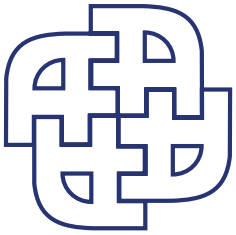

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# Am I Riskier if I Rescue my Banks? Beyond the Effects of Bailouts


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# Am I Riskier if I Rescue my Banks? Beyond the Effects of Bailouts

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## ABSTRACT

This paper examines the relationship between bank bailouts and sovereign risk in 35 countries and 19 bailouts during 2005-2015. Bailouts negatively affect sovereign ratings, with rating agencies consistently perceiving higher risk when a country's banking system has been rescued (*risk-increasing effect*). The increase in public debt as a result of the bank bailouts is the main mechanism through which the *risk-increasing* effect occurs. Financial soundness and banking market structure shape the impact of bailouts on sovereign risk. In particular, proactiveness in undertaking public bailouts for banking systems that are largely distressed – that is, risky and low profitable – and highly concentrated seems to lead to smaller increases in sovereign risk. However,

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the strength of the connection between the public sector and the banking system neither moderates nor magnifies the impact of bailouts. Moreover, ratings dynamics (duration, momentum, timing) are found to be affected by bailouts revealing that the effects of bailouts on ratings are not short-lived. Results are robust to endogeneity concerns, sample selection bias and several robustness tests.

**Keywords:** *bank bailouts, sovereign risk, sovereign ratings, public debt, banking sector.*

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## 1. INTRODUCTION

During the Global Financial Crisis (GFC), several countries bailed out their banks with the medium-term objective of restoring confidence and stability in the banking sector and thereby recovering the supply of credit to households and businesses (King, 2019). While prior literature has shown that these bailout packages had a positive effect on credit supply (Berger et al., 2018; Berger and Roman, 2017; Chu et al., 2019; Li, 2013) and in the real economy (Berger and Roman, 2017; Norden et al., 2020), bank bailouts also generated undesirable effects. It has been shown that bank bailouts may have distorted banking competition (Berger and Roman, 2015; Calderon and Schaeck, 2016) and led to an increase in bank risk-taking (Black and Hazelwood, 2013). These effects may have extended beyond the bank level, with implied consequences for the whole economy (Böhm and Eichler, 2020). As the IMF (2009)

recognizes, government bailouts increase national debt burdens, cause a deterioration in public finances and reduce economic growth. As such, it can be argued that bank bailouts may have had effects in terms of sovereign risk.

Based on market-based measures of sovereign risk, it has been argued that bank bailouts triggered the rise of sovereign credit risk after the GFC. This strand of literature argues in favor of a *risk-increasing effect*, mainly due to a deterioration in public finances after the bailout. Acharya, Drechsler and Schnabl (2014) document that increases in sovereign CDS in the Eurozone could be explained by the high fiscal costs of bank bailouts. Attinasi, Checherita-Westphal and Nickel (2009) demonstrate that bank rescue packages increase sovereign bond yield spreads because of concerns about a country's credit risk and liquidity risk, as well as the higher international risk aversion. On the other hand, a *risk-reducing effect* of bank bailouts on sovereign risk can also be argued for. Bailouts help to decrease the vulnerability of the banking system (Homar and van Wijnbergen, 2017; Brůha and Kočenda, 2018) and signal the government's ability to implement sound policies (Fratzscher and Rieth, 2019). As pointed out by King (2019), bailouts are implemented to prevent systemically important banks from defaulting.

When determining the prevalent effect of bank bailouts on sovereign risk *(risk-increasing effect* vs *risk-reducing effect)*, it is necessary to examine the soundness of the banking system (Boumparis et al., 2019; Brůha and Kočenda, 2018), as well as the heterogeneous effects of bailouts across countries and bailed-out banks (Banerjee et al., 2016; Buch et al., 2019).

Thus, the primary objective of this paper is to further explore the relationship between bank bailouts and sovereign risk. We contribute to the literature in the following ways. Firstly, our analysis provides additional insight into the impact of bailouts on sovereign risk through an empirical examination of sovereign ratings. This novelty is particularly relevant because, unlike other measures of sovereign risk, sovereign ratings assess a country's creditworthiness and its ability and willingness to repay its debt obligations. Moreover, sovereign ratings tend to focus on the long term and thus aim to respond only to the perceived permanent component of credit-quality changes (Altman and Rijken, 2004). Furthermore, in addition to market-based information (Fitch, 2014; Moody's, 2015b, 2015a; Standard and Poor's, 2014), ratings also include information retrieved from economic, financial and qualitative indicators.

Secondly, we conduct an empirical examination of the potential mechanisms underlying the relationship between bank bailouts and sovereign ratings. Specifically, we test

the role of public debt as the main mechanism through which the *risk-increasing effect* may occur. Previous papers (IMF, 2009; Laeven and Valencia, 2018) have argued that the deterioration in public finances and, in particular, the increase in public debt as a result of implementing bailout packages are the main potential channels for understanding the relationship between bank bailouts and sovereign risk. However, to the best of our knowledge, only Acharya et al.'s (2014) results seem to indicate that the channel through which the relationship between bank bailouts and sovereign risk occurs is the increase in public debt. We develop an empirical approach that allows us to consider the effect of bailouts on public debt and sovereign ratings simultaneously and test whether changes in public debt are an indirect channel leading to changes in sovereign ratings.

Thirdly, we demonstrate empirically that the strength of the effect associated with bailouts may be contingent on the specific characteristics of the country and, in particular, of the banking sector. While previous literature has found that financial system characteristics both determine sovereign ratings (Boumparis et al., 2019; Brůha and Kočenda, 2018; Cuadros-Solas and Salvador, 2021) and affect the probability of bailout implementation (Beccalli and Frantz, 2016; Fernandes et al., 2016), no empirical studies have examined the influence of banking system characteristics on bailouts' impact on sovereign ratings. Providing additional evidence regarding bailouts' heterogeneous effect on sovereign risk clarifies that the ultimate effects of bank bailouts (*risk-increasing* vs *risk-reducing*) are specifically linked to the status of the banking system (its soundness, structure, and the strength of its connections with the government).

Finally, as prior literature has argued in favor of the existence of long-run effects of bank bailouts (Berger et al., 2020; Berger and Roman, 2015; Berger and Roman, 2017; Calderon and Schaeck, 2016), we also focus on the dynamic effects of the relationship between bailouts and sovereign ratings.

Using a panel dataset of 35 OECD countries and 19 bank bailout programs during the 2005-2015 period, we find a negative relationship between bailouts and sovereign ratings provided by the three most important credit rating agencies (CRAs): Fitch, Standard & Poor's (S&P) and Moody's. Consistently with a *risk-increasing effect*, the larger the amount of public funding injected into the banking sector, the stronger the negative effect on ratings is. These results are found to be robust after considering potential endogeneity concerns and performing additional robustness checks. We also find that the increase in public debt provoked by bank bailouts is the main channel through which these rescue packages negatively impact sovereign ratings. Further-

more, we demonstrate that bank bailouts' effect on sovereign risk is not homogeneous across countries but is modulated by particular characteristics of the banking sector. Specifically, proactiveness in undertaking public bailouts for banking systems that are largely distressed (i.e., that have a high level of risk and low profitability) and highly concentrated seems to lead to smaller increases in sovereign risk. However, the strength of the connections between the government and the banking industry does not seem to play a determining role in explaining the differences in ratings. Lastly, the dynamics of the sovereign ratings as a result of the bailout provides additional evidence of a *risk-increasing effect*.

The remainder of the paper is organized as follows. Section 2 reviews the related literature and discusses the main hypotheses. Section 3 describes the data and methodology. The main results are presented in Section 4. Section 5 addresses some endogeneity concerns. Additional robustness checks are presented in Section 6. Finally, Section 7 concludes.

## 2. RELATED LITERATURE AND HYPOTHESES DEVELOPMENT

A relevant strand of literature has examined the potential concerns derived from the definition and implementation of bank bailouts from an ex-ante perspective. It is understood that financial safety nets aim to prevent bank runs and promote financial stability (Demirgüç-Kunt and Detragiache, 2002). However, there is evidence that such mechanisms can also foster excessive risk-taking behavior among banks (Dam and Koetter, 2012). Regarding the ex-post effects of bailouts, Gerhardt and Vennet (2017) provide evidence that banks in the EU that were bailed out during the 2007-2013 period hardly improved their performance indicators in the years following the receipt of government aid, indicating that bailouts are not sufficient to restore bank health. Berger, Makaew and Roman (2018) find that, on average, borrower contract terms are more favorable after bailouts. Prior related studies have also examined the effects of bailout programs on bank risk-taking (Black and Hazelwood, 2013; Hakenes and Schnabel, 2010), liquidity creation (Berger et al., 2016), competition (Calderon and Schaeck, 2016; Carbó-Valverde et al., 2020) and bank accounting quality (Fan et al., 2020).

From a country-level perspective, Acharya and Yorulmazer (2007, 2008) and Philippon and Schnabl (2013) demonstrate that taxation-related fiscal costs increase with the quantity of bailout funding. Reinhart and Reinhart (2010) provide evidence that

economic activity remains in a deep slump after a distressing episode and that private debt shrinks significantly while sovereign debt rises. Laeven and Valencia (2018) compile a time series of banking crises and examine their effects and costs using various measurements specifically related to bank interventions. They find that the median output loss of banking crisis episodes was large, accounting for about 25% of GDP. Focusing on the indirect effects of bailouts on banks' borrowers, Berger and Roman (2017) show that TARP funds increased net job creation and net hiring establishments and decreased business and personal bankruptcies.

At the same time, the 2008 GFC and the subsequent European debt crises have also increased academics' and policymakers' interest in understanding and measuring sovereign credit risk. As a measure of sovereign risk, ratings play an important role in mitigating information asymmetries between insiders (governments) and outsiders (investors) (Bosch and Steffen, 2011; Sufi, 2009). In this regard, prior literature has used credit ratings as a synthetic indicator of sovereign risk (Reinhart, Rogoff and Savastano, 2003; Mora, 2006; Correa *et al.*, 2014). Ratings are also used to measure the creditworthiness of banks (Caporale et al., 2012; Salvador et al., 2014), non-financial corporations (Jiang and Packer, 2019) and financial assets – bonds, loans and securitized assets (Kliger and Sarig, 2000; Wheelock and Wilson, 2012).

The relevance of sovereign ratings is also explained by their implications for the rated countries and the economy as a whole. Sovereign ratings affect the funding costs of states (Afonso et al., 2012), non-financial firms (Drago and Gallo, 2017; Kanno, 2020) and banks (BIS, 2011; Correa et al., 2014). Moreover, sovereign ratings tend to focus on the long term and thus aim to respond only to the perceived permanent component of credit-quality changes (Altman and Rijken, 2004). In this sense, unlike other common measures of sovereign risk, such as sovereign bond yields and CDS spreads, sovereign ratings are not pure market-based measures but also include this type of information.[4]

Among the earlier studies that base their analyses on quantitative factors, Cantor and Packer (1996) show that sovereign ratings are affected by macroeconomic indicators, such as GDP growth, inflation, external debt, per capita income, the country's level of economic development and default history. Subsequent studies provide evidence that alongside macroeconomic indicators, qualitative factors such as political and in-

[4] For example, Moody's, in their "Procedures and Methodologies Used to Determine Credit Ratings," recognize that *"… we may use various other opinions on credit quality such as those implied by bond yields, CDS, and stock prices"* (Moody's, 2020).

stitutional variables are also significant in explaining sovereign ratings (Afonso et al., 2009, 2011; De Moor et al., 2018; Reusens and Croux, 2017)

Given the relevance of both quantitative and qualitative factors to ratings, it could be expected that sovereign ratings would be adjusted following a bank bailout if this government intervention affected the country's ability to repay its debt obligations. Consequently, the impact of bank bailouts on sovereign ratings will depend on whether the sovereign risk changes due to a bailout episode. However, the influence of bank bailouts on sovereign ratings may a priori lead to contradictory predictions. On the one hand, following the seminal paper of Acharya et al. (2014), it could be stated that bank bailouts triggered a rise in sovereign credit risk after the GFC. These authors underline that bank bailouts transferred default risk from the financial sector to sovereigns, triggering the increase in sovereign credit risk (*risk-increasing effect).* They argue that the increase in sovereign risk – which increases sovereign CDS spreads – could be explained by the high fiscal costs of government bailouts. In the same vein, the IMF, (2009) has shown that government bailouts increase national debt burdens and cause a deterioration in public finances. Thus, bailing out a distressed banking sector would deteriorate the creditworthiness of the public sector, which, consequently, would negatively affect sovereign ratings. Similarly, other papers using market-based measures of sovereign risk have provided evidence of a negative effect of bank rescue packages on sovereign risk. Ejsing and Lemke (2009) examine the co-movements between sovereign and bank CDS spreads in the Euro area. They find that bank rescue packages increased sovereign spreads, as investors perceived a credit risk transfer from the banking sector to the government. Attinasi et al., (2009) demonstrate that these intervention mechanisms have led to a widening of sovereign bond yield spreads, indicating an increase in sovereign risk.

On the other hand, implementing active policies to reduce financial frictions and restore financial stability may help to reduce sovereign risk (*risk-reducing effect).* Prior studies have found that sovereign risk is linked to the vulnerability of a country's banking system (Gerlach, Schulz and Wolff, 2010). Brůha and Kočenda (2018) conclude that policy measures focused on reducing the vulnerability of the banking system can positively affect sovereign risk. Moreover, bank bailouts were implemented to avoid the default of systemically important banks while restoring confidence in the financial system and ultimately restarting the credit flow to support the real economy (King, 2019). Homar and van Wijnbergen (2017) examine the effects of several policy measures – guarantees, liquidity support and bank bailouts – taken to restore banks' soundness. They find that among these measures, bailouts had the largest positive

significant effect. Berger, Roman and Sedunov (2020) provide evidence at the bank level of bank bailouts' effectiveness in reducing systemic risk.

Moreover, while capital preservation measures may create moral hazard for the bailed-out banks (Dam and Koetter, 2012; Gropp et al., 2011), effective bank bailouts signal a government's ability to formulate and implement sound policies to restore financial stability. This signal to the markets may assuage sovereign bondholders' doubts regarding the country's capacity and willingness to repay its debt obligations. Cordella and Yeyati (2003) show that the ex-ante commitment to bail out potentially insolvent bank entities in adverse macroeconomic conditions can create a *risk-reducing effect* that could outweigh the traditionally argued-for moral hazard component of the rescue tool and thus lower risk levels. Similarly, Fratzscher and Rieth (2019) find that the announcements alone of rescue policies targeting the banking system, especially capital injections, reduce sovereign spreads.

The existence of opposing arguments and mixed empirical evidence means that the potential impact of bailouts on sovereign ratings (*risk-reducing effect* vs *risk-increasing effect*) is an empirical question.

In this context, accounting for cross-country differences in banking sector characteristics could shed additional light on whether and to what extent these country-level factors may shape the relationship between bailouts and sovereign ratings. Prior literature has found that specific characteristics of the domestic banking system partially explain sovereign risk. Brůha and Kočenda (2018) show that certain features of the banking system – risk, stability, size of the industry and foreign bank penetration and competition – affect the level of sovereign risk. Boumparis et al., (2019) provide evidence of a significant effect of non-performing loans on sovereign rating decisions. Using sovereign ratings as synthetic indicators of sovereign risk, Cuadros-Solas and Salvador, (2021) show that profitability, liquidity, concentration and the volume of non-performing loans are important predictors of sovereign ratings. Overall, these findings suggest that specific characteristics of the bailed-out banking system may explain differences in sovereign risk.

Furthermore, previous literature has underlined heterogeneity in the impact of bank support programs. From a bank-level perspective, several papers have found that the effects of bank bailouts differ across types of banks (Berger and Bouwman, 2013; Black and Hazelwood, 2013; Berger, Roman and Sedunov, 2020; Carbó-Valverde, Cuadros-Solas and Rodríguez-Fernández, 2020). From a country-level perspective, Banerjee, Hung and Lo (2016) show that the outcomes of bank bailouts were heterogeneous

among European countries. They find that private-to-public risk transfer differed in Germany due to the greater stability of the country's financial system. In a similar vein, Alter and Schüler (2012) show that the heterogeneity of bailout programs across European countries translates into asymmetric interdependence between sovereign risk and banks' default risk. Buch et al., (2019) also find that the effects of bank bailouts are heterogeneous across countries and banks.

Taken together, previous findings suggest that the ultimate effects of bank bailouts on sovereign risk may be heterogeneous and dependent on cross-country differences related primarily to the characteristics of the banking system.

## 3. METHODOLOGY

### *3.1. SAMPLE*

The sample is composed of the bank bailout processes – public recapitalization packages – that occurred in the OECD countries during the period 2005-2015.[5] These bailout measures in the OECD countries accounted for 95.91% of the total volume of funds injected into the worldwide banking system through bailout packages (Laeven and Valencia, 2018; Homar and van Wijnbergen, 2017).[6] Given the paper's interests, we focus on the OECD countries, since they represent a group of countries that are relatively homogeneous from the economic and democratic perspectives, and as such the alternative cost of policy adoption will be similar across these countries. The bailout episodes were retrieved from Homar and van Wijnbergen (2017) and the IMF Country Reports, which provide detailed information on the countries implementing public bailout programs, the size of the packages and the exact timing of these government measures.[7]

Consistently with prior literature examining the impact of bank bailouts during the GFC (Berger et al., 2018, 2020; Berger and Roman, 2015), the period analyzed – from

[5] As specified in Appendix A, the sample is composed of the 35 countries that were in the OECD during the period analyzed (2005-2015). Lithuania and Colombia are not considered because these countries were brought into the OECD in 2018 and 2020, respectively.

[6] According to Homar and van Wijnbergen (2017), the total volume of bank bailouts during the GFC amounted to $771.64 bn.

[7] In Table A1 of the online appendix of Homar and van Wijnbergen (2017), the authors report all the bank recapitalizations, providing details of the bailed-out banks and the amounts.

2005 to 2015 – allows us to cover all the bank bailouts that resulted from this financial crisis.[8] As pointed out by Laeven and Valencia (2018), from the 1970s to 2008, banking crises predominantly occurred in low- and middle-income countries. In fact, before the GFC and sovereign debt crisis in Europe, there was no sign of sovereign credit risk in most high-income countries and thus in the OECD members (Acharya et al., 2014). Nevertheless, beginning in late 2008, some countries took substantial measures to rescue and restructure their financial sectors, which led to significant macroeconomic imbalances.

The table in Appendix A shows that 19 out of the 35 OECD countries bailed out their banks. In this case, it is shown that the recapitalization packages involved, on average, a direct fiscal cost from the government of 6.78% of GDP. Furthermore, it is observed that in some countries, these costs exceeded 10% of GDP. In particular, in Ireland, Greece, Iceland and Slovenia, the recapitalization packages involved a public expense that represented 40.7%, 20.3%, 17.7% and 11.1% of GDP, respectively. On average, each bailed-out bank received $5.58 bn. However, the average bailout packages (bail-out amount over the total number of bailed-out banks) were larger in the UK ($34.28 bn), Ireland ($15.64 bn) and Germany ($10.27 bn).

To measure sovereign risk, we use the long-term foreign currency sovereign credit ratings issued by the three main CRAs (Fitch, S&P, and Moody's), which we obtained from Thomson Reuters and checked against CRA publications.[9] As is standard in the rating literature, the categorical scale of ratings was transformed to a numerical scale and grouped into 21 categories, so that higher values imply higher quality. Our sample consists of 385 ratings awarded by Fitch, S&P and Moody's for each of the 35 OECD countries on an annual basis. The investment-grade rating categories represent most of the ratings issued by the three CRAs (around 93%). Likewise, it is observed that the top rating category 21 (AAA/Aaa) represents the highest share of ratings issued by Fitch (38.4%), S&P (38.2%) and Moody's (44.9%), followed by rating categories 17 (A+/A1) and 16 (A/A2). The speculative-grade rating categories represent only between 6.8% and 8% of the total number of ratings issued by the three CRAs. This

[8] For robustness purposes, we also expanded our sample period to one year before its start (i.e., to include 2004) and to one year after its close (i.e., to include 2016). The results were unchanged.

[9] Although CRAs also issue Watchlists (short-term prospects regarding future ratings changes) and Outlooks (medium-term), we have not used them for two main reasons. The first relates to the main objective of the paper, which is to analyze whether bank bailouts have significant rather than short-lived effects on sovereign risk. Secondly, most prior literature on sovereign rating modelling only uses ratings (Afonso et al., 2011; De Moor et al., 2018; Reusens & Croux, 2017, among others). Watchlists and Outlooks are considered only on very rare occasions.

latter result is consistent with the OECD's composition, as its members are mainly developed countries.

### *3.2. ECONOMETRIC MODEL*

#### *3.2.1. DIFFERENCE-IN-DIFFERENCES (DID) ANALYSIS*

The effects of bank bailouts on sovereign ratings are examined using a DID analysis. The aim of the analysis is to compare the evolution of sovereign ratings across those countries that implemented bank bailout measures and those that did not. Recent studies have used a similar approach to examine the effects of state capital injections in the banking sector (Berger et al., 2018, 2020; Berger and Roman, 2015; Black and Hazelwood, 2013; Fan et al., 2020). The DID estimates allow us to compare a treatment group – countries that bailed out their banks – with a control group – countries that did not conduct interventions – before and after the treatment. By employing this approach, we control for observable and unobservable factors that affect both groups of countries.

Since some countries bailed out their banks repeatedly during our sample period,[10] we examine the effects of bailouts on sovereign ratings using a generalized DID approach that deals with multiple events (in this case, bank bailouts). This approach, employed in Bertrand and Mullainathan's (2003) seminal paper and subsequently used in several studies (Chen and Vashishtha, 2017; Fang et al., 2014; Francis et al., 2010), addresses many threats to the validity of our analysis. As argued in the above-mentioned papers, this methodology allows makes it possible to handle the different bank bailout measures that occurred at different times (multiple treatment events). Consequently, this generalized DID approach allows us to account for the fact that some countries (e.g., Luxembourg, the US, Iceland and Hungary) recapitalized their banks before December 2010, while other countries (e.g. Austria, Belgium, Denmark and Spain) recapitalized their banks repeatedly before and after December 2010.

As in other studies in the sovereign rating literature, an ordered probit model with country fixed effects is used in the modelling of the sovereign ratings (see among others, Broto and Molina, 2016; Vernazza and Nielsen, 2015).[11] Taking into account

[10] Homar and van Wijnbergen (2017) show that some countries implemented several bailout packages at different times. For example, Austria bailed out banks in 2008, 2009 and 2012.

[11] As an alternative to the fixed effects ordered probit model, we estimate 1) a panel data ordered logit model with random effects, 2) a linear regression model with panel-corrected standard errors,

the approach employed by Calderon and Schaeck (2016) to analyze government interventions in the financial sector at the country level, the following equation (1) is estimated:

$$SOVEREIGN\ RATING_{i,t+1} = \alpha + \beta_0\ BANK\ BAILOUT_{i,t} + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

where the dependent variable is the sovereign rating of country $i$ at the end of the first quarter of year $t+1$. This allows us to account for potential endogeneity concerns, as CRAs issue their ratings based on qualitative and quantitative macroeconomic fundamentals, which are not publicly disclosed immediately at the end of each period.[12] Then, we lead the dependent variable by one quarter to ensure that the sovereign ratings, as measures of sovereign risk, include all the relevant public information (quantitative and qualitative) about the creditworthiness of the country analyzed.

$BANK\ BAILOUT_{it}$ is our variable of interest. Alternatively, it is defined as an indicator that equals one when and after a country $i$ injects public capital into its banking system at year $t$ and zero otherwise ($Bailout\ Dummy_{it}$). We also account for the intensity of government recapitalization by using a continuous variable that is computed as the ratio of the total capital the country injected into the banking system to the country's GDP ($Bailout\ Amount\ (\%GDP)_{it}$). The slope $\beta_0$ provides information about the effect of the bank bailouts. Hence, this variable serves as the DID operator with the precise timing of the bailouts of each country. A negative coefficient would mean lower sovereign ratings for countries that bailed out their banking systems (the treatment group) compared to those countries that did not (the control group) after the bailout decision. $\theta_i$ is a vector of country fixed effects that refers to the individual effect of each country and allows us to account for unobservable time-invariant fixed effects. We also include year fixed effects ($\delta_t$) to control for aggregate fluctuations in sovereign ratings over time. In particular, the year fixed effects difference away trends that affect treatment and control group countries. $\varepsilon_{it}$ is the error term. Lastly, in order to prevent

and 3) a linear panel data model with country fixed effects. The results, available upon request, show that our main findings hold after employing alternative econometric models.

[12] This approach (leading or lagging variables) to avoid the endogeneity concerns related to the use of contemporaneous values of the dependent variable and the set of sovereign risk determinants has been used in the rating literature (Caporale et al., 2012; De Moor et al., 2018; Hu et al., 2002 among others). In any case, in Section 5, we specifically control for potential endogeneity issues by applying different estimation techniques.

potential heteroscedasticity and/or autocorrelation problems in the residuals, the equations are estimated considering clustered standard errors at the country level.

The vector includes all those control variables that measure the creditworthiness, economic situation and institutional quality of the countries rated by the CRAs and thus their sovereign risk. Following prior literature (Afonso et al., 2011, 2012; Cantor and Packer, 1996; De Moor et al., 2018; Reusens and Croux, 2017; Vernazza and Nielsen, 2015, among others), we include as control variables GDP[13] per capita (*GDP per Capita*), annual GDP growth rate (*GDP Growth*), inflation level (*Inflation*), fiscal balance (*Fiscal Balance*), level of external debt as a percentage of GDP (*External Debt (%GDP)*), default history of the country (*Default History)*, amount of reserves as a percentage of GDP (*Reserves (%GDP)*) and level of institutional quality (*Inst. Quality*).

### *3.2.2. THE PARALLEL TREND ASSUMPTION AND TREATMENT EXOGENEITY*

Before using a DID estimation to examine the potential effects of bank bailouts on sovereign risk, we take two steps. Firstly, we check whether the treatment assignment is plausibly exogenous with respect to sovereign ratings (*treatment exogeneity condition*). By testing this condition, we ensure that sovereign ratings are not driving bank bailouts. Secondly, we check whether, in the absence of treatment, the changes in sovereign ratings are similar for the treatment and control groups. This second condition is the well-known *parallel trend assumption.*

Regarding the exogeneity of the treatment assignment, we follow Calderon and Schaeck (2016) and estimate a Cox (1972) proportional hazard model on the conditional probability of implementing a public bank bailout. In doing so, we are able to examine the exogeneity of bank bailouts. In this duration analysis, the dependent variable is the time taken to bail out a bank in the banking system since 2005 (the initial year in our sample) and the key explanatory variable is the sovereign rating. We include the same control variables that are considered in the main regression, as well as year fixed effects and country fixed effects. The hazard rate *h(t)* represents the likelihood that an intervention is observed at time *t* in country *i*, given that there was no intervention until *t*. As Calderon and Schaeck (2016) point out, the Cox model seems to be the best way to test the treatment exogeneity because it does not impose

[13] Appendix B describes all the variables employed in the regressions, as well as the main sources from which they were retrieved.

a shape on the hazard function. Panel A of Table 1 shows that for all three CRAs, the coefficient of the sovereign rating is not statistically significant. This result suggests that prior sovereign ratings do not affect the hazard of conducting a bank bailout.

We explore the parallel trend assumption by examining whether changes in sovereign ratings are similar across countries that bailed out their banks and those that did not. In doing so, we compute the mean changes in sovereign ratings between the groups of countries over the two years before the first bank bailouts occurred (2006 and 2007). Panel B of Table 1 presents the t-tests for differences in means. As can be observed, the t-test results are insignificant for the three CRAs. This means that, in the absence of treatment (before any bank bailouts occurred), changes in sovereign ratings were similar for the two groups of countries.

## 4. RESULTS

### *4.1. BANK BAILOUTS AND SOVEREIGN RISK*

Table 2 reports the main descriptive statistics for the variables used in our analysis. As can be observed, the mean values obtained for each of the measures of sovereign risk are quite similar (17.74 in the case of Fitch, 17.65 for S&P and 17.88 for Moody's). On the rating scale, these numerical values represent a rating between A+ (17) and AA- (18), which is consistent with investment-grade ratings for developed countries. According to the results presented for the *Bailout Dummy*, bank bailout processes affect around 13% of the country–year observations in our sample. *Bailout Amount (%GDP)* implies 1.96% of GDP on average. However, the high standard deviation of the bailout amount (5.78) suggests that there are significant differences across countries in terms of the intensity of the bank bailout packages.

Table 2 also presents the means of all the variables for those countries that did not bail out their banks (non-bailing-out countries) and those that did (bailing-out countries). This table also shows the means for the bailing-out countries before and after the bailout period. The results show that the average sovereign rating value decreased for the bailing-out countries after the bailout episode. Moreover, the results of the t-tests confirm that the differences are statistically significant at the 1% confidence level. Regarding the main macroeconomic variables, it is interesting to observe that external debt increased significantly during the post-bailout period. The logarithm of external debt in terms of GDP increased from 3.82 to 4.27, which means, taking anti-loga-

rithms, that the external indebtedness of those countries that bailed out their banks increased from 55.25% to 79.97% (a 44.74% increase). Likewise, for those countries that bailed out their banks the public deficit increased from -2.02% to -4.19%, which means that the deficit doubled during the post-bailout period. These results confirm that the implementation of bank bailout measures causes a deterioration in the public finances of the relevant countries.

Although the results seem to be in line with a *risk-increasing effect*, a multivariate analysis is needed to better understand the relationship between bank bailouts and sovereign risk. This will allow us to include country-level explanatory variables and to control for any potential endogeneity problems that may affect our main variables of interest.

Table 3 presents the results for our baseline model [1] for the ratings issued by the three CRAs: Fitch in columns (1) and (4), S&P in columns (2) and (5) and Moody's in columns (3) and (6). In columns (1) to (3), we present the results for the impact of the occurrence of a bank bailout process on sovereign ratings. The negative and statistically significant coefficients at the 1% level of the *Bailout Dummy* variable for all the CRAs reveal that sovereign ratings were lower for bailing-out than non-bailing-out countries. These results suggest that bailing out part of the banking system leads to relatively lower ratings and, thus, higher sovereign risk.

Additionally, we examine the impact of bailouts on ratings, accounting for the intensity of the bailout packages. The empirical findings obtained using the size of the bailout measures relative to GDP (*Bailout Amount %GDP*) are presented in columns (4) to (6) of Table 3. We note that the greater the funds involved in each bailout process, the lower the rating provided by each of the three CRAs compared to those countries that did not bail out their banks. Hence, the negative effect of bailouts does not emerge only from implementing this kind of policy measure; rather, the size of the bailout package also matters. As sovereign ratings are lower for those countries that bailed out their banks, these results provide evidence that bank bailouts are associated with higher sovereign risk (*risk-increasing effect*). As prior literature argues, the high costs of bailing out distressed banks and, by extension, banking sectors could explain the increase in sovereign credit risk and, thereby, the *risk-increasing effect*. Hence, while bank rescue measures are implemented to reduce bank default probability, they also seem to have negative consequences for the whole economy, as the country's perceived risk among the CRAs increases because of the larger amount of funds committed. Therefore, this result would support the existence of a credit risk transfer from the banking sector to the government (Acharya et al., 2014; Ejsing and Lemke, 2009).

## Table 1. Exogeneity of bank bailouts and test for the parallel assumption trend

Panel A presents the Cox (1972) proportional hazard (Cox PH) models to verify bank bailouts are exogenous with respect to sovereign ratings. The dependent variable denotes the hazard of conducting a bank bailout. Our sample period is 2005-2015. A country is dropped from the analysis once it has bailed out its banking system. The vector of control variables are the same ones as those reported in the main regression. Standard errors are clustered at the country level. Robust t-statistics are given in parentheses. Panel B presents t-tests for the assumption of parallel trends in changes in the sovereign ratings between treatment group countries (countries that bailed-out their banking system) and the control group (countries that did not bailout their banking system) for the 2 years prior to the first bank bailout.

| **Panel A. Estimates for the Cox (1972) proportional hazard (Cox PH) models on exogeneity of bank bailouts with respect to sovereign ratings** | | | |
|---|---|---|---|
| | **Fitch** | **S&P** | **Moody's** |
| | (1) | (2) | (3) |
| **Sovereign Rating** | -0.010<br>(0.343) | -0.128<br>(0.265) | -0.259<br>(0.193) |
| **Controls** | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country |
| **Observations** | 266 | 266 | 266 |
| **Number of countries** | 35 | 35 | 35 |
| **Log pseudolikelihood** | -47.89 | -47.80 | -47.41 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 |

| **Panel B. T-test for the parallel trends assumption** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Fitch** | | | **S&P** | | | **Moody's** | | |
| Change Sov. | Bailing out | Non-bailed out | T-test | Bailing out | Non-bailed out | T-test | Bailing out | Non-bailed out | T-test |
| 2006 (t-2) | 0 | 0.0625 | 0.5004 | -0.1052632 | 0.0625 | 1.3704 | 0.1875 | 0 | 1.2019 |
| 2007 (t-1) | 0 | 0.125 | 1.4639 | -0.0526316 | 0.1875 | 1.6469 | 0 | 0.0625 | 1 |

## Table 2. Univariate results

This table shows the descriptive statistics – mean, standard deviation, 25th percentile, median, 75th percentile – of the main variables of interest. The T-statistics reported are obtained for the differences between the means across group of countries for the whole period (column 9) and for the differences between the means across periods for bailing-out countries (column 12). All the variables are defined in Appendix B.

| Variable | Obs. | Mean | St. Dev. | 25% | Median | 75% | Non Bailing-out country | Bailing-out country | T-statistic | Bailing-out countries | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Pre-bailout period | Post-bailout period | T-statistic |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| **Fitch** | 385 | 17.74 | 3.59 | 15 | 19 | 21 | 17.53 | 17.91 | -1.05 | 18.86 | 17.43 | 2.84 |
| **S&P** | 385 | 17.65 | 3.72 | 15 | 19 | 21 | 17.92 | 17.86 | 0.16 | 19.34 | 17.09 | 4.41 |
| **Moody's** | 385 | 17.88 | 3.82 | 16 | 19 | 21 | 17.60 | 17.70 | -0.28 | 18.62 | 17.23 | 2.63 |
| **Bailout Dummy** | 385 | 0.13 | 0.34 | 0 | 0 | 0 | 0.00 | 0.66 | -20.10 | 0.00 | 1.00 | . |
| **Bailout Amount (%GDP)** | 385 | 1.96 | 5.78 | 0 | 0 | 1.10 | 0.00 | 3.72 | -7.21 | 0.00 | 5.63 | -7.71 |
| **GDP per Capita** | 385 | 10.36 | 0.64 | 9.86 | 10.54 | 10.81 | 10.14 | 10.55 | -6.33 | 10.43 | 10.61 | -2.22 |
| **GDP Growth** | 385 | 1.98 | 3.61 | 0.73 | 2.20 | 3.66 | 2.75 | 1.34 | 3.93 | 2.91 | 0.54 | 4.79 |
| **Inflation** | 385 | 2.32 | 2.30 | 0.85 | 2.08 | 3.3 | 2.60 | 2.10 | 2.12 | 3.36 | 1.46 | 5.23 |
| **Fiscal Balance** | 385 | -2.21 | 4.73 | -4.32 | -2.56 | 0.07 | -0.75 | -3.45 | 5.79 | -2.02 | -4.19 | 3.58 |
| **External Debt (%GDP)** | 385 | 3.87 | 0.76 | 3.54 | 3.90 | 4.39 | 3.58 | 4.12 | -7.13 | 3.82 | 4.27 | -4.92 |
| **Default History** | 385 | 0.21 | 0.40 | 0 | 0 | 0 | 0.25 | 0.18 | 1.73 | 0.20 | 0.17 | 0.53 |
| **Reserves (%GDP)** | 385 | 11.64 | 11.95 | 3.46 | 7.12 | 16.45 | 13.28 | 10.26 | 2.60 | 6.50 | 12.19 | -3.53 |
| **Inst. Quality** | 385 | 71.03 | 6.62 | 66.4 | 70.9 | 76.1 | 71.66 | 70.51 | 1.71 | 69.80 | 70.87 | -1.04 |
| **NPL (% Gross loans)** | 385 | 3.96 | 4.97 | 1 | 2.5 | 4.6 | 2.18 | 5.47 | -7.34 | 2.40 | 7.05 | -7.28 |
| **Concentration** | 385 | 67.04 | 18.78 | 53.25 | 65.08 | 81.55 | 68.00 | 66.24 | 0.90 | 66.71 | 66.01 | 0.26 |
| **Profitability** | 385 | 0.84 | 3.91 | 0.29 | 0.79 | 1.34 | 1.30 | 0.45 | 2.30 | 0.82 | 0.26 | 0.95 |
| **Size** | 385 | 109.01 | 44.08 | 72.65 | 102.81 | 137.28 | 94.42 | 121.30 | -6.29 | 118.52 | 122.73 | -0.63 |
| **Banking Credit to Government (%GDP)** | 385 | 14.03 | 11.62 | 7.43 | 11.73 | 17.89 | 13.99 | 14.07 | -0.06 | 10.78 | 15.76 | -4.47 |
| **Government-Owned Bank Assets (% Total bank assets)** | 385 | 9.87 | 12.34 | 0 | 4 | 17 | 6.99 | 12.30 | -4.41 | 9.61 | 13.69 | -2.05 |

Regarding the traditional explanatory factors of sovereign ratings, we obtain positive and statistically significant coefficients for *GDPpc*, *Growth in GDP* and *Fiscal Balance* in all the estimates reported in Table 3. The proxy for institutional quality (*Inst. Quality*) is also positive and statistically significant at conventional levels in most of the estimates shown. The inflation variable (*Inflation*) and the default history of the country (*Default History*) have a negative relationship with sovereign ratings. However, these last three variables are not always statistically significant at conventional levels. These results are in line with prior literature on sovereign ratings (Afonso et al., 2011; Cantor and Packer, 1996; Reusens and Croux, 2017, among others) and provide evidence that better economic prospects, a better fiscal balance position and stronger institutional setups decrease sovereign risk and, consequently, prompt CRAs to provide better sovereign ratings.

### *4.2. PUBLIC DEBT AS A MECHANISM*

Literature exploring the interconnection between intervention policies and systemic risk in the banking industry has remarked on the need to examine the mechanisms underlying this relationship. Berger et al. (2020) find that the primary channel through which TARP affected bank systemic risk was the injections of preferred equity, as they raised the value of common equity and reduced the leverage of entities. Regarding the relationship between bank bailouts and sovereign risk, previous literature has argued that the deterioration in public finances[14] – realized in an increased level of public debt – is the main channel through which bailout programs affect sovereign risk (IMF, 2009; Laeven and Valencia, 2018). To the best of our knowledge, only the model developed in Acharya et al. (2014) suggests that bank bailouts affect sovereign credit risk – proxied by CDSs – through an increase in the public debt-to-GDP ratio.

In order to further understand the channel through which the deterioration in public finances, we examine the behavior of public debt before and after the implementation of the bailout decisions, mainly focusing on the differences across countries. As can be seen in Figure 1, bailing-out countries experienced significantly larger growth in public debt than non-bailing-out countries. Consequently, differences in public

[14] The IMF (2009) shows that in the advanced economies, fiscal stimulus and financial support to the banking sector are the main factors contributing to the deterioration in public finances as a result of the GFC.

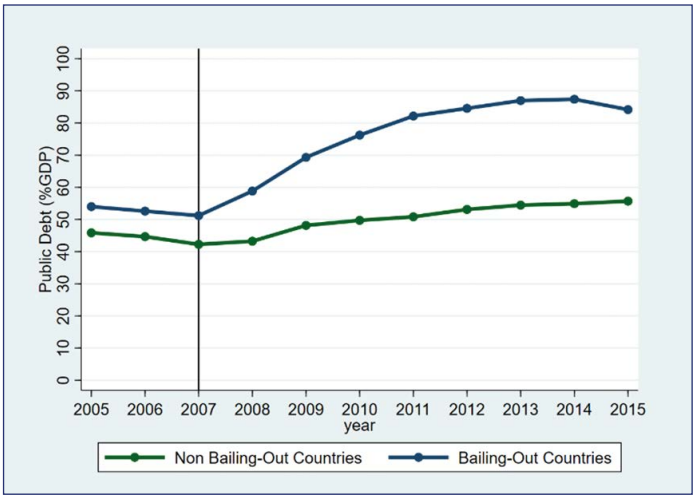
## Table 3. Baseline results: Bank bailouts and sovereign risk

This table shows the results for the relationship between bank bailouts and sovereign risk. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P and, Moody's. *Bailout Dummy* takes the value 1 for the year of the bailout and the following, and 0 otherwise. *Bailout Amount (%GDP)* is the share of the country's GDP that the bailout program represents. The rest of the variables are defined in Appendix B. Year and country fixed effects are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| **Dependent variable:** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Bailout Dummy** | -1.853*** | -1.784*** | -2.115*** | | | |
| | (0.583) | (0.530) | (0.665) | | | |
| **Bailout Amount (%GDP)** | | | | -0.096*** | -0.082** | -0.136*** |
| | | | | (0.0343) | (0.0340) | (0.0277) |
| **GDP per Capita** | 7.579*** | 5.836*** | 8.273*** | 8.219*** | 6.499*** | 8.971*** |
| | (1.361) | (1.360) | (1.443) | (1.497) | (1.508) | (1.577) |
| **GDP Growth** | 0.103** | 0.102*** | 0.0952** | 0.132*** | 0.127*** | 0.133*** |
| | (0.0401) | (0.0362) | (0.0463) | (0.0370) | (0.0368) | (0.0494) |
| **Inflation** | -0.101 | -0.114* | -0.126** | -0.0806 | -0.0942* | -0.111* |
| | (0.0653) | (0.0601) | (0.0598) | (0.0536) | (0.0492) | (0.0581) |
| **Fiscal Balance** | 0.124*** | 0.104*** | 0.0972*** | 0.115*** | 0.0968** | 0.104** |
| | (0.0282) | (0.0314) | (0.0333) | (0.0328) | (0.0376) | (0.0407) |
| **External Debt (%GDP)** | 0.678 | 1.152 | 0.667 | 0.957 | 1.439* | 1.040* |
| | (0.696) | (0.768) | (0.523) | (0.674) | (0.765) | (0.571) |
| **Default History** | -2.471*** | -1.298** | -1.533* | -2.371*** | -1.360*** | -1.591*** |
| | (0.639) | (0.523) | (0.853) | (0.465) | (0.426) | (0.560) |
| **Reserves (%GDP)** | 0.00191 | 0.00753 | 0.0184 | -0.000515 | 0.00396 | 0.0110 |
| | (0.0247) | (0.0267) | (0.0138) | (0.0278) | (0.0292) | (0.0167) |
| **Inst. Quality** | 0.115* | 0.155** | 0.168*** | 0.0766 | 0.123 | 0.119* |
| | (0.0664) | (0.0742) | (0.0623) | (0.0714) | (0.0749) | (0.0637) |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | -333.97 | -362.96 | -338.17 | -337.75 | -368.70 | -338.41 |
| **Pseudo R2** | 0.5883 | 0.5652 | 0.5623 | 0.5837 | 0.5583 | 0.5620 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

debt increased across countries that injected capital into their banks and countries that did not at the time when the bulk of the recapitalization packages were implemented. Moreover, the t-test of the mean differences shows that the observed differences between the groups of countries are only statistically significant at conventional levels from 2008 onwards.

**Figure 1. Evolution public debt as potential channel between bank-bailouts and sovereign risk**




This figure plots the evolution of the public debt (%GDP) from 2005 to 2015 for bailing-out countries (blue line) and non bailing-out countries (green line). The x-axis shows the relative years before and after the bank bailout (2008). The Y-axis show the average of public debt (%GDP).

Hence, we further explore the role of public debt as the main mechanism underlying the relationship between bailouts and sovereign ratings. In particular, our empirical approach assumes that bailouts may affect public debt and sovereign ratings simultaneously and that changes in public debt may be an indirect channel leading to changes in sovereign ratings. This analysis requires a two-stage procedure that controls for the potential endogeneity of both public debt and sovereign ratings and their potential simultaneous dependence on bailouts. Therefore, we combine our baseline ordered probit model with a Two-Stage Least Squares (2SLS) procedure. In particular, we regress our measures of sovereign ratings on the *Bailout Dummy* and a proxy of each country's public debt, controlling for other relevant factors as in the baseline model [eq.1]. The structural equation (2) to be estimated is:

$$SOVEREIGN\ RATING_{i,t+1} = \alpha + \beta_0\, BANK\ BAILOUT_{i,t} + \beta_1\, \Delta\widehat{PUBLIC\ DEBT}_{i,t} + \sum_{z=1}^{8} \beta_z\, CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (2)$$

In order to determine whether the effect of bank bailouts on sovereign ratings is transmitted by the difference in public debt growth resulting from the bailout, we calculate the predicted values of the change in public debt ΔPUBLIC DEBT$_{i,t}$. We do so by estimating a first-stage regression, in which the observed value of the change in public debt (measured as the ratio of total public sector debt to GDP) is the dependent variable. The first-stage equation is defined as follows:

$$\Delta PUBLICDEBT_{i,t} = \alpha + \lambda_0 BANK\ BAILOUT_{i,t} + \lambda_1 TOTAL\ DEATHS\ BY\ NATURAL\ DISASTERS_{i,t} + \sum_{z=1}^{8} \lambda_z\, CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

As independent variables of the first-stage regression, we include all the explanatory variables in the baseline model and the country and year fixed effects [eq.1]. Likewise, standard errors are clustered at the country level. This equation (3) has its own predetermined variable or instrument: TOTAL DEATHS BY NATURAL DISASTERS, a variable that measures the number of deaths by natural disaster that occurred in our sample of countries during the research period (2005-2015). This variable, collected from the Centre for Research on the Epidemiology of Disasters[15] (CRED), reveals not only the occurrence of natural disasters but also their magnitude. Instruments should affect the second-stage variable only through their effect on the first-stage endogenous variable. As it is always difficult to find suitable instruments, we motivate the choice of our instrument with economic and statistical arguments. From an economic point of view, it is clear that the occurrence of natural disasters and the severity of these disasters provoke an unexpected drop in public savings, along with a foreign capital outflow (Klomp, 2017).[16] In the aftermath of a natural disaster, governments need immediate funds for

[15] Available at https://www.emdat.be/

[16] Focusing on relationship lending, Berg & Schrader, (2012) also demonstrate that while credit demand increases due to a natural disaster, access to credit is restricted. However, bank-borrower relationships can mitigate these lending restrictions. In fact, clients who are known to the institution are about equally likely to receive loans before and after the occurrence of a disaster.

reconstruction, cleanup and emergency relief and aid to ensure a rapid recovery. Thus, increases in public debt can be expected, and they would be more relevant as it does the severity of the disaster (Albala-Bertrand, 1993; Mohan and Strobl, 2021; Noy and Nualsri, 2011).[17] In addition to selecting our instrument based on economic arguments, we require it to be relevant and valid. As reported in Table 4, the tests employed to measure the validity of the instrument reveal that it is relevant and valid.

The 2SLS approach allows us to separate the various effects of bank bailouts in the equation explaining sovereign ratings. In the second stage, the fitted values of the change in public debt ($\Delta$PUBLIC $DEBT_{i,t}$) from equation (3) are used as the independent variable to estimate model (2). Therefore, the coefficient $\beta_1$ of equation (2) would capture the extent to which bank bailouts influence sovereign ratings through changes in public debt. Coefficient $\beta_0$ of equation (2) would indicate the direct effect of bailouts on sovereign ratings regardless of changes in public debt.

We report the results obtained in Table 4. Column (1) reports the results for the first-stage equation explaining the annual growth in public debt. *Bailout Dummy* presents a positive and statistically significant coefficient, indicating that, as expected, annual growth in public debt increases as a consequence of bank bailouts. The variable *Total Deaths by Natural Disasters* enters the regression with a positive and significant coefficient, suggesting that increases in public debt can be expected after the occurrence of a severe natural disaster.

Columns (2), (3) and (4) of Table 4 report the results for the second-stage equations explaining how bank bailouts affect the sovereign ratings of each of the three CRAs. In all the second-stage estimates, the predicted value of the increase in public debt presents a negative and statistically significant coefficient. This suggests that, in accordance with the *risk-increasing effect* previously argued for, the increase in the annual growth of public debt resulting from bank bailouts reduces sovereign ratings. Moreover, after explicitly accounting for the public-debt channel, the coefficient of *Bailout Dummy*, while still negative, is no longer significant at conventional levels in any of the second-stage estimates. This result suggests that, when accounting for the underlying mechanism, it is the increase in public debt that absorbs the negative impact of bailouts on sovereign ratings. In a sense, this finding reinforces and confirms the role of public debt as the main channel through which bank bailouts affect sovereign ratings.

[17] Using a large sample of countries from 1990 to 2005, Noy & Nualsri, (2011) find that for the advanced economies, outstanding government debt increases following a natural disaster (1.07% of GDP), accumulating to more than 8% of GDP over a year and a half.

## Table 4. Two Stage Least Squares (2SLS) procedure: the role of public debt as a mechanism

This table shows the effect of bailouts on sovereign ratings examining the role of public debt as a mechanism and, by means of Two Stage Least Squares (2SLS) procedure. In the first stage, the dependent variable is the change in public debt *(%GDP), ΔPublic debt. Total deaths by natural disasters,* is an exogenous variable that measures the number of deaths in natural disasters. *Bailout Dummy$_{it}$* is a dummy variable that takes the value 1 for the year of the bailout and the following, and 0 otherwise. In the second stage, the dependent variable is the long-term foreign currency sovereign credit ratings issued by Fitch, S&P and, Moody's. Furthermore, to consider the *Bailout Dummy$_{it}$* variable as in the first stage, we include the predicted value of the increase of public debt in the First Stage (*ΔPublic debt),* as the mechanism between the bank bailout and sovereign rating. In both stages, the same set of quantitative and qualitative controls included in our baseline model [1] are included. Year and country fixed effects are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| | 1st Stage | 2nd Stage | | |
|---|---|---|---|---|
| **Dependent variable:** | **ΔPublic Debt** | **Fitch** | **S&P** | **Moody's** |
| | (1) | (2) | (3) | (4) |
| **Total Deaths by Natural Disasters** | 0.00026***<br>(0.00006) | | | |
| **Bailout Dummy** | 3.362***<br>(0.837) | -0.361<br>(0.338) | -0.340<br>(0.262) | -0.171<br>(0.240) |
| | | -0.374**<br>(0.189) | -0.394**<br>(0.162) | -0.532***<br>(0.202) |
| **CONTROLS** | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | - | -337.28 | -364.53 | -338.82 |
| **R2 /Pseudo R2** | 0.65 | 0.5842 | 0.5633 | 0.5613 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Durbin-Wu-Hausman** | | 4.19** | 8.45*** | 4.33** |
| **Kleibergen-Paap underidentification F-Test** | | 36.81*** | 36.81*** | 36.81*** |
| **Kleibergen-Paap weak identification F-Test** | | 17.10*** | 17.10*** | 17.10*** |

### *4.3. THE IMPACT OF BANKING SYSTEM CHARACTERISTICS*

#### *4.3.1. THE SOUNDNESS AND STRUCTURE OF THE BAILED-OUT BANKING SYSTEM*

In order to examine whether the soundness and structure of the banking sector affect the influence of bailouts on sovereign risk, we extend the baseline model [eq.1]. In particular, the extended model [eq.4] includes the banking sector variables that define the national banking sectors and the interactions of these variables with the variable accounting for the implementation of a bank bailout. The model is defined as follows:

$$SOVEREIGN_{i,t+1} = \alpha + \beta_0 BANK\ BAILOUT_{i,t} + \beta_1 BANKING_{i,t} + \beta_2\ BANK\ BAILOUT_{i,t} x\ BANKING_{i,t} + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (4)$$

$BANKING_{i,t}$ is the country-level factor related to the characteristics of the banking sector in terms of soundness and structure. In line with prior studies in the banking literature (Barth et al., 2002; Barth, Caprio, and Levine, 2004; Schaeck and Cihák, 2014), we consider the most relevant dimensions defining the banking sector to be size, risk, market concentration and profitability. The size of the banking sector (*Size*) is proxied by the ratio of total assets held by deposit money banks to GDP. We also include the share of non-performing loans over gross loans as a proxy of the risk level of the banking system (*Risk*). To account for the banking market structure, we consider the three largest banks' asset concentration ratios (*Concentration*). A profitability proxy of the banking industry in each country – the ROA ratio – is also included in our analysis (*Profitability*). We also include the same set of quantitative and qualitative factors included in the baseline model [eq.1], as well as country and year fixed effects. Likewise, standard errors are clustered at the country level.

Table 5 reports the results[18] of the regressions of the extended model [eq.4]. In columns (1) to (4), the dependent variable is the sovereign rating provided by Fitch. In columns (5) to (8), the ratings provided by S&P are the dependent variable. Finally,

[18] For the sake of brevity, we only report the results using the amount of funding involved in the bailout process (%GDP) as the key explanatory variable of our analysis (Bailout Amount %GDP). The results (available upon request) hold using the Bailout Dummy.

in the last four columns (9 to 12), we consider Moody's ratings as the dependent variable. The results show that the effect of bank bailouts on sovereign risk remains negative and statistically significant at the 1% level ($\beta_0<0$). This result indicates that the global *risk-increasing effect* holds after accounting for the characteristics of the banking sector. However, the influence of bank bailouts on sovereign ratings varies across countries depending on the specific characteristics of the banking sector ($\beta_2$). In particular, the interaction term between the bailout variable and the variable *Risk* has a positive coefficient. This implies that the effect of bailouts on sovereign ratings is reduced if the bailed-out banking sector is highly risky. This may be due in part to the positive assessment of government reactions to the problems identified in the banking sector. Our results also show a negative and statistically significant coefficient for the interaction between the bailout variable and the proxy of banking sector profitability, indicating that interventions targeting entities from banking sectors with higher levels of profitability magnify the negative impact of bank bailouts on sovereign ratings. This result could be supported by the fact that the *risk-increasing effect* is less relevant if the entity intervened in belongs to a banking sector that is perceived as less profitable. In such environments, CRAs may be of the view that the bailout process was necessary to prevent the economy suffering the worst consequences of a generalized bank-distressed situation. The positive coefficient obtained for the multiplicative term between the bailout variable and bank concentration also suggests that the negative effect of bailouts on sovereign risk is reduced in the case of more concentrated banking markets. Given that more concentrated markets are usually characterized by the presence of too-big-to-fail entities, government interventions in these markets could be more understandable and consistent with the *risk-reducing effect*. Lastly, regarding the size of the banking system, we do not find that it significantly shapes the effect of the bailout.

Together with the statistical significance of most of the banking sector characteristics that do not interact with the bailout variable ($\beta_1$), these findings reveal that the soundness and structure of the banking sector matters in determining sovereign credit ratings.

Therefore, these results show that proactive implementation of public measures in banking systems that are largely distressed (i.e., that have a high level of risk and low profitability) and concentrated leads to relatively lower increases in sovereign risk. While the *risk-increasing effect* dominates, these results suggest that there is also a *moderating risk-reducing effect* in those countries that specifically undertake public bank bailouts to restore financial stability in these kinds of banking systems.

## Table 5. Bank bailouts, sovereign risk, and the influence of banking sector characteristics

This table shows the results for the relationship between bank bailouts and sovereign risk. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P, and Moody's. *Bailout Dummy* takes the value 1 for the year of the bailout and the following, and 0 otherwise. *Bailout Amount (%GDP)* is the share of the country's GDP that the bailout program represents. *NPL* is the share of non-performing loans over gross loans in each country's banking sector. *Concentration* is the banking market concentration defined as the share of banking sector assets held by the three largest banks in each country. *Profitability* is the annual value of the ROA of the banking sector. *Size* is proxied by total assets held by deposit money banks, % GDP. The same set of quantitative and qualitative controls included in our baseline model [1] are included. Year and country fixed effects are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| **Dependent variable:** | **Fitch** | | | | **S&P** | | | | **Moody´s** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| **Bailout Amount (%GDP)** | -0.173** | -0.153*** | -0.121*** | -0.634*** | -0.181** | -0.150*** | -0.105*** | -0.557*** | -0.228*** | -0.344*** | -0.179*** | -0.515*** |
| | (0.081) | (0.066) | (0.035) | (0.136) | (0.080) | (0.057) | (0.035) | (0.096) | (0.055) | (0.061) | (0.031) | (0.122) |
| **Bailout Amount (%GDP) x Size** | 0.0001 (0.000) | | | | 0.0003 (0.0005) | | | | 0.0006 (0.0004) | | | |
| **Bailout Amount (%GDP) x Risk** | | 0.007*** | | | | 0.0071*** | | | | 0.0126*** | | |
| | | (0.002) | | | | (0.001) | | | | (0.003) | | |
| **Bailout Amount (%GDP) x Profitability** | | | -0.009*** | | | | -0.011*** | | | | -0.014*** | |
| | | | (0.003) | | | | (0.003) | | | | (0.004) | |
| **Bailout Amount (%GDP) x Concentration** | | | | 0.008*** | | | | 0.006*** | | | | 0.004*** |
| | | | | (0.001) | | | | (0.001) | | | | (0.001) |
| **Size** | -0.034*** (0.007) | | | | -0.035*** (0.008) | | | | -0.010 (0.009) | | | |
| **Risk** | | -0.319*** | | | | -0.242*** | | | | -0.231*** | | |
| | | (0.044) | | | | (0.044) | | | | (0.062) | | |
| **Profitability** | | | 0.239*** | | | | 0.261*** | | | | 0.272*** | |
| | | | (0.053) | | | | (0.063) | | | | (0.067) | |
| **Concentration** | | | | -0.033*** | | | | -0.029*** | | | | -0.061*** |
| | | | | (0.009) | | | | (0.009) | | | | (0.017) |
| **Controls** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | -319.08 | -312.21 | -322.33 | -319.24 | -349.05 | -352.87 | -414.73 | -353.45 | -336.56 | -320.50 | -326.92 | -320.85 |
| **Pseudo R2** | 0.6067 | 0.6152 | 0.6027 | 0.6065 | 0.5818 | 0.5773 | 0.5776 | 0.5766 | 0.5644 | 0.5851 | 0.5768 | 0.5847 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

### *4.3.2. THE PARTICIPATION OF THE PUBLIC SECTOR IN THE BAILED-OUT BANKING SYSTEM*

Another question of interest is whether the connections between the public sector and the banking system may also moderate or magnify the strength of the relationship between bank bailouts and sovereign risk. This heterogeneous effect is relevant to examine because the *pass-through channel* from banking risk to sovereign risk could differ due to the existence of ties between the public sector and the banking system. To examine this possibility, we extend our baseline model [eq.1] by including two variables that account for the public sector's level of participation in the banking system (*BANK_PUBLIC SECTOR*$_{i,t}$) and its interaction with the *BANK BAILOUT* variable. In this case, the extended model [eq.5] is defined as follows:

$$SOVEREIGN_{i,t+1} = \alpha + \beta_0 BANK\ BAILOUT_{i,t} + \beta_1 BANK\_PUBLIC\ SECTOR_{i,t} + \beta_2 BANK\ BAILOUT_{i,t} x\ BANK\_PUBLIC\ SECTOR_{i,t} + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (5)$$

*BANK_PUBLIC SECTOR*$_{i,t}$ is the country-level variable related to the participation of the public sector in the national banking system. We account for these connections, firstly, by computing the total credit granted by domestic banks to the government and state-owned enterprises as a percentage of GDP (*Banking Credit to Government*). A large ratio would mean that the public sector is largely dependent on the banking sector. Secondly, we compute the percentage of total bank assets controlled by the government (*Government-owned bank assets*).[19] In this latter case, a large percentage would reveal that the public sector intervenes considerably in banks. Table 2 shows that in the OECD countries, banking credit to the government represents, on average, 14.03% of national GDP. Likewise, Table 2 shows that although the mean percentage of government-owned bank assets is 9.87% in all the OECD countries, this is higher for bailing-out countries (ranging from 9.61% to 13.69%). This result is consistent with the approval of equity injections from the public sector.

Table 6 reports the results obtained for this extended model [5]. As can be seen, in

[19] Both measures have been employed in prior literature exploring the participation of the public sector in the national banking system (see, among others, Andrianova, Demetriades and Shortland, 2008 and Wolde-Rufael, 2009).

all the estimates, the coefficient for the percentage of GDP that the bank bailouts represent in each country ($\beta_0$) is negative and statistically significant. This result suggests that, even accounting for the connections between the public sector and the banking system, bank bailouts have a negative impact on sovereign ratings (*risk-increasing effect*). Regarding the interaction terms between *Bailout Amount (%GDP)* and *Banking Credit to Government (%GDP)*, Table 7 shows that the effect differs across the CRAs. This result suggests that, when the CRAs assess the impact of bank bailouts on sovereign risk, they evaluate the potential dependency of the public sector on bank credit differently. Specifically, it is observed that in the cases of Fitch and S&P, the coefficient of the interaction between *Bailout Amount (%GDP)* and *Banking Credit to Government* ($\beta_2$) is not significant. This suggests that the effect of bailouts is neither moderated nor magnified by the public sector's reliance on banking credit. Only in the case of Moody's is this effect positive and significant at 5%, which provides evidence that bank bailouts' effect on sovereign ratings is less negative if the government is largely financed by the banking system. Furthermore, we find that the interactions between *Bailout Amount (%GDP)* and *Government-Owned Bank Assets* are not statistically significant for any CRA. Thus, the impact of bank bailouts on sovereign risk is not influenced by the percentage of bank assets under government control.

Lastly, it is noted that although the interaction terms between the participation of the public sector in the national banking system and bank bailouts ($\beta_2$) are not significant, the individual effect ($\beta_1$) of the credit granted by domestic banks to the government and state-owned enterprises is negative and statistically significant at 1% for the three CRAs. This implies that countries with governments and state-owned enterprises that are financed largely by banks have lower ratings (exhibit larger sovereign risk). This result could be explained by the fact that a government being financed largely by its own banks could reinforce the *pass-through channel* between banking risk and sovereign risk. In this sense, a negative potential shock to the banking sector that causes a credit crunch may entail a higher risk for those governments that rely heavily on financing from domestic banks.

### *4.4. DYNAMICS OF THE EFFECTS OF BANK BAILOUTS*

#### *4.4.1. TIMING*

Unlike other papers focused on specific bailout programs (e.g., TARP in the US), some OECD countries bailed out their banks repeatedly in different years. For this reason, it is relevant to examine whether the impact of bank bailouts differs depend-

## Table 6. Bank bailouts, sovereign risk, and the influence of the public and banking sector connections

This table shows the results for the relationship between bank bailouts and sovereign risk. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P, and Moody's. *Bailout Amount (%GDP)* is the share of the country's GDP that the bailout program represents. *Bank Credit to Government (%GDP)* is the ratio between credit by domestic money banks to the government and state-owned enterprises and GDP. *Government-Owned Bank Assets* is the percentage of banks assets controlled by the government to the total bank assets. The same set of quantitative and qualitative controls included in our baseline model [1] are included. Year and country fixed effects are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| **Dependent variable:** | **Fitch** | | **S&P** | | **Moody's** | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Bailout Amount (%GDP)** | -0.136** | -0.203*** | -0.098* | -0.151*** | -0.236*** | -0.122** |
| | (0.063) | (0.076) | (0.058) | (0.051) | (0.044) | (0.054) |
| **Bailout Amount (%GDP) x Bank Credit to Government (%GDP)** | 0.002 | | 0.0006 | | 0.003** | |
| | (0.003) | | (0.002) | | (0.001) | |
| **Bailout Amount (%GDP) x Government-Owned Bank Assets** | | 0.004<br>(0.004) | | 0.003<br>(0.003) | | 0.001<br>(0.023) |
| **Bank Credit to Government (%GDP)** | -0.169*** | | -0.136*** | | -0.207*** | |
| | (0.049) | | (0.045) | | (0.037) | |
| **Government-Owned Bank Assets** | | 0.008 | | 0.004 | | -0.0006 |
| | | (0.020) | | (0.021) | | (0.002) |
| **Controls** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | -311.18 | -331.34 | -348.36 | -364.91 | -303.01 | -338.31 |
| **Pseudo R2** | 0.6164 | 0.5916 | 0.5827 | 0.5628 | 0.6078 | 0.5621 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

ing on the year in which these public recapitalizations are undertaken (*Timing*). To provide evidence regarding this issue, we estimate the following model:

$$SOVEREIGN\ RATING_{i,t+1} = \alpha + \gamma_n\ BANK\ BAILOUT_{i,t} x\ BAILOUT\ YEAR_t + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (6)$$

In this model [eq.6], we replace our generalized DID term with a series of DID terms that interact the *Bailout Dummy* with dummies for each of the years in which a bank bailout may have occurred (2008 to 2013). The coefficients of these interactions ($\gamma_n$) would reveal whether the impact of the bank bailouts differs depending on when these interventions are agreed upon. This equation includes all the control variables in the baseline model and the country and year fixed effects [eq.1]. Likewise, standard errors are clustered at the country level.

The results obtained are reported in Table 8. The negative and statistically significant coefficients ($\gamma_n$) BANK BAILOUT$_{i,t}$ x BAILOUT YEAR$_t$ of the series of interactions for all the CRAs reveal that the sovereign ratings of countries that implement bank bailouts are negatively affected regardless of when the recapitalization occurs. This result is in line with our main findings supporting the previously argued-for *risk-increasing effect*. However, the magnitude of the coefficients reveals that late bank bailouts had a larger negative effect on sovereign ratings. These findings suggest that, while all bank bailouts negatively affected sovereign ratings regardless of the year in which they were implemented, those public recapitalizations agreed upon after 2011 were perceived as riskier for the creditworthiness of the country. In this sense, since the outbreak of the GFC caused a deterioration in public finances, bank bailouts implemented from 2011 onwards increased sovereign risk more than those implemented at the beginning of the crisis period (2007-2008), when public finances were, on average, in a better situation.

### *4.4.2. DURATION*

In line with prior literature on bank bailouts, we also examine the *duration* of the impact of bank bailouts on sovereign ratings. Specifically, following the methodology employed in Beck, Levine and Levkov (2010), we examine the timing of the relationship between bank bailouts and sovereign ratings for those countries that bailed out their banking

## Table 7. Dynamics of the effects of bank bailouts: impact by bailout year

This table reports difference-in-difference (DID) regression estimates for the impact of bank bailouts on the sovereign risk. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P, and Moody's. In this table, the reported coefficients are the interactions of the *Bailout Dummy* with year dummies for each of the years in which a bank bailout may take place (2008 to 2013). *Bailout Dummy* equals to 1 if the country *i* injects public capital into its banking system at year *t* and 0 otherwise. Country-level controls and year and country dummies are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

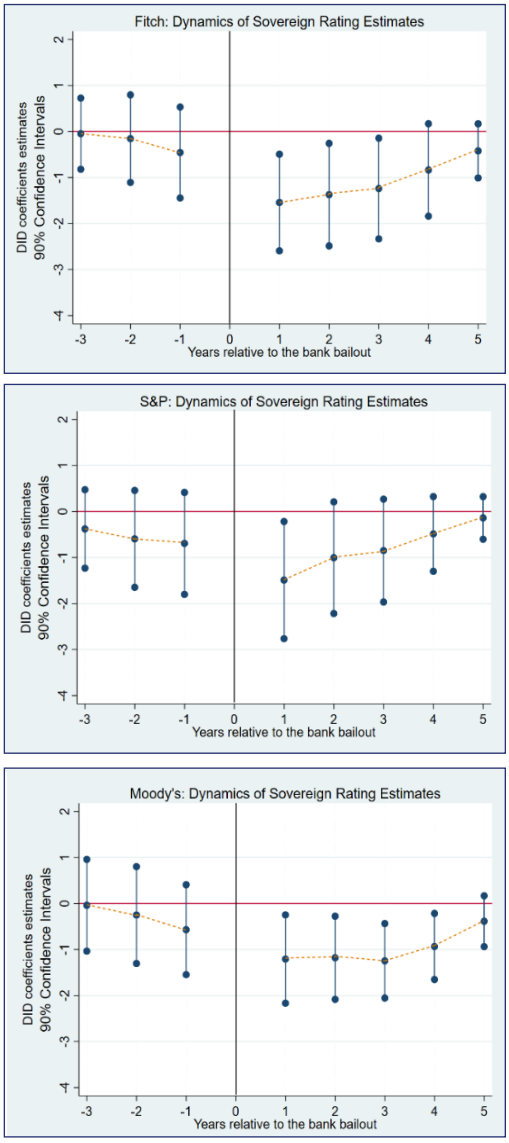
| **Dependent variable:** | **Fitch** | **S&P** | **Moody's** |
|---|---|---|---|
| | (1) | (2) | (3) |
| **Bailout Dummy$_{it}$ x 2008** | -3.373*** | -2.744*** | -4.162*** |
| | (0.787) | (0.693) | (0.543) |
| **Bailout Dummy$_{it}$ x 2009** | -1.628** | -1.712*** | -2.131*** |
| | (0.723) | (0.609) | (0.601) |
| **Bailout Dummy$_{it}$ x 2010** | -1.933** | -2.518*** | -3.158*** |
| | (0.982) | (0.839) | (0.775) |
| **Bailout Dummy$_{it}$ x 2011** | -5.775*** | -5.841*** | -7.535*** |
| | (0.757) | (0.957) | (0.833) |
| **Bailout Dummy$_{it}$ x 2012** | -5.161*** | -5.057*** | -6.555*** |
| | (0.996) | (0.767) | (0.784) |
| **Bailout Dummy$_{it}$ x 2013** | -6.421*** | -5.940*** | -7.297*** |
| | (0.748) | (0.733) | (0.722) |
| **CONTROLS** | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country |
| **Observations** | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 |
| **Log pseudolikelihood** | -336.07 | -365.22 | -342.37 |
| **Pseudo R2** | 0.5857 | 0.5625 | 0.5568 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 |

systems. To do this, we include a series of dummy variables in the standard regression [eq.1] to trace the year-by-year effects of bank bailouts. As in Beck, Levine and Levkov (2010), these dummies serve as the DID terms for the effects of the bank bailouts for an eight-year window, spanning from three years before to five years after the public recapitalizations:

$$SOVEREIGN\ RATING_{i,t+1} = \alpha + \beta_1\ BANK\ BAILOUT_i^{-y} + \ldots + \beta_4\ BANK\ BAILOUT_i^{+y} + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (7)$$

In this extended model [eq.7], BANK BAILOUT$_i$ equals zero, except in the following cases: BANK BAILOUT$_i^{-y}$ equals one for countries in the $y^{th}$ year before the bank bailout ($y$ = *-3 to -1*), while BANK BAILOUT$_i^{+y}$ equals one for countries in the $y^{th}$ year after the bank bailout ($y$ = 1 to 5). This model also includes all the control variables of the baseline model and the country and year fixed effects. Figure 2 plots the 90% confidence intervals for the bank bailout dummy variables, where the standard errors are adjusted for a country-level clustering. The figure illustrates that the coefficients for the bailout dummy variables are not significantly different from zero for all years before the recapitalization measure is implemented. This result confirms that there were no trends in sovereign rating differences before the implementation of a bank bailout (*parallel trend assumption*). The immediate negative impact (at year t+1) on the sovereign ratings of those countries conducting a bank bailout confirms the *risk-increasing effect*. It is from the moment that bailouts are implemented, and not before, that differences across bailing-out countries (treated) and non-bailing-out countries (control) arise. Moreover, we see that for Fitch and Moody's, the coefficients are all negative and statistically significant three and four years after the bailout, respectively. These results suggest that the effects of bank bailouts on sovereign ratings are not short-lived. Thus, for three to four years after the bailout, countries that conducted bank bailouts seem to have lower ratings (higher sovereign risk) than those that did not. However, for S&P, the coefficients remain negative for some years after the bailout, but there are no statistically significant effects from the second year after the bailout onwards. This shorter-lived effect for S&P is in line with prior findings regarding the asymmetries in agencies' evaluations of sovereign risk (Fabozzi and Vink, 2015). At the same time, this result also suggests that S&P might be more interested in its reputational credibility than Moody's and Fitch and thus may change its ratings more promptly (Camanho et al., 2020; Salvador et al., 2020).

**Figure 2. Dynamics of the effects of bank bailouts: *duration***




These figures plot the difference-in-differences (DID) point estimates (for the difference between countries bailing out their banks and countries non-bailing out their banks) on the sovereign risk. For the three ratings, we report the DID estimates with their 90% confidence intervals (represented by the blue solid lines). The x-axis shows the relative years before and after the bank bailout, spanning from 3 years before the bank bailout and until 5 years after the bank bailout.

### *4.4.3 RATING MOMENTUM*

Finally, another interesting question relates to the *momentum* of sovereign rating adjustments following a bank bailout. In particular, this analysis allows us to examine whether sovereign ratings are adjusted at once or whether they are more likely to be adjusted gradually some years after the recapitalization measure is implemented. To answer this question, we compute the rating adjustment ($\Delta$SOVEREIGN RATING$_{i,t}$), which is the difference between the current rating (SOVEREIGN RATING$_{i,t}$) and the sovereign rating in the previous year (SOVEREIGN RATING$_{i,t-1}$). If $\Delta$SOVEREIGN RATING$_{i,t}$ is negative, it means that the sovereign rating has been downgraded, while a positive value indicates a rating upgrade. However, if $\Delta$SOVEREIGN RATING$_{i,t}$ is equal to zero, the sovereign rating has not been adjusted. We estimate the following model [eq.8] to address the dynamics of the rating adjustments:

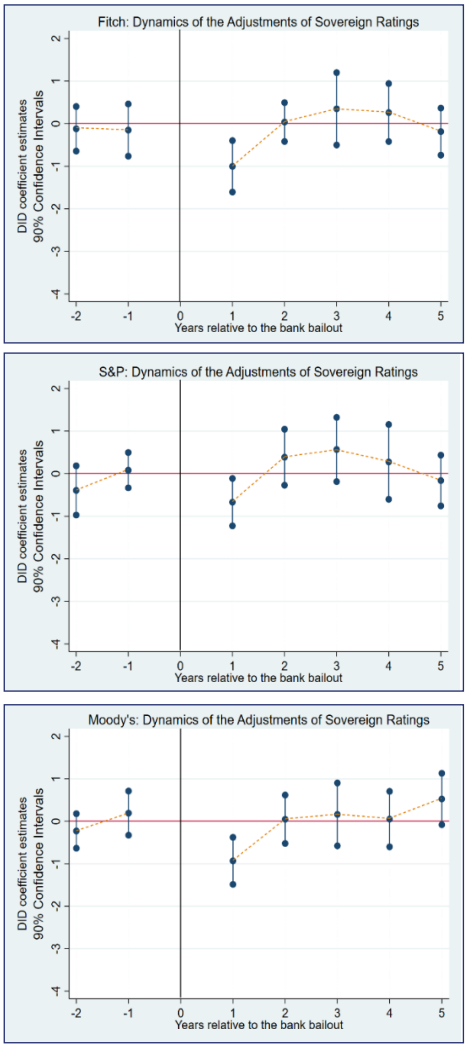
$$\Delta SOVEREIGN\ RATING_{i,t} = \alpha + \beta_1\ BANK\ BAILOUT_i^{-y} + \ldots + \beta_3\ BANK\ BAILOUT_i^{+y} + \ldots + \sum_{z=1}^{8} \beta_z\ CONTROLS_{i,t} + \theta_i + \delta_t + \varepsilon_{i,t} \quad (8)$$

As before, we include a set of dummies that serve as the DID terms to account for the effects of bank bailouts on the rating adjustments in the years before and after the public recapitalizations. Likewise, we also consider all the control variables of the standard regression [eq.1] and the country and year fixed effects. Figure 3 plots the 90% confidence intervals for the coefficients of eq. [8]. As expected, for all the CRAs, we observe that the coefficients for the years before the bank bailout are not significant. This confirms that those countries that bailed out their banks were less likely to experience rating adjustments before the treatment event. Moreover, we observe that only the coefficient for the first year after the bank bailout is negative and statistically significant for all the CRAs. Hence, countries bailing out their banks were more likely to be downgraded during the year after the bank bailout. The rest of the coefficients are not statistically significant for any of the CRAs, which suggests that there were no substantial subsequent rating adjustments – *rating momentum* – from one year after the bank bailout onwards. At the same time, the non-significant coefficient for the second year following the bailout means that the rating adjustment (change in the rating at bailout+2 compared to the rating at bailout+1) for those countries that bailed out their banks was not significantly different from the adjustment for those countries that did not.

Taken together, the dynamics of bailouts' effects on sovereign ratings support the existence of a *risk-increasing effect* of bank bailouts on sovereign risk. For the bailing-out countries, ratings were mainly adjusted (downgraded) at once during the year after

the bailout, but these lower ratings persisted for at least three or four years (in the case of Fitch and Moody's) until the rating recovered to its pre-bailout level.

**Figure 3. Dynamics of the effects of bank bailouts: *rating momentum***




These figures plot the difference-in-differences (DID) point estimates (for the difference between countries bailing out their banks and countries non-bailing out their banks) on the adjustment of sovereign ratings ($\Delta$Sovereign rating = $Rating_t$ - $Rating_{t-1}$). For the three CRAs, we report the DID estimates with their 90% confidence intervals (represented by the blue solid lines). The x-axis shows the relative years before and after the bank bailout.

## 5. ENDOGENEITY CONCERNS

### *5.1. INSTRUMENTAL VARIABLES (IV) ANALYSIS*

An important methodological concern regarding our empirical approach is that bank bailouts are likely to be endogenously determined. Indeed, the probability of a bank bailout cannot be considered fully exogenous but could be driven in part by the sovereign risk level of the country in question. In such a setting, where observations cannot be randomly assigned to different groups, ordered probit regressions may not provide consistent estimates. Although the original construction of our baseline models' dependent and explanatory variables (in which we led the dependent variable by one quarter) could partially mitigate this concern, we now aim to increase the sophistication of our empirical analysis as regards this specific econometric concern. To this end, we undertake two steps. First, we apply an instrumental variables (IV) methodology, which enables us to focus on the effect on sovereign risk of the exogenous component of the bank bailouts. Second, we perform a two-stage Heckman (1979) regression analysis that controls for the potential endogeneity between the choice of a bailout over another type of resolution process and sovereign risk.

Due to the potential endogeneity of our bailout variable, we conduct an IV analysis similar to those employed in earlier bank bailout studies (Berger and Roman, 2015, 2017; Calderon and Schaeck, 2016; Berger, Makaew and Roman, 2018; Carbó-Valverde, Cuadros-Solas and Rodríguez-Fernández, 2020, among others). In the first stage, we use a probit model to explain the dummy variable that identifies bailouts. We consider three instruments that have been employed in prior studies dealing with endogeneity concerns in bank bailouts. In particular, we base the selection of our instruments on different strands of the literature. The first is related primarily to the importance of national political elections and the political orientation of the largest government party (Brown and Dinç, 2005). Following Calderon and Schaeck (2016), we define a dummy variable that takes a value of one if the largest government party has a more conservative orientation (*Conservative*) and zero otherwise. Governments led by such parties are expected to be focused on market-oriented policies to increase their chances of re-election (Bortolotti and Faccio, 2009). Moreover, conservative governments can be expected to be associated with favorable outcomes for the banking sector (King, 2015).

Second, the specific characteristics of the banking sector, in terms of supervision and market structure, could also affect the decision to implement a bank bailout. Following Calderon and Schaeck (2016) and Carbó-Valverde et al., (2020), we use the prompt corrective power index (*Prompt Corrective Power*) built from the Bank Regula-

tion and Supervision Survey in Barth, Caprio and Levine (2004, 2013).[20] This index ranges from 0 to 6 and proxies whether there are predetermined levels of bank solvency deterioration that force automatic actions such as interventions. We would expect powerful regulators to press for the implementation of bailout packages.

Third, we also consider the percentage of bank assets held by non-domestic banks (*Foreign Banks' Assets*) as an instrument. The expected sign of the coefficient of this variable is unclear when explaining the probability of a bank bailout. On the one hand, the presence of foreign banks in a national banking market increases the level of competition in the domestic banking sector. Hence, according to the *competition-fragility view* (Allen and Gale, 2004; Hellmann et al., 2000; Matutes and Vives, 2000), it could argued that the level of instability in those markets would be higher and the probability of bailout processes for domestic banks in trouble would increase. On the other hand, if the relative importance of foreign banks' activity in a particular country is high, the probability of non-domestic banks being rescued by the national government is lower. Thus, if foreign banks' presence in the domestic market is large enough, we should observe a negative association between their assets and bank bailouts.

In the first stage, we run a probit model that regresses the discrete dummy for bailouts (*Bailout Dummy*) on the abovementioned instruments (*Conservative, Prompt Corrective Power* and *Foreign Banks' Assets*) and all the control variables of our baseline second-stage model. Subsequently, we use the predicted probability obtained from the first stage as an instrument for the second stage. The results are reported in Table 8. In column (1), we report the first-stage regression results. The second-stage results are shown in columns (2) to (4). As can be seen, all three instruments are statistically significant at conventional levels. Moreover, all first-stage F-tests are above the rule of thumb of 10, and the Kleibergen-Paap tests reject the null hypothesis of weak instruments, suggesting that the instruments are valid. Regarding the effect of each instrument, the *Conservative* variable presents a positive coefficient, indicating that the presence of a more conservative political party in the government favors bailouts as resolution mechanisms for banks in distress. In line with our expectations, the coefficient for the measure of regulators' power is positive, whereas in the case of *Foreign Banks' Assets*, we obtain a negative coefficient. This latter result suggests that, if the activity of foreign banks in a domestic market

[20] As Barth et al. (2004) argue, prompt corrective power measures the extent to which the law establishes predetermined levels of bank solvency deterioration that force automatic enforcement actions such as intervention and the extent to which supervisors have the requisite powers to take such action. A larger value (closer or equal to 6) reflects greater authority of the official supervisory authorities to take specific actions to prevent and correct problems.

is higher, the probability of bailouts occurring is lower. In the second-stage regressions, we find that the main results for the relationship between bailouts and sovereign risk hold completely. Hence, after explicitly controlling for potential concerns regarding the endogeneity between bank bailouts and sovereign risk, our results still support a *risk-increasing effect* and thus a negative effect of bailouts on sovereign ratings.

### *5.2. SAMPLE SELECTION BIAS*

To control for potential sample selection bias and endogeneity problems between the occurrence of a bank bailout and its effects on sovereign ratings, we perform a two-stage Heckman (1979) regression analysis. We run a first-stage probit regression, where the dependent variable is again the dummy variable identifying the country-year observations affected by a bank bailout (*Bailout Dummy*), to estimate λ, the inverse *Mill's ratio* of the choice whether to publicly recapitalize banks or not. As explanatory variables, we consider the whole set of variables explaining the sovereign rating in the second stage, plus additional variables acting as exogenous variables to identify the recapitalization decision. The results of the two-stage Heckman selection models are presented in columns (5) to (7) of Table 8. The first-stage regressions are identical to those previously described for the IV method reported in the same Table 8 (Column (1)). As can be observed, the inverse *Mill's ratio* (λ) only enters the regression with a statistically significant coefficient in column (5), and it is not significant at conventional levels in columns (6) or (7). This empirical finding suggests that unobserved factors that make bank bailouts more likely are not significantly associated with sovereign ratings. Therefore, we are able to state that our empirical analysis is not affected by potential sample selection problems.

## 6. ROBUSTNESS CHECKS

### *6.1. CHANGES IN SOVEREIGN RATINGS*

To ensure that our results are robust, we also analyze the impact of bank bailouts on rating adjustments. By doing so, we are able to test whether countries that bail out their banks are more likely to suffer downgrades (upgrades) than those countries that do not. To this end, we use as dependent variable the rating adjustment after the start of the bailout process ($\Delta$Sov.Rating $_{\text{post vs.pre}}$). This variable is computed as the difference between each year's rating after the start of the bailout processes (Sov.

## Table 8. Endogeneity concerns

This table shows the results for the relationship between bank bailouts and sovereign risk controlling for potential endogeneity concerns. Column (1) reports the results for the first stage regression estimating the probability of a bank bailout. In columns (2) to (4) we show the results obtained for the second stage of an IV method explaining sovereign rating. Columns (5) to (7) present the results for the second stage of the Heckman (1979) analysis for sample selection bias. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P and Moody's. *Bailout Dummy* takes the value 1 for the year of the bailout and the following, and 0 otherwise. *Conservative, Prompt Corrective Power*, and *Foreign Banks' Assets* are the first-stage instruments for *Bailout Dummy*. *Conservative* is a dummy variable that takes value 1 if the largest government party has a conservative orientation. *Prompt Corrective Power* is an index that measures if there are predetermined levels of bank solvency deterioration that force automatic actions such as interventions. *Foreign Banks' Assets* is the share of assets held by non-domestic banks. Country-level controls and country and year dummies are included but not reported. Clustered standard errors in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

| | 1st-Stage | Instrumental Variable Analysis: Final Stage IV | | | Sample Selection: Heckman (1979) analysis | | |
|---|---|---|---|---|---|---|---|
| **Dependent variable:** | **Bailout Dummy** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| **Conservative** | 0.496**<br>(0.250) | | | | | | |
| **Prompt Corrective Power** | 0.286***<br>(0.072) | | | | | | |
| **Foreign Banks' Assets** | -0.018***<br>(0.007) | | | | | | |
| **Bailout Dummy** | | -1.068***<br>(0.327) | -1.186***<br>(0.277) | -1.201***<br>(0.334) | - 1.233**<br>(0.489) | -0.977**<br>(0.500) | -1.086*<br>(0.659) |
| **Inverse Mills Ratio** | | | | | 0.430*<br>(0.256) | 0.284<br>(0.240) | 0.312<br>(0.252) |
| **CONTROLS** | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Standard Errors** | Country | Country | Country | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | -80.45 | -534.12 | -576.71 | -517.39 | -267.88 | -285.87 | -249.12 |
| **Pseudo R2** | 0.6932 | 0.5820 | 0.5589 | 0.5439 | 0.6058 | 0.5937 | 0.6153 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Durbin-Wu-Hausman** | | 5.83** | 4.47** | 4.31** | | | |
| **Kleibergen-Paap underidentification F-Test** | | 40.50*** | 40.50*** | 40.54*** | | | |
| **Kleibergen-Paap weak identification F-Test** | | 15.48*** | 15.48*** | 15.48*** | | | |

$Rating_{t,post}$) and the sovereign rating in 2007, before any of the bank bailouts occurred ($Sov.Rating_{2007}$). A negative (positive) value of this variable would indicate that the sovereign rating has been downgraded (upgraded).

In columns (1) to (3) of Table 9, it is noted that the DID coefficients (*Bailout Dummy*) are negative and statistically significant. This result suggests that after controlling for the main determinants of sovereign risk, those countries that bailed out their banking systems were more likely to experience rating downgrades than those that did not. This is in line with our previous findings. Bank bailouts negatively affect sovereign ratings by increasing the probability of a downgrade (e.g., indicating higher sovereign risk) for those countries that bailed out their banks (*risk-increasing effect*).

### *6.2. PLACEBO EXPERIMENT*

Furthermore, as in related studies employing a DID methodology, we conduct a placebo experiment by assigning random placebo bank bailouts. Then, we randomly consider the countries that bailed out their banking systems and the years in which these public recapitalizations occurred. Panel A of Table 9 (columns (4) to (6)) shows that the DID coefficients are not statistically significant after the placebo experiment. This finding suggests that the results are not driven by chance.

### *6.3. SUBSAMPLE ANALYSES*

To ensure that our results are not driven by the large bank bailouts that were conducted in a small set of countries, we conduct several subsample analyses. First, we re-run our models excluding those countries that experienced the largest bank bailouts, for which the bailout amount in terms of GDP is above the 75$^{th}$ percentile (*Bailout Amount GDP%* >4.65%). After doing this, 26 (74.3%) countries remain in our sample (10 treated and 16 non-treated). Panel A of Table 9 (columns (7) to (9)) shows that the results are qualitatively similar to our previous findings. Second, we re-run the DID estimations excluding Greece, Ireland, Italy, Portugal, and Spain (the GIPSI countries), since the banking systems of these European countries were most affected by the GFC, which consequently led their national governments to undertake large bank bailouts. Columns (10) to (12) of Table 9 (Panel A) show that the coefficients of the DID terms are still negative and statistically significant after excluding these countries.

### *6.4. ALTERNATIVE MEASURES OF SOVEREIGN RATINGS AND BANK BAILOUTS*

We conduct our analysis employing the standard transformation of sovereign ratings into a 21-category numerical scale. To ensure that this rating scale is not driving our findings, we re-run our model using a condensed scale (12 categories) that groups together those categories with few observations. Panel B of Table 9 (columns (1) to (3)) shows that the results are robust after employing an alternative sovereign rating scale.

In the main specifications, we lead the dependent variable by one quarter to ameliorate potential endogeneity biases between the sovereign ratings and the determinants of sovereign risk. For robustness purposes, we estimate the equations leading the dependent variable two quarters. As shown in Panel B of Table 9 (columns (4) to (6)), our findings remain consistent with the *risk-increasing effect*.

The main specifications are also estimated using alternative measures of bank bailouts. The bank bailout measures are replaced with *Number Bailed-out Banks* and *Bailout Amount per Bank*. Both measures are continuous variables that provide additional information about the extent of the bailout programs implemented. Specifically, *Number Bailed-out Banks*$_{it}$ is the total number of banks into which country *i* injected capital until year *t*. *Bailout Amount per Bank*$_{it}$ is computed as the ratio of the total capital injected by country *i* into the banking system to the number of bailed-out banks until year *t*. As can be observed in Panel B of Table 9 (columns (7) to (12)), our results hold after employing these alternative continuous measures accounting for injections of public capital into the banking system.

## 7. CONCLUSIONS

During and after the onset of the 2007-2008 GFC, many countries around the world intervened in financially distressed banks with the primary objective of restoring confidence and stability in the banking sector. Policymakers decided to undertake public recapitalizations of troubled banks as a means of avoiding the spread of systemic risk in the financial markets and consequently to the economy. At the same time, however, bank bailouts have also been seen as a factor underlying some countries' weak fiscal and economic situations in recent years.

This paper aimed to further explore the relationship of bank bailouts to sovereign risk. To do this, we used a sample of 35 OECD countries and 19 bank bailout episodes

## Table 9. Bank bailouts and sovereign risk: robustness

This table shows the results for the robustness checks. Our dependent variables are the long-term foreign currency sovereign credit ratings issued by Fitch, S&P and Moody's. Columns (1) to (3) of Panel A provide the results for the regressions on the rating adjustments (changes in the sovereign ratings). Columns (4) to (6) of Panel A provide the regression results for the placebo experiment on assigning randomly the countries that have bailed out their banking systems and the years at which those public recapitalizations have taken. Columns (7) to (9) of Panel A provide the results for the regressions excluding those countries for which the amount of the bank bailout in terms of GDP is above the 75$^{th}$ percentile (>4.65%). Columns (10) to (12) of Panel A provide the results for the regressions excluding the GIPSI countries (Greece, Italy, Ireland, Portugal, and Spain). Columns (1) to (3) of Panel B provide the results for the regressions using a rating scale with 12 categories. Columns (4) to (6) of Panel B provide the results for the regressions using the ratings at the end of the second quarter of year t+1. Columns (7) o (9) of Panel B provide the results for the regressions using the total number of banks for which country *i* has injected capital injection until year t as DID term. Columns (10) to (12) of Panel B provide the results for the regressions using the ratio of the total capital injected by the country *i* in the banking system to the number of bailed-out banks as DID term. Country-level controls and country and year dummies are included but not reported. Clustered standard errors in parentheses. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

| **Panel A. Robustness: Rating adjustments, Placebo and Subsample analyses** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Δ Sov.Rating$_{post\ vs.\ pre}$** | | | **Placebo** | | | **Excluding large Bank Bailouts** | | | **Excluding the GIPSI countries** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** |
| **Bank Bailout$_{it}$** | -1.766*** | -1.087* | -1.784*** | 0.150 | 0.162 | 0.164 | -3.005*** | -2.608*** | -3.244*** | -2.694** | -2.463*** | -3.138*** |
| | (0.671) | (0.641) | (0.570) | (0.228) | (0.212) | (0.236) | (1.154) | (0.890) | (1.074) | (1.051) | (0.826) | (1.061) |
| **Controls** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Std. Errors** | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country |
| **Observations** | 315 | 315 | 315 | 385 | 385 | 385 | 286 | 286 | 286 | 330 | 330 | 330 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 | 26 | 26 | 26 | 30 | 30 | 30 |
| **Log pseudolikelihood** | -273.55 | -316.76 | -228.39 | -347.47 | -375.87 | -354.09 | -139.83 | -183.45 | -167.41 | -189.73 | -225.98 | -214.52 |
| **Pseudo R2** | 0.4970 | 0.4555 | 0.5991 | 0.5717 | 0.5497 | 0.5417 | 0.7434 | 0.6696 | 0.6554 | 0.7086 | 0.6618 | 0.6383 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Panel B. Robustness: Alternative measures of sovereign ratings and alternative measures of bank bailouts** | | | | | | | | | | | | |
| | **Dep. Var.: Sov. Rating (12 scale rating)** | | | **Dep. Var.: Sov. Rating (2$^{nd}$ quarter t+1)** | | | **Bank Bailout = Number Bailed-out banks** | | | **Bank Bailout = Bailout Amount per Bank** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** | **Fitch** | **S&P** | **Moody's** |
| **Bank Bailout$_{it}$** | -1.861*** | -1.727*** | -2.147*** | -1.949*** | -1.935*** | -2.343*** | -0.213*** | -0.180*** | -0.216*** | -0.404*** | -0.394*** | -0.308** |
| | (0.588) | (0.526) | (0.670) | (0.594) | (0.627) | (0.731) | (0.048) | (0.040) | (0.046) | (0.152) | (0.115) | (0.140) |
| **Controls** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Year Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Country Dummies** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Clustered Std. Errors** | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country | Country |
| **Observations** | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 | 385 |
| **Number of countries** | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| **Log pseudolikelihood** | -323.59 | -335.76 | -309.27 | -350.12 | -372.76 | -344.55 | -343.04 | -372.40 | -350.07 | -327.36 | -356.71 | -342.78 |
| **Pseudo R2** | 0.5943 | 0.5829 | 0.5843 | 0.5751 | 0.5562 | 0.5589 | 0.5771 | 0.5539 | 0.5469 | 0.5965 | 0.5726 | 0.5563 |
| **p-value (chi2)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

that occurred from 2005 to 2015. We find that bank bailouts negatively affect sovereign risk, measured by the sovereign ratings provided by the three most important CRAs worldwide: Fitch, S&P and Moody's. In fact, the larger the amount of public funding injected into the banking sector, the stronger the negative effect on ratings. Hence, the results are consistent with a *risk-increasing effect* that indicates a deterioration in public finances caused by the bailout packages. These results are found to be robust after considering potential endogeneity concerns, sample selection bias and additional robustness tests.

The empirical examination of the potential mechanisms underlying the relationship between bank bailouts and sovereign ratings shows that the increases in public debt driven by bank bailouts explain the *risk-increasing effect*. Our empirical findings also indicate that the particular characteristics of each banking sector shape the influence of bailouts on sovereign risk. Specifically, banking systems characterized by high levels of risk, low profitability and concentrated markets seem to experience relatively lower increases in sovereign risk. Nevertheless, the strength of the connections between the government and the banking industry does not seem to moderate or magnify the impact of bank bailouts on sovereign risk.

We also provide evidence regarding the dynamics of the effects of public recapitalizations. The results obtained reveal a *timing* effect, indicating that late bank bailouts had a larger negative effect on sovereign ratings compared to early bank bailouts. As regards the *duration* analysis, countries conducting bailouts had lower ratings three to four years after the bailouts occurred compared to those that did not undertake public recapitalizations. Moreover, an examination of the *momentum* effect revealed that countries that bail out their banks are downgraded in the year after the bank bailout, and no substantial subsequent rating adjustments occur for these countries

Our findings may have relevant economic implications. On the one hand, authorities' implementation of bailout packages for banking sectors in trouble could help avoid a late response's worst consequences for confidence in the financial system. On the other hand, the negative effect of bank bailouts on sovereign ratings may cause a deterioration in public finances and increase the cost of financing for the state and its firms, as the sovereign rating acts as a rating "ceiling" for most corporate borrowers within their home country.

In any case, the results of this paper should be contextualized in relation to a particular financial crisis, the GFC in 2007/2008. However, our results argue in favor of conducting future research accounting for the characteristics of the domestic banking

system when examining sovereign risk. This future research could help increase the effectiveness of macroprudential policies and further our understanding of bailouts' future impacts on economic systems.

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## APPENDIX A. BANK BAILOUTS

This table provides details on the composition of the bank bailouts for the 35 OECD countries in our sample.

| Country | Bailout | Bailout Amount (%GDP) | # Banks | Avg. Bailout package ($ bn) (Bailout Amount/ Bailed-out Banks) | Bailout packages |
|---|---|---|---|---|---|
| **Australia** | No | - | - | - | |
| **Austria** | Yes | 2.60 | 7 | 1.51 | State aid SA.32554 (2009/C); State aid SA.31883 (N516/2010); State aid N 261/2010 (ex PN 9/2010); State aid SA.32745 (2011/NN); State aid SA.31883 (2011/C); State aid SA.32554 (2009/C) |
| **Belgium** | Yes | 4.74 | 3 | 8.06 | State aid C 9/2009 (ex NN 49/2008); State aid NN 42/2008; State aid C 18/2009 (ex N 360/2009); IMF Country Report No. 13/124 |
| **Canada** | No | - | - | - | |
| **Chile** | No | - | - | - | |
| **Czech Rep.** | No | - | - | - | |

| | | | | | |
|---|---|---|---|---|---|
| **Denmark** | Yes | 3.18 | 14 | 0.73 | State aid NN 52/2010; State aid scheme N31a/2009; State aid N415/2009; State aid NN 46/2009; State aid NN 23/2009; State aid N 560/2009; IMF Country Report No. 13/23; Source: State aid N 560/2009; State aid SA.33117 (2011/N); State aid SA.31945 (2011/NN); State aid SA.34423 (2012/N) |
| **Estonia** | No | - | - | - | |
| **Finland** | No | - | - | - | |
| **France** | Yes | 1.02 | 8 | 3.63 | State aid C 9/2009 (ex NN 49/2008); State aid N 613/2008; State aid N 249/2009; IMF Country Report No. 13/124 |
| **Germany** | Yes | 2.02 | 7 | 10.27 | State aid SA.34539 (2012/N); IMF Country Report No. 11/368; State aid C 29/2009 (ex N 503/2009); State aid 15/2009 (ex N 196/2009), N 333/2009 & N 557/2009; State aid C/17/2009 (ex N265/2009); IMF Country Report No. 11/368; Staatliche Beihilfe C 40/2009; State aid SA.33571 (2011/N); State aid SA.34381 (2012/N) |
| **Greece** | Yes | 20.33 | 16 | 3.22 | State aid N 504/2009; State aid N 260/2010; State aid N429/2010; State aid SA.34488 (2012/C) (ex 2012 /NN); State aid SA.35460 (2013/NN); State aid No SA.34824 (2012/C, ex 2012/NN); State aid SA.34122 (2011/N); State aid SA.31155 (2013/C) (2013/NN) (ex 2010/N); State aid No SA.34823 (2012/C, ex 2012/NN); State aid No SA.34825 (2012/C, ex 2012/NN); State aid No SA.34826 (2012/C, ex 2012/NN); State aid SA.37967 (2013/N); State aid SA.36007 (2013/NN); State aid SA.36005 (2013/NN) |

| | | | | | |
|---|---|---|---|---|---|
| **Hungary** | Yes | 0.10 | 1 | 0.13 | IMF Country Report No. 10/80; State aid SA.29608 (C37/2010) |
| **Iceland** | Yes | 17.76 | 3 | 0.76 | IMF Country Report No. 10/95; IMF Country Report No. 10/96 |
| **Ireland** | Yes | 40.79 | 6 | 15.64 | State aid SA.33216 (2011/N); State aid SA.33443 (2011/N); State aid SA.33296 (2011/N); State aid NN12/2010 and C11/2010 (ex N667/2009); State aid NN12/2010 and C11/2010 (ex N667/2009); State aid NN 50/2010 (ex N 441/2010); State aid NN 35/2010 (ex N 279/2010); State aid N 160/2010; State aid 32504 (2011/N); State aid SA.33296 (2011/N); State aid NN 35/2010 (ex N 279/2010); State aid 32504 (2011/N) and C 11/2010 (ex N 667/2009); State aid SA.33296 (2011/N);State aid SA.33296 (2011/N); State aid SA.33311 (2011/N) |
| **Israel** | No | - | - | - | |
| **Italy** | Yes | 0.38 | 4 | 2.07 | State aid N 425/2010; State aid N 425/2011; State aid N 425/2012; State aid N 425/2013; State aid SA.35137 (2012/N) |
| **Japan** | No | - | - | - | |
| **Korea, Rep.** | No | - | - | - | |
| **Latvia** | Yes | 4.69 | 2 | 0.58 | State aid NN 60/2009; State aid C 26/2009 (ex N 289/2009); State aid 30704 (2012/C) (ex NN 53/2010) |
| **Luxembourg** | Yes | 7.14 | 2 | 1.99 | State aid C 9/2009 (ex NN 45/2008); State aid NN 46/2008; State aid N 274/2009 |
| **Mexico** | No | 0.00 | - | - | |
| **Netherlands** | Yes | 2.71 | 3 | 8.16 | State aid C 10/2009 (ex N 138/2009); State aid N 611/2008; State aid NN 53/A/2008; State aid C 11/2009 (ex NN 53b/2008, NN 2/2010 and N 19/2010); State aid SA.35382 (2013/N) |

| | | | | | |
|---|---|---|---|---|---|
| **New Zealand** | No | - | - | - | |
| **Norway** | No | - | - | - | |
| **Poland** | No | - | - | - | |
| **Portugal** | Yes | 4.65 | 5 | 2.02 | State aid SA. 26909 (2011/C); State aid SA.34724 (2013/N); State aid SA. 35238 (2013/N); State aid SA.35062 (2012/NN); |
| **Slovak Rep.** | No | - | - | - | |
| **Slovenia** | Yes | 11.44 | 5 | 1.10 | State aid SA. 34937 (2012/C) (ex 2012/N); IMF Country Report No. 11/121; IMF Country Report No. 12/319; State aid SA.35709 (2012/N); State aid n° SA.37690 (2013/N); |
| **Spain** | Yes | 5.69 | 13 | 6.04 | State aid NN 61/2009; State aid SA.34536 (2012/N); State aid SA.33095 (2011/N); State aid SA.35488 (2012/N); State aid SA.34820 (2012/N); State aid SA.33096 (2011/N); State aid SA.33734 (2012/N); State aid SA.33103 (2011/N); State aid SA. 33735 (2012/N); State aid SA.34053 (2012/N); State aid SA.34820 (2012/N); State aid SA.33734 (2012/N); State aid SA.35489 (2012/N); State aid SA.35490 (2012/N); State aid SA.36249 (2013/N) |
| **Sweden** | No | - | - | - | |
| **Switzerland** | Yes | 1.01 | 1 | 5.58 | IMF Country Report No. 09/164; |
| **Turkey** | No | - | - | - | |
| **United Kingdom** | Yes | 4.06 | 3 | 34.28 | State aid N 422/2009; State aid N 621/2009; State aid N 428/2009; State aid C 14/2008 (ex NN 1/2008) |
| **United States** | Yes | 1.40 | 707 | 0.29 | Capital Purchase Program (under the Troubled Asset Relief Program) |
| **TOTAL #** | 19 | | | | |

## APPENDIX B. DEFINITIONS OF THE VARIABLES AND DATA SOURCES

This table describes the variables used in the paper and indicates the sources from which the data were retrieved.

| Variable | Definition | Source |
|---|---|---|
| **Panel A. Sovereign risk & Bank bailouts** | | |
| **Sovereign credit ratings** | Long-term foreign currency sovereign credit ratings issued by the three main CRAs: Fitch, Moody's, and Standard & Poor's (S&P) | Thomson Reuters & rating agencies' publications |
| **Bailout Dummy$_{it}$** | Dummy taking the value 1 when and after country *i* injects public capital into its banking system at year *t* and 0 otherwise | Homar and van Wijnbergen (2017), the IMF Country Reports and the World Bank |
| **Bailout Amount (%GDP)$_{it}$** | The total capital injected by country i into its banking system up to year t as a % of GDP | Homar and van Wijnbergen (2017), the IMF Country Reports and the World Bank |
| **Panel B. Economic indicators** | | |
| **GDP Growth** | Annual percentage growth rate of GDP | World Bank |
| **GDP per Capita** | Log GDP over total population | IMF |
| **Inflation** | Annual percentage change of end-of-period consumer prices | IMF |
| **Fiscal Balance** | General government net lending/borrowing, calculated as government revenue minus total government expenditure, as a % of GDP | IMF |
| **External Debt/GDP** | Total external debt stocks as a % of GDP | World Bank |
| **Default History** | 1 if the country has experienced a sovereign default in the last 10 years and 0 otherwise | Beers and Mavalwalla (2017) |
| **Total Reserves** | Total reserves (including gold) as a % of GDP | World Bank |
| **Institutional Quality** | Economic freedom index | Heritage Foundation |
| **Panel C. Banking system characteristics** | | |
| **Size** | Total assets held by deposit money banks as a % of GDP | Global Financial Development Dataset (World Bank) |
| **Risk** | Non-performing loans over gross loans | |
| **Concentration** | Assets of three largest banks as a share of assets of all banks | |
| **Profitability** | Average return on assets (ROA) | |
| **Banking Credit to Government** | Total credit granted by domestic banks to the government and state-owned enterprises as a % of GDP | |
| **Government-Owned Bank Assets** | Percentage of total bank assets controlled by the government | |
| **Panel D. Instruments** | | |
| **Conservative** | Dummy variable with the value 1 if the largest government party has a conservative orientation | Official sources and Acharya et al. (2020) |
| **Prompt Corrective Power** | Index measuring whether there are predetermined levels of bank solvency deterioration that force automatic actions such as interventions | Built from the World Bank Regulation and Supervision Survey, as in Barth, Caprio and Levine (2004, 2013) |
| **Foreign banks' assets** | Share of assets held by non-domestic banks in % | World Bank Regulation and Supervision Survey |
| **Total deaths by natural disasters** | Number of deaths in natural disasters | Centre for Research on the Epidemiology of Disasters (CRED) |

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