

Böhm, Hannes; Eichler, Stefan

Conference Paper

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Beiträge zur Jahrestagung des Vereins für Socialpolitik 2019: 30 Jahre Mauerfall - Demokratie und Marktwirtschaft - Session: International Finance Markets, No. B11-V1

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Böhm, Hannes; Eichler, Stefan (2019) : Avoiding the Fall into the Loop: Isolating the Transmission of Bank-to-Sovereign Distress in the Euro Area and its Drivers, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2019: 30 Jahre Mauerfall - Demokratie und Marktwirtschaft - Session: International Finance Markets, No. B11-V1, ZBW - Leibniz-Informationszentrum Wirtschaft, Kiel, Hamburg

This Version is available at:

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Avoiding the Fall into the Loop: Isolating the Transmission of Bank-to-Sovereign Distress in the Euro Area and its Drivers

Hannes Böhm* and Stefan Eichler†

*Halle Institute for Economic Research (IWH)
TU Dresden*

This Version: January 2019

Abstract

We isolate the direct bank-to-sovereign distress channel within the Eurozone's sovereign-bank-loop by exploiting the global, non-Eurozone related variation in stock prices. We instrument banking sector stock returns in the Eurozone with exposure-weighted stock market returns from non-Eurozone countries and take further precautions to remove any Eurozone crisis-related variation. We find that the transmission of instrumented bank distress, while economically relevant, is significantly smaller than the corresponding coefficient in the unadjusted OLS framework, confirming concerns on reverse causality and omitted variables in previous studies. Furthermore, we show that the spillover of bank distress is significantly stronger for countries with poorer macroeconomic performances, weaker financial sectors and financial regulation and during times of elevated political uncertainty.

Keywords: Sovereign-bank loop, bank distress, instrumental variable estimation, bank exposures, macroeconomic performance

JEL Classification: G21, G15, G28, F3, E44

*hannes.boehm@iwh-halle.de

†stefan.eichler@tu-dresden.de

1 Introduction

The fatal relationship between bank and sovereign distress in the Eurozone, the *sovereign bank loop*, has put the political and economic survivability of the currency union to the test. Bank distress started to amplify sovereign distress with the beginning of the Eurozone crisis, as expensive financial sector bailouts weakened the fiscal capacity of sovereigns (*bailout channel*). In addition, deteriorating sovereign creditworthiness was transmitted to domestic banks' balance sheets through their vast holding of government debt securities. Impaired by these negative shocks, banks holding larger amounts of sovereign debt from GIPS countries are associated with reducing credit supply, thus hampering general economic activity (*sovereign-bond channel*). Ultimately, distressed banks made further public rescue efforts more likely which once again endangered sovereign solvency. Taken together, both channels place the sovereign bank loop as one of the primary reasons for the escalation of the Eurozone crisis as well as the sluggish economic recovery of the Eurozone after the financial crisis (Brunnermeier et al. 2016).

However, while the literature on these effects is extensive and compelling, the precise empirical identification of both channels of distress inside the loop remains challenging. First, bank and sovereign fragility in the Euro Area are highly interlinked with the bailout and the sovereign bonds channel amplifying each other, therefore leading to reverse causality. Furthermore, unobserved risk-attitudes of investors towards the institutional and political specificities of the Eurozone are a cause for concern in applied studies. Factors such as a potential break-up of the EMU or the pricing of political declarations stated in the midst of the crisis are hard to quantify, yet are likely to influence both sovereign and bank distress. If such omitted factors are economically relevant, they could render the estimates of the effects between both distress types inconsistent. Simply regressing sovereign on bank distress or vice versa is therefore unlikely to yield any causal effects between both types and is insufficient to disentangle the reinforcing bailout and sovereign-bond channels. As long as the isolated channels that transmit bank distress on sovereigns and vice versa are difficult to identify, it is also uncertain which macroeconomic factors drive the bank-sovereign relationship.

We propose a novel approach to identify the direct bank-to-sovereign distress channel in the Euro Area using an instrument that takes both the inherent reverse causality between financial and sovereign fragility as well as the impact of unobserved factors specific to the

Euro Area into account. To this end, we collect stock returns of 121 banks in the Eurozone to construct country-specific bank distress measures for the most important members of the Euro Area. We instrument these bank returns on the country level using exposure-weighted *non*-Eurozone stock market returns that are tailored to the international claims of each Eurozone-country's banking sector. These imported exposure shocks indicate, if negative, loan losses or asset write-downs for banks in the respective market and thus drive stock returns of Eurozone banks. More importantly, our instrument is less likely to be affected by the sovereign risk structure of the respective member state or Eurozone crisis-specific unobservables since we use a weighted average of non-Eurozone returns and take additional steps to remove any Eurozone related variation in them. More specifically, our main specification uses claim data from before the Eurozone crisis to rule out that Eurozone banking sectors endogenously shifted their international credit exposure as a response to the crisis. We also drop all non-Eurozone countries in the construction of the instrument if they depend excessively on financing from a Eurozone country and might therefore react more distinctly to Eurozone bank distress. Lastly, we orthogonalize the instrument with respect to Eurozone-specific variation of stock returns, thus removing any Euro crisis-related correlation in the instrument. Our approach therefore isolates as precisely as possible the effects of non-Eurozone-driven exposure shocks affecting Eurozone banking sector distress which ultimately impacts sovereign distress.

One further potential concern for our identification strategy could be that non-Eurozone stock returns may have an effect on EMU sovereign risk that is not transmitted through the banking system, thereby violating the exclusion restriction of the instrument. For instance, the deterioration of the economic stance indicated by falling stock returns in a non-EMU country could be associated with worsening export opportunities and thus higher sovereign spreads of an EMU country. To remedy this concern, first, we control for non-financial stock market returns for each Eurozone country which should account for real economic shocks to the EMU country's economy, for instance due to deteriorating economic conditions of a non-EMU trading partner. Second, we control for the effective exchange rate of the Euro, which should directly account for trade shocks affecting the Euro Area. We conduct two further robustness tests to address this concern. First, we repeat our benchmark estimation with non-Eurozone stock market returns consisting only of bank stocks as such bank-specific

shocks are more likely to be transmitted only through the banking sector of a country, in line with the exclusion restriction. Second, we construct a measure of trade-specific shocks and add it as an additional control variable. Both tests confirm our main results.

Our empirical analysis uncovers an economically meaningful and highly statistically significant effect from the instrumented banking sector distress of a Euro Area country on its sovereign distress level. An increase of one standard deviation of instrumented national-specific bank distress of a Eurozone country leads to a rise in national sovereign distress by 0.109 standard deviations on average when using our most careful specification. Banking sector distress was therefore a dominant cause for the propagation of the Eurozone crisis. However, the distress coefficient obtained using ordinary least squares (OLS) is larger by an order of magnitude of roughly 80% compared to the one from our instrumental variable (IV) regression and both coefficients differ statistically significantly. This result points to an aforementioned bias due to omitted variables and/or reverse causality which are unaddressed in the OLS framework. The gap between instrumented and non-instrumented coefficients remains when using different dependent variables, measures for bank distress, starting dates and other versions of the instrument.

The derived exogenous variation in the transmission of bank-to-sovereign distress enables us to estimate the drivers of this distress transfer which is important from a policy perspective and the second contribution of our paper. We find that countries with higher public debt ratios, weaker fiscal positions or macroeconomic performances, measured by GDP growth, unemployment and the current account balance, are associated with a stronger transmission of bank-to-sovereign distress. Second, banking sectors impaired by higher non-performing loan ratios, lower equity ratios, stronger dependence on central bank financing, less macro-prudential regulatory intensity, less developed capital markets and lower return-on-assets are likely to reveal a more intense bank to sovereign fragility transmission. Third, and in contrast to some of the previous literature, we cannot reject the hypothesis that months with a higher issuance or redemption of government securities show no statistically significant effect on the analyzed distress channel. However, banking sectors with larger holdings of domestic government debt securities in relation to total sovereign bond holding appear to transmit distress more pronounced compared to banking sectors with a lower home bias in sovereign debt. Lastly, we uncover that political risk, approximated either through months

with parliamentary elections or political uncertainty measures, are statistically significantly connected to stronger bank-sovereign distress spillovers. However, the political orientation of ruling parties seems largely unassociated to this transmission.

Overall, our specific setting gives us more confidence than prior works in uncovering a more clearly identified economically and statistically significant effect of bank to sovereign distress in the Euro Area. Our results allow the conclusion that isolated bank distress is a dominant cause for the escalation and severity of the Eurozone crisis. With respect to the previous literature, our results suggest that it is important to distinguish between the bailout and the sovereign bonds channel, since both channels amplify each other when using OLS which leads to sizeable reverse causality. From a policy perspective, we provide evidence that banking sector stress is not just a by-product of the Eurozone crisis but one of the major causes for its propagation. If rising bank distress is accompanied by political uncertainties as well as macroeconomic and financial sector vulnerabilities then this is associated with a more forceful impact on the creditworthiness of sovereigns. An economic architecture of the Eurozone that is more resilient in terms of macroeconomic shocks and tougher with regard to financial sector regulation can therefore likely contribute to a more stable currency union.

The rest of this article is organized as follows: In section 2, we conduct a literature review on related articles and argue that previous research on the sovereign bank loop has not taken reverse causality and omitted factors sufficiently into account. Section 3 describes the data we use and the construction of the instrument. Following on this, section 4 presents our empirical strategy and compares results from the OLS framework to the IV estimation. Section 5 investigates the drivers of the identified bank-sovereign distress channel. We conduct encompassing robustness checks in section 6. Section 7 concludes.

2 Literature Review and Endogeneity Concerns

This article is related to a large body of literature that has studied the feedback loop between bank and sovereign distress during the Eurozone crisis. In their seminal paper, Acharya et al. (2014) show that with the onset of the Eurozone crisis in 2009-10 and the private-to-public risk transfers during the financial crisis, sovereign and banking distress started to positively intensify each other. This bailout-channel likely emerges from the fact that governments might face insolvency themselves if they allocate vast fiscal means for the rescue

of an ailing and potentially too-big-to-fail banking sector. Alter & Schüler (2012) find results in accordance with this channel. Gerlach et al. (2010) research the determinants of rising sovereign bond spreads in the Euro Area and find that the balance sheet size of a country's banking sector relative to the country's GDP to be a significant determinant of rising sovereign bond spreads relative to Germany.

The sovereign-bond channel is constituted by several incentives banks face to hold domestic government debt. This effect is shaped by the zero risk weight of such assets in the calculation of banks' capital ratios (the risk shifting hypothesis, see Acharya & Steffen (2015), Acharya et al. (2018), Kirschenmann et al. (2017), Buch et al. (2016)), political pressure by their home governments (the moral suasion hypothesis, see Ongena et al. (2016) Becker & Ivashina (2017), De Marco & Macchiavelli (2016)), monetary policy interventions (Drechsler et al. (2016), Crosignani et al. (2017)) or a combination of these factors (Altavilla et al. (2017), Horváth et al. (2015)). In the context of the sovereign bank loop, banks' inclination towards government debt of their home state might stabilize their sovereign's bond spread as the domestic banking sector acts as a "buyer of last resort" for these securities (see Crosignani (2017)). However, the sovereign-bond-channel also constitutes a direct transmission of increasing sovereign distress to bank balance sheets which might impair banks' lending activities. In accordance with this channel, Popov & Van Horen (2015) and Acharya et al. (2018) find that banks that hold larger exposures of sovereign debt by GIIPS countries issue less credit to non-financial firms.

Our research is furthermore connected to Battistini et al. (2014) who split sovereign risk in a country-specific and a common component. The authors find evidence that banking sectors in periphery countries, but not core countries, respond to increases in the country-specific risk factor by expanding their holding of domestic sovereign debt. Comparably, we focus in our analysis on country-specific banking sector distress that captures idiosyncratic variation in the bank stock returns of a country. De Bruyckere et al. (2013) study the contagion between bank and sovereign risks during the Eurozone crisis and find that lower Tier 1 ratios on the banking and higher debt-to-GDP ratios on the country level are connected to stronger contagion which we can confirm. Schnabel & Schüwer (2016) investigate the relationship between financial and sovereign risk over time and find that the magnitude of the loop was largest in the period between 2010 and 2013 before it contracted somewhat

while gaining new momentum in 2016. They also uncover the home bias in banks' sovereign debt portfolio as well as lower government effectiveness to be dominant drivers of the loop. Fratzscher & Rieth (2018) highlight the two-way causality between banking and sovereign distress in a VAR-approach and find that the ECB's non-standard monetary policies and bank bailout announcements reduced credit risks of sovereigns and banks. Singh et al. (2016) also use bank distress measures based on stock market data to investigate the direction of bank-to-sovereign and sovereign-to-bank distress transfers and find evidence for both types of spillovers. Breckenfelder & Schwaab (2018) also recognize difficulties in handling the two-way dependence of bank and sovereign risks and use the ECB's stress test results from 2014 as a quasi-natural experiment to isolate bank-sovereign distress spillovers, finding that bank risks in stressed countries spilled over to non-stressed countries.

Kallestrup et al. (2016) use a measure comparable to ours by multiplying the international exposures of a country's banking sector derived from BIS consolidated statistics with the banking or sovereign risk of the respective foreign country. However, they do not use this measure as an instrument for national bank distress, but rather to show correlations between domestic and foreign bank risk. Furthermore, and in contrast to Kallestrup et al. (2016), our focus is in particular on the crisis of the Euro Area as the sovereign-bank-loop in this currency union shows special features compared to countries with independent monetary policy and the possibility to devalue their currency (see also De Grauwe & Ji (2013)). Lastly, we take further steps than them to ensure that imported bank shocks are as unrelated as possible to Eurozone-crisis-related developments to ensure their exogeneity by removing the component in world stock returns that is driven by EMU-specific variation.

While all these papers provide compelling evidence for the existence and drivers of a sovereign-bank loop in the Euro Area, a straightforward identification of the bank-to-sovereign distress transmission is still lacking in the literature. When estimating this channel in an unadjusted OLS framework, several potential omitted variables could hamper the analysis and produce biased and possibly inconsistent estimators. For instance, concerns about the break-up of the Euro Area, especially during the most fragile times in 2010-2012, are difficult to quantify and control for. Similarly, sovereign and bank distress were likely also affected by the political credibility investors attributed to agreed rescue packages, newly formed institutions or general declarations of politicians concerning the future of the currency union. Once

again, these factors are difficult to measure and therefore appear in the error term of the respective regression estimation. Crucially, it is likely that such factors are also correlated with the distress measure used as a right-hand-side variable, i.e. sovereign or bank distress. Depending on the effect of the omitted variables on the dependent variable and the covariance between right-hand-side and omitted variables, this omitted variable bias could lead to biases or inconsistencies in the respective coefficients.

A second concern with previous studies is the issue of reverse causality. Simply put, increasing national banks distress will likely lead to rising sovereign distress but rising sovereign distress will at the same time increase national bank distress. This reciprocity is the constituting factor of the sovereign bank loop due to the interplay between the sovereign bond and the bailout channel sketched above. As sovereign and banking distress amplify each other, we would expect that the coefficient that estimates the economic and statistical strength of their relationship will be upward-biased.

Our identification strategy using non-Eurozone exposure returns as an instrument for national bank distress therefore adds an additional layer of exogeneity to the above literature. It provides evidence that bank distress affects sovereign distress to a significant degree even when the former are unaffected by home country government fragility themselves and other unobserved crisis-related factors.¹

3 Data Description

3.1 Deriving Country-Specific Bank Distress

Our banking sector distress measure is based on daily stock returns of all publicly-traded banks in the ten major Eurozone countries during the Euro Area crisis from Datastream, 121 banks in total (see a list of the banks in the Appendix in Table 14).

Weighted bank stock returns are a simple measure for the fragility or distress of a country's banking sector. The bank stocks in our panel are frequently traded, making the stock price an easily observable and daily-available measure. In the absence of new stock issuances or buy-backs, stock price movements correspond to changes in the market value of the equity of a bank. Falling stock prices can therefore be a clearer signal for a deterioration of a bank's

¹In this sense, our research is more broadly connected to contributions like e.g. Autor et al. (2013) who use global variation in trade flows to instrument for local affectedness of trade.

fundamentals, as measured by the market, than balance sheet items which vary only quarterly and are subject to the reporting habits by the regulator.² It is also common in the financial literature to use buy-and-hold stock returns as a measure for a bank's performance over a certain period (see Fahlenbrach & Stulz (2011), Beltratti & Stulz (2012)) and it is intuitive to assume that a poor performance by a large, potentially too-big-to-fail bank has an adverse impact on sovereign creditworthiness. Lastly, stock market data has been frequently used to measure bank fragility in similar contexts (Eichler & Sobański (2016), Bongini et al. (2002), Demirgüç-Kunt & Huizinga (2013), Gropp et al. (2006)).

Though CDS spreads are also a common distress measure for banks, we choose stock returns, first, because they were more liquid during the crisis. Using CDS would force us to drop several Greek or Portuguese banks in the analysis as their CDS spreads turned illiquid. Second, stock returns are a better match for our instrument which relies on the international exposure of a banking sector towards all borrowers of a country, i.e. they encompass all sectors, whereas CDS spreads are sector-specific. Third, stock returns are more accurate to incorporate future profit expectations than CDS premiums. Imported stock return shocks as we construct them should therefore encompass international economic activity more broadly than CDS spreads.

We focus on the period of 2009-2016 in order to capture the distress channel between banks and sovereigns after the bailouts of the financial crisis and the beginning of the Eurozone crisis, starting with the revision of Greece's budget deficit in late 2009 and up to the banking sector distress in Italy in late 2016 surrounding Monte dei Paschi.³

We weight the daily stock return of each bank with its yearly total asset share on its home country level and then aggregate these weighted return series of a country's banking sector for each country i in our sample ($BankReturns_{it}$). This step provides us with a daily

²For instance, in September 2015 Moody's downgraded Greek banks to C despite their CET1 equity ratios being fairly above the regulatory requirement (e.g. 12.1% in the case of National Bank of Greece). However, a major part of this equity consisted of state preference shares and deferred tax assets which are considered to be low-quality equity. The banks' stock prices, on the other hand, had been declining for months at this point. See Moody's investors service: https://www.moody.com/research/Moodys-downgrades-Greek-banks-senior-unsecured-debt-ratings-to-C-PR_333800.

³We set the return of a bank to missing if the bank was delisted or taken over in order to control for survivorship bias. We also disregard the stock return of a bank when there was no turnover of the stock. If the stock return of a bank in a given quarter was missing for more than seven consecutive trading days, we set all returns of the bank in the respective quarter to missing in order to avoid jumps in the indices we construct in the following. This procedure affects mainly small banks with low trading volumes and is not critical for our results.

measure for bank distress on the country level in which the largest banks of the respective country have the greatest weight.

However, the bank stock returns from which each country’s return series is built will be subject to national, Eurozone and global variation in stock prices and economic activities. In the Eurozone, banking distress after the common shock of the financial crisis often took place on a national level, such as Ireland’s bank bailout in 2010, Spain’s nationalization of Bankia in 2012 or Italy’s series of rescue packages for its ailing banking sector in 2015 and 2016. This national component of bank distress, separated from common financial distress affecting all EMU states at the same time, will likely react more strongly to country-specific macroeconomic or political factors. In order to construct a measure for bank distress on the country level that is only driven by national and global factors, i.e. to remove the Eurozone component in stock prices, we proceed as follows:

Similarly to the bank return series on the country level, we derive a Eurozone-specific return series by weighting the stock return of each bank in our panel with its asset share on the Eurozone level, i.e. of the asset size of all banks in our panel, and subsequently aggregate all weighted returns on the Euro Area level. Since this return series will still feature a global component of stock prices, we orthogonalize this Euro Area return series with respect to a Datastream bank stock return series for all global banks, except those from the Euro Area. Doing so, we clean the Eurozone bank returns from worldwide, non-Eurozone variation in stock prices and therefore isolate the Eurozone-specific component in bank stocks ($EurozoneBankReturns_t$).

Finally, we follow the approach of Buch & Neugebauer (2011) and subtract these Eurozone-specific bank returns from the derived bank stock return series for each EMU country i , arriving at a bank distress measure that picks up country-specific variations of bank distress, separated from common financial distress affecting all Eurozone states similarly.⁴ We multiply with minus one to interpret the returns as a distress measure.

$$\Delta NationalBankDistress_{it} = (-1) * (BankReturns_{it} - EurozoneBankReturns_t) \quad (1)$$

⁴We subtract the Eurozone-specific returns to be as close as possible to Buch & Neugebauer (2011). In a robustness check, we also remove Eurozone-specific returns by orthogonalization. Both distress measures correlate at almost 99% and we arrive at nearly identical results.

Though we receive similar results if we apply our following analysis with the more broadly defined $BankReturns_{it}$, as shown in the robustness section, we have reason to believe that the national-specific bank distress measure approximates more precisely for the observed events of idiosyncratic bank distress during the Eurozone crisis.

Table 1 provides summary statistics of $\Delta NationalBankDistress$ for the five GIIPS countries three months before different key events of banking sector turmoil during the crisis, showing in all cases considerable positive distress on average and elevated standard deviations.

- Table 1 around here -

3.2 Instrumenting Bank Distress using Exposure-Weighted Stock Market Returns

Our goal is to derive a variation in $NationalBankDistress_{it}$ that is, first, unaffected by omitted variables representing Eurozone-specific developments and risk attitudes during the crisis. Secondly, the instrument should not increase simultaneously with national sovereign distress of the respective Eurozone country, thus limiting the biasing impact of reverse causality. In a nutshell, a valid instrument to identify the transmission of bank-to-sovereign distress in the Eurozone needs to have a strong correlation with national bank distress (relevance condition) and affect sovereign distress only through its impact on national bank distress while being uncorrelated with unobserved factors in the error term (exclusion restriction).

We argue that economic shocks that occur outside the Euro Area but directly impact the credit exposure and thereby the performance of Eurozone banks can fulfill these criteria, as discussed in the following.⁵ We measure imported fragility from outside the EMU by focusing on stock returns of non-EMU countries where the respective EMU banking sector is invested in and weight these returns using the bilateral claims of the respective EMU banking sector. Using the Consolidated Banking Statistics of the BIS, we collect the consolidated claims of a Eurozone country's banking sector i against all borrowers (banks, official sector, non-

⁵For example, a New York Times article from January 31, 2013 reports that Spanish bank Santander “now generates half of its earnings in Latin America’s emerging economies” and that “a slowdown in Brazil and Mexico, combined with financial troubles in Europe, weighed on Santander’s earnings last year.” As a consequence “shares in Santander fell 2.3 percent in morning trading in Madrid on Thursday after the bank’s fourth-quarter earnings fell below analysts’ expectations.” See <https://dealbook.nytimes.com/2013/01/31/santanders-profit-hit-by-real-estate-concerns/>.

bank private sector) of a non-Eurozone country k in quarter q . These claims are a suitable approximation for the international credit exposure of a country's banking sector as they aggregate all international claims, including from banks' foreign affiliates, consolidated on the bank's headquarter level. We exclude the direct claims between Eurozone countries since they are subject to common Eurozone crisis factors and distress spillovers which is precisely the correlation we want to avoid. Since we require both the BIS exposure data towards and stock return series of a non-Eurozone country, we end up with 48 countries outside the EMU. The list of countries can be found in the appendix (Table 15) and covers the most important markets for Eurozone banks. Our data shows that the exposure towards these non-Eurozone countries, when converted to Euro, makes up on average roughly 21% of the total asset size of a country's banking sector in 2007:Q1, and is therefore meaningful enough to have an economic impact on its financial sector performance. Table 17 in the appendix shows this ratio for all countries in the estimation. We focus on the BIS's ultimate risk basis though our results are robust when using the immediate counterparty basis.⁶

The claim of each EMU country i towards a country k ($BankClaim_{ikq}$) is then set in relation to the total claims of i towards all K countries in the sample:

$$Weight_{ikq} = \frac{BankClaim_{ikq}}{\sum_{k=1}^K BankClaim_{iq}} \quad (2)$$

$Weight_{ikq}$ is therefore a measure for the importance of a non-Eurozone country k in the portfolio of the banking sector in Euro country i in quarter q . In order to measure the distress of the exposure, we then multiply this weighting factor with a daily-varying stock market return series of country k :

$$ExposureWeightedReturns_{ikt} = Weight_{ikq} * StockMarketReturns_{kt} \quad (3)$$

We use broad stock market series that encompass all industries of the respective non-Eurozone country so that the exposure weights match the stock returns by covering all sectors of the economy. With regard to the currency of the non-Eurozone stock returns, we derive all our

⁶The BIS statistics show occasionally small gaps in the claim data which we interpolate as described in detail in the appendix. Through this adjustment, we avoid mechanical jumps in the exposure weights and are able to perform certain specifications of the instrument, for instance to utilize only non-European countries, more cleanly. Our results are not critically affected by this adjustment.

return series in US Dollar.⁷ Finally, these exposure weighted returns are aggregated on the country level of each country i to construct a series of $NonEMUStockReturns_{it}$.

We have reason to believe that our measure of exposure-weighted bank returns from outside the Eurozone is a valid instrument to isolate bank-to-sovereign distress shocks. First of all, stock market returns in open economies such as the Eurozone have a sizeable global component and should therefore likely be affected by return series from other countries, especially if these returns are tailored to the actual exposure of the banking sector. Negative shocks transmitted from these non-EMU markets can hurt EMU banks, e.g. by loan losses, asset write-downs or currency losses. Secondly, because these shocks are imported from other countries not part of the Euro currency area, they are less likely to be affected by unobserved factors regarding Euro Area politics or break up risks and should less strongly react to increasing national sovereign fragility of a country in the Eurozone. Still, there is a legitimate concern that non-Eurozone stock returns still feature a Eurozone component or that banks shifted their international exposure endogenously as a response to the crisis. We will address these concerns in section 4 by using claim data from before the Eurozone crisis, dropping all non-Eurozone countries that depend excessively on financing from a Eurozone country and by orthogonalizing the instrument with respect to Eurozone-specific variation in stock prices.

3.3 Set of Dependent and Explanatory Variables

3.3.1 Dependent Variable

Similar to Gerlach et al. (2010) and Singh et al. (2016) sovereign distress is measured as the 10-year sovereign bond return of an EMU country minus Germany's corresponding rate (taken from Datastream).⁸

⁷Although bank stocks in the EMU are priced in Euro, we have reason to believe that US Dollar returns might lead to a more suitable instrument to answer our research question. First and foremost, the value of the Euro itself was affected by the Euro crisis. Stock returns in Euro could therefore re-introduce crisis-related endogeneity we want to avoid. Secondly, the US Dollar constitutes the world's most important international currency and should thus matter for Eurozone bank stock returns. Thirdly, data providers like Datastream, FTSE or MSCI provide most of the equity series we employ either in US Dollar or in the local currency of the respective country. Though one could derive stock returns in local currencies and convert them to Euro using the respective exchange rate, this approach would assume that Eurozone banks convert foreign stock market gains into Euros on a daily basis. Since this behavior is unlikely, we construct the instrument using international stock returns in US Dollar provided, if available, by Datastream and otherwise by FTSE, MSCI or S&P. We relegate other currency versions of the instrument to the robustness section in which they are shown to be also highly statistically significant.

⁸A robustness check using yields instead of returns yields similar results.

$$\Delta SovereignDistress_{it} = (-1) * (NationalSovereignBondReturn_{it} - GermanSovereignBondReturn_t) \quad (4)$$

Figures 1 to 5 depict $\Delta NationalBankDistress$ and $\Delta SovereignDistress$ for the five GIIPS countries over different 3- or 4-month periods which include several events that affected bank and sovereign distress in the respective country. All figures show that our measures for bank and sovereign distress are highly positively correlated and respond to key events during the Eurozone crisis.

We again prefer bond yields over CDS spreads since certain CDS markets turned illiquid during the Euro Area crisis which would require to disregard e.g. Greece from the analysis. However, we also use CDS spreads of sovereigns as a dependent variable in the robustness section and find similar effects.

- Figures 1-5 around here -

3.3.2 Control Variables

In order to control for the impact of daily developments in financial markets that could influence both sovereign and bank distress, we introduce a broad set of explanatory variables to capture international, European and national financial market developments. The precise definitions and sources of all control variables can be found in the Appendix in Table 16.

Global factors have been shown to drive sovereign creditworthiness to a sizeable degree (Longstaff et al. 2011). We therefore control for the VIX to capture the implied volatility of US equity markets. Also, we include the US corporate credit spread, i.e. the yield of a US 10-year BBB-rated corporate bond minus the equivalent yield of AAA-rated corporate bond. Both measures capture volatility, “fear”, or increased risk premiums in US financial markets. Finally, we control for the US term spread, i.e. the yield spread of a 10-year US treasury bond and a 3-month T-Bill which approximates the premium investors receive for long-term investments.

On a European level, we control for changes in the VSTOXX which captures similar volatility dynamics than the VIX but is based on the EuroStoxx50. We expect increases in the VSTOXX to be associated with heightened financial market volatility and thus rising sovereign distress. Also, we incorporate the nominal effective exchange rate of the Euro into

our analysis, i.e. the weighted exchange rate of the Euro against the EMU's most important trading partners. This variable represents movements in the external value of the Euro. A lower external value could indicate better export opportunities for firms in the Eurozone which could lead to lower sovereign distress. However, a depreciation of the Euro could also be the result of negative news shocks regarding the Eurozone crisis that are associated with higher sovereign spreads. We use the nominal effective exchange rate provided by JP Morgan but our framework is robust towards the version of other providers.

Controlling for European-wide credit distress of firms would ensure that our results are not driven by general economic fluctuations in the non-financial sector. The iTraxx Europe which is constructed of the 125 firms with the most liquid CDS series would be a natural candidate to capture market-wide variation in credit risk. However, since a large fraction of the most liquid CDS series belong to banks, they provide a less clear signal for real sector returns and correlate excessively with bank distress on the country level. To remedy both concerns we regress the 10-year iTraxx Europe against the iTraxx series for senior and subordinated financial firms and draw out the corresponding residuals. That way, we capture the variation in the iTraxx Europe series that is specifically due to real-economic shocks.

The ECB's monetary policy, especially its unconventional programs, are likely to impact both sovereign and bank distress. In order to account for these effects, we use the current account holdings of EMU banks at the ECB as a measure for the general stance of monetary policy. The current account holdings are the sum of bank's required and excess reserves held at the ECB and expanded considerably as a consequence of the central bank's asset purchase programs, i.e. SMP and QE. We believe expansionary monetary policy that is visible in the current account holdings to have a negative impact on sovereign spreads.

The term spread on a Eurozone-level might differ in its informativeness regarding short- and longterm interest rates compared to the US version. Hence, we also control for the spread between a 7-10 year FTSE MTS Eurozone government broad yield, which is designed to be a measure of the overall interest rate level in the Eurozone government bond market, and the 3-month Euribor rate.

Finally, we want to account for macroeconomic factors on the country level that go beyond the financial sector impact picked up by our bank distress measure. If, for instance, firm distress due to the recession in the Eurozone drives up sovereign spreads and impairs the banking

sector through non-performing loans, not controlling for these effects could hamper our statistical inferences. We therefore include each EMU country’s stock return index comprising non-financial firms in our panel, provided by Datastream, as a covariate. As we are interested in the non-financial-specific variation of these stock prices and not the co-movement with banking sector distress, we orthogonalize the non-financial stock returns towards the bank distress measure of every country. That way, which is similar to the approach of Beck et al. (2017), we are provided with a measure of stock return shocks specific to the real-sector of a country. In order to separate these shocks further from common Eurozone-wide effects, we, similar to our construction of country-specific bank distress, also orthogonalize the non-financial stock returns with respect to a total Eurozone stock return series provided by Datastream. The resulting returns are now both country- and non-financial-sector-specific. We test our model also for other versions of this variable in the robustness section and find concordant results.

All variables we use are winsorized at the 1st and 99th percentile to alleviate the impact of outliers. Subsequently, the variables are standardized to ease the interpretation of the estimated economic effects.

4 Empirical Strategy

4.1 Main Specification and Results

To get a first indication of the effect of national bank distress on sovereign distress during the Eurozone crisis we estimate the following OLS regression for all nine Eurozone countries in our panel⁹ from $t = 01/01/2009 - 12/31/2016$:

$$\Delta SovereignDistress_{it} = \beta_1 \Delta NationalBankDistress_{it} + \beta_x \Delta Controls_{(i)t} + \alpha_i + \delta_t + \epsilon_{it} \quad (5)$$

$\Delta SovereignDistress_{it}$ measures the daily sovereign bond return of EMU country i minus Germany’s sovereign bond return and $\Delta NationalBankDistress_{it}$ are the country-specific banking sector returns with converted signs, just as described in section 3.1. For both vari-

⁹Austria, Belgium, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain. We have to exclude Germany as it is the reference country in the construction of the dependent variable, i.e. sovereign return spreads. We also disregard small countries such as Luxembourg or Malta and Finland, as it has both a bad BIS and bank stock coverage.

ables, higher values indicate larger fragility. $\Delta Controls_{(i)t}$ encompass all explanatory variables introduced in the previous section, specified either in simple first differences or natural log first differences. α_i are country fixed effects to address the possibility that both sovereign creditworthiness and financial sector distress are driven by time-invariant country-specific unobservable factors, such as customs and culture in the financial market structure and regulation. We also include time fixed effects δ_t for every quarter to alleviate concerns that our results are influenced by time-specific market-wide developments that have a common effect on all countries. We cluster standard errors at the country level to allow for the correlation of unobserved factors in the error terms within countries. We expect a positive β_1 , i.e. higher levels of banking sector fragility are associated with higher sovereign distress.

However, as highlighted above, a fundamental shortcoming of this OLS approach is that it produces possibly biased estimates of β_1 as it is prone towards reverse causality between bank and sovereign distress and unable to control for unobserved crisis-related factors driving both distress sources. We use an IV regression to overcome these endogeneity concerns. The first and second stage of the IV approach are as follows:

$$\Delta NationalBankDistress_{it} = \gamma_1 NonEMUStockReturns_{it} + \gamma_x \Delta Controls_{(i)t} + \alpha_i + \delta_t + \phi_{it} \quad (6)$$

$$\Delta SovereignDistress_{it} = \lambda_1 \Delta \widehat{NationalBankDistress}_{it} + \lambda_x \Delta Controls_{(i)t} + \alpha_i + \delta_t + \epsilon_{it} \quad (7)$$

Controls and fixed effects refer to the same variables used in the OLS framework. By drawing the predicted values from the first stage regression ($\widehat{NationalBankDistress}_{it}$), we explicitly exploit the variation in bank distress in the Eurozone that is due to international returns in stock markets that are tailored to the exposures of Euro Area banking sectors. The results of the OLS and the IV estimation are reported in Table 2. The estimated outcomes of the first IV stage in column (2) suggest that our instrument of exposure-weighted stock returns in non-Eurozone countries is highly statistically significant in explaining national-specific banking sector distress of Eurozone countries. An increase of exposure-weighted non-Eurozone stock returns by one standard deviation is associated with a rise in national-specific bank returns by 0.432 standard deviations on average. The F-statistic of 112.81 suggests that the instrument is unlikely to be weak.

The second stage, reported in column (3), estimates the impact of the predicted values of national-specific bank distress on sovereign creditworthiness.¹⁰ We find that the isolated transmission of imported bank distress on sovereign creditworthiness in the IV regression is both economically and statistically highly significant at the 1% level: An increase of instrumented national-specific banking sector distress by one standard deviation yields a 0.16 standard deviation increase in sovereign distress. While this effect is sizeable, it is, however, somewhat lower than the corresponding coefficient estimated with OLS of 0.195 and reported in column (1). This difference in coefficient sizes suggests that estimating the sovereign bank loop with simple OLS could lead to an over-estimation of the corresponding coefficients due to the reverse causality or omitted variables.

With regard to the control variables, we find reasonable signs and significance levels on all specifications. One questionable sign could be the negative impact of the change in the VIX on sovereign distress in both the IV and the OLS estimation. However, this effect only emerges once the VSTOXX is included as a covariate. This result could indicate that, once stock market volatility on the European level is controlled for, the VIX picks up international stock market volatility or panic outside of Europe. In such internationally fragile periods, GIIPS countries in the Eurozone might become relatively more attractive and investors might re-orientate portfolios towards the Eurozone which could lead to lower interest rate spreads between EMU sovereigns.

- Table 2 around here -

4.2 Further Adjustments in Instrumented Bank Distress

The results so far suggest that our instrument is highly relevant in explaining Eurozone banking sector fragility and that the size of the fragility transmission coefficient is somewhat lower than the OLS benchmark. In this section, we want to strengthen the exclusion restriction of the instrument even further to alleviate concerns that our results are driven by Eurozone crisis-related effects picked up by the instrument. One possible concern with the instrument in the baseline estimation is that banking sectors in the Eurozone could have shifted their

¹⁰In practice, we estimate both stages in a single procedure to receive correct standard errors. However, this technique has the drawback that the predicted values from the first stage are not standardized when they enter the second stage and thus the size of the final coefficient cannot be compared to the OLS version. As a solution we estimate both IV stages separately and standardize the predicted values to receive comparable coefficient sizes, while extracting standard errors and significance levels from the conventional 2sls manner.

international exposures both in size and geography as a result of their performance during the Euro Area crisis. Indeed, our data shows that financial firms headquartered in the Eurozone countries in our panel have on average reduced their exposure towards non-Eurozone countries by 44.18% from 2009 to 2016, thereby focusing more on domestic markets (see also CGFS (2017)). If banks shifted to countries with more stable macroeconomic performances because they fear negative spillover effects from their foreign investments, the exposure-weights in our instrument would be affected by Eurozone crisis-related factors. To account for this possibility, we construct the instrument using the exposure weights banking sectors had in the first quarter of 2007, i.e. before the outbreak of the financial or Eurozone crisis. We use the weights from this period as constant weighting factors for our observation span from 2009 to 2016. The results, reported in columns (1) and (2) of Table 3, show a slightly smaller but comparably-sized coefficient with respect to our baseline results.

The next concern we address is the possibility that certain non-Eurozone markets may be affected by the Eurozone crisis via international capital markets. If, for example, Spanish banks are the most important lenders for residents in Peru, then we could expect that turmoil in the Spanish banking sector could easily spill over to stock markets in Peru, as Peru's most prominent creditor country might reduce future credit supply. We take this issue into account by identifying the most important creditor nations for each non-Eurozone country in our dataset. Drawing again from the BIS's consolidated banking statistics, we remove all non-Eurozone countries in the exposure portfolio of a Eurozone country, if this Eurozone country held at any point in our sample period more than 20% of the total international claims towards the respective non-Eurozone country. This step mostly affects emerging market economies in South America that depend considerably on Spanish banks or Eastern European borrowers whose most important lenders are often Italian, French or Austrian banks. We remove non-Eurozone countries that borrow excessively from a Eurozone member state and use the BIS weights from the first quarter of 2007, as explained above. The results in columns (3) and (4) of Table 3 suggest that both the instrument and the second stage coefficient become slightly weaker with this adjustment but stay statistically highly significant.

A final adjustment we carry out concerns the issue that distress spillovers from the Eurozone crisis affected international stock returns not just in countries with high credit exposure towards Eurozone banking sectors, but in general. If banking sector distress in the EMU

indeed sent ripples through the global financial system because of its tight international linkages then all stock returns around the world could feature a Eurozone crisis component. If so, international stock returns would react to increases in sovereign distress in the Eurozone, re-introducing reverse causality in our analysis, or be partially driven by crisis-related unobservables. To deal with this concern, we aim to remove the Eurozone-specific component in global stock returns. To this end, we orthogonalize the bank returns on the Eurozone level we derived in section 3.2 with respect to a world stock return series for banks that excludes the EMU in its composition ($EurozoneBankReturns_t$). We have therefore removed all global, non-Eurozone stock return variation from bank returns in the Eurozone. This adjustment leaves us with a pure Eurozone-specific bank distress measure. We then orthogonalize the instrument towards this Eurozone-specific variable, thus removing all variation from the exposure-weighted stock returns that is connected to pure Eurozone bank stock returns.¹¹

The adjusted instrument, now purged from Eurozone-specific bank return variation, with claim data from before the crisis and without all non-Eurozone countries that likely show Eurozone crisis-related spillovers, enters the IV framework with results reported in columns (5) and (6) of Table 3. The first stage of the IV regression still reports a highly statistically significant instrument, the F-statistic being at 69.13. The second stage coefficient which declined with each layer of adjustment to the instrument is now at 0.109. The corresponding OLS coefficient is roughly 80% larger compared to this value. Both coefficients are statistically significantly different at the 5% level.¹²

We believe that this procedure is the most thorough way of isolating the bank-to-sovereign distress channel during the Eurozone crisis that is least likely to be subject to reverse causality or omitted factors related to the crisis. Our results indicate that concerns about reverse causality and potentially omitted variable bias in the sovereign-bank loop literature are valid as both IV and OLS coefficients differ by a significant order of magnitude. However, since the isolated bank-to-sovereign distress coefficient is statistically and economically significant, we provide evidence that banking sector distress was not just a by-product or correlation, but a major cause for deteriorating sovereign creditworthiness during the Eurozone crisis.

¹¹We conduct a different test specification to remove the Eurozone-specific variation in the robustness section and find similar results.

¹²This test also corresponds to the Durbin-Wu-Hausman test.

- Table 3 around here -

5 Drivers of Bank-to-Sovereign Distress Transmissions

We now use the most careful specification to isolate transmissions of bank-to-sovereign distress that we derived in the previous section and reported in Table 3 columns (5) and (6) to investigate the potential drivers of bank-sovereign distress spillovers. We hypothesize that the distress transfer is stronger for countries with weaker macroeconomic performances, larger vulnerabilities in their market for sovereign bonds, impaired banking sectors and elevated political risks. For each channel under investigation we estimate the following model:¹³

$$\begin{aligned} \Delta SovereignDistress_{it} = & \lambda_1 \Delta NationalBankDistress_{it} * Channel_{it-1} + \lambda_2 Channel_{it-1} + \\ & \lambda_3 \Delta NationalBankDistress_{it} + \lambda_x \Delta Controls_{(i)t} + \alpha_i + \delta_t + \epsilon_{it} \end{aligned} \quad (8)$$

Each interaction enters with a lag of one quarter or one month, corresponding to the frequency of the interaction variable, except when stated otherwise. This step is to account for the presumption that financial market participants in time t base their analysis on the released data from $t - 1$. Concerning the sign of the interaction terms, we expect variables which increase the transmission of distress to have a positive, while factors that lower the distress transfer to have a negative coefficient. We trim the interaction variables at the 1th and 99th percentile to account for potential outliers, such as Ireland's 25% increase in GDP in the first quarter of 2015 resulting from foreign companies switching their base to Ireland. However, in the absence of such obvious outliers, all our results also hold for winsorizing or using the data in its original format. All data sources are reported in the appendix in Table 16.

5.1 Macroeconomic Performance

We test the impact of the macroeconomic performance of a Eurozone country on the isolated bank-to-sovereign distress channel using six variables. The public debt-to-GDP ratio of a country should approximate the fiscal space a government might have to finance financial sector rescue packages in times of banking sector turmoil. Similarly, the fiscal deficit to

¹³In practice, we estimate an IV regression with two endogenous variables (national-specific bank distress and the interaction of bank distress with the interaction term), and two instruments (international exposure-weighted stock returns and the interaction of international stock returns with the interaction term), see Wooldridge (2010) chapter 9.

GDP ratio, shows how much a government has to go into debt in a specific period and thus also control for its potential access to financial markets in case of increasing banking sector distress. We multiply the fiscal deficit to GDP ratio times minus one so that an increase translates to increased borrowing which makes the interpretation similar to the debt-to-GDP interaction. We hence expect that countries with higher debt-to-GDP ratios and larger fiscal deficits should be associated with a stronger bank-to-sovereign distress channel, i.e. a positive interaction coefficient.

Higher GDP growth and current account balance to GDP ratios as well as a lower unemployment rate should signal improved macroeconomic fundamentals and thus a reduction in the fragility transmission. We also test for the interactive effects of inflation, for which both increased or decreased transmissions are plausible.

The results in Table 4 seem to confirm most of our hypotheses. We find evidence that both high public debt ratios and fiscal deficits show a positive and statistically significant relationship on the bank-to-sovereign distress channel, i.e. the transmission of distress strengthens with increasing levels of public indebtedness (columns (1) and (2)). However, both size and significance are larger for the debt-to-GDP ratio, probably because fiscal deficits were often adjusted in the short- to medium-run as a response to the crisis, while the outstanding indebtedness of the sovereign can only be reduced in the long-run.¹⁴

We find no statistically significant coefficient of the interaction term featuring lagged GDP growth, though it has the expected negative sign (column (3)). However, the margin plot in Figure 6 provides some evidence that countries with a higher quarterly growth rate, in our case at around 1%, are no longer subject to a statistically significant transmission of distress from banks on sovereigns. Regarding the unemployment ratio, we find a highly significant positive interaction coefficient (column (4)) which suggests that periods of depressed economic performance are associated with stronger private-to-public distress transfers.

Also, countries with an increasing current account surplus seem to have statistically significant weaker transmissions of distress (column (5)), possibly indicating that economies with stronger export sectors and less import dependence seem more robust in fending off financial shocks. We cannot reject the null-hypothesis that higher inflation has no statistically

¹⁴At least in the absence of sovereign insolvency regimes or haircuts on government debt, which, during the crisis, was only applied for Greece.

significant impact on the effect of financial sector distress on sovereign creditworthiness, in accordance with our hypothesis (column (6)).

Considering the marginal effect of instrumented bank distress on sovereign bond spreads, conditional on the macroeconomic performance of a country, the marginal effects plots depicted in Figure 6 support the evidence we gained in the regression framework. The marginal effect of bank distress only becomes insignificant if macroeconomic factors are sufficiently stable, in our case at a debt-to-GDP ratio of roughly 70%, a fiscal deficit under -2% of GDP, quarterly GDP growth of 1%, an unemployment ratio of 8% or a current account ratio of roughly 3%. With regards to the marginal effects of bank distress conditional on inflation, we find evidence that higher rates of inflation can indeed lead to statistically significant transmissions, however, this result seems to be primarily driven by the fewer observations of periods with lower inflation.

- Table 4 around here -

- Figure 6 around here -

5.2 Government Bond Issuance, Redemption and Holding

The primary issuance of government bonds features prominently in the literature as a key transmission channel for the sovereign bank loop. Both Gaballo & Zetlin-Jones (2016) and Farhi & Tirole (2017) model the loop with a sovereign that issues new public debt in order to finance bank bailouts. The increased supply of bonds lowers their prices and raises their interest rates. Bond losses are transmitted to bank balance sheets with a preference for holding domestic sovereign debt which necessitates further bailouts. Similarly, Ongena et al. (2016) identify months in which governments have to roll-over maturing government debt as periods in which the sovereign likely performs moral suasion towards its banking sector, pressuring domestic banks to stand ready as buyers of government debt. Following this literature, it is likely that periods with higher issuances or redemptions of government bonds could be associated with a stronger transmission of bank-to-sovereign distress.

We therefore test if the effect of instrumented bank distress on sovereign bond spreads is conditional on the amounts of government debt a country issues or repays. We assume that the effect of the issuance or redemption should affect the financial distress of the same month, and hence we consecutively interact the contemporaneous level of issuance or redemption of

government bonds in relation to a country's GDP with instrumented bank distress in our estimation. In both cases we find a similar effect on the transmission of distress that is, however, statistically indistinguishable from zero, as shown in columns (1) and (2) of Table 5. Concerning the marginal effect of the distress channel conditional on government bond issuances and redemptions in Figure 7, we find that there are values of the interaction variable for which the marginal effect of bank distress turns insignificant, however, this finding seems to be clearly driven by fewer observations and therefore wider confidence intervals in the distribution of government bond redemptions or issuances.

We further investigate this channel by using the actual amounts of government bonds issued or redeemed and marking the months in which the amounts of bonds given out or repayed lay above the median for this country during our sample with a dummy that is 1 in these months and 0 otherwise. Again, we find no statistically significant effects when we interact this variable with the instrumented bank distress measure (columns (3) and (4)). We view this finding as evidence that, while there may certainly have been cases in which large chunks of new government bonds entering the market could have had price effects, financial markets, on average, did not discriminate between months with high or low government debt issuances when they re-priced such securities.

Lastly, we look if the holding of domestic government bonds by the banking sector could have had an impact on the bank-sovereign distress channel. The literature has shown that governments likely pressure domestic banking sectors to purchase their own securities to ease refinancing (De Marco & Macchiavelli (2016), Ongena et al. (2016)). A banking sector with strong exposure towards its own government getting hit by a negative shock could have a detrimental impact on sovereign creditworthiness as the bank might rapidly sell government securities to raise liquidity. Another possible channel is that the holding of government bonds artificially increases the equity ratio of the bank due to the zero risk weight of government securities which makes the bank look saver on paper than in practice. Lastly, the bank might be more likely to be bailed out because the government wants to keep it as a buyer of government securities. Consequently, we interact our main specification with the lagged home bias of a banking sector, i.e. the share of domestic government debt securities held compared to the total holdings of government securities. Column (5) in Table 5 and the margin plot in Figure 7 show that a larger home bias has a strong and statistically highly significant positive

effect on the bank-sovereign distress channel. We also find this effect when scaling domestic government bond holdings to the GDP of a country (unreported).

- Table 5 around here -

- Figure 7 around here -

5.3 Banking Sector Structure and Stability

In the following, we shed light on the link between the bank-to-sovereign distress channel and the structure and stability of the corresponding country's banking sector. Our hypothesis is that the effect of bank distress, instrumented by imported stock market returns, is conditional on the profitability, capitalization, amount of non-performing loans, liability structure and size of the banking sector. Furthermore, we suspect that both stronger macroprudential regulation and more developed capital markets can cushion the transmission of distress, as the former might point to a more comprehensive regulatory handling of financial sector shocks whereas the latter can serve as a substitute for firm financing in case of an impaired banking sector.

We obtain data on the non-performing loans ratio, the Tier 1 capital to risk-weighted asset ratio and the return on assets of each country's banking sector on a quarterly frequency from the IMF's financial soundness indicator database. We interact the instrumented bank distress measure consecutively with these variables and report results in Table 6. The findings suggest that the transmission of distress depends in a statistically significant manner on the return on assets (column (2)) and the non-performing loans ratio (column (1)) of a banking sector, the former with a cushioning impact when higher, the latter with an accelerating one, as hypothesized. With regard to the interaction of the Tier 1 capital ratio, we find a negative effect that does, however, not differ statistically significant from zero (column (3)). This finding could be explained by the fact that higher capital requirements were arguably the most often prescribed action by regulators for ailing banking sectors. Demanding higher equity in times when the transmission of bank distress is strongest would bias the corresponding coefficient towards zero and hence account for the result. However, when investigating the marginal effects depicted in Figure 8, we find indeed some evidence suggesting that banking sectors with sufficient Tier 1 capital ratios, in our case at around 16%, are no longer subject to a statistically significant marginal effect of bank distress on sovereign

creditworthiness. The marginal effects of bank distress, conditional on non-performing loans or return on assets are, in a similar vein, pointing towards an insignificant transmission of distress when non-performing loans are lower than 4% and return on assets higher than 0.8. Stronger banking sectors, in terms of capitalization, non-performing loans or profitability, may therefore contribute to less distress spillovers on sovereign creditworthiness.

Turning towards the size of the banking sector, we interact national bank distress with the total bank asset to public revenue ratio of a country. This ratio sets the size of banks in relation to the fiscal means the government has in this period to potentially finance rescue packages. However, we cannot statistically significantly reject the null-hypothesis of a zero effect of this interaction term on sovereign creditworthiness (column (4) in Table 6). This is also the case if we scale bank assets to another measure such as GDP (unreported). One interpretation for this result could be that too-big-to-fail banking sectors are not an exclusive driver of the bank-sovereign distress channel but that interconnected financial sectors, for instance in the case of a regional banking system in distress as witnessed in Italy or Spain, can also be responsible for spreading financial distress to the sovereign, even if they are smaller in size.

Next, we interact bank distress with a measure for liability risks of the financial sector. We use the share of banking sector liabilities that is funded by the central bank, i.e. the ECB or in practice the national central bank. Banks that turn to the central bank to finance their assets likely do so, because it is more expensive or no longer possible for them to receive funds on private markets. Indeed, during the Eurozone crisis international money market funds started to withdraw short-term funding for Eurozone banks in 2011, with the ECB stepping in as a lender of last resort to limit the funding gap (Acharya et al. (2017)). In our estimation, the positive and highly statistically significant interaction term in column (5) suggests that banking sectors that required more financing by the central bank also featured a stronger transmission of bank-to-sovereign distress.¹⁵

Finally, we investigate the impact of two measures that could potentially cushion the analyzed distress channel. We obtain the cumulative macroprudential index from Cerutti et al. (2016) which is an index that sums up all macroprudential instruments such as sector-specific capital buffers or loan-to-value caps introduced by regulators on a quarterly frequency.

¹⁵Of course, this result does not imply that the ECB should stop financing banks if it wants to break the bank-to-sovereign distress channel, as this finding is not a causal effect but only a correlation.

Also, we estimate the model using the amount of debt securities issued by non-financial firms in relation to GDP as an interaction term. This variable approximates how well firms could substitute bank credit in case the loan supply by banks was disrupted during the crisis. We find negative but not statistically significant effects for both interaction terms (columns (6) and (7)). However, the marginal effect plots in Figure 8 provide some evidence that countries with higher macroprudential regulation or a more pronounced capital market are subject to a lower and at some point statistically insignificant transmission of bank to sovereign distress.

- Table 6 around here -

- Figure 8 around here -

5.4 Political Stability

Lastly, we test whether different levels of political risk or events approximating them have a significant effect on bank-sovereign distress transfers. We hypothesize that elevated political uncertainty in Europe or the Eurozone could increase the transmission of distress because they make a collaborative approach concerning the regulatory architecture of the Eurozone or a common political strategy on rescue packages for banks or countries more difficult. This insecurity could feed into the bank-sovereign distress channel by creating lack of clarity or ambiguity in handling financial sector shocks which ultimately leaves sovereigns and tax payers on the country-level to deal with these risks.

To analyze this channel, we interact instrumented bank distress with a political uncertainty index for Europe as established by Baker et al. (2016). This continuous index is based on articles from various European newspapers covering political uncertainty and hence provides a monthly-varying approximating of political risks in Europe. The results in Table 7, both for the monthly-lagged and contemporaneous interaction, suggest that an increasing level of political uncertainty can lead to a stronger transmission of bank distress on sovereign creditworthiness, as the interaction term is positive and statistically highly significant (column (1)).

In order to test if political risks that are more closely related to the Euro Area crisis than the broader European index have a similar effect, we proceed as follows: We collect the political uncertainty indices for Ireland, Spain and Italy which are the only GIIPS countries with an uncertainty index. We then conduct a principal component analysis and estimate

the first component of these three indices. This component describes variation in the indices that is common for all three countries and should therefore pick up political risk factors that are shared by these countries, such as uncertainty related to the future of the EMU. This first component accounts for 57,77% of the total variation. Interacting the variable with national-specific bank distress, we find a positive statistically significant effect at the 1% level for the interaction term (column (2)).

Next, we test the effect of political uncertainty on the country level. We use the *parlgov* database to pinpoint the months in which federal parliamentary elections for each country in our panel took place. We give these months a value of 1 and 0 for months without elections. Interacting this dummy with our measure for bank distress, we find a highly positive and statistically significant effect which suggests that months with elections and hence greater political uncertainty seem to be associated with a stronger bank-sovereign distress channel compared to months without elections (column (3)). These results suggest that in times of elevated political uncertainty, the transmission of distress from banking sectors to sovereigns is amplified.

Lastly, we exploit the *parlgov* database to test if the political preferences of political parties in ruling governments had any impact on the investigated distress channel. Similar to Eichler & Sobański (2016) we weight the size of the political parties in the ruling cabinet based on their seats in parliament. We then create a weighted index of the government's stance of being a left versus a conservative, a state-friendly versus a market-friendly and a pro-European versus a EU-skeptical cabinet coalition. A higher value of the index indicates a more conservative, market-friendly or EU-friendly government respectively. However, the interaction of the contemporaneous index value with the bank distress measure yields small and in each case statistically insignificant coefficients (columns (4)-(6) of Table 7). Figure 9 supports this conclusion, as the marginal effects of bank distress depicted are largely unconditional towards the government's ideological stance. Only for more pro-EU governments, there seems to be a stronger transmission of distress. However, it should be noted that almost all governments during our sample period are represented by a pro- or at least EU-tolerating index which limits the informative value of this outcome. Overall, these results could suggest that the political ideology of governments during the Eurozone crisis, on average, had only a secondary role when it comes to coping with the bank-sovereign distress channel.

- Table 7 around here -

- Figure 9 around here -

6 Robustness

6.1 Alternative Versions for Dependent Variable

We perform a range of sensitivity analyses to demonstrate the robustness of our results. First, we re-estimate our baseline IV regression with the most careful specification from section 4.2. using different dependent variables. We replace the sovereign bond return spreads with sovereign bond yield spreads. Also, we conduct the estimation using the 5-Year US Dollar CDS rate of a country towards Germany's rate to show that our results do not depend on using government bonds as a sovereign fragility indicator. For this version, we have to disregard Greece from the analysis, as its CDS rate turned illiquid during the course of the crisis. Columns (1-3) in Table 8 report the second stages of the IV-2SLS regressions with the results of the baseline (1) and the versions using sovereign bond yields (2) and CDS spreads (3). We find broadly similar results on all specifications. Most control variables enter with the same sign and significance. More importantly, the coefficient of instrumented bank distress has the same level of statistical significance and a comparable size in all three specifications, though it is slightly larger when using CDS spreads.

- Table 8 around here -

6.2 Alternative Versions for Bank Distress Variable

Next, we check if the effects we derived were due to our definition of national-specific bank distress. We therefore repeat the baseline analysis using the weighted bank stock returns on the country level but without subtracting any Eurozone-specific component ($BankReturns_{it}$, here multiplied times minus one).¹⁶ Column (1) in Table 9 shows that the instrument for this estimation is also strong and highly significant. Results in column (2) yield a highly statistically significant effect of instrumented bank distress on the second stage of the IV. The coefficient is somewhat larger than in the baseline which could undermine our conjecture that

¹⁶To estimate in accordance with our baseline approach, we now orthogonalize the non-financial returns on the county level with respect to the EMU stock returns and $BankReturns_{it}$, as this is now the right-hand-side variable of interest.

the original OLS version seems to overestimate the transmission of distress in the sovereign bank loop. Therefore, column (3) reports the OLS estimation using the same unadjusted bank distress on the country level as a right-hand side measure of interest. In this case, the respective coefficient is also larger in size and surpasses the IV coefficient by almost 50%. This finding suggests that we can maintain our presumption that our IV specification accounts for the reverse causality and omitted variable biases present in the OLS estimation.

One further concern could be the way in which we removed the Eurozone-specific variation from the bank distress variable. We chose to subtract the Eurozone return index to follow as close as possible to Buch & Neugebauer (2011). However, one could also eliminate the EMU component by means of orthogonalization. Columns (4) to (6) in Table 9 show the two IV stages and the OLS estimation when following this approach. The results are extremely close to our benchmark and the IV and OLS coefficients differ by roughly 80%.

- Table 9 around here -

6.3 Alternative Versions for Instrumental Variable

The next concern we address is the orthogonalization of the instrument by which we removed the Eurozone-specific variation in section 4.2. We used the Eurozone return index we derived beforehand and orthogonalized it towards a world stock return series that excludes the EMU. As an alternative, we also utilize a previously derived variable, namely the total (i.e. not country-specific) bank returns of Eurozone countries constructed in section 3.2 ($BankReturns_{it}$). We conduct a principal component analysis based on these bank returns of all EMU countries. The first component, approximating return variation that is common for all Eurozone countries, explains roughly 60% of the total variation. In order to isolate the Eurozone-specific part of the variation, we once again orthogonalize this first principal component with respect to the same world bank stock return series that excludes the EMU. Finally, we clean the instrument of this Eurozone-specific component by means of orthogonalization. The results of this different elimination procedure for both IV stages is reported in columns (1) and (2) of Table 10 in which we find almost identical results compared to our baseline.

Another potential concern related to our IV specification could be the removal of credit-dependent non-Eurozone countries in the construction of the instrument. We removed all

non-Eurozone countries in the exposure portfolio of a Eurozone country, if this Eurozone country held at any point in our sample period more than 20% of the total international claims towards the respective non-Eurozone country. Another way to remove countries that are economically close to the EMU and could face Eurozone crisis spillovers is to simply remove all EU countries which do not have the Euro as their main currency from the sample as they share similar institutions and regulation with the rest of the Eurozone (though several of these countries are also affected when removing the credit-dependent nations). We do so in columns (3) and (4) of Table 10, while otherwise specifying the instrument in the same way as before, i.e. with BIS exposure weights from 2007 and by orthogonalizing it towards the Eurozone-specific component. Though the instrument is slightly weaker in the first stage, our main results are unaffected by this exercise.

We also convert the non-Eurozone stock market returns into Euro using the corresponding daily exchange return (columns (5) and (6) in Table 10). Our results are qualitatively almost unaffected by these adjustments.

- Table 10 around here -

6.4 Strengthening the Exclusion Restriction of the Instrument

One key assumption of the instrumental variable approach is that the instrument, in our case exposure-weighted stock market returns from non-EMU countries, affects the dependent variable, sovereign creditworthiness, only through the instrumented variable, i.e. an EMU country's banking sector distress. A potential concern for our identification strategy could be that non-EMU stock return shocks are transmitted to EMU sovereign distress through other channels than banking sectors. For instance, real economic downturns in a non-EMU country that are visible in falling stock returns could spill over to firms in a country of the Eurozone and worsen its sovereign creditworthiness, independent of banking sector claims. This effect could be more pronounced if the countries share stronger trading relationships. In this case, the exclusion restriction of the instrument would be violated.

Though we cannot categorically reject this channel, we have reason to believe that our approach is robust to these concerns. First, we already control for non-financial stock market returns of every EMU country which should account for any real economic shocks transmitted to or stemming from any Eurozone economy. In addition, we also control for potential trade

shocks affecting the Euro Area by including the effective exchange rate of the Euro. We thereby account for any non-financial shocks transmitted to sovereigns that could otherwise bypass the banking sector in our instrumental variable approach. Second, several papers show that trade or trade openness is not statistically significantly related to sovereign risk of Euro Area countries (Aizenman et al. (2013), Beirne & Fratzscher (2013)), suggesting that such shocks or any remaining biasing effect in our instrument would be limited in size.

Lastly, we conduct two robustness tests to further strengthen the exclusion restriction of the instrument. First, we build a version of exposure-weighted non-EMU stock market returns that consists only of bank stocks. By focusing on bank-specific stock market shocks of a non-EMU country as an instrument, it is less likely that this approach transmits distress to sovereign creditworthiness through non-financial sector or trade-specific channels that could otherwise be present in total stock market returns of a non-EMU country. Simply put, banking sector shocks of a non-Eurozone country are more likely to affect EMU sovereign creditworthiness in no other ways than through the banking sector of a Eurozone country. We construct this alternative specification in the same way as our baseline, i.e. by using pre-crisis BIS data, dropping credit-dependent borrower countries and orthogonalizing the instrument with respect to Eurozone-specific stock market variation. Results in Table 11 column (1) show that the instrument is somewhat more significant in the first stage which is not surprising given that both data series now consist only of bank stocks. Column (2), however, reports a slightly smaller but highly statistically significant second stage coefficient of instrument bank distress that is very close to our benchmark. This result suggests that alternative channels of how non-EMU stock market shocks could affect sovereign creditworthiness in other ways than bank distress are, if present, limited in size and not critical for our results.

In a further robustness check, we control directly for trade-related shocks. To do so, we construct an export-weighted non-financial stock market variable: export volumes of EMU to non-EMU countries are drawn from the IMF's Direction of Trade Statistics. We construct export weights that approximate the importance of a trading partner country in the same way as the BIS weights in section 3.2. We multiply the export importance of a non-EMU country towards an EMU country with a non-financial stock market return series of the former since this variable closer captures real-economic variation that affects the trading performance of a country. Since we are interested in the trade-specific variation of this variable and not the

co-movement with stock returns captured in the instrument, we orthogonalize the trade shock measure towards our instrumental variable. The trade shock variable enters our baseline as an additional control variable. Results in column (3) of Table 11 show that trade-specific stock market returns enter statistically significantly in the first stage of the instrument, indicating that trade-specific shocks drive part of the variation in EMU bank distress. However, while the instrument remains statistically significant in the first stage, column (4) shows that the second stage coefficient of instrumented bank distress is nearly identical to our baseline while the export-weighted returns are statistically indistinguishable from zero. We conclude that alternative channels our instrument can influence sovereign creditworthiness are, if present, not a significant threat to our identification strategy.

- Table 11 around here -

6.5 Alternative Starting Date, Weekly Frequency

Another potential concern could be the choice for the beginning of our estimation period which we set at 01/01/2009. Though bank and sovereign distress started to co-depend in this period as a result of the financial crisis, the gradual deterioration in the economic performances of the GIIPS countries and thereby the beginning of the Eurozone crisis happened at later points in time. We therefore re-estimate the baseline regression starting with the second quarter of 2010 in which Greece received its first bailout from the EU and the IMF (column (1) of Table 12). We find similar albeit somewhat larger effects with respect to the isolated bank-sovereign distress channel. This finding could suggest that the transfer of financial distress indeed intensified with Greece's bailout. We also re-estimate the OLS regression (column (2)), beginning at the same point in time, and also observe a substantially larger bank distress coefficient by almost 65%.

The next concern we address is related to our data frequency. We use daily data in order to draw from a larger set of observations. However, daily data may be noisy. Even though we already winsorized our data to account for this possibility, we collapse the data to a weekly frequency and re-do the baseline IV estimation in which we find very similar effects (columns (3) and (4) of Table 12).

- Table 12 around here -

6.6 Alternative Control Variables and Time Fixed Effects

Lastly, we want to make sure that certain daily control variables in the IV regression do not critically drive our results. One potential candidate to do so could be the non-financial stock market returns on the country level. In our baseline, we orthogonalized this variable with respect to the national-specific bank returns and the stock returns on the Eurozone level. However, the former adjustment renders the non-financial returns insignificant in explaining bank return variation in the first stage of the instrument. To investigate if this step has any consequences for our main results, we introduce a version of non-financial stock returns that is only orthogonal towards stock returns on the Eurozone level. Columns (1) and (2) in Table 13 report the first and second stage of the IV regression. The new non-financial return variable is now negative and significant in the first stage regression, as expected. However, the magnitude of the second stage coefficient for predicted country-specific bank distress remains almost unchanged. This result suggests that our chosen specification of non-financial returns is not critical for our main findings.

Another control variable that might require an additional robustness check is the Eurozone term spread as it is partly constructed from a weighted average of Eurozone government bonds to create a long-term interest rate series for the Eurozone. Since our dependent variable is also a government bond spread, this correlation might drive some of our result. However, when we remove the Eurozone term spread from the list of covariates, our results hardly change (column (3) of Table 13). In a further test, we replace the nominal Euro exchange rate from JP Morgan with the actual exchange rate of the Euro towards the Dollar, finding again similar effects (column (4)). Finally, we replace quarterly with monthly time fixed effects in our IV regression to account for market-wide changes on a higher frequency. Column (5) indicates that our results are not sensitive to this adjustment.

- Table 13 around here -

7 Conclusion

We present a novel approach to account for reverse causality and omitted variable biases in the estimation of the sovereign bank loop in the Eurozone. Banking sector distress of Eurozone countries, measured by the asset-weighted stock returns of 121 Eurozone banks, is

instrumented using the total stock returns of non-Eurozone countries that are weighted with the BIS banking sector claims of an Euro Area country towards borrowers in the respective non-Eurozone country. These imported shocks, tailored to the international exposures of Eurozone banking sectors, are shown to be a highly significant instrument for bank distress in the Eurozone. We respond to concerns that challenge the exogeneity of the instrument by carrying out an extensive set of adjustments and tests in order to avoid reverse causality and omitted variable issues possibly present in the previous literature.

Controlling for a range of financial market indicators, we find a statistically and economically significant effect of instrumented banking sector stock returns on sovereign bond return spreads in the Eurozone from 2009 to 2016. Banking sector distress was therefore a major cause for deteriorating sovereign creditworthiness during the crisis and not just a by-product or a correlation. The corresponding coefficient from the OLS framework is, however, roughly 80% and thereby statistically significantly larger than our most careful IV estimation. This finding supports our conjecture of reverse causality and omitted variables in the sovereign bank loop estimation which are uncontrolled for in the OLS framework. The statistical significance of the IV estimator and sizeable difference between OLS and IV coefficient holds for several robustness checks.

Turning to the drivers of the identified transmission of bank-to-sovereign distress, we uncover that weaker macroeconomic performances in terms of higher government debt to GDP ratios, fiscal deficits, unemployment ratios and lower GDP growth or current account surpluses are strongly associated with a more forceful distress transfer. We find no evidence that allow the conclusion that the transmission of distress is stronger in months with increased issuances and redemptions of government debt. We find, however, that instrumented bank distress affects sovereign creditworthiness more strongly if the banking sector holds a higher share of domestic government debt compared to its total sovereign debt holdings. Also, if the financial sector of a country is weakened by non-performing loans, has poor profitability, low capital ratios beyond a critical level and depends heavily on central bank financing, we obtain a statistically significantly stronger transmission of distress from banks to sovereigns. Our results also provide some evidence that the distress channel can be cushioned by stronger macroprudential regulation and more developed capital markets. Lastly, we find that political uncertainty or parliamentary elections are associated with an increased distress transfer from

banks to sovereigns. The ideological stance of a government in terms of market-friendliness or conservatism, on the other hand, does not seem to have played a pivotal role during the Eurozone crisis.

Our results have straightforward ramifications for the debate on the future of the Eurozone. We showed that bank distress still matters significantly for the creditworthiness of sovereigns. This finding calls for the stringent participation of equity holders and junior creditors in the loss participation of bank bankruptcies which are currently governed by the bank recovery and resolution directive (BRRD). Applying these bail-ins predictably and credibly, while limiting exceptions for large or politically connected banks, could have the potential to lower this transmission of financial distress.

Our evidence also suggests that the financial and macroeconomic environment determines the severity of the bank to sovereign distress transmission. This fragility could be particularly harmful for a currency union such as the Eurozone, with no possibility to devalue exchange rates and a possibly more restricted central bank to act as a buyer of last resort. Eurozone policy makers should therefore strengthen the institutions of the Eurozone: less micro-management or complexity concerning fiscal rules and ESM crisis-lending, and towards transparent and simple fiscal targets that allow countercyclical fiscal policy to stabilize macroeconomic shocks and crisis-lending that follows predictable guidelines and shared incentives.

8 References

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9 Tables and Figures

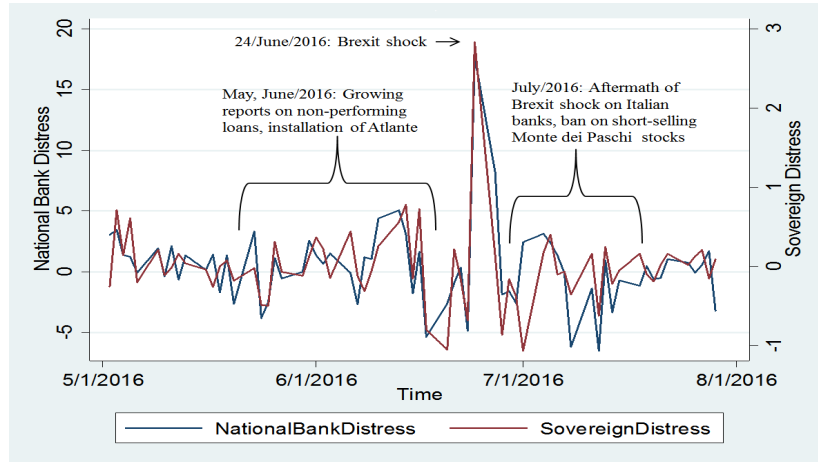


Figure 1: Bank Distress (based on Δ NationalBankDistress) and sovereign distress (based Δ Sovereign Distress) in Italy from May 1st 2016 to August 1st 2016

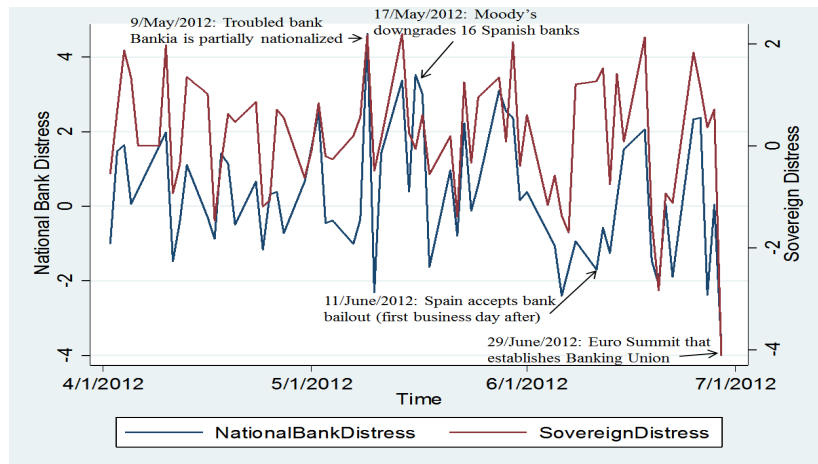


Figure 2: Bank distress and sovereign distress in Spain from April 1st 2012 to July 1st 2012

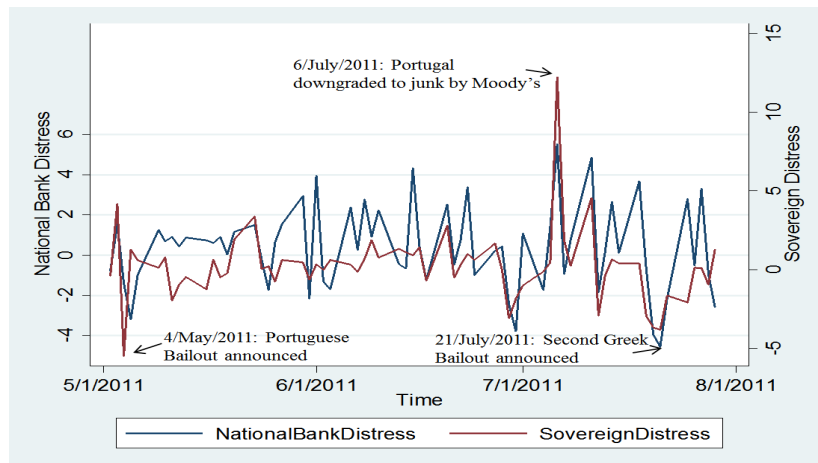


Figure 3: Bank distress and sovereign distress in Portugal from May 1st 2011 to August 1st 2011

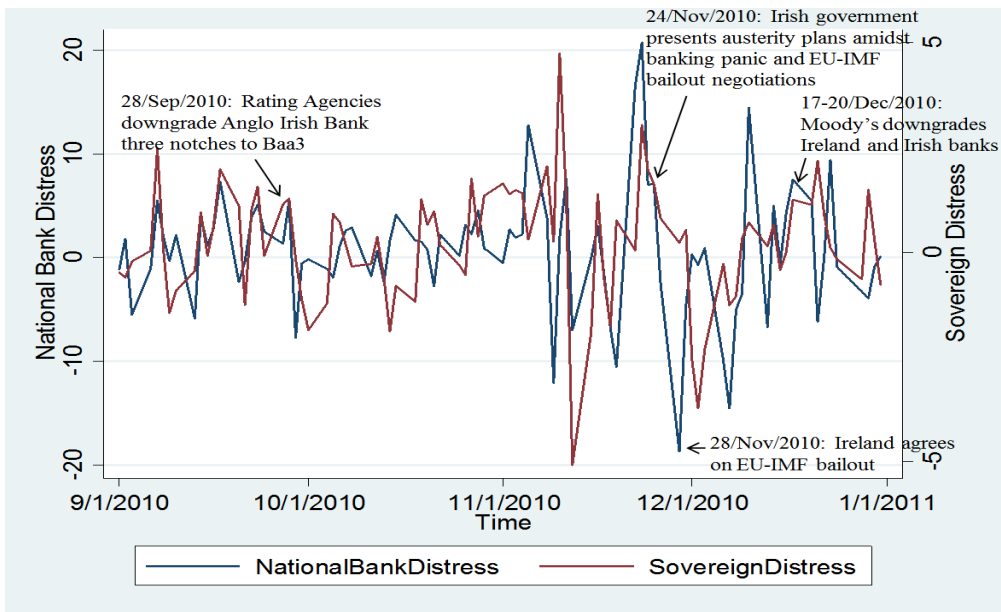


Figure 4: Bank distress and sovereign distress in Ireland from September 1st 2010 to January 1st 2011

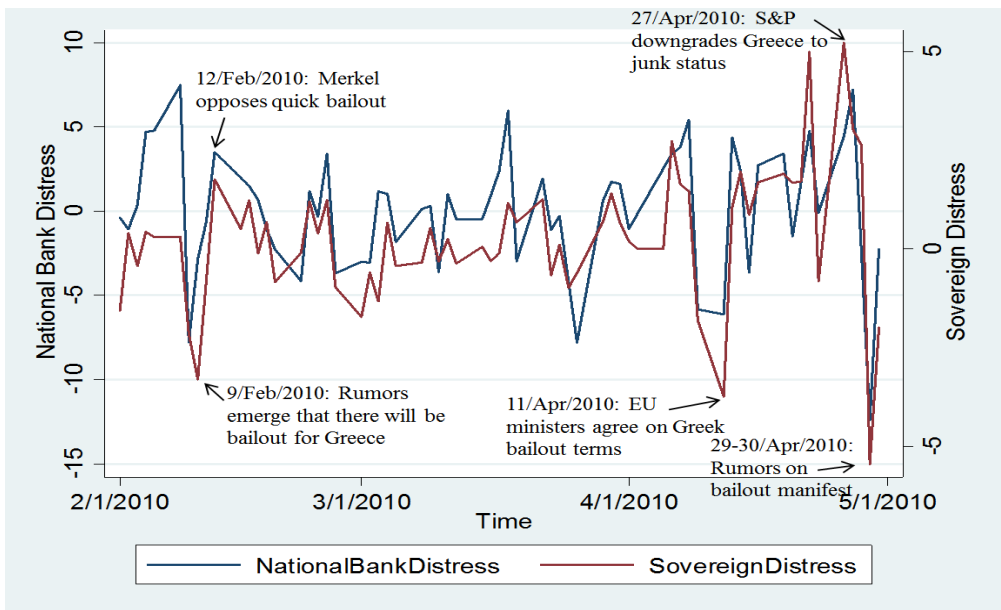
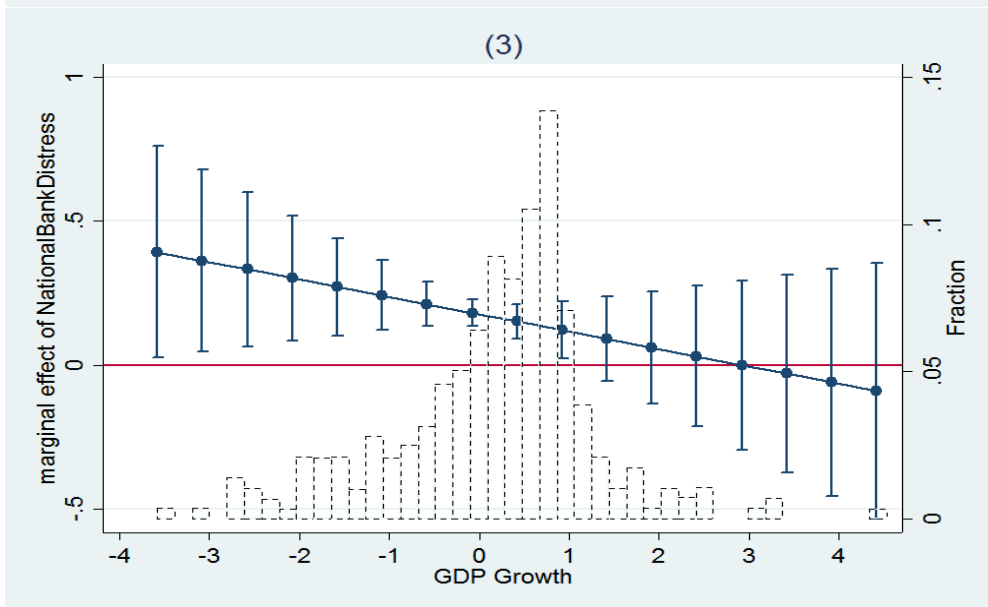
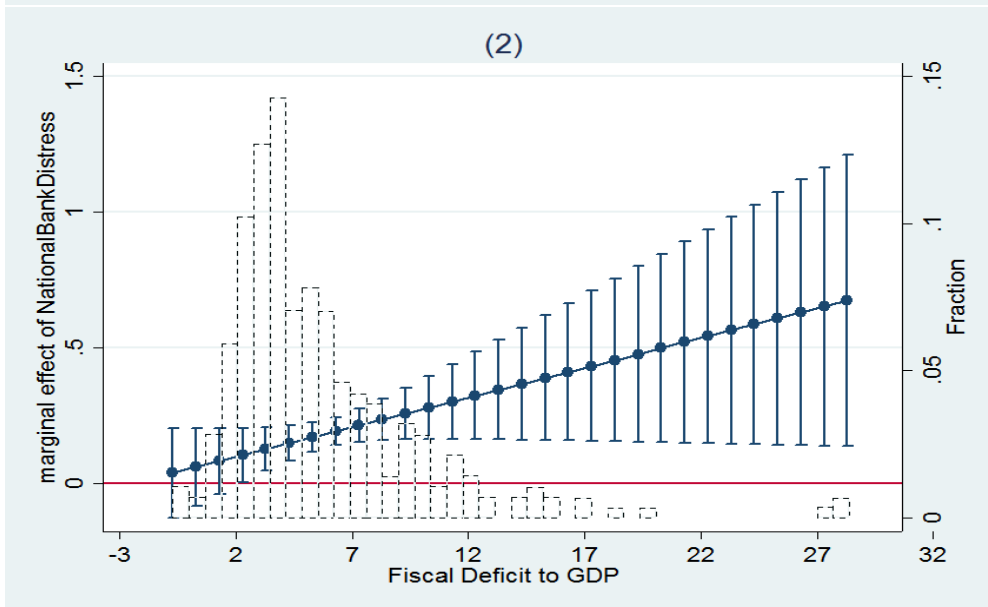
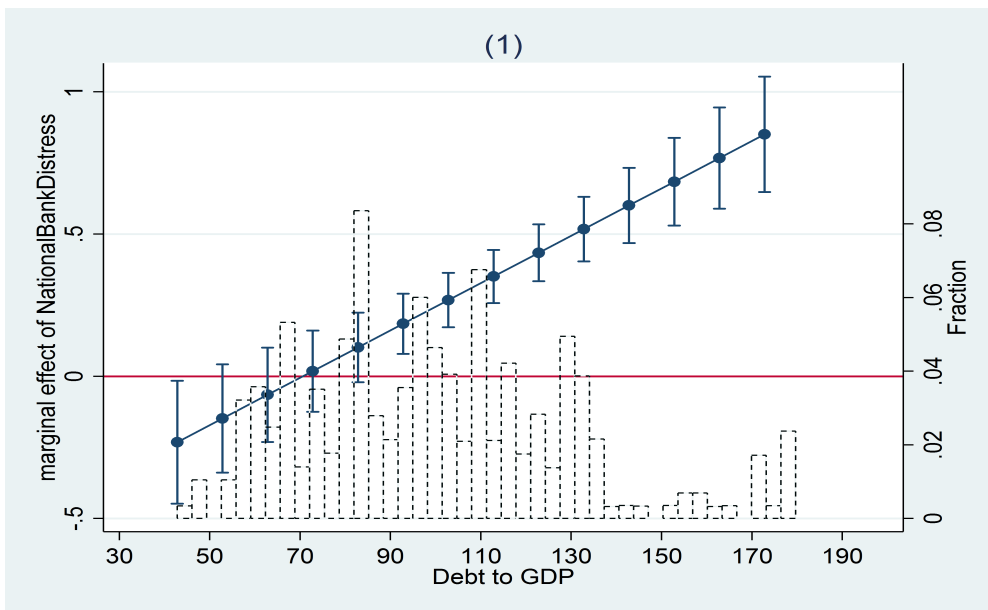


Figure 5: Bank distress and sovereign distress in Greece from February 1st 2010 to May 1st 2010



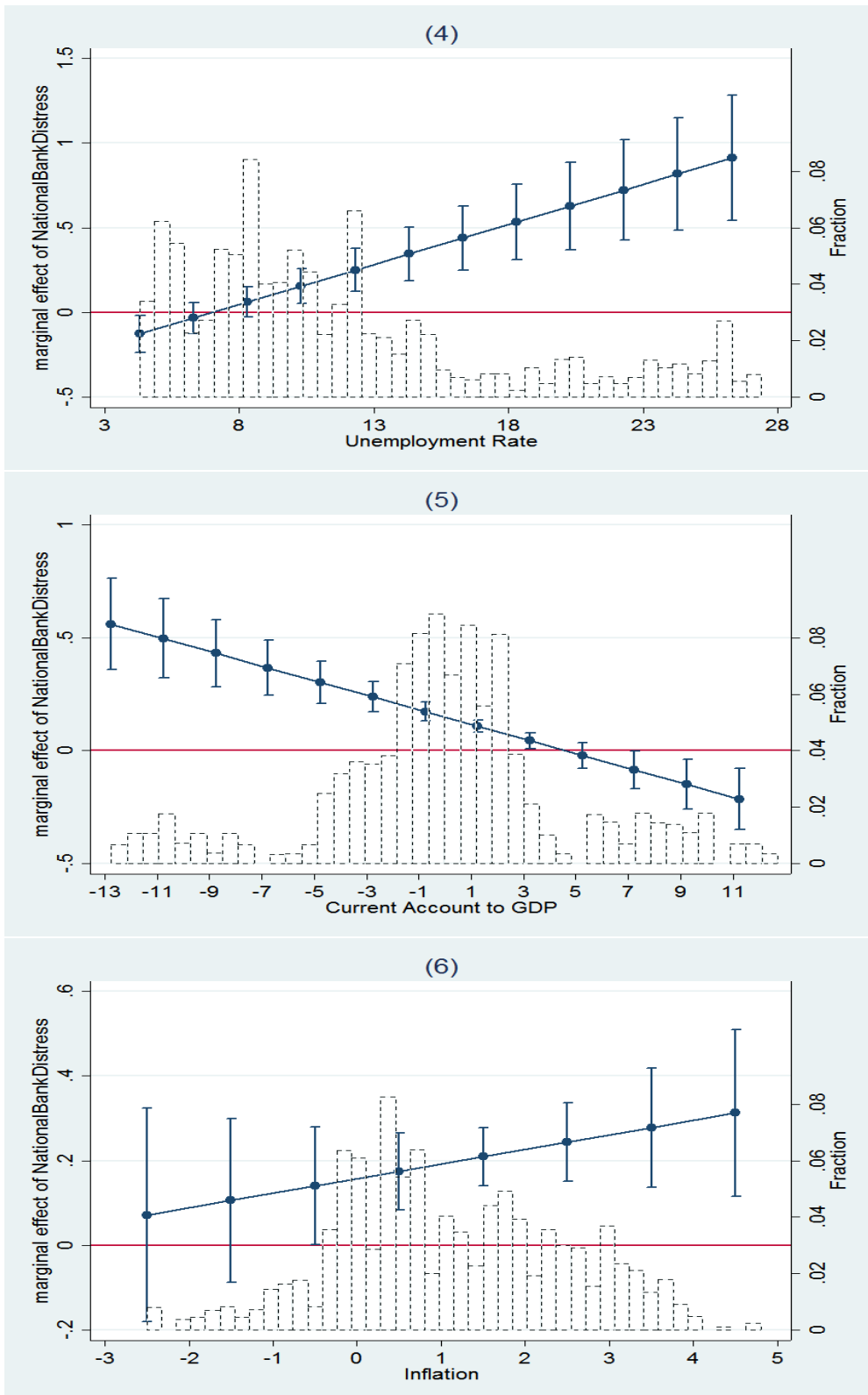
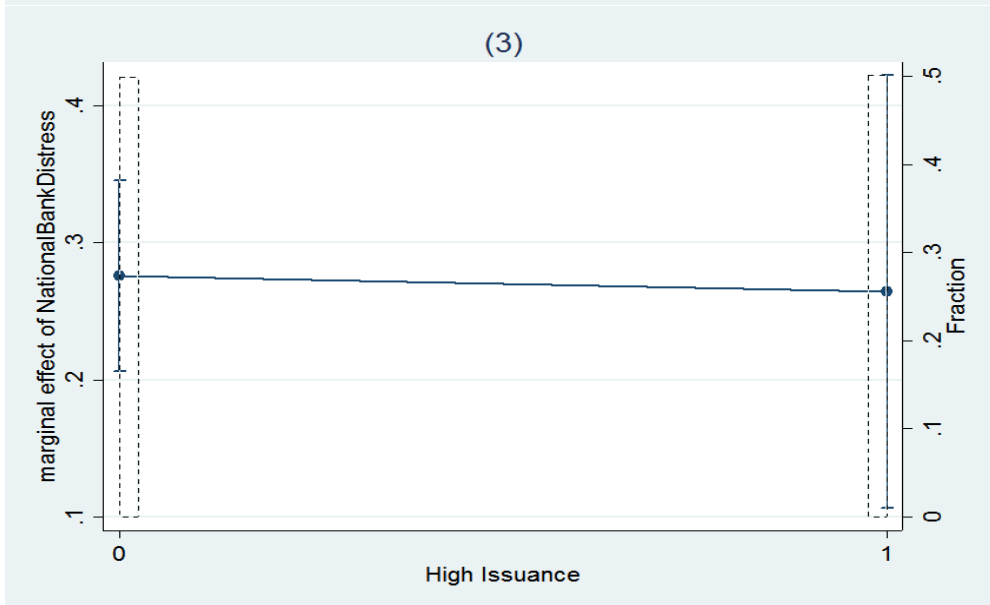
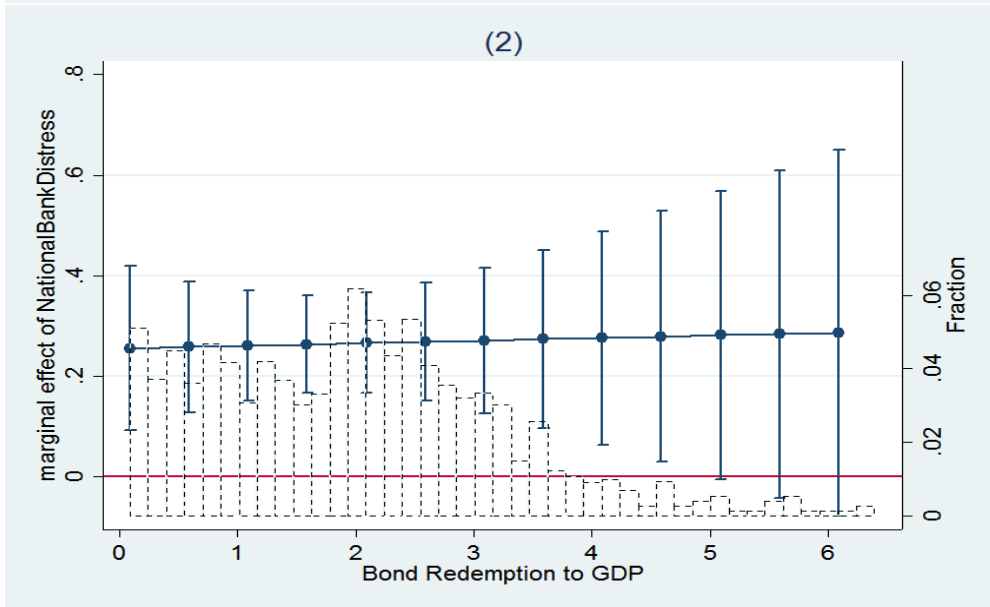
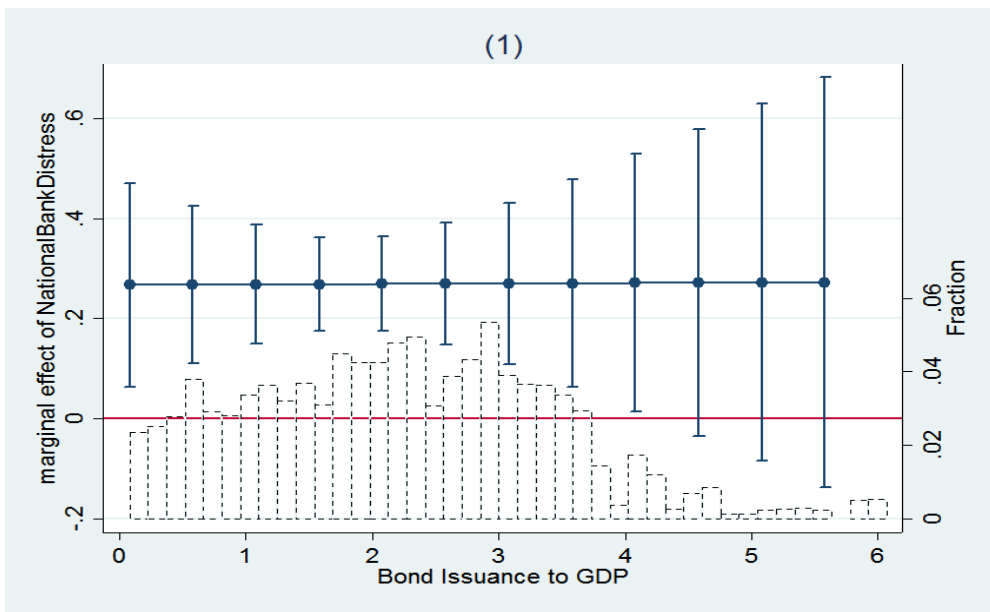


Figure 6: Marginal effect of national bank distress, instrumented with weighted stock market returns from non-Eurozone countries, on sovereign distress conditional on debt to GDP (1), fiscal deficit to GDP (2), GDP growth (3), unemployment rate (4), current account to GDP (5) and inflation (6). Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 4.



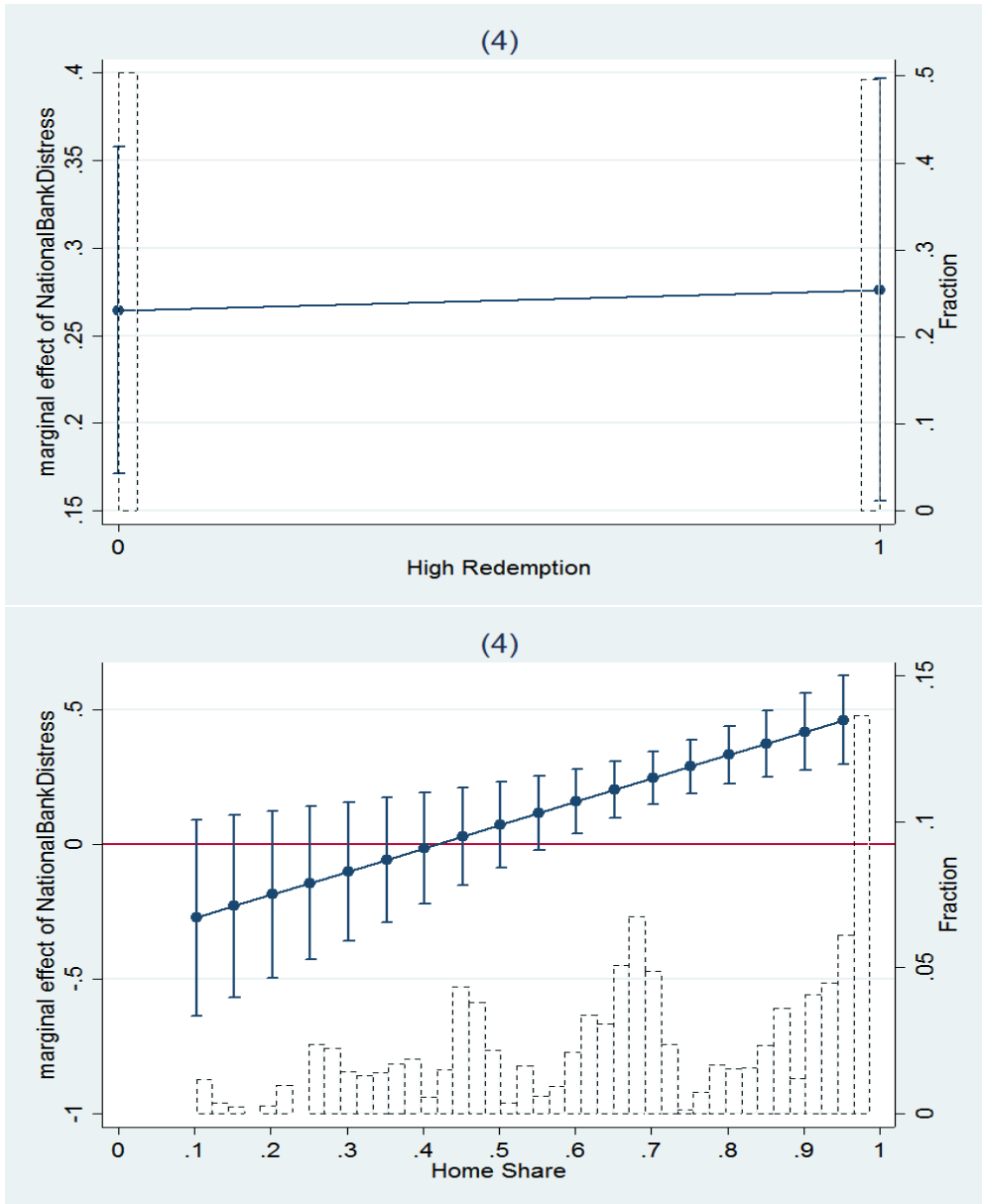
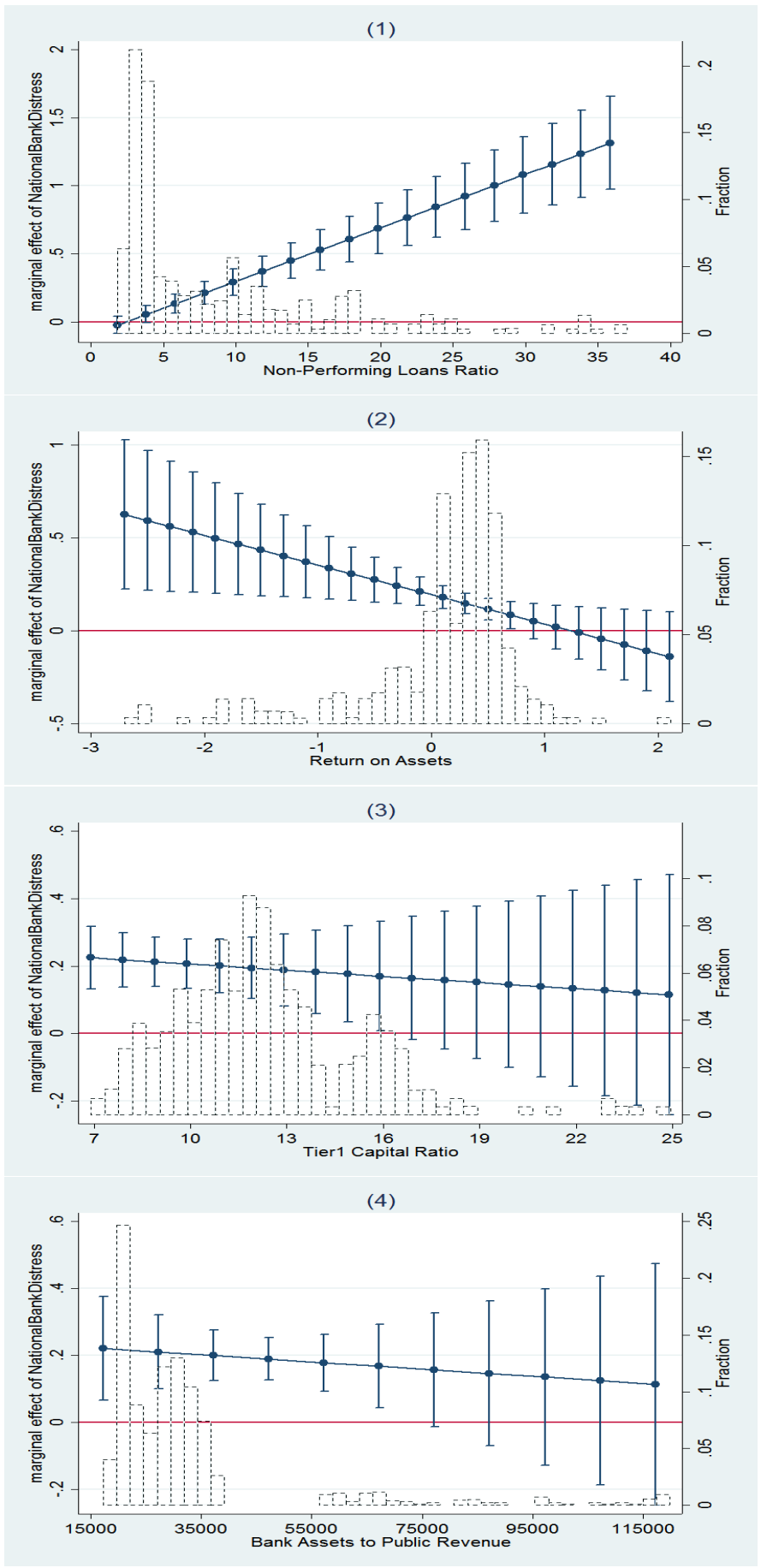


Figure 7: Marginal effect of national bank distress, instrumented with weighted stock market returns from non-Eurozone countries, on sovereign distress conditional on the issuance of debt securities by the general government to GDP (1), the redemption of debt securities by the general government to GDP (2), months in which the issuance of government debt securities lay above the media for this country (3), months in which the redemption of government debt securities lay above the media for this country (4) and the share of domestic government bonds held in relation to the total holding of government bonds by the banking sector. Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 5.



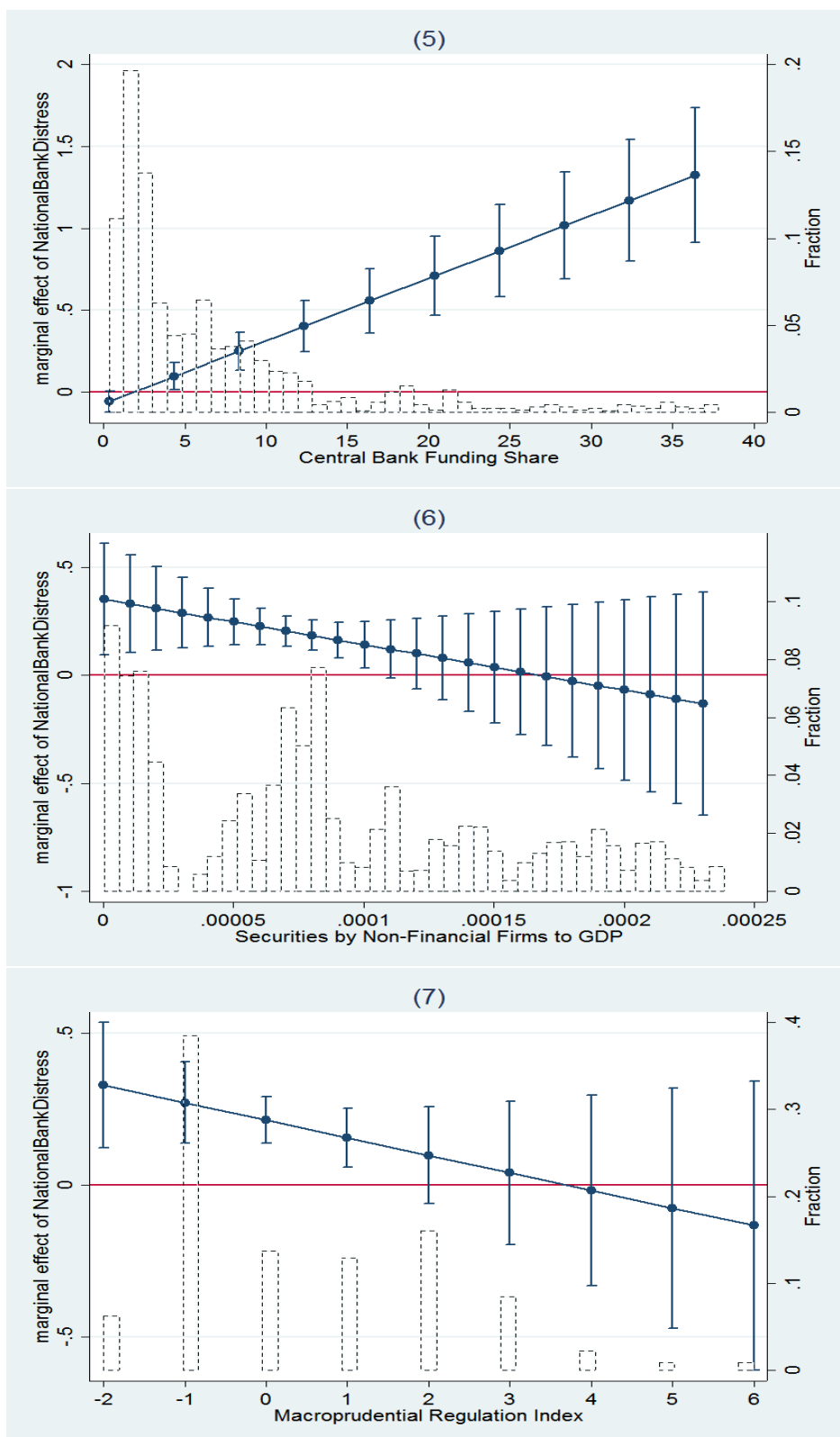
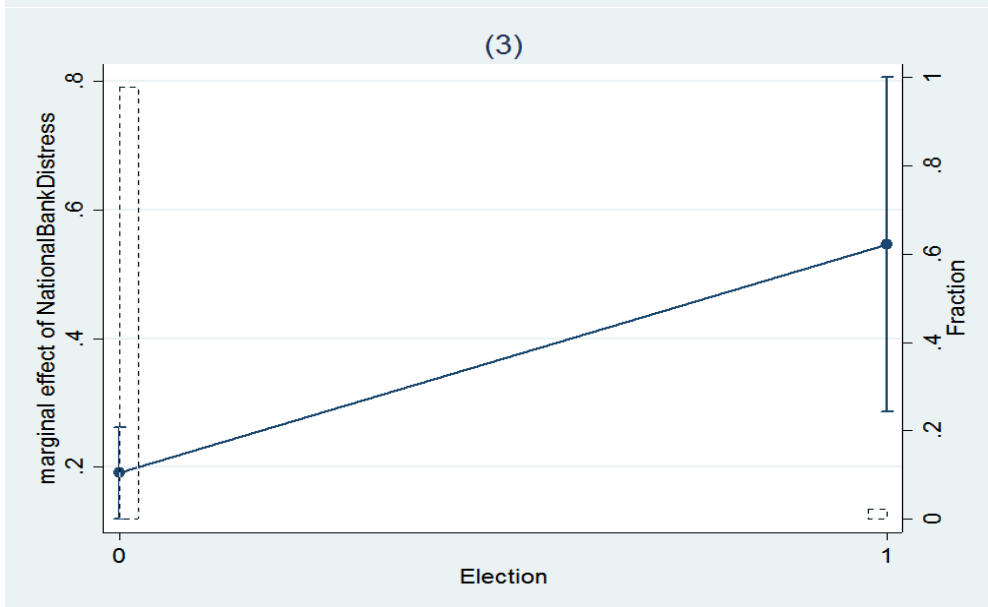
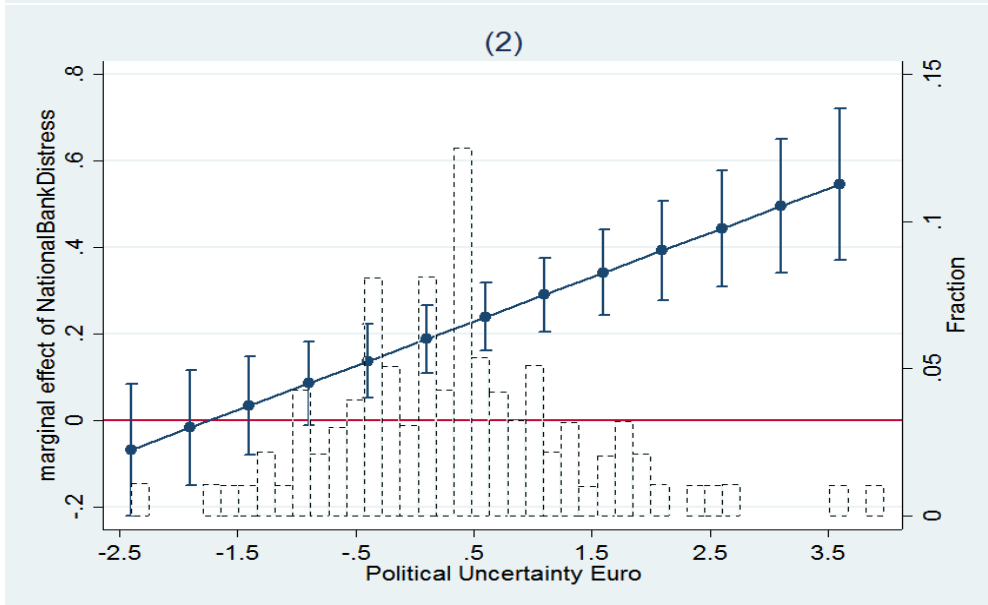
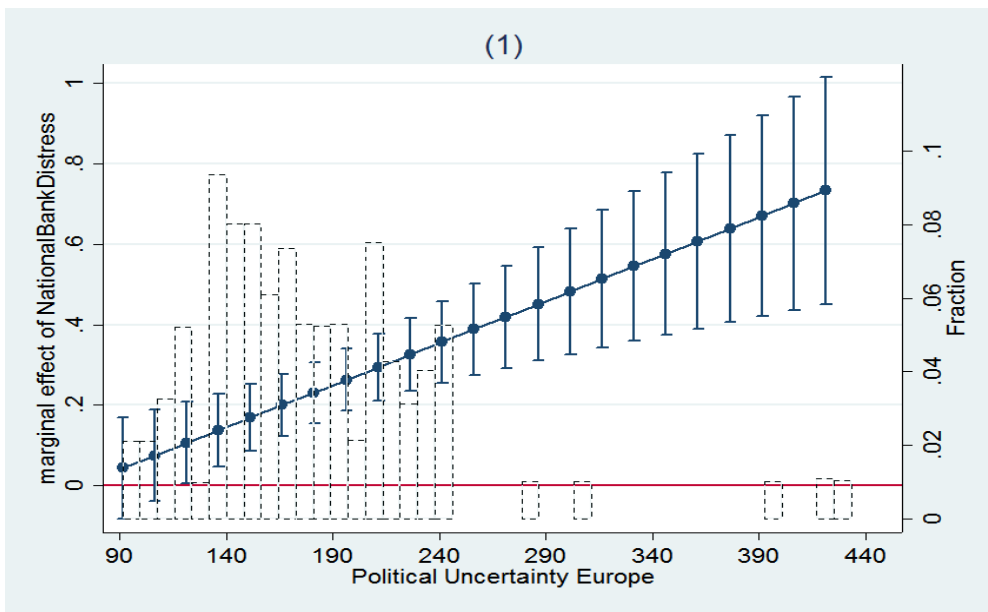


Figure 8: Marginal effect of instrumented national bank distress on sovereign distress conditional on the non-performing loans (1), return on assets (2) and Tier1 capital ratio (3) of a banking sector, the total bank assets to government revenue ratio (4), the share of bank liabilities funded by the central bank (5), the amount of securities issued by non-financial firms to GDP (6) and the cumulative macroprudential index indicating the number of implemented macroprudential measures (7). Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 6.



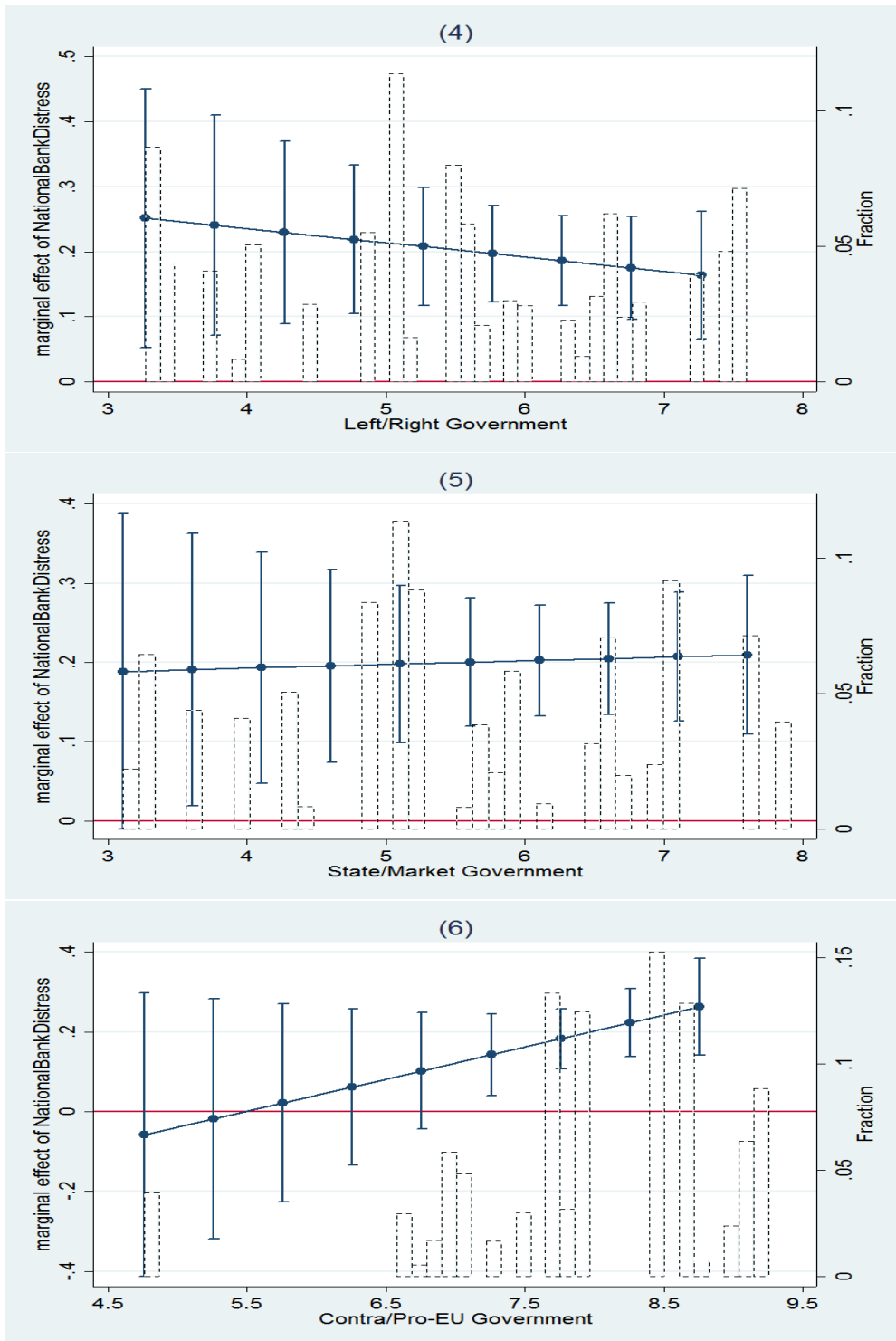


Figure 9: Marginal effect of national bank distress, instrumented with weighted stock market returns from non-Eurozone countries, on sovereign distress conditional on the political uncertainty in Europe based on Baker et al. (2016) (1), political uncertainty concerning the Euro Area derived from the first principal component of the political uncertainty index for Ireland, Spain and Italy (2), months with parliamentary elections (3), the left/right, state/market and contra/pro-EU party preference of the ruling cabinet coalition weighted by their seats in parliament with higher index values indicating more conservative, market-friendly or EU-friendly governments respectively ((4)-(6)). Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 7.

Table 1: Summary statistics of country-specific bank distress ($\Delta\text{NationalBankDistress}$) three months before events of financial sector turmoil during the Eurozone crisis

$\Delta\text{NationalBankDistress}$	(1) N	(2) mean	(3) median	(4) sd	(5) min	(6) max
Ireland: 09/16/2010 to 12/16/2010 (when EU-IMF bailout was signed)	66	0.661	0.661	6.483	-18.71	20.70
Spain: 03/09/2012 to 06/09/2012 (when EU-IMF bailout was agreed upon)	63	0.392	0.392	1.546	-2.783	4.611
Portugal: 05/03/2014 to 08/03/2014 (when bailout for Espirito Santo was announced)	66	0.206	0.206	2.828	-12.05	6.532
Italy: 04/29/2016 to 07/29/2016 (when ECB stress test results were announced in which Italian banks performed poorly)	66	0.419	0.419	3.384	-6.483	17.70
Greece: 01/26/2011 to 04/27/2011 (when Greece was downgraded to junk status)	62	0.462	0.462	3.446	-7.813	7.498

Table 2: Transmission of bank-sovereign distress: OLS and instrumental variable

Dependent Variable	OLS		IV-2SLS
	(1) $\Delta\text{SovereignDistress}$	(2) $\Delta\text{NationalBankDistress}$	(3) $\Delta\text{SovereignDistress}$
$\Delta\text{NationalBankDistress}$	0.195*** (0.0502)		0.160*** (0.0273)
NonEMUStockReturns		-0.432*** (0.0407)	
ΔVIX	-0.0280*** (0.00414)	0.0274 (0.0166)	-0.0385*** (0.00491)
$\Delta\text{USCorporateSpread}$	0.0184* (0.00924)	0.0112* (0.00586)	0.0163* (0.00843)
$\Delta\text{USTermSpread}$	-0.106*** (0.0217)	-0.0298*** (0.00740)	-0.101*** (0.0201)
ΔVstoxx	0.152*** (0.0364)	0.0986*** (0.0250)	0.123*** (0.0336)
$\Delta\text{NominalExchangeRate}$	-0.129*** (0.0264)	0.0532 (0.0454)	-0.124*** (0.0224)
$\Delta\text{EurozoneTermSpread}$	0.125*** (0.0174)	0.0163** (0.00660)	0.122*** (0.0162)
$\Delta\text{NonFinancialItraxx}$	0.0194** (0.00724)	0.0318** (0.0119)	0.0105 (0.00951)
$\Delta\text{CurrentAccountHoldings}$	-0.0191** (0.00638)	-0.00933 (0.00529)	-0.0174*** (0.00618)
NonFinancialStockReturns	-0.123** (0.0390)	0.0178 (0.115)	-0.126*** (0.0273)
Constant	-0.0272 (0.0304)	0.0848* (0.0454)	
Observations	18,208	18,208	18,208
R-squared	0.176	0.301	
Number of Countries	9	9	9
Time & Country FE	Yes	Yes	Yes

This table shows the effects of increases in national-specific bank distress on sovereign distress for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016. $\Delta\text{SovereignDistress}$ is the daily change in the natural logarithm of a country's 10-year government bond index relative to Germany's respective bond index change. $\Delta\text{NationalBankDistress}$ are asset-weighted bank stock returns on the country-level minus asset-weighted bank stock returns on the Eurozone-level. Estimated coefficients in (1) are from least squares regression. Column (2) instruments $\Delta\text{NationalBankDistress}$ with weighted stock market returns from non-Eurozone countries that are weighted according to the BIS claims of the Eurozone country towards all borrowers in the respective non-Eurozone country (NonEMUStockReturns). Column (3) shows the 2nd stage of this IV regression in which $\Delta\text{NationalBankDistress}$ refers to the predicted values from (2). ΔVIX is the daily change in the VIX volatility index, $\Delta\text{USCorporateSpread}$ is the daily change in the spread between the corporate benchmark BBB 10-year yield and the respective AAA yield, $\Delta\text{USTermSpread}$ is the daily change between the 10-year US Treasury yield and the 3-month T-Bill yield, ΔVstoxx is the daily change in the Vstoxx volatility index, $\Delta\text{NominalExchangeRate}$ is the change in the natural logarithm of the nominal effective exchange rate of the Euro, $\Delta\text{EurozoneTermSpread}$ is the daily change in the spread between a Eurozone 7-10 year broad yield and the 3-month Euribor yield, $\Delta\text{NonFinancialItraxx}$ are the residuals from a regression of the daily change in the natural logarithm of the 10-year Itraxx Europe against the corresponding change of the 10-year Itraxx senior and subordinated financial indices, $\Delta\text{CurrentAccountHoldings}$ is the daily change in the natural logarithm of current account holdings (i.e. minimum and excess reserves held by banks at the ECB) and $\Delta\text{NonFinancialStockReturns}$ are the daily changes in the natural logarithm of a country's non-financial stock market returns, which are orthogonalized towards $\Delta\text{NationalBankDistress}$ and total stock market returns in the Eurozone. All variables are standardized. All columns include country and time fixed effects on the quarterly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 3: Transmission of bank-sovereign distress: Further adjustment in instrumented bank distress

Specification	(1) Using 2007:Q1 BIS Claims: First Stage	(2) Using 2007:Q1 BIS Claims: Second Stage	(3) 2007:Q1 Claims and excluding dependent Borrower Countries: First Stage	(4) 2007:Q1 Claims and excluding dependent Borrower Countries: Second Stage	(5) 2007:Q1 Claims, excluding dependent Borrowers, eliminating EMU Component: First Stage	(6) 2007:Q1 Claims, excluding dependent Borrowers, eliminating EMU Component: Second Stage
NonEMUStockReturns: 2007:Q1 BIS Claims	-0.471*** (0.0416)					
NonEMUStockReturns: 2007:Q1 BIS Claims excluding dependent Borrowers			-0.457*** (0.0595)			
NonEMUStockReturns: 2007:Q1 BIS Claims excluding dependent Borrowers eliminating EMU Component					-0.427*** (0.0513)	
Δ NationalBankDistress		0.154*** (0.0263)		0.151*** (0.0253)		0.109*** (0.022)
Observations	18,208	18,208	18,208	18,208	18,208	18,208
R-squared	0.308		0.302		0.296	
Number of Countries	9	9	9	9	9	9
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

This table shows further adjustments in the instrument for the estimated transmission of instrumented national-specific bank distress on sovereign distress for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016 compared to Table 2. NonEMUStockReturns is adjusted as described below. Δ NationalBankDistress refers to the corresponding second stage coefficient of the IV. Columns (1) and (2) show the first and second stage results using the BIS claims from the period 2007:Q1 and applying them as constant weighting factors for the sample period to control for the shifting of international exposures by banks due to the crisis. Columns (3) and (4) report the first and second stage of using the BIS claims from 2007:Q1 and additionally removing all non-Eurozone countries in the exposure portfolio of a Eurozone country, if this Eurozone country held at any point in the sample period more than 20% of the total international claims towards the respective non-Eurozone country. Columns (5) and (6) apply the adjustments from (3) and (4) and additionally orthogonalizing the instrument towards a Eurozone-specific bank stock component. This step is implemented by orthogonalizing the asset-weighted Eurozone bank returns derived in section 3.1 towards a world bank stock return series which excludes the EMU. This procedure gives us a Eurozone-specific bank stock variation and we purge our instrument from these factors by means of orthogonalization. All variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 4: Drivers of bank-sovereign distress transmissions: Macroeconomic performance

Interaction Variable	(1) Public Debt to GDP	(2) Fiscal Deficit to GDP	(3) GDP Growth	(4) Unemployment Ratio	(5) Current Account to GDP	(6) Inflation
Δ NationalBankDistress	0.249*** (0.0496)	0.177*** (0.0264)	0.166*** (0.0239)	0.231*** (0.0619)	0.150*** (0.0182)	0.195*** (0.0370)
Δ NationalBankDistress#c.Debt-to-GDP	0.250*** (0.0443)					
Debt to GDP	-0.0558** (0.0244)					
Δ NationalBankDistress#c.FiscalDeficitToGDP		0.0919* (0.0510)				
FiscalDeficitToGDP		-0.00561 (0.0138)				
Δ NationalBankDistress#GDP Growth			-0.0687 (0.0585)			
GDP Growth			-0.0110* (0.00653)			
Δ NationalBankDistress#Unemployment Rate				0.286*** (0.0591)		
Unemployment Rate				-0.120*** (0.0367)		
Δ NationalBankDistress#Current Account to GDP					-0.153*** (0.0338)	
Current Account to GDP					-0.0701** (0.0297)	0.0474 (0.0428)
Δ NationalBankDistress#c.Inflation						0.0328 (0.0300)
Inflation						
Observations	18,017	17,951	17,960	17,874	17,958	17,916
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

This table shows the IV-regression where the country-specific bank distress, which is instrumented with exposure-weighted non-Eurozone stock market returns according to Table 3 columns (5) and (6), is interacted with quarterly or monthly variables representing the macroeconomic performance of a country. The model is estimated using IV-2SLS with two endogenous variables (country-specific bank distress and the interaction between bank distress and the interaction term) and two instruments (international exposure-weighted stock returns and the interaction of international stock returns with the interaction term) for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016. Each interaction term enters with a lag of one quarter or one month, depending on its frequency. Debt-to-GDP (1) is the debt of the general government in relation to GDP. Fiscal Deficit to GDP (2) is the net borrowing (+) or net saving (-) of a general government in proportion to GDP. GDP Growth (3) is the quarterly growth of GDP in market prices. Unemployment Rate (4) is the harmonized, seasonally adjusted unemployment rate of a country. Current Account to GDP (5) is the current account of a country in ratio to its GDP. Inflation (6) is the annual rate of change in the harmonized index of consumer prices. All variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 5: Drivers of bank-sovereign distress transmissions: Issuance, redemption and holding of government debt

Interaction Variable	(1) Government Bond Issuance to GDP	(2) Government Bond Redemption to GDP	(3) High Issuance	(4) High Redemption	(5) Home Share in Government Bonds
Δ NationalBankDistress	0.269*** (0.0513)	0.266*** (0.0499)	0.276*** (0.0360)	0.264*** (0.0470)	0.230*** (0.0509)
Δ NationalBankDistress #DebtIssuanceGDP	0.00115 (0.0652)				
DebtIssuanceGDP	-0.00764 (0.0112)				
Δ NationalBankDistress #DebtRedemptionGDP		0.00636 (0.0510)			
DebtRedemptionGDP		0.00497** (0.00234)			
Δ NationalBankDistress #HighIssuance			-0.0117 (0.0707)		
HighIssuance			-0.0316 (0.0212)		
Δ NationalBankDistress #HighRedemption				0.0117 (0.0346)	
HighRedemption				0.0379** (0.0177)	
Δ NationalBankDistress #HomeShare					0.206*** (0.0694)
HomeShare					0.0680 (0.0743)
Observations	15,824	15,823	16,116	16,116	17,872
Time & Country FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

This table shows the IV-regression where the country-specific bank distress, which is instrumented with exposure-weighted non-Eurozone stock market returns according to Table 3 columns (5) and (6), is interacted with quarterly or monthly variables representing the issuance, redemption or holding of government debt securities. The model is estimated using IV-2SLS with two endogenous variables (country-specific bank distress and the interaction of bank distress with the interaction term) and two instruments (international exposure-weighted stock returns and the interaction of international stock returns with the interaction term) for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016. As we are interested in the specific quarters with higher or lower government debt issuance or redemption, the variables in these estimations enter with their contemporaneous value, unless stated otherwise. Government Bond Issuance to GDP (1) is the gross issuance of debt securities of a general government in relation to GDP. Government Bond Redemption to GDP (2) is the gross redemption of debt securities of a general government in relation to GDP. High Issuance (3) is a dummy variable equal to one in months in which the gross issuance of government debt was above the sample median of this country. High Redemption (4) is a dummy variable equal to one in months in which the gross redemption of government debt was above the sample median of this country. Home Share (5) is the share of domestic government bonds held by a country's banking sector compared to its total government bond holding. All non-dummy variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 6: Drivers of bank-sovereign distress transmissions: Banking sector structure and stability

Interaction Variable	(1) Non-Performing Loans Ratio	(2) Return on Assets	(3) Tier1 Capital Ratio	(4) Bank Assets to Public Revenue Ratio	(5) Central Bank Funding Share	(6) Non-Financial Securities to GDP	(7) Macroprudential Regulation Index
Δ NationalBankDistress	0.256*** (0.0462)	0.180*** (0.0310)	0.191*** (0.0499)	0.205*** (0.0461)	0.188*** (0.0523)	0.176*** (0.0379)	0.214*** (0.0419)
Δ NationalBankDistress #Non-Performing Loans Ratio	0.312*** (0.0403)						
Non-Performing Loans Ratio	-0.114*** (0.0315)						
Δ NationalBankDistress #Return on Assets		-0.108** (0.0457)					
Return on Assets		0.0140 (0.0113)					
Δ NationalBankDistress #Tier1 Capital Ratio			-0.0182 (0.0344)				
Tier1 Capital Ratio			-0.00310 (0.0209)				
Δ NationalBankDistress #Bank Assets to Revenue				-0.0202 (0.0476)			
Bank Assets to Revenue				0.0245** (0.00969)			
Δ NationalBankDistress #Central Bank Funding Share					0.288*** (0.0425)		
Central Bank Funding Share					-0.0536*** (0.00877)		
Δ NationalBankDistress # Non-Financial Securities to GDP						-0.140 (0.112)	
Non-Financial Securities to GDP						0.0579 (0.0409)	
Δ NationalBankDistress # Macroprudential Index							-0.0579 (0.0421)
Macroprudential Index							0.0132 (0.00834)
Observations	17,956	18,021	17,955	17,869	17,936	17,616	14,265
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Drivers of bank-sovereign distress transmissions: Banking sector structure and stability (continued)

This table shows the IV-regression where the country-specific bank distress, which is instrumented with exposure-weighted non-Eurozone stock market returns according to Table 3 columns (5) and (6), is interacted with quarterly or monthly variables representing the banking sector structure and stability of a country. The model is estimated using IV-2SLS with two endogenous variables (country-specific bank distress and the interaction of bank distress with the interaction term) and two instruments (international exposure-weighted stock returns and the interaction of international stock returns with the interaction term) for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016. Each interaction term enters with a lag of one quarter or one month, depending on its frequency. Non-Performing Loans Ratio (1) is the ratio of non-performing loans to total gross loans of a banking sector. Return on Assets (2) is the return on assets ratio of a banking sector. Tier1 Capital Ratio (3) is the ratio of regulatory Tier1 capital to risk-weighted assets. Bank Assets to Public Revenue Ratio (4) is the ratio of the total balance sheet size of a banking sector towards the total general government's revenues. Central Bank Funding Share (5) is the share of liabilities in a country's banking sector funded by the central bank. Non-Financial Securities to GDP (6) is the ratio of outstanding securities issued by non-financial corporations in ratio to GDP. Macroeprudential Regulation Index (7) is an index from Cerutti et al. (2016) that aggregates the number of implemented macroprudential instruments in a country. All non-index variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 7: Drivers of bank-sovereign distress transmissions: Political stability

Interaction Variable	(1) Policy Uncertainty Europe	(2) Policy Uncertainty Euro	(3) Election	(4) Left/Right Preference	(5) State/Market Preference	(6) Contra./Pro-EU Preference
Δ NationalBankDistress	0.231*** (0.0386)	0.213*** (0.0396)	0.191*** (0.0364)	0.204*** (0.0423)	0.200*** (0.0419)	0.200*** (0.0383)
Δ NationalBankDistress#Policy Uncertainty Europe	0.125*** (0.0344)					
Policy Uncertainty Europe	0.00562 (0.00576)					
Δ NationalBankDistress#Policy Uncertainty Euro		0.111*** (0.0267)				
Policy Uncertainty Euro		-0.00653 (0.00878)				
Δ NationalBankDistress#Election			0.355*** (0.107)			
Election			0.102** (0.0508)			
Δ NationalBankDistress#Left/Right Preference				-0.0293 (0.0437)		
Left/Right Preference				-0.0272* (0.0146)		
Δ NationalBankDistress#State/Market Preference					0.00632 (0.0397)	
State/Market Preference					-0.0263* (0.0139)	
Δ NationalBankDistress#Conta/Pro-EU Preference						0.0786 (0.0554)
Conta/Pro-EU Preference						0.0177 (0.0114)

Observations 18,208 18,208 18,208 18,208 18,208 18,208

Time & Country FE Yes Yes Yes Yes Yes Yes

Controls Yes Yes Yes Yes Yes Yes

This table shows the IV-regression where the country-specific bank distress, which is instrumented with exposure-weighted non-Eurozone stock market returns according to Table 3 columns (5) and (6), is interacted with quarterly or monthly variables representing the political stability of a country. The model is estimated using IV-2SLS with two endogenous variables (country-specific bank distress and the interaction of bank distress with the interaction term) and two instruments (international exposure-weighted stock returns and the interaction of international stock returns with the interaction term) for 9 Eurozone countries during the Eurozone crisis from 01/01/2009 to 12/31/2016. Policy Uncertainty Europe (1) is a policy uncertainty index for Europe established in Baker et al. (2016). Policy Uncertainty Euro (2) is the first component of a principal component analysis of the policy uncertainty indices of Ireland, Spain and Italy. Election (3) is a dummy that is 1 if the country held a parliamentary election in that month. Left/Right, State/Market and Contra/Pro-EU (4, 5, 6) are weighted indices of the political preferences of ruling parties in the cabinet weighted by their seats in parliament. A higher index implies a more conservative/market-friendly or EU-friendly government, respectively. The interaction terms in (1) and (2) enter with a lag of one month, whereas the other variables enter the estimation with their contemporaneous value. All non-dummy variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 8: Robustness section: Alternative versions for dependent variable

Dependent Variable	(1) Δ SovereignDistress (Baseline)	(2) Δ Sovereign Yield Spread	(3) Δ CDS Spread
Δ NationalBankDistress	0.109*** (0.022)	0.0928*** (0.0203)	0.155*** (0.0248)
Δ Vstox	0.150*** (0.0332)	0.138*** (0.0336)	0.116*** (0.0430)
Δ NominalExchangeRate	-0.129*** (0.0249)	-0.123*** (0.0262)	-0.132*** (0.0343)
Δ EurozoneTermSpread	0.124*** (0.0164)	0.130*** (0.0195)	0.112*** (0.0289)
Δ NonFinancialItraxx	0.0189** (0.00866)	0.0161* (0.00910)	-0.00817 (0.0114)
Δ USTermSpread	-0.106*** (0.0203)	-0.0806*** (0.0163)	-0.0585*** (0.0189)
Δ USCorporateSpread	0.0183** (0.00860)	0.0182** (0.00814)	0.0372*** (0.00797)
Δ VIX	-0.0286*** (0.00372)	-0.0250*** (0.00299)	-0.0334*** (0.00750)
NonFinancialStockReturns	-0.123*** (0.0359)	-0.124*** (0.0391)	-0.105*** (0.0387)
Δ CurrentAccountHoldings	-0.0190*** (0.00610)	-0.0161** (0.00714)	0.00234 (0.00543)
Observations	18,208	18,140	16,288
Time & Country FE	Yes	Yes	Yes

This table shows robustness checks with respect to the dependent variable in the main specification. All columns show the second stage of the IV-2SLS estimation in which country-specific bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016 according to Table 3 columns (5) and (6). Column (1) repeats the regression from Table 3 column (6) with the change in spread between the natural logarithm of a 10-year government bond index of a country with respect to the German government bond index change as the dependent variable. Column (2) uses the spread in 10-year sovereign bond yields between a country and the German rate as a dependent variable. Column (3) repeats the analysis with the 5-year CDS rate of a country with respect to the German CDS rate. All variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 9: Robustness section: Alternative versions for national bank distress variable

Specification	(1) Using Bank Distress: First Stage IV	(2) Using Bank Distress: Second Stage IV	(3) Using Bank Distress: OLS	(4) Using Nat. Bank Distress by orthogonalization: First Stage IV	(5) Using Nat. Bank Distress by orthogonalization: Second Stage IV	(6) Using Nat. Bank Distress by orthogonalization: OLS
NonEMUStockReturns	-0.258*** (0.0393)			-0.485*** (0.0592)		
Δ BankDistress		0.163*** (0.0301)	0.244*** (0.0530)			
Δ NationalBankDistress by orthogonalization					0.0947*** (0.0195)	0.170*** (0.0505)
Observations	18,208	18,208	18,208	18,208	18,208	18,208
R-squared	0.297		0.187	0.288		0.169
Number of Countries	9	9	9	9	9	9
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

This table shows robustness checks with respect to changes in the specification of national bank distress. In the IV specifications, bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016 according to Table 3 columns (5) and (6). Column (1) estimates the first IV stage using the more broadly specified bank distress on the country level, i.e. without removing a Eurozone-specific component ($BankReturns_{it}$, here multiplied times minus one). This bank distress variable is instrumented using the same exposure-weighted foreign stock returns as before. Column (2) shows the result of the second IV stage using this variable and column (3) uses the same specification but applying OLS. Column (4) estimates the first IV stage using the national bank distress measure in which the Eurozone-specific component was not removed by subtraction but by orthogonalization. Columns (5) and (6) show the results of the corresponding second IV stage and OLS. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 10: Robustness section: Alternative versions for instrument variable

	(1)	(2)	(3)	(4)	(5)	(6)
Specification	Different elimination of EMU Component: First Stage IV	Different elimination of EMU Component: Second Stage IV	Excluding EU instead of dependent Borrowers: First Stage IV	Excluding EU instead of dependent Borrowers: Second Stage IV	Instrument in Euro: First Stage IV	Instrument in Euro: Second Stage IV
NonEMUSockReturns: Different elimination of EMU Component	-0.408*** (0.0505)					
NonEMUSockReturns: Excluding EU instead of dependent Borrowers			-0.375*** (0.0751)			
NonEMUSockReturns: Instrument in Euro					-0.373*** (0.0497)	
Δ NationalBankDistress		0.105*** (0.0213)		0.114*** (0.0417)		0.115*** (0.0213)
Observations	18,208	18,208	18,208	18,208	18,208	18,208
R-squared	0.290		0.280		0.279	
Number of Countries	9	9	9	9	9	9
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

This table shows robustness checks with respect to changes in the specification of the instrument variable. Bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016 according to Table 3 columns (5) and (6). Column (1) estimates the first IV stage using a different orthogonalization procedure to remove the EMU component from the instrument. We conduct a principal component analysis of the asset-weighted bank stock returns of each Eurozone-country ($BankReturns_{it}$), as derived in section 3.1. We orthogonalize the first component of these returns towards the world bank return factor. Similarly to the procedure in Table 3, this variable gives us a Eurozone-specific bank stock variation and we purge our instrument from these factors by means of orthogonalization. Column (2) shows the second stage of the corresponding IV. Columns (3) and (4) estimate a specification in which we remove all EU countries in the construction of the instrument instead of the removal of non-EU countries whose founding depends heavily on a Euro member. Columns (5) and (6) show the results when converting the stock returns of non-Eurozone countries into Euro using the corresponding exchange rate. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 11: Robustness section: Strengthening exclusion restriction

	(1)	(2)	(3)	(4)
	Δ NationalBank Distress	Δ Sovereign Distress	Δ NationalBank Distress	Δ Sovereign Distress
NonEMUBankStockReturns	-0.398*** (0.0342)			
Δ NationalBankDistress		0.0802*** (0.0176)		0.106*** (0.0185)
Trade-Weighted Shocks			-0.118*** (0.0158)	0.0113 (0.0189)
NonEMUStockReturns			-0.466*** (0.0421)	
Observations	18,208	18,208	18,208	18,208
R-squared	0.301		0.306	
Number of Countries	9		9	
Time & Country FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

This table shows robustness checks to strengthen the exclusion restriction of the IV approach. The columns show the first and second stage of the IV-2SLS estimation in which bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016. Columns (1) and (2) show first and second stages when using only bank stocks in the exposure-weighted stock returns as an instrument. Columns (3) and (4) show first and second stages when repeating the baseline estimation of Table 3 columns (5) and (6) but adding trade-weighted shocks as an additional control, i.e. export-weighted non-financial stock returns of non-EMU countries. All variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 12: Robustness section: Starting in 2010, weekly frequency

Specification	(1)	(2)	(3)	(4)
	Starting in 2010:Q2: IV	Starting in 2010:Q2: OLS	Weekly Frequency: IV	Weekly Frequency: OLS
Δ NationalBankDistress	0.140*** (0.0253)	0.230*** (0.0461)	0.164*** (0.0418)	0.290*** (0.0682)
Observations	15,364	15,364	3,731	3,731
R-squared		0.197		0.280
Time & Country FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Number of Countries	9	9	9	9

This table shows robustness checks with respect to a different starting point of the estimation and a change in frequency. All columns indicating “IV” show the second stage of the IV-2SLS estimation in which bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016 according to Table 3 columns (5) and (6). Column (1) repeats the baseline regression but starts the estimation in 2010:Q2 instead of 2009:Q1. Column (2) conducts the same estimation using OLS. Column (3) shows the baseline IV-2SLS result when collapsing the data to the weekly frequency and column (4) the corresponding results from OLS. All variables are standardized. All columns include country and time fixed effects on the quarterly level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

Table 13: Robustness section: Changing control variables and time fixed effects

Dependent Variable & Specification	(1)		(2)		(3)		(4)		(5)	
	Δ NationalBankDistress Alt. NonFinancial Returns	Δ NonFinancial Returns	Δ SovereignDistress Alt. NonFinancial Returns	Removing E/Z Term Spread	Δ SovereignDistress Euro-Dollar Exchange Rate	Δ SovereignDistress Euro-Dollar Exchange Rate	Δ SovereignDistress Month Fixed Effects			
Δ NationalBankDistress		0.111*** (0.0212)	0.114*** (0.0232)	0.0855*** (0.0197)	0.108*** (0.0208)					
NonEMUStockReturns	-0.420*** (0.0481)									
NonFinancialStockReturns			-0.124*** (0.0361)	-0.114*** (0.0384)	-0.123*** (0.0351)					
NonFinancialStockReturns: Alt. Version	-0.272** (0.104)	-0.106*** (0.0372)								
Δ NominalExchangeRate	-0.0935* (0.0478)	-0.126*** (0.0259)	-0.126*** (0.0244)		-0.125*** (0.0240)					
Δ EuroDollar ExchangeRate				0.126*** (0.0229)						
Δ EurozoneTermSpread	0.0157* (0.00792)	0.125*** (0.0165)		0.126*** (0.0166)	0.124*** (0.0169)					
Δ Vstox	0.0771*** (0.0172)	0.159*** (0.0349)	0.148*** (0.0326)	0.165*** (0.0348)	0.150*** (0.0340)					
Δ NonFinancialtraxx	0.0284** (0.0107)	0.0200** (0.00894)	0.0182** (0.00859)	0.0191** (0.00798)	0.0175** (0.00825)					
Δ USTermSpread	-0.0305*** (0.00514)	-0.107*** (0.0205)	-0.0947*** (0.0190)	-0.111*** (0.0207)	-0.105*** (0.0204)					
Δ USCorporateSpread	0.00502 (0.00355)	0.0186** (0.00860)	0.0206** (0.00866)	0.0196** (0.00872)	0.0171** (0.00850)					
Δ VIX	-0.00740 (0.0199)	-0.0302*** (0.00391)	-0.0250*** (0.00345)	-0.0490*** (0.00721)	-0.0284*** (0.00365)					
Δ CurrentAccountHoldings	-0.00803 (0.00632)	-0.0192*** (0.00617)	-0.0112** (0.00551)	-0.0168*** (0.00561)	-0.0193*** (0.00627)					
Observations	18,208	18,208	18,208	18,208	18,208					
R-squared	0.356									
Number of Countries	9	9	9	9	9					
Quarterly Time & Country FE	Yes	Yes	Yes	Yes	No					
Monthly Time & Country FE	No	No	No	No	Yes					

This table shows robustness checks with respect to changes in the specification of certain control variables. All columns show either the first or the second stage of the 2SLS estimation in which bank distress of 9 Eurozone countries is instrumented using exposure-weighted non-Eurozone stock returns during the Eurozone crisis from 01/01/2009 to 12/31/2016 according to Table 3 column (5) and (6). Δ NationalBankDistress refers to the predicted values of country-specific bank distress from the respective specification. Columns (1) shows the first and column (2) the second stage of the baseline regression in which non-financial stock returns of a country, which are originally orthogonalized to Δ NationalBankDistress and a stock return index for the Eurozone, are now only orthogonalized towards the Eurozone stock return index. The first stage is shown to see that this version of non-financial returns has a negative impact on bank distress. Column (3) removes the Eurozone Term Spread when estimating the baseline regression. Column (4) uses the change in the natural logarithm of the Euro-to-Dollar exchange rate instead of the Euro's nominal effective exchange rate. Column (5) conducts the baseline regression using monthly instead of quarterly time fixed effects. All variables are standardized. All columns include country and time fixed effects on the quarterly (or monthly) level and the daily control variables discussed in Table 2. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. See Table 16 for variable definitions and sources.

10 Appendix

Table 14: List of included banks

Country	Banks
Austria	BKS Bank, Erste Group Bank, Oberbank, Raiffeisen Bank International
Belgium	Dexia, KBC Ancora, KBC Group
France	Banque De La Reunion, Banque Parneaud, BNP Paribas, Boursorama, Credit Agricoles Alpes Provenances, Credit Agricole Atlantique Vendee, Credit Agricole Brie Picardie, Credit Agricole Centre Loire, Credit Credit Agricole d'Ile de France, Agricole d'Ille-et-Vilaine, Credit Agricole Languedoc, Credit Agricole Loire Haute-Loire, Credit Agricole Normandie Seine, Credit Agricole Morbihan, Credit Agricole Nord de France, Credit Agricole SA, Credit Agricole Sud Rhone Alpes, Credit Agricole Toulouse, Credit Agricole Touraine Poitou, Credit Foncier de Monaco, Credit Industriel et Commercial CIC, Natixis, Societe Generale, Rothschild & Co
Germany	Aareal Bank, Baader Bank, Berlin-Hannoversche Hypothekenbank, Comdirect Bank, Commerzbank, Deutsche Bank, Deutsche Pfandbriefbank, Deutsche Postbank, DVB Bank, HSBC Trinkaus and Burkhardt, Hypo Real Estate, IKB, Landesbank Berlin Holding, Merkur Bank, Net-M Privatbank, Odenburgische Landesbank, Quirin Bank, Umweltbank, Varengold Bank
Greece	Agricultural Bank of Greece, Alpha Bank, Attica Bank, Bank of Piraeus, Eurobank Ergasias, Emporiki Bank, General Bank of Greece, Marfin Egnatia Bank, Marfin Investment Group, National Bank of Greece, Proton Bank, T Bank, TT Hellenic Postbank
Ireland	Allied Irish Banks, Bank Of Ireland, Permanent Tsb Group
Italy	Banca Carige, Banca Finnat Euramerica, Banca Generali, Banca IFIS, Banca Intermobiliare, Banca Italease, Banca Mediolanum, Banca Monte Dei Paschi, Banca Piccolo Credito Valtellinese, Banca Popolare dell'Etruria e del Lazio, Banca Popolare di Milano, Banca Popolare di Sondrio, Banca Popolare di Spoleto, Banca Profilo, Banca Sistema, Banco Di Sardegna, Banco BPM, Banco di Desio e della Brianza, BPER Banca, Credito Artigiano, Credito Bergamasco, Credito Emiliano, FinecoBank, Intesa Sanpaolo, IW Bank, Mediobanca, Unicredit, Unione di Banche Italiane
Netherlands	ABN AMRO, Binckbank, ING Groep, KAS Bank, SNS Reaal, Van Lanschot
Portugal	Banco BPI, Banco Comercial Portugues, Banco Espirito Santo, Banif Financial Group, Finibanco, Montepio
Spain	Banca Civica, Banco Bilbao Vizcaya Argentaria, Banco De Andalucia, Banco De Sabadell, Banco De Valencia, Banco Espanol De Credito, Banco Guipuzcoano, Banco Pastor, Banco Popular Espanol, Banco Santander, Bankia, Bankinter, Caixabank, Caja De Ahorros Del Mediterraneo, Liberbank

Table 15: List of non-Eurozone countries

Argentina, Australia, Bahrain, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Egypt, Hong Kong, Hungary, India, Indonesia, Israel, Japan, Jordan, Kuwait, Malaysia, Mexico, Morocco, New Zealand, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Qatar, Romania, Russia, Singapore, South-Africa, South-Korea, Sri Lanka, Sweden, Switzerland, Thailand, Turkey, United Arab Emirates, United Kingdom, United States, Venezuela

Table 16: Description and sources of variables

Variable	Description	Source
Bank-specific Variables		
Weighted Bank Stock Returns	Daily change in the natural logarithm of bank stocks weighted with yearly total asset size of bank in that country. Return is set to missing within a quarter if the stock had no turnover or no stock value was reported for more than seven consecutive trading days in a quarter.	Datastream
BankReturns	Asset-weighted bank stock returns aggregated on the country-level.	
World Stock Returns Banks Excluding EMU	Daily change in natural logarithm of a world stock index of bank stocks that excludes stocks from the EMU.	Datastream
Eurozone Bank Returns	Asset-weighted bank stock returns on the Eurozone-level, i.e. of all banks in the panel. Variable is orthogonalized with respect to World Stock Returns Banks (Excl. EMU).	
NationalBankDistress	BankReturns minus EurozoneBankReturns. Variable is then multiplied times -1.	
Non-Eurozone Exposure Variables		
Bank Claim	Quarterly consolidated claims of banking sector of a Eurozone country towards all sectors in a non-Eurozone country (Ultimate Risk Base). Adjustment in case of reporting gaps: If gap is three periods or shorter: gap is replaced with average value of two neighboring periods. If gap is more than three periods: gap is replaced with average Bank Claim towards this country over sample period.	BIS Consolidated Banking Statistics
Total Bank Claim	Sum of Bank Claims of this Eurozone country towards all non-Eurozone countries.	
Weight	Quarterly share of Bank Claims towards a non-Eurozone country compared to Total Bank Claims.	
Stock Market Returns	Daily change in natural logarithm of (market-wide) stock market returns of a non-Eurozone country in US Dollar.	Datastream, FTSE, MSCI, S&P
Non-Financial Stock Market Returns	Daily change in natural logarithm of non-financial stock market returns of a non-Eurozone country in its local currency.	Datastream
Exposure-Weighted Returns	Weight towards non-Eurozone country times StockMarketReturn of the same non-Eurozone country.	
NonEMUStockReturns	Sum of ExposureWeightedReturns of every Eurozone country in the sample.	
Daily Financial Market Data		
Sovereign Distress	Daily change in the natural logarithm of the benchmark 10-year Datastream government bond index of Germany minus the corresponding index change of a country in the sample.	Datastream
VIX	Daily change in VIX volatility index.	Chicago Board Options Exchange
US Corporate Credit Spread	Daily change in spread between the Thomson Reuters corporate benchmark BBB 10-years yield and the corresponding AAA 10-years yield.	Thomson Reuters
US Term Spread	Daily change in spread between 10-years US Treasury yield and the 3-Months US T-Bill yield.	Datastream, Federal Reserve
VSTOXX	Daily change in Vstoxx volatility index.	STOXX

Table 16: Description and sources of variables

Nominal Euro Exchange Rate	Daily change of natural logarithm of nominal effective exchange rate of the Euro.	JP Morgan
Non-Financial Itraxx	The daily change of natural logarithm of the 10-year Itraxx Europe is regressed against the daily change of 10-Year Itraxx senior and subordinated financial indices. The residuals from this regression are the non-financial Itraxx.	Markit
Current Account Holdings	Daily change in the natural logarithm of current account holdings (sum of minimum and excess reserves held by banks at the ECB).	ECB
Eurozone Term Spread	Daily change in the spread between EuroMTS Government 7-10 year broad yield and the 3-month Euribor yield.	European Banking Federation, FTSE MTS
Non-Financial Stock Market Returns	The daily change in the natural logarithm of the non-financial stock indices of every country is orthogonalized towards NationalBankDistress and daily changes in the Eurozone total stock market returns.	Datastream
Interaction Variables		
Debt to GDP	General government consolidated gross debt in % of gross domestic product (quarterly).	Eurostat
Fiscal-Deficit-to-GDP	Net saving (-) / net borrowing (+) of general government in % of gross domestic product (quarterly); Oxford Economics data used for all countries except Netherlands and Portugal; Eurostat data used for Netherlands and Portugal, as Oxford data is noisy for these countries.	Oxford Economics, Eurostat
GDP Growth	Quarterly GDP growth in market prices (quarterly).	OECD
Unemployment Rate	Harmonised unemployed rates, all persons, all ages, seasonally adjusted (monthly).	OECD
Current Account to GDP	Current Account to GDP Ratio (quarterly).	OECD
Inflation	Annual rate of change of harmonised index of consumer prices (monthly).	Eurostat
Government Bond Issuance to GDP	Gross issuance of debt securities of general government in % of GDP (monthly). The data (and all other issuance/redemption data) starts only in December 2009.	ECB
Government Bond Redemption to GDP	Gross redemption of debt securities of general government in % of GDP (monthly).	ECB
High Issuance	Dummy variable equal to one in months in which the gross issuance of government debt securities was above the sample median of this country.	ECB
High Redemption	Dummy variable equal to one in months in which the gross redemption of government debt securities was above the sample median of this country.	ECB
Home Bias	Share of domestic government bonds held by a banking sector in relation to total government bonds held.	ECB
Non-Performing Loans Ratio	Non-Performing loans to total gross loans ratio (quarterly). Adjustment in case of reporting gaps: If gap is two periods or shorter: gap is replaced with average value of two neighboring periods. If gap is more than two periods: gap is replaced with yearly value.	IMF Financial Soundness Indicators
Return on Assets	Return on assets ratio of banking sector (quarterly). Same adjustment as for Non-Performing Loans Ratio.	IMF Financial Soundness Indicators
Tier1 Capital Ratio	Regulatory Tier1 capital to risk-weighted asset ratio (quarterly). Same adjustment as for Non-Performing Loans Ratio.	IMF Financial Soundness Indicators

Table 16: Description and sources of variables

Bank Asset to Public Revenue Ratio	Ratio of monthly total balance sheet size of banking sector towards total general government revenue. The latter uses the same data sources as Fiscal-Deficit-to-GDP (monthly).	ECB, Oxford Economics, Eurostat
Central Bank Funding Share	Share of central bank funding in bank's liabilities (monthly).	ECB
Macroprudential Regulation Index	Index aggregating the number of implemented macroprudential instruments (quarterly). Data is only available until 2014:Q4.	Cerutti et al. (2016)
Non-Financial Securities to GDP	Monthly outstanding securities issued by non-financial corporations in ratio to GDP (monthly).	ECB
Policy Uncertainty Europe	Economic policy uncertainty index for Europe (monthly).	policyuncertainty.com
Policy Uncertainty Euro	First component of principal component analysis of the policy uncertainty indices of Ireland, Spain and Italy (monthly).	policyuncertainty.com
Election	Dummy that is 1 if the country held a parliamentary election in that month.	ParlGov Database
Left/Right Government	Weighted index of left/right party preference of cabinet coalition. Preferences of ruling parties are weighted based on their seats in parliament. Higher index means more conservative government (monthly).	ParlGov Database
State/Market Government	Weighted index of state/market-friendly party preference of cabinet coalition. Preferences of ruling parties are weighted based on their seats in parliament. Higher index means more market-friendly government (monthly).	ParlGov Database
Contra/Pro-EU Government	Weighted index of contra/pro-EU party preference of cabinet coalition. Preferences of ruling parties are weighted based on their seats in parliament. Higher index means more EU-friendly government (monthly).	ParlGov Database
Variables used in Robustness Section		
Sovereign Bond Yield Spread	Daily change in the yield spread between a country's benchmark 10-year government bond and the corresponding German bond.	Datastream
CDS Spread	Daily change in CDS spread of a 5-year US Dollar CDS rate of a country and the corresponding German CDS rate.	Thomson Reuters
Bank Distress	BankReturns times -1.	
NonEMUBankStock Returns	NonEMUStockReturns using only bank stocks.	Datastream
Trade-Weighted Shocks	Export weight of EMU towards non-EMU country times non-financial stock market returns. Variable is orthogonalized towards NonEMUStcokReturns.	IMF (Direction of Trade), Datastream
Non-Financial Stock Market Returns: Alt. Version	The daily change in the natural logarithm of the non-financial stock indices of every country is orthogonalized towards daily changes in the Eurozone total stock market returns.	Datastream
Euro-Dollar Exchange Rate	Daily change in the natural logarithm of the exchange rate Euro per Dollar.	Thomson Reuters

Table 17: Ratio of a banking sector's BIS exposure towards non-Eurozone creditors to total bank assets in 2007:Q1

Austria	Belgium	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
0.220	0.341	0.187	0.0964	0.155	0.0779	0.518	0.0808	0.211