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Sub-National Credit Risk and Sovereign Bailouts—Who Pays the Premium?

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Fiscal Affairs Department

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Abstract

Studies have shown that markets may underprice sub-national governments' risk on the implicit assumption that these entities would be bailed out by their central government in case of financial difficulties. However, the question of whether sovereigns pay a premium on their *own* borrowing as a result of (implicitly or explicitly) guaranteeing sub-entities' debt has been explored only little. We use an event study approach with separate equations for two levels of government to test for a simultaneous *increase* in sovereign risk premia and *decrease* in sub-national risk premia—or a de facto transfer of risk from the latter to the former—on the day a sovereign bailout is announced. Using daily financial market data for Spain and its autonomous regions from January 2010 to June 2013, we find support for our risk transfer hypothesis. We estimate that the Spanish sovereign's spread may have increased by around 70 basis points as a result of the central government's support for fiscally distressed *comunidades autónomas*.

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I. INTRODUCTION

As fiscal pressures at all levels of government heightened during the global financial crisis, the issues of risk pooling and intergovernmental fiscal support have come under renewed focus (Bordo et al., 2011). The question whether to bail out a fiscally profligate sub-national government (SNG) is mostly approached from two angles: the need to reduce systemic spillovers, and the potential for creating or exacerbating moral hazard. More often than not decisions are taken in light of the former, imminent pressures, and moral hazard concerns are addressed through conditionality and a tightening of fiscal constraints; although there has been a growing preference for some bailing in of private sector creditors to deter irresponsible lending.

Despite often extensive public debate on the merits and cost of providing financial assistance along the lines described above, one additional aspect has received only scant attention thus far: the question whether bailouts may impair the creditworthiness of the entity *providing* financial support, leading to higher borrowing costs over the short to medium-run. This additional risk could add substantially to the total cost of the bailout, and undermine already precarious debt sustainability. Our paper aims to fill the analytical gap on this little-understood phenomenon and contribute to the policy debate on sub-national bailouts.

Part II introduces the issues of sub-national borrowing and potential implications of explicit or implicit sovereign support for sub-national borrowing, including our central hypothesis on the transfer of risk. Part III presents our empirical analysis of the case of Spain and its autonomous regions as they underwent significant fiscal stress during the first half of 2012. We find support in favor of a risk transfer from the region of Valencia to the Spanish sovereign. Part IV concludes.

II. A NEW TAKE ON SOVEREIGN GUARANTEES FOR SUB-NATIONAL BORROWING

A. Overview

Over the last decades, borrowing on capital markets became a significant source of financing for state and local governments around the globe.² At the same time, many central governments have sought to regulate such borrowing, on the basic premise that market discipline alone is not deemed sufficient to ensure sound fiscal performance.³ Rules and restrictions imposed (or self-imposed) on SNGs have ranged from cooperative controls to outright prohibition (Ter-Minassian, 1997; Eyraud and Gomez-Sirera, 2014).

² While the United States still have by far the largest market for sub-national bonds with an approximate annual capitalization of 400 billion dollars, issuances in Germany, Japan, China, Canada, and Spain have gained in importance, reaching approximately 260 billion dollars in 2009 (Canuto and Liu, 2010).

³ Evidence varies across countries, likely according to the history of bailouts (Von Hagen et al. 2000; Bordo et al. 2011). For example, Bayoumi et al. (1995) find support for the market discipline hypothesis in the case of U.S. States; and the US federal government has a long-established, credible no bailout policy.

Finally, borrowing costs least depend on fiscal fundamentals in German or Canadian provinces that receive the most in transfers (Schuknecht et al., 2008). On the contrary, the same study finds credit risk premia in Spanish regions to be in line with their fiscal fundamentals.⁴

B. The Risk Transfer Hypothesis

While some research indicates that bailout expectations may lead markets to underprice sub-national risk, the question whether sovereigns at the same time pay a premium on their borrowing as a result of (implicitly or explicitly) assuming sub-entities' risk has been explored only little. To fill this gap, we try to determine if an observed, sudden drop in sub-national risk in reaction to a sovereign intervention coincides with an increase in the sovereign risk premium—or, in other words, whether there is a transfer of risk from the sub-national entity to the sovereign. Specifically, we use daily financial market data to test for a simultaneous *increase* in sovereign risk premia and *decrease* in sub-national risk premia on the very same day that new information on sovereign support for sub-national entities becomes available.

To the best of our knowledge, practically no studies have tried to establish the existence of such a risk transfer between the sovereign and sub-sovereign government levels. In the only similar study, albeit at lower levels of government, Feld et al. (2013) examine the case of the Swiss community Leukerbad which experienced financial difficulty in 2003. After a court decision in July 2003 *not* to hold the canton Valais responsible for its sub-entity's debt, they observe a drop in cantonal risk premia of around 25 basis points—ostensibly as a credible non-bailout regime has been established. However, several studies established the existence of a transfer of risk from financial sector entities to sovereign entities during the financial sector turmoil in 2008-09 (Ejsing and Lemke, 2011; Attinasi, Checherita and Nickel, 2010; IMF, 2009). Specifically, they found empirical evidence that in the event of financial sector bailouts financial sector risk premia declined and sovereign risk premia climbed beyond levels that can be explained by other fundamental determinants. This is interpreted as markets transferring risk from the financial sector to the sovereign.

III. THE EMPIRICAL ANALYSIS: SPAIN AND ITS *COMUNIDADES AUTÓNOMAS* IN 2012

A. General Approach and Methodology

In our empirical analysis, we examine daily financial sector data to find evidence of simultaneous decreases in regional credit risk and increases in sovereign credit risk coincidental with the announcement of sovereign guarantees or financial support of sub-national entities. Our research faces a number of major challenges.

⁴ Dell'Ariccia et al. (2006) find evidence that emerging market countries' risk spreads became more dispersed as Russia was *not* bailed out in 1998—presumably on the basis of more country-specific risk assessments and reduced expectations of bailouts.

First, we can only expect guarantees or bailouts to affect regional or sovereign risk premia if they are indeed a surprise to the market and have not already been factored into current risk assessments. This is a critical prerequisite. Second, risk premia are driven by a number of factors—some observed and some unobserved—and it is hard to control for the universe of these potential determinants while trying to identify the impact of a single event. Consequently, even if an unexplained increase in sovereign borrowing costs is observed upon a bailout, this does not automatically confirm a risk transfer to be the underlying explanation. Third, the initial fiscal position of the sovereign and the relative size of the financial obligations taken on can potentially make a significant difference. Markets may not react to a financial transfer or new contingent liabilities that do not fundamentally affect the central government's fiscal soundness.

In order to address these challenges, we use an event study approach with a very short time window. Specifically, we set the window to be one day. One day is long enough for the information to be incorporated by markets, and it is the shortest interval for which we do not need to worry about the synchronization of trades in different over-the-counter markets. The identification assumption is that—even if some kind of intervention had been expected and incorporated by markets—the exact date and magnitude were unknown, and the unexpected part of the intervention will still be reflected as a discontinuous short-term jump in prices. Using a very short time horizon also helps us control for other underlying determinants of credit risk premia, especially slower-moving structural and economic factors. We note, however, that high-frequency estimations in relatively shallow markets, such as SNG debt markets at a time of distress, carry challenges of themselves, and will need to be interpreted with caution.

Finally, we estimate two separate equations for credit risk at the sovereign and sub-national levels. As discussed above, sovereign and sub-sovereign risk assessments tend to be closely linked and can be influenced by a number of unobserved factors in the short run. Simultaneous *decreases* in sub-sovereign risk and *increases* in sovereign risk are therefore a good indication that shared determinants of risk (such as general risk aversion) can be ruled out and that a risk transfer has occurred.

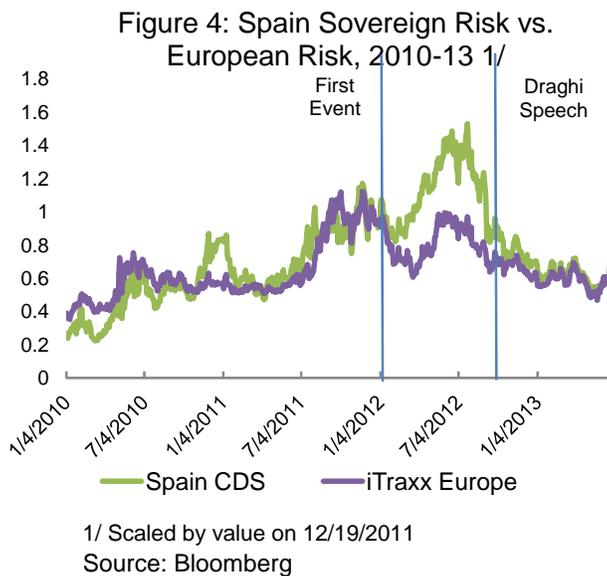
The Spanish autonomous regions' fiscal crisis in the first half of 2012 is a good case to examine our risk transfer hypothesis. First, Spain enshrined a formal no-bailout clause in its Constitution in 2011, after amending its budget systems law to the same effect in 2006. Moreover, as discussed above, the findings of Schuknecht et al. (2008) imply that Spanish regional risk premia did not reflect any bailout expectations even before 2005—which is reassuring for our analysis. Second, if sovereign debt had been at its low pre-crisis levels, markets could have easily ignored the unexpected additional burden from the autonomous regions. However, the sovereign's perceived financial vulnerability at the time made a discernible impact on sovereign risk more likely, all the more so as regional debt and deficit

levels had grown significantly in the run-up to the crisis episode, posing a realistic threat to fiscal consolidation efforts at the central level.⁵

B. The Events to Study: Spain and Its *Comunidades Autónomas* in 2012

After the onset of the 2008 global financial crisis, Spain entered into a double-dip recession, and its budget surplus turned into deficits of around 10 percent of GDP from 2009-11. Spain's total debt to GDP ratio increased substantially, from 36 percent in 2007 to 86 percent in 2012 (Banco de España, 2013). Apart from the recession, fiscal stimulus measures contributed to elevated fiscal deficits (IMF, 2012). In addition, financial sector weaknesses kept surfacing, raising uncertainties about the need for further capital

injections from the government. As a result, Spain's sovereign yields and CDS spreads increased through 2010-11. In the course of 2012, Spain's sovereign CDS spread was propelled well above average European market risk, and the country's financing cost rose towards unsustainable levels (Figure 4).^{6, 7} In response, the central government stuck to its ambitious fiscal consolidation and economic reform plan, and ultimately tapped European partners for financial sector support.⁸ However, pressures on Spanish public debt only subsided after ECB President Draghi sent a strong signal to markets by announcing his "unlimited support" for euro area countries on July 26, 2012. This policy was formally



⁵ Other episodes of sub-national fiscal distress that could be studied include Argentina, Brazil, Mexico, or the UAE (See Jaramillo et al (2014) for a survey). However, regional credit ratings and some daily sub-national financial sector data are more easily available for Spain, facilitating our analysis.

⁶ As will be discussed later, a number of studies have suggested that CDS and bond spreads may rise well above reasonable default risk expectations; potentially due to market overreactions, proxy hedging or speculation (see De Grauwe and Ji, 2012 and 2013; or Becker, 2009).

⁷ We use the iTraxx index Europe as a proxy for general risk aversion. See Part C and Appendix 1 for a more detailed description.

⁸ An EC support loan of 100 billion euros for Spanish banks was approved in June; see IMF (2012) and (2013) for a more comprehensive description of the government's reform efforts.

enshrined as Outright Monetary Transactions (OMT) in August, and later institutionalized through the creation of the European Stability Mechanism (ESM).⁹

The central governments' long-standing difficulty to control spending by the autonomous regions was a major contributing factor to Spain's fiscal troubles. Debt of the *comunidades autónomas* increased from 6 percent of GDP in 2007 to 18 percent of GDP at end-2012, with more than half concentrated in the three most indebted regions: Catalonia, Andalucía, and Valencia. Even scaled by regional GDP—Catalonia being a major contributor to national GDP—liabilities exceeded 25 percent in Catalonia and Valencia. The regions' deficit surged from 0.2 percent of GDP in 2007 to 5.2 percent of GDP in 2011. The central government's lack of control over regional spending became particularly clear in May 2012, when the 2011 general government public deficit had to be revised up to 8.9 percent of GDP—compared to an original target of 6 percent of GDP—on account of upward revisions in three regions (MHAP, 2012). At last, the 2011 deficit was estimated at 9.6 percent of GDP, with the regions' contribution at 5.2 percent of GDP—seriously undermining consolidation efforts that had taken place at the central level (Banco de España, 2013).¹⁰

As fiscal pressures and the weak economy made it harder and harder for many regions to pay their suppliers and roll over their debt, the government was forced to gradually increase its support for the embattled regions. Initially, towards the end of 2011, the government advanced regular transfers to regions as needed, provided verbal support, and extended repayment periods of past revenue overpayments with a view to calm markets (IMF, 2012). However, as market pressures continued to build, arrears to suppliers further dampened the weak economy, and some regions (notably Valencia) were teetering on the brink of default, it became evident that more substantial interventions would be required. In response, the central government set up three main financing mechanisms (subsequently) to help the autonomous regions pay suppliers and meet their debt obligations:

- In early February 2012, the government provided cash-strapped regions with a 10 billion euros credit line (extendable to 15 billion euros) through the state-owned bank ICO.
- In early March 2012, the FFPP (Fund for the Financing of Payments to Suppliers) was set up to provide up to 35 billion euros in 10-year loans to help regions pay their mounting debt to suppliers.
- In July 2102, additional liquidity support was made available to regions through a Regional Liquidity Mechanism (FLA), with 18 billion euros allocated in 2012 and 23 billion euros projected to be needed in 2013.

⁹ See De Grauwe and Ji (2012) and (2013) for an analysis of sovereign risk pricing in selected euro area countries and a justification of ECB liquidity support.

¹⁰ Between 2009 and 2011, the central government deficit decreased from 9.3 percent of GDP to 3.5 percent of GDP.

Well aware of the need to strengthen control over sub-national finances, the government linked all financial support to strict monitoring and conditionality (such as sharp deficit reductions) in line with the budget stability law (BSL) enacted in April 2012. In particular, the BSL (also referred to as Organic Budget Law) provided the central government with additional control mechanisms over regional finances, that were deemed critical in order to meet fiscal obligations under the European Stability and Growth Pact going forward (IMF, 2012; IMF, 2013b). Importantly, the BSL enhances timely monitoring of SNG finances (including through an early-warning system), and establishes enforcement and sanction mechanisms.¹¹ Not least as a result of these efforts to improve fiscal responsibility at the regional level, regional deficits decreased sharply in 2012, to 1.8 percent of GDP. However, full implementation of all the tools in the BSL remains pending (IMF, 2013).

In our empirical estimation, we focus on the period between end-2011, as the central government started supporting regions, and end-July 2012, as the ECB President Draghi announced unlimited ECB support—easing pressures on the Spanish sovereign—and regions started to tap the regional liquidity fund (FLA). In order to determine whether a risk transfer may have occurred as the rescue of the regions unfolded in the course of 2012, we apply the event study approach to Spain’s sovereign CDS (credit default swap), a proxy for credit risk at the sovereign level; and regional bond yields, a proxy for the credit risk premium at the regional level (since there are no CDSs for regional bonds).¹² In our analysis we concentrate on the potential impact of the following three groups of events: central government verbal pledges of support for regions; announcements of concrete guarantees and financial support for regions (including the three mechanisms described above); and so-called “credit negative” events for regions, including rating downgrades or the May 2012 upward revision of three regions’ 2011 deficit levels.¹³

For our risk transfer hypothesis to be confirmed, we would expect the first two groups of events (sovereign support for regions) to *decrease* the regional risk premia and simultaneously *increase* the sovereign risk premium. Furthermore, we would also expect the (completed) risk transfer to manifest itself in two additional effects: First, we would expect to

¹¹ The Organic Law of Budgetary Stability and Financial Sustainability (Ley 2/2012) establishes a set of fiscal discipline principles at all levels of government in Spain in line with the limits set out in the European Growth and Stability Pact (EGSP). Its focuses on prevention, transparency and compliance: the law includes a new early-warning system, aimed at detecting imbalances and issuing the relevant recommendations to achieve the budget targets; it requires monthly and quarterly reporting on budget execution, and the central government-issued guidelines prior to the approval of regional government budgets; and the law establishes sanctions and forced compliance for SNGs (Source: <http://www.spanishreforms.com/-/organic-law-on-budget-stability-and-financial-sustainability>).

¹² As bond yields include information beyond credit risk (notably interest rate risk and liquidity risk), we are likely to see more estimation noise even after we control for the short-term risk free rate and a proxy for liquidity, raising the bar of finding significant results. Also, liquidity risk is generally found to be higher for bond yields than CDS, and sub national bond markets are particularly shallow (Kiff et al. 2009; Canuto and Liu, 2010).

¹³ For more detail please see Appendix 1, Table 2.

see stronger co-movements in Spanish sovereign and regional credit risks. Second, we would expect *regional* credit negative events to increase the *sovereign* risk premium as markets factor in the de-facto sovereign guarantee for regional debt.

C. Specifications and Data

The basic model

The estimated model has separate equations for the sovereign and the regional governments, respectively. At the sovereign level, the model is:

$$SCR_{i,t} = \beta_0 + \beta_1 liq_{i,t} + \beta_2 RA_t + \sum_{k=1}^4 \gamma_k D_k + \varepsilon_{i,t}, \quad (1)$$

where $SCR_{i,t}$ is sovereign credit risk; $liq_{i,t}$ is market liquidity; RA_t is general risk aversion; and D_k are dummies for events of interest. Subscript i denotes country i ; subscript t denotes trading day t ; subscript k denotes dummy.

The dependent variable is $SCR_{i,t}$, or sovereign credit risk. We use the spread of 5-year sovereign CDSs as a proxy for sovereign credit risk, as CDS is the price assigned to the sovereign credit exposure by the market. Since CDS spreads are influenced by factors other than credit risk—most importantly, market liquidity conditions and general risk aversion—we try to control for them to reduce any potential estimation errors.¹⁴ We control for the liquidity factor $liq_{i,t}$ in the CDS market by using the bid/ask spread of the CDS; and we control for the general market risk in Europe RA_t by using the Markit iTraxx Europe index, which is an equally weighted index of 125 investment grade corporate CDSs in Europe.¹⁵

At the regional level, we use a slightly different set-up:

$$RCR_{i,t} = \beta_0 + \beta_1 SCR_t + \beta_2 liq_{i,t} + \beta_3 RA_t + \beta_4 RF_t + \sum_{k=1}^4 \gamma_k D_k + \varepsilon_{i,t}, \quad (2)$$

where $RCR_{i,t}$ is regional credit risk; SCR_t is Spain's sovereign credit risk; $liq_{i,t}$ is market liquidity; RA_t is general risk aversion; RF_t is the short-term interest rate; D_k are dummies for events of interest. Subscript i denotes region i ; subscript t denotes trading day t ; subscript k denotes dummy.

¹⁴ The question whether CDS spreads reflect liquidity risk has been subject to debate, yet a lot of research has shown the existence and importance of liquidity in determining CDS spreads (see for example Tang and Yan (2007), Arakelyan et al. (2012) or Bongaerts et al. (2011)). CDS spreads also reflect counterparty risk; we assume that counterparty risk is slow-moving (or relatively constant) throughout our estimation period, which seems defensible for the time period under consideration.

¹⁵ We choose the iTraxx Europe index because it tracks the European risk more closely than other commonly used measures of general risk, such as VIX (CBOE volatility index) and the Bank of America BBB spread. Substituting them in our estimation still produces similar results, however.

The regional credit risk equation is slightly different from the sovereign credit risk equation (1) for two main reasons. First, we expect that sovereign risk represents an important factor in market assessments of sub-entities' risk, so we include SCR_t on the right-hand side.¹⁶ Also, in absence of CDSs, we have to use regional bond yields as a proxy for credit risk of each of the autonomous regions, $RCR_{i,t}$.¹⁷ This requires us to additionally include the Euribor 3-month rate to control for the short-term interest rate, RF_t . Finally, as in equation (1), we compute the bid/ask spread of the regional bond to control for liquidity, $liq_{i,t}$, and use the Markit iTraxx Europe index to control for general risk aversion in Europe, RA_t .¹⁸

For both equations, our main variables of interest are the event dummies $D_1 - D_4$ which capture a number of related events each. These dummies are equal to 1 only on the specific event days that pertain to each group, and are aimed to capture any changes in market risk assessments that might have taken place shortly after the events in question.¹⁹ Essentially,

- $D1$ captures “news” on central government verbal pledges of support for regions;
- $D2$ captures “news” on concrete central government guarantees and financial support for regions (the key variable for testing our hypothesis);
- $D3$ captures “news” on so-called “credit negative” events for regions; and
- $D4$ marks ECB President Draghi’s July 26th speech about the ECB’s commitment to preserving the euro.

Further tweaks

Moving to the empirical estimation, we take a few additional steps to adjust our basic model:

>First, our daily series of CDSs and regional bond yields are highly persistent.²⁰ Therefore, a dynamic specification estimated in first difference seems appropriate, and we

¹⁶ Please see Ianchovichina et al. (2006), or Liu and Tan (2009) or Von Mueller (2012) for empirical evidence and a detailed explanation of the underlying reasons.

¹⁷ We use the yield of the most liquid bond issued by the respective region; data remains patchy.

¹⁸ Market risk is a major explanatory factor of sovereign CDS spreads (and we find this confirmed in our results below). Hence, in our robustness check, we drop the iTraxx index from our regional equation, which already contains sovereign credit risk as a control variable. Our results remain virtually unchanged (Table 2, column 7).

¹⁹ See Appendix 1, Table 2 for a more detailed description of the individual events.

²⁰ We run the Phillips-Perron unit root test with 5 lags, which uses Newey-West standard errors to account for serial correlation (Phillips and Perron, 1988). Both the Phillips-Perron τ test and ρ test cannot reject the hypothesis that Spanish CDS have a unit root at all common significance levels, regardless of whether we use a trend specification or not. Similarly, none of the tests can reject that the Valencia’s bond yield has a unit root. See Appendix 1, Table 3 for our results.

include the lagged dependent variables $\Delta SCR_{i,t-1}$ and $\Delta RCR_{i,t-1}$ on the right-hand side. Using first differences also helps us to minimize the potential influence of omitted slow-moving macroeconomic state variables, which are commonly included in similar estimations with lower frequencies.

>Second, as we are expecting the relationship between regional credit risk and sovereign credit risk to be time-variant with respect to market expectations of sovereign support, we include an interaction term. Specifically, to test for a structural break we create a period dummy, $I_{pre-bailout}$, which is equal to one prior to the “bailout period” (January 1, 2010 to December 19, 2011), and interact it with the sovereign credit risk variable included in the regional credit risk equation.²¹

>Third, we include a period dummy for the period after ECB President Draghi’s speech (July 26, 2012), $I_{post-Draghi}$, which had a specifically calming effect on debt markets in Spain and Italy that had come under heavy pressure. By inserting the two period dummies into the sovereign credit risk equation, we allow the constant term to be different in the pre-bailout era and the post-Draghi’s speech era to capture potential regime shifts.

>Fourth, we estimate the regional credit risk equation for Valencia, as only Valencia’s bonds have tradable quotes on the event days we are interested in. As a result, our event dummies for regional credit negative events, group D_3 , are equal to one only on the days of the first, second, fourth, and sixth events, since the other events are not credit negative for Valencia. Nevertheless, in the robustness section, we present panel regression results using data for Catalonia and Andalucía whenever they are available.

The final equations we estimate are therefore:

$$\Delta SCR_{i,t} = \beta_0 + \beta_1 \Delta SCR_{i,t-1} + \beta_2 \Delta liq_{i,t} + \beta_3 \Delta RA_t + \sum_{k=1}^4 \gamma_k D_k + \beta'_0 I_{pre-bailout} + \beta'_0 I_{post-Draghi} + \varepsilon_{i,t} \quad (3)$$

$$\Delta RCR_{i,t} = \beta_0 + \beta_1 \Delta RCR_{i,t-1} + \beta_2 \Delta SCR_t + \beta_3 \Delta liq_{i,t} + \beta_4 \Delta RA_t + \beta_5 \Delta RF_t + \sum_{k=1}^4 \gamma_k D_k + \beta'_2 \Delta SCR_t \times I_{pre-bailout} + \varepsilon_{i,t}, \quad (4)$$

where $I_{pre-bailout}$ is a period dummy for the period up to December 19, 2011; and $I_{post-Draghi}$ is a period dummy for the period after July 26, 2012.²²

²¹ To assess our risk hypothesis we test for a structural break with the onset of the bailouts (associated with the pre-bailout dummy); we do not expect a reversal of greater co-movements after July 2012 (the post-Draghi dummy) and hence only test for it for robustness purposes.

²² In Tables 1 and 2 we refer to these period dummies as PD1 and PD2, respectively.

Given the very limited number of events under each category, we find OLS standard errors to be appropriate. We explore a number of different approaches in the robustness section below.²³

D. Main Results

The estimation results for sovereign credit risk are presented in Table 1, column 1. Overall, results are consistent with our risk transfer hypothesis: the coefficients of the events where the government pledges support (D_1) and concrete bailout measures are implemented (D_2) are both positive, implying that on those days sovereign credit risk—as assessed by the market—increased. Specifically, during the two events in which the central government provides verbal support, the Spanish sovereign CDS spread on average went up by 8 basis points. The coefficient is not statistically significant, however; as such pledges may not be taken as seriously by the market. In contrast, the coefficient on D_2 , the group of concrete bailout measures is significant and suggests that the government's steps raised the Spanish sovereign CDS spread by 10½ basis points, on average.

To put these findings in context, during the seven event days represented by D_1 and D_2 the sovereign CDS spread increased by about 70 basis points in total. This represents a significant amount, given that the CDS spread in our sample ranges from 93 to 641 basis points, with an average of 310.²⁴ In terms of interest payments, a 70 basis points increase could translate into an extra cost of 600 million euros per year for short-term debt, and almost 2 billion euros once medium-term bonds are also rolled over and serviced at higher rates.²⁵

²³ In the robustness section, we also show standard errors adjusted for serial correlation and heteroskedasticity (Newey and West, 1987). However, these adjustments are based on asymptotic theory and should be viewed with caution (Wooldrige, 2002). We also estimate both equations jointly using seemingly unrelated regressions.

²⁴ As could be expected, we also find the first single events to have the largest coefficients and to be the most significant. The total size of the financial assistance pledged at each point in time does not seem to be relevant. This result is in line with Attinasi et al. (2010), who find the size of financial rescue packages in Europe during the global financial crisis not to have a significant impact on government bond yields.

²⁵ These figures are approximate and calculated on the basis of Q2-2013 central government debt figures from the Bank of Spain (2013): roughly 85 billion euros in short-term debt, and 173 billion in medium-term fixed-rate bonds. At end-June 2013, the bulk of Spanish central government debt was in long-term fixed-rate bonds (over 10-30 years). Using all marketable debt as a basis (730 billion euros) would imply an additional interest cost of about 5 billion euros per year.

Table 1. Sovereign Equation
(t statistics below the estimated coefficients)

	Columns					
	1	2	3	4	5	6
	OLS (Spain)	NW_L5 (Spain)	SUR (Spain) 1/	OLS Panel 2/	OLS (Spain)	OLS Panel 2/
L.D_cds_5y	0.051** (2.066)	0.051* (1.663)	0.051** (2.076)	0.187*** (21.865)	0.051** (2.065)	0.187*** (21.862)
D_itrx	2.277*** (27.85)	2.277*** (20.854)	2.279*** (28.024)	0.960*** (50.013)	2.278*** (27.911)	0.960*** (50.033)
D_bid_ask	-0.798*** (-5.622)	-0.798*** (-3.492)	-0.801*** (-5.685)	0.298*** (10.817)	-0.796*** (-5.619)	0.298*** (10.827)
D1	8.23 (1.128)	8.230* (1.96)	8.231 (1.135)	3.307 (0.548)		
D2	10.449** (2.242)	10.449* (1.77)	10.451** (2.257)	10.206*** (2.647)		
D3	3.368 (0.789)	3.368 (1.311)	3.335 (0.786)	0.66 (0.187)	3.369 (0.79)	0.661 (0.187)
D4	-14.997 (-1.459)	-14.997*** (-11.067)	-14.982 (-1.467)	-24.361*** (-2.87)	-14.989 (-1.459)	-24.358*** (-2.869)
DD					9.815** (2.477)	8.235** (2.51)
PD1	-0.688 (-0.699)	-0.688 (-0.797)	-0.759 (-0.775)	-0.455 (-0.559)	-0.688 (-0.699)	-0.456 (-0.559)
PD2	-1.606 (-1.451)	-1.606* (-1.789)	-1.607 (-1.462)	-1.567* (-1.714)	-1.605 (-1.452)	-1.567* (-1.714)
Constant	0.79 (0.906)	0.79 (1.086)	0.791 (0.914)	0.053 (0.535)	0.79 (0.907)	0.053 (0.535)
Adj-R-squared	0.484			0.241	0.485	0.241
N	874	874	871	10437	874	10437

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

1/The sovereign and regional equations are estimated jointly when using the SUR technique.

2/Including 12 countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

The coefficient of D_3 is positive but not significant, suggesting that regional credit negative events are associated with some upward pressure on sovereign risk assessments at the margin, but the effect is not large enough to be significant. Finally, the coefficient of D_4 is large and negative, confirming that the ECB President Draghi's announcement of OMT coincided with a large reduction in markets' perceived sovereign credit risk in Spain, perhaps

reflecting “exaggerated fears” (De Grauwe and Ji, 2013) or an unraveling of speculative positions betting on higher spreads.²⁶ The coefficient is not significant, which is not surprising given the limited power of a single event day. Likewise, both *period dummies* for the periods before the bailouts (PD1) and after President Draghi’s speech (PD2) have a negative sign, implying that the Spanish sovereign CDS market was generally more distressed in 2012 (beyond what is captured by the explanatory variables), but the difference is relatively small and not significant.

The signs of the control variables are mostly in line with expectations. Changes in *general risk aversion* in Europe are associated with significant and positive changes in the Spanish CDS spread, consistent with findings in the literature. Changes in the bid/ask spread, our measure of *liquidity*, are associated with significant and negative changes in the Spanish CDS spread. Intuitively, one may expect a positive relationship, or higher spreads being associated with lower liquidity. The negative sign is reasonable in this particular context, however, if we assume that during this period the market for Spanish sovereign CDS was dominated by protection buyers motivated by proxy hedges or speculation that spreads would increase further. Specifically, our results indicate that those protection buyers would only be willing to pay a lower spread as the market becomes less liquid and the CDS instruments become harder to trade, reflected in the negative association between the bid/ask spread and CDS prices. Applying the same logic to the bond market, bond yields would be expected to rise (and bond prices to fall) in a less liquid market *ceteris paribus*, as issuers would need to compensate investors for holding less liquid instruments.²⁷ This relationship is confirmed below in the case of our regional credit risk equation (4) with changes in regional bond yields on the left-hand side.

Our regression results on changes in bond yields issued by Valencia are shown in Table 2, column 1. The coefficients for both D_1 and D_2 are negative, confirming that both government pledges of support and concrete steps to provide financing to distressed regions are associated with lower bond yields. Specifically, pledges are associated with reductions of about 2 basis points, and concrete financial support measures with a statistically significant drop in yields by 16 basis points. Again, to put these findings in context, during the five

²⁶ In line with De Grauwe and Yin (2012)’s analysis of bond spreads, Becker (2009) finds that default probabilities contained in European sovereign CDS spreads during the 2008-09 financial crisis were excessive, even compared to bond yields’ predictions, indicating the likely presence of speculation or cross-hedging (hedging financial sector risk with insurance for sovereign risk). Such factors may have been at play in Spain in 2012 as well.

²⁷ While the positive liquidity premium contained in bond yields is relatively uncontroversial, the existence, size and sign of any liquidity premium in CDS spreads remain the subject of debate. Empirical studies examining the size and the sign of the liquidity premium in the CDS market have produced a number of different results, especially across credit quality categories (higher or lower-rated instruments), maturities, and times of more or less market distress (Tang and Yan (2007); Bongaerts et al. (2011); Arakelyan et al. (2012)). Theoretically, if we assume that the bid/ask spread in bond prices and the bid/ask spread in CDS are positively correlated, investors demanding higher bond yields to compensate for illiquidity in the bond market could also produce higher CDS spreads via the non-arbitrage condition, thus inducing a positive relationship between CDS spreads and illiquidity. However, our results seem to indicate the dominance of protection buyers at the time.

event days represented by D_2 , Valencia's yield fell by about 80 basis points in total. While one may question the relevance of this finding, taking into account that Valencia—and other regions—remained shut of debt markets, it nonetheless constitutes a significant step towards regions ultimately being able to issue their own debt at sustainable rates.

The coefficient on D_3 is positive—credit negative events are associated with higher bond yields—but it is not significant. The coefficient on D_4 is again negative, suggesting that the ECB's announcement was associated with an immediate (albeit small) drop in the financing cost for Valencia. The fact that we find our *period dummies* (PD 1 and PD2) to be significantly more negative for the pre-bailout and post-Draghi's speech era confirms the presence of significant upward pressure on Valencia's financing costs during the first half of 2012.

The signs of the control variables in the regional credit risk equation are also generally in line with expectations. Increases in the bid/ask spread of bond yields (proxying for a reduction in *liquidity*); increases in *sovereign credit risk*; increases in *general risk aversion*; and increases in *short-term interest rates* are all positively associated with Valencia having to borrow at higher yields. As discussed before, these signs are all in line with our priors.

In sum, combining our estimation results for the Spanish sovereign's and Valencia's credit risks, we find evidence in support of a risk transfer having taken place. Specifically, the significantly positive coefficient on D_2 in the sovereign credit risk equation coinciding with a significantly negative coefficient on D_2 in the regional credit risk equation implies that concrete bailout measures in Spain in 2012 coincided with higher sovereign credit risk and lower bond yields in Valencia. Alternative explanations, while plausible ex-ante, are therefore not supported by the data.²⁸ However, as discussed above, obvious caveats apply given the difficulty of estimating high-frequency event studies in relatively shallow markets.

²⁸ For example, a (perfectly plausible) story that bailout announcements are viewed upon positively by markets as they reduce uncertainty would imply a negative coefficient on D_2 in both regressions. In contrast, the hypothesis that the bailout might reveal new regional risks to the market should lead to positive coefficients on D_2 in both estimations.

Table 2: Regional Equation
(t statistics below the estimated coefficients)

	Columns						
	1	2	3	4	5	7	8
	OLS (Valencia)	NW_L5 (Valencia)	SUR (Spain) 1/	OLS Panel 2/	OLS (Valencia)	OLS Panel 2/	OLS (Valencia)
L.yld_chg	-0.083** (-2.445)	-0.083* (-1.81)	-0.083** (-2.462)	-0.009 (-0.456)	-0.084** (-2.487)	-0.009 (-0.477)	-0.083** (-2.47)
D_bid_ask	0.073*** (2.787)	0.073 (0.953)	0.073*** (2.81)	0.005 (0.24)	0.074*** (2.828)	0.005 (0.266)	0.072*** -2.777
D_itrx	0.001 (0.426)	0.001 (0.32)	0.036 (0.208)	-0.001 (-0.746)	0.001 (0.387)	-0.001 (-0.771)	
D_cds	0.232*** (3.18)	0.232** (2.473)	0.250*** (3.442)	0.371*** (7.447)	0.230*** (3.147)	0.370*** (7.429)	0.248*** (3.934)
D_euribor	1.268 (1.523)	1.268* (1.86)	1.27 (1.537)	0.868 (1.52)	1.264 (1.519)	0.865 (1.515)	1.255 (1.509)
D1	-0.023 (-0.197)	-0.023 (-0.371)	-0.025 (-0.212)	-0.012 (-0.091)			-0.027 (-0.229)
D2	-0.159** (-2.127)	-0.159* (-1.861)	-0.161** (-2.165)	-0.183** (-2.087)			-0.160** (-2.147)
D3	0.097 (1.174)	0.097* (1.718)	0.097 (1.175)	0.089 (0.912)	0.097 (1.173)	0.089 (0.911)	0.096 (1.157)
D4	-0.093 (-0.567)	-0.093** (-2.009)	-0.09 (-0.553)	-0.063 (-0.324)	-0.095 (-0.577)	-0.064 (-0.327)	-0.094 (-0.574)
DD (D1+D2)					-0.120* (-1.882)	-0.134* (-1.804)	
PD1	-0.065*** (-3.835)	-0.065** (-2.447)	-0.065*** (-3.855)	-0.047*** (-4.079)	-0.065*** (-3.838)	-0.047*** (-4.079)	-0.065*** (-3.823)
PD2	-0.115*** (-6.253)	-0.115*** (-4.266)	-0.115*** (-6.284)	-0.088*** (-7.084)	-0.116*** (-6.264)	-0.088*** (-7.088)	-0.115*** (-6.248)
PD1*c.D_cds	-0.255*** (-3.172)	-0.255** (-2.152)	-0.255*** (-3.198)	-0.419*** (-7.642)	-0.251*** (-3.127)	-0.418*** (-7.617)	-0.255*** (-3.182)
Constant	0.064*** (4.283)	0.064** (2.528)	0.063*** (4.305)	0.050*** (5.023)	0.064*** (4.288)	0.050*** (5.024)	0.063*** (4.275)
Adj-R-squared	0.069			0.046	0.069	0.046	0.070
N	871	871	871	2618	871	2618	871

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

1/The sovereign and regional equations are estimated jointly when using the SUR technique.

2/Including 3 regions: Andalucia, Catalonia and Valencia.

In order to find further support for our hypothesis, we also examine co-movements of our sovereign and regional credit risk measures across time. Should sovereign support for regions indeed lead to a closer link between market assessments of sovereign and regional risks, we would expect to see a greater co-movement between the sovereign and the regional financing costs after such interventions occurred. In order to test for this, we interact the period dummy for the pre-crisis period (PD 1) with the sovereign credit risk variable in the regional credit risk equation for Valencia. If no shift had taken place, this interaction term should not be significantly negative, implying that regional credit risk did not become more sensitive to movements in sovereign credit risk as the bailouts unfolded. However, we find that the coefficient on the interaction term is significant and negative, almost exactly canceling out the significant and positive coefficient on the unconstrained sovereign credit risk variable (Table 2, column 1). In other words, we find the correlation between Valencia's bond yields and Spanish sovereign CDSs to become significant and positive in early 2012, after having been close to zero in the pre-bailout era up to end-2011, lending additional support to our hypothesis.²⁹ The only prior we cannot confirm is that regional credit negative events also started putting upward pressure on sovereign borrowing cost: the coefficient on D_3 in equation (3) is still positive, but not significant.³⁰

E. Robustness Checks

We undertake a number of checks to determine the robustness of our results to changes in estimation methodology; to a pooling of events; to changes in the time window; and to inclusion of additional European sovereigns and Spanish regions.

In Tables 1 and 2, columns 2, we estimate the same coefficients using Newey-West standard errors, which adjust for heteroskedasticity and serial correlation (Newey and West, 1988). The results for both equations show only very small changes in coefficients and significance.³¹ As common unobserved factors may lead to errors in both equations being correlated, we also estimate both equations jointly, using seemingly unrelated regressions (SUR) (Tables 1 and 2, columns 3). Our results remain robust. In order to test for the robustness of our various event assumptions, we pool the dummies D_1 and D_2 together: they remain significant with our three estimation techniques (Tables 1 and 2, columns 5).³² We

²⁹ Including a separate interaction term of sovereign credit risk with the post-Draghi dummy (PD2) confirms even more pronounced co-movements after July 2012, as the FLA has started operating. Results are available upon request.

³⁰ It is worth noting that the same is true for equation (4), meaning that also Valencia's yields were not significantly affected by those regional credit negative events, hence suggesting that overall the credit negative events chosen may not have been deemed significant from the markets' perspective.

³¹ In the sovereign equation, the significance of the key dummy variables D_1 was boosted to the 10 percent level, while the significance of D_2 decreases a bit to the 10 percent level. D_4 becomes highly significant under the Newey-West adjustment, but this result has to be interpreted with caution as asymptotic standard errors are not suitable to assess a single event's significance. Similarly, estimation results for the regional equation with Newey-West standard errors remain largely the same.

³² Newey-West adjusted and SUR estimations available on request.

also test for significance of our event dummies up until 5 days before and after each event. The results need to be interpreted with caution, as we may be capturing a number of additional, unrelated events. However, they re-confirm the appropriateness of the event days chosen.³³

In Table 1 columns 4 and 6, we estimate the equation for sovereign risk under a fixed effect pooling panel specification with 11 other European countries.³⁴ The event dummies remain exclusive to Spain and are equal to zero for all other countries. If these European countries have the same coefficients of the control variables, pooling them together should help us estimate the coefficients more accurately. On the other hand, if they have different coefficients, estimating them separately would be more appropriate. Since we do not have a strong prior, we estimate the panel to see whether our main results are robust to modest variations in specification. Overall, there are some appreciable changes in coefficients. The estimated signs remain mostly the same, however, except that the coefficient on our liquidity proxy, the bid/ask spread of CDS, becomes positive—possibly because the general prior on the liquidity premium holds after all in our broader data set.³⁵ Importantly, the coefficient of the key variable D_2 is remains stable, and its significance is boosted.

We also re-estimate the regional bond yield equation by adding two more regions: Andalucía and Catalonia (Table 2, columns 4 and 6).³⁶ As in the panel regression for sovereigns, both our main results still hold under this alternative specification: the coefficient on D_2 increases by 24 basis points and remains significant, and the coefficient on the interaction term of the pre-bailout period dummy and the sovereign credit risk variable remains negative and highly significant. As a final check, we drop the general risk aversion measure from the regional equation (Table 2, column 7). Since the iTraxx index is a significant determinant of changes in sovereign credit risk (Table 1), it might be preferable to drop it as a control variable in equation (4) to avoid multicollinearity. As Table 2 column 7 shows, our results for Valencia remain robust to this change in specification.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

As our findings for the Spanish 2012 sub-national credit crisis illustrate, fiscal risks emanating from SNGs can have significant implications for the sovereign's own creditworthiness. Similar to what was found in the case of financial sector bailouts in Europe in 2008-09, our analysis lends support to the hypothesis that sub-national bailouts might also have the capacity to influence markets' risk assessments *of the entity bailing out* a troubled debtor—specifically if the entity in question is under pressure itself. This could lead to

³³ Results available upon request.

³⁴ See the Appendix 1 for a list of the countries included.

³⁵ See discussion above.

³⁶ Unfortunately the bond yield data for these two regions are quite patchy, however, and data are missing on most event days.

potentially higher borrowing costs for already vulnerable central governments—in addition to the (commonly repayable) bailout amount committed up-front.³⁷

In light of these additional risks, central governments—apart from keeping their own fiscal house in order— may consider two policy options to guard against any potential negative spillovers: to establish a credible no bailout regime (as illustrated in Feld et al. 2013); or to try to ensure fiscal discipline at local government levels through means such as fiscal rules and regulations. In practice, few no-bailout regimes are fully credible due to the considerable spillover risks and social and political consequences of letting states or communities default: Spain—which boasted a no-bailout clause in its Constitution—is a key example. This makes tight fiscal controls on SNG finances inevitable, and, as the example of Spain its Organic Budget Law shows, many countries are moving in this direction.³⁸

Notably, even countries with relatively credible no-bailout regimes and high fiscal autonomy of SNGs (such as Switzerland or the U.S.) boast almost universal, self-imposed borrowing restrictions at local government levels (Eyraud and Gomez-Sirera, 2014)—which are shown to reduce financing costs (Poterba and Rueben, 1999; Feld et al., 2013). Joint borrowing, another alternative to support sub-entities that was also considered in Spain, could lower financing costs of weaker entities, but would likely accomplish little to improve markets' risk perceptions and those entities' implicit risk premia. The main result would also be a financial transfer from the stronger to the weaker participants (as seen with the German *Bund-Länder Anleihen*, Appendix 2) and the creation of moral hazard that could exacerbate fiscal weaknesses even further.³⁹

³⁷ The persistence of higher yields should be subject to further research.

³⁸ The German *Schuldenbremse* that requires states to balance their books by 2020 is another example.

³⁹ Whether the subsidy will be limited to the joint debt issue or the joint issue will affect the universe of sovereign borrowing should be the subject of further research. As in the case we study, the result might be driven by initial fiscal conditions and the significance of the potential additional liability for central government debt.

References

- Arakelyan, A., G. Rubio, and P. Serrano, 2012, *Market-Wide Liquidity in Credit Default Swap Spreads*, mimeo, University CEU Cardenal Herrera.
- Attinasi, M.-G., C. Checherita, and C. Nickel, 2010, “What Explains the Surge in Euro Area Sovereign Spreads During the Financial Crisis of 2007–09?” *Public Finance and Management* 10 (4), 595–645.
- Baigorri, Manuel, 2012, “Spain’s Deputy PM Saenz Says Spain Approves ICO Line for Regions,” *Bloomberg*, February 3.
- Banco de España, 2013, *Boletín Estadístico Septiembre 2013*
http://www.bde.es/bde/es/secciones/informes/boletines/Boletin_Estadistico/actual/
- Bayoumi, T., M. Goldstein, and G. Woglom, 1995, “Do Credit Markets Discipline Sovereign Borrowers? Evidence From the U.S. States,” *Journal of Money, Credit and Banking* 27 (4), 1046–1059.
- Becker, Sebastian, 2009, *EMU Sovereign Spread Widening: Reasonable Market Reaction or Exaggeration?* Reports on European Integration, EU Monitor 68, June 29. Deutsche Bank Research, Frankfurt am Main.
- Benoit, Angeline, 2012a, “Moody’s Downgrades Valencia,” *Bloomberg*, January 12.
- Benoit, Angeline, 2012b, “Spain Lines Up EU35 Bln 10-Yr Loan for Payment of Suppliers,” *Bloomberg*, March 2.
- Benoit, Angeline, 2012c, “Spain May Guarantee Regions’ Debt to Restore Market Access,” *Bloomberg*, March 3.
- Benoit, Angeline, 2012d, “Guindos Says Spain to Create Fund to Help Regions Finance,” *Bloomberg*, July 13.
- Black, Jeff and Jana Randow (2012), “Draghi Says ECB Will Do What’s Needed to Preserve Euro: Economy,” *Bloomberg*, July 26.
- Bongaerts, Dion, Frank de Jong, and Joost Driessen, 2011, “Derivative Pricing with Liquidity Risk: Theory and Evidence from the Credit Default Swap Market,” *Journal of Finance* 66 (1).
- Bordo, M., A. Maciewicz and L. Jonung, 2011, “A Fiscal Union for The Euro: Some Lessons from History,” NBER Working Paper. No. 17380. (Cambridge, Massachusetts: National Bureau of Economic Research).

- Canuto and Liu, 2010, "Sub-National Debt Finance and the Global Financial Crisis - Economic Premise Note," Number 13, 2010. World Bank.
- Collet, Stephanie, 2012, *A Unified Italy? Sovereign Debt and Investor Scepticism*, mimeo, Universite Libre de Bruxelles.
- De Grauwe, P. and Y. Ji, 2012, "Mispricing of Sovereign Risk and Multiple Equilibria in the Eurozone," CEPS Working Document, www.ceps.eu.
- De Grauwe, P. and Y. Ji, 2013, "Panic-Driven Austerity in the Eurozone and its Implications," February 21, voxeu.org.
- Dell'Ariccia, G., Schnabel, I., and Zettelmeyer, J., 2006, "How Do Official Bailouts Affect the Risk of Investing in Emerging Markets?" *Journal of Money, Credit and Banking* 38 (7), 1689–1714.
- Deutsche Finanzagentur, 2013, Bund-Länder Anleihe: Auf einen Blick, <http://www.deutsche-finanzagentur.de/private-anleger/bund-laender-anleihe/>
- Ejsing, J., Lemke, W., 2011, "The Janus-Headed Salvation: Sovereign and Bank Credit Risk Premia During 2008-2009," *Economics Letters* 110 (1), 28–31.
- Eyraud, L. and R. Gomez Sirera, 2014, "Constraints on Sub National Fiscal Policy", in Carlo Cottarelli and Martine Guerguil, eds., *Designing a European Fiscal Union: Lessons from the Experience of Thirteen Federations* (Routledge, forthcoming 2014).
- Feld, Kalb, Moessinger und Osterloh, 2013, "Sovereign Bond Market Reactions to Fiscal Rules and No-Bailout Clauses-The Swiss Experience," ZEW Discussion Paper No. 13-034.
- Hepke-Falk, K. H., Wolff, G. B., 2008, "Moral Hazard and Bailout in Fiscal Federations: Evidence for the German Länder," *Kyklos* 61 (3), 425–446.
- Iantchovichina, Liu and Nagarajan, 2006, "Sub-National Fiscal Sustainability Analysis: What Can We Learn from Tamil Nadu?" World Bank PRWP 3947.
- IMF, 2009, "Global Financial Stability Report: Responding to the Financial Crisis and Measuring Systemic Risk," IMF, Washington DC, April.
- IMF, 2012, "Spain 2012 Article IV Consultation," IMF Country Report No. 12/202, IMF, Washington, D. C.
- IMF, 2013a, "Spain 2013 Article IV Consultation," IMF Country Report No. 13/244, IMF, Washington, D. C.

- IMF 2013b, “Spain 2013 Article IV Consultation”, Selected Issues, IMF Country Report No. 13/245, IMF, Washington, D. C.
- Jaramillo, L. and others, 2014, “Sub National Fiscal Crises,” in Carlo Cottarelli and Martine Guerguil, eds., *Designing a European Fiscal Union: Lessons from the Experience of Thirteen Federations* (Routledge, forthcoming 2014).
- Joffe , 2012, *Provincial Solvency and Federal Obligations*, Macdonald-Laurier Institute, October.
- Kiff, J., J. Elliott, E. Kazarian, J. Scarlata, C. Spackman, 2009, Credit Derivatives: Systemic Risks and Policy Options, IMF Working Paper 09/254.
- Landon, S., Smith, C. E., 2000. “Government Debt Spillovers and Creditworthiness in a Federation.” *Canadian Journal of Economics* 33 (3), 634–661.
- Liu and Tan, 2009, *Sub-National Credit Ratings, A Comparative Review*, World Bank PRWP 5013.
- Ministerio de Hacienda y Administraciones Publicas, 2012, “Ministry Estimates that the Deficit Increased by Four Tenths in 2011 due to the Regions,” May 18, MHAP Press Office.
- Moody’s, 2011, “Moody’s Downgrades Region of Valencia to Ba1/NP from Baa2/P-3,” December 19, Moody’s Investors Service.
- Moody’s, 2012, Moody’s Downgrades 4 Spanish Regions; Confirms Ratings of Valencia and Castilla-La Mancha, May 17, Moody’s Investors Service.
- Newey, Whitney K., and Kenneth D. West, 1987, “A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix,” *Econometrica* 55, No. 3 (May 1): 703–708. doi:10.2307/1913610.
- P alomba, G, E. Jenkner, J. Menkulasi and S.Sola, 2014, Financing of Central and SNGs, in Carlo Cottarelli and Martine Guerguil, eds., *Designing a European Fiscal Union: Lessons from the Experience of Thirteen Federations* (Routledge, forthcoming 2014)
- Phillips, P.C.B and P. Perron, 1988, "Testing for a Unit Root in Time Series Regression," *Biometrika*, 75, 335–346.
- Poterba, J. M., Rueben, K., 1999, “State Fiscal Institutions and the U.S. Municipal Bond Market,” In: Poterba, J., von Hagen, J. (Eds.), *Fiscal Institutions and Fiscal Performance*. University of Chicago Press, Chicago, pp. 181–208.
- Rodden, Jonathan, 2006: *Hamilton’s Paradox: The Promise and Peril of Fiscal Federalism*.

- Ross-Thomas, Emma, 2012a, "Spanish Premier Rajoy Prepared to "Rescue," Indebted Regions" Bloomberg, January 17.
- Ross-Thomas, Emma, 2012b, "Spain Raises 2011 Deficit to 8.9% on Regions' Unpaid Bills," Bloomberg, May 5.
- Schuknecht, L., von Hagen, J., Wolswijk, G., 2008, "Government Risk Premia in the Bond Market: EMU and Canada," ECB Working Paper Series No. 879/March 2008.
- Schulz, A., Wolff, G. B., 2009, "The German SNG Bond Market: Structure, Determinants of Yield Spreads and Berlin's Forgone Bailout," *Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik)* 229 (1), 61–83.
- Sills, Ben, 2012, "Spain Helped Valencia With \$160 Million Payment, EL Pais Reports," Bloomberg, January 4.
- Sills, Ben and Emma Ross-Thomas, 2012, "Spain Insists \$15 Billion Aid for Regions Won't Swell Debt," Bloomberg, July 20.
- Smyth, Sharon, 2012, "Valencia May Default Without Central Government Aid," Bloomberg July 9.
- Sparkes, Matthew, 2012, "Catalonia Calls for Help from Government to Pay Debt," Bloomberg 2012/05/25.
- Tang, D. Y. and H. Yan, 2007, "Liquidity and Credit Default Swap Spreads," University of Hong Kong Working Paper.
- Ter-Minassian, Teresa (ed.), 1997, *Fiscal Federalism in Theory and Practice*, IMF.
- Von Hagen et al, 2000, "Sub-National Government Bailouts in OECD Countries: Four Case Studies," Research Network Working Paper R-399 (Washington: IADB).
- Von Hagen, J., Schuknecht, L., and Wolswijk, G., 2011, "Government Bond Risk Premia in the EU revisited: The Impact of the Financial Crisis," *European Journal of Political Economy* 27 (1), 36–43.
- Von Müller, C., 2012, "Bond Yields and Bailout Guarantees: Regional Debt Markets in Germany," FEN Capital Markets: Asset Pricing & Valuation eJournal.
- Weistroffer, Christian, 2009, "Credit Default Swaps: Heading Towards a More Stable," System. *International Topics, Current Issues*, December 21, Deutsche Bank Research, Frankfurt am Main.
- Wooldridge, Jeffrey, 2002, *Econometric Analysis of Cross Section and Panel Data*, MIT Press, 2002.

APPENDIX 1: GENERAL DATA DESCRIPTION

Table 1: Data Description

Variable	Data	Quotes	Time Stamp	Source	Frequency
Sovereign Credit Risk	CDS 5y	mid	1:00 p.m. ET	Bloomberg	Daily
Liquidity (CDS)	CDS 5y	bid/ask	1:00 p.m. ET	Bloomberg	Daily
Regional Credit Risk	Regional bond yields	mid	12PM ET	Bloomberg	Daily
Liquidity (Regional Bonds)	Regional bond yields	bid/ask	12PM ET	Bloomberg	Daily
General Risk Aversion	iTraxx Index	mid	1:00 p.m. ET	Bloomberg	Daily
Short Term Interest Rate	EURIBOR	ask	6pm ET	EBF	Daily
4 Groups of 14 Event Dummies 1/	Set to 1 on respective event day			Bloomberg News	Daily
Period Dummy 1 (PD1)	Set to 1 until 12/19/2011				Daily
Period Dummy 2 (PD2)	Set to 1 after 7/26/2012				Daily

1/ See Table 2.

The sample comprises daily data from 1/1/2010 to 6/25/2013.

We use CDS data for 12 countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden, and United Kingdom; and regional bond yields for Andalucía, Catalonia, and Valencia (which had sufficiently frequent quotes).

We use the most liquid bond for each region and apply a few data cleaning steps: i) we take the absolute value of the bid/ask spreads because in a few occasions the spreads are negative, suggesting the bid/ask quotes are put in reverse order; ii) we use the Bloomberg “BGN” quotes whenever they are available and “BVAL” quotes otherwise (“BGN” quotes are trade-based and “BVAL” quotes are synthetic).

We use the Markit iTraxx Europe index, which is an equally weighted index of 125 investment grade corporate CDSs in Europe.⁴⁰

Period Dummy 1 (PD1) captures the time period before the sub-national debt crisis (*pre-bailout*) and Period Dummy 2 (PD2) the time period after ECB president Draghi’s speech (*post-Draghi*).

Events studied

We use the Bloomberg news search function to determine the exact timing of the first news break for each of the events. We then organize these news events into four groups (Table 2). The first group comprises news events about the central government’s pledges of support (without any concrete commitments). The second group comprises news events about concrete government guarantees or bailout mechanisms. The third group comprises events

⁴⁰ For a complete description see <http://www.markit.com/assets/en/docs/products/data/indices/credit-and-loan-indices/iTraxx/Markit%20iTraxx%20Europe%20Index%20Rules%20S19.pdf>

that are bad news from a regional credit risk point of view. The last event is ECB president Draghi's speech that reconfirmed the ECB's "unlimited" commitment to preserving the euro (widely interpreted to refer to continued purchases of sovereign bonds with excessively high yields). In our robustness checks we also pool D1 and D2 into a joint dummy (DD).

Table 2: Event Dummies

D1: Government Pledges of Support		
1/17/2012	15:48 GMT	Prime Minister announces a broad agenda to address regional liquidity issues (Ross-Thomas, 2012a)
3/27/2012	12:22GMT	Economy Minister is considering joint bond issuance, backed by the treasury (Benoit, 2012c)
D2: Concrete Bailout Measures		
1/4/2012	16:30GMT	Treasury provides a "verbal guarantee" for Valencia's loans (Sills, 2012)
2/3/2012	12:45 GMT	ICO sets up a credit line of 15 billion euros (Baigorri, 2012)
3/2/2012	12:56GMT	FFPP is set up to pay regions' debts to suppliers (Benoit, 2012b)
7/13/2012	14:05GMT	FLA is set up to provide 18 billion euros in liquidity initially (Benoit, 2012d)
7/20/2012	13:28GMT	Valencia announces that it will tap FLA-the first region to do so (Sills and Ross-Thomas, 2012)
D3: Subnational Credit Negative Events		
12/19/2011	20:42GMT	Moody's downgrades Valencia (Moody's 2011)
1/12/2012	10:22GMT	Moody's downgrades Valencia, puts 6 other regions on downgrade watch (Benoit, 2012a)
5/17/2012	17:02 GMT	Moody's downgrades several regions but confirms Valencia (Moody's, 2012)
5/19/2012	8:31 GMT	Negative general government fiscal deficit revision, caused by 3 regions (Ross-Thomas, 2012b)
5/25/2012	14:00 GMT	Catalonia requests additional government support, calls for "Hispanos" (Sparkes, 2012)
7/9/2012	6:31 GMT	Valencia announces that it may default without government support (Smyth, 2012)
D4: ECB Announcement		
7/26/2012	13:50 GMT	Draghi: "ECB will do what's needed" to preserve the euro (Black and Randow, 2012)

Source: Bloomberg News

Table 3: Unit Root Tests

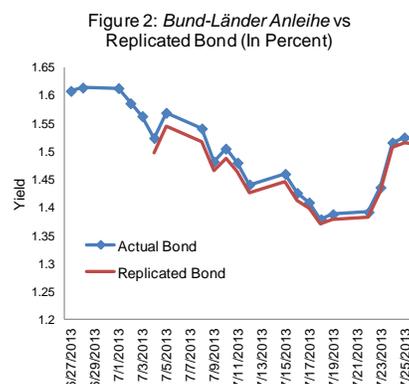
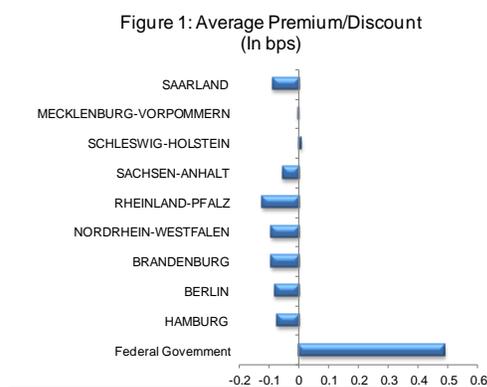
Spanish CDS	Phillips-Perron w/ 5 lags	trend	MacKinnon approximate p-value	0.6147
		no trend	MacKinnon approximate p-value	0.2216
Valencia bond yield	Phillips-Perron w/ 5 lags	trend	MacKinnon approximate p-value	0.9847
		no trend	MacKinnon approximate p-value	0.6496

Source: Authors' calculations.

APPENDIX 2: GERMANY'S *BUND-LÄNDER ANLEIHEN*

As Spanish regions were shut out of debt markets and the sovereign rescue unfolded, the issuance of joint bonds by the central government and regions (so-called *Hispanobonos*) was also being discussed. The recent issuance of the first joint federal-state government bond in Germany offers an illustration of how joint borrowing of sovereign and state governments results in a subsidy to the latter—similar to the increase in sovereign borrowing costs we found to coincide with outright bailouts—but much more circumscribed and mainly applicable to the specific joint debt issue.⁴¹

In June 2013, the German federal government and 10 states jointly issued a *Bund-Länder Anleihe*, with each entity being liable on a pro rata basis for their respective share.⁴² As the joint bond has been traded in the market, we can observe the financing cost charged by the market both for the joint bond as well as for each individual issuer.⁴³ Figure 1 shows that the joint bond commands a yield that is higher than the federal government yield, but lower than most of the individual Länder yields. Specifically, since the debut of the bond, the data indicate that the federal government has to pay 50 basis points more by financing through the joint bonds, while in doing so most of the Länder can get a discount over their own financing cost, ranging from 8 basis points to 12 basis points.^{44 45}



⁴¹ The impact on general risk premia could be assessed. Most likely, results will be driven by the significance of the new potential liability for central government finances as a whole.

⁴² The bond has a maturity of 7 years and a size of 3 billion euros. Shares are as follows: Federal government (13.5%); Berlin (13.5%); Brandenburg (6.75%); Bremen (13.5%); Hamburg (5.25%). Mecklenburg-Vorpommern (3.25%); NRW (20%); Rheinland-Pfalz (6.75%); Saarland (6.75%); Sachsen-Anhalt (2.75%); Schleswig-Holstein (8%). Source: Deutsche Finanzagentur (2013).

⁴³ We download daily data of the bond yields for the joint bond, individual bond, and jumbo bond from Bloomberg. Data are from 2013/6/23 to 2013/7/26.

⁴⁴ Bremen does not issue fixed rate coupon bonds, so it could not be included in our calculations. Weights are adjusted accordingly.

⁴⁵ There are a number of caveats: Given the size of the joint bond, its liquidity is relatively low, and no other bond will have the exact same maturity. However, to get around the latter issue we linearly interpolate individual bond yields to match the maturity of the joint bond.

Since the joint bonds and the individual bonds differ in terms of size, liquidity, maturity, and other aspects, we double-check our result by calculating a weighted average of the interpolated individual bond yields according to each state's share. We find that the weighted average yield tracks the actual joint bond yield very closely (Figure 2). This implies that the market's risk assessment of individual entities does not seem to have changed, and for the Länder to pay less in interest, the federal government has to make up the difference.

Summing up, while it does not constitute a risk transfer scheme as the one we identified in Spain, this example illustrates the subsidy that would be paid by any entity as a result of pooling its borrowing with lesser-rated entities.⁴⁶ However, joint borrowing by sovereigns and sub-entities is a rare exception in financing arrangements in federations (Palomba et al 2014).⁴⁷

⁴⁶ In the case of this bond the subsidy is maximized as it particularly attracted financially weaker states while financially stronger states (such as Bayern or Baden-Wuerttemberg) did not opt to participate.

⁴⁷ The same phenomenon has occurred with a slightly different twist when separate states with separate financial histories join a federation. For example, Collet (2012) examines Italian states' bond premia during Italy's unification process in the 19th century and finds that Naples' previously low borrowing costs increased substantially as it joined the highly indebted unitary state.