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ABSTRACT

Governments often issue bonds in foreign jurisdictions, which can provide additional legal protection vis-à-vis domestic bonds. This paper studies the effect of this jurisdiction choice on bond prices. We test whether foreign-law bonds trade at a premium compared to domestic-law bonds. We use the euro area 2006–2013 as a unique testing ground, controlling for currency risk, liquidity risk, and term structure. Foreign-law bonds indeed carry significantly lower yields in distress periods, and this effect rises as the risk of a sovereign default increases. These results indicate that, in times of crisis, governments can borrow at lower rates under foreign law.

Keywords: Sovereign Debt; Creditor Rights; Seniority; Law and Finance

JEL classification: F34, G12, K22

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1 Introduction

When governments borrow from capital markets, many decide to issue their bonds under a foreign jurisdiction. This paper explores the pricing effects of this choice. Specifically, we test whether sovereign bonds that are governed by foreign law, e.g. English or New York law, trade at a premium compared to bonds issued under domestic law. The intuition behind this question is simple. Domestic-law bonds can have weaker legal protection since the contract terms can be altered retroactively by changes in the law of debtor countries. Through an act of parliament, governments can, in principle, change the currency denomination of domestic-law bonds, their payment terms, or the voting rules for a potential restructuring. Such a retroactive change of contracts is not possible for foreign-law bonds, because legislation by national parliaments has no authority beyond domestic borders. Foreign-law bonds are also increasingly prone to litigation and enforcement in foreign courts, possibly making them better shielded against unilateral default and restructuring.[1] This paper explores if there is a "legal safety premium" priced into sovereign bond yields: how do markets value bonds that are protected by the rule of law abroad?

Our study is motivated by events in the run-up to the Greek debt restructuring of 2012, which showed that governing law can play a crucial role in sovereign bond markets. On February 23, 2012, the Greek parliament passed the "Greek Bondholder Act", which retroactively introduced collective action clauses (CACs) with aggregation features into its outstanding *domestic-law* sovereign bonds.[2] After the exchange offer was launched shortly later, more than 66% of domestic-law bonds were tendered. This forced minority holders to also exchange their bonds and accept the associated haircut, even if they voted against the offer. In contrast, the Greek legislation could not change the terms of the *foreign-law* bonds, allowing investors in those bonds to reject the exchange offer and hold out. The result was that more than 50% of Greek bonds under English, Swiss and Japanese law were not restructured and have been serviced in full and on time ever since.[3] The foreign-law clause thus protected these investors from deep losses: the nominal principal on domestic-law bonds was reduced by 53.5%, amounting to a 65% haircut in net present value terms (for a detailed assessment of the case see Choi, Gulati and Posner, 2011; Gulati and Zettelmeyer, 2012; IMF, 2013; Zettelmeyer, Trebesch and Gulati, 2013). More recently, the Austrian government retroactively inserted CACs into the bonds of an Austrian wind-down entity. Randl and Zechner (2016) estimate that following this legislative action, the spread between domestic and foreign-law bonds issued by the Austrian government increased.

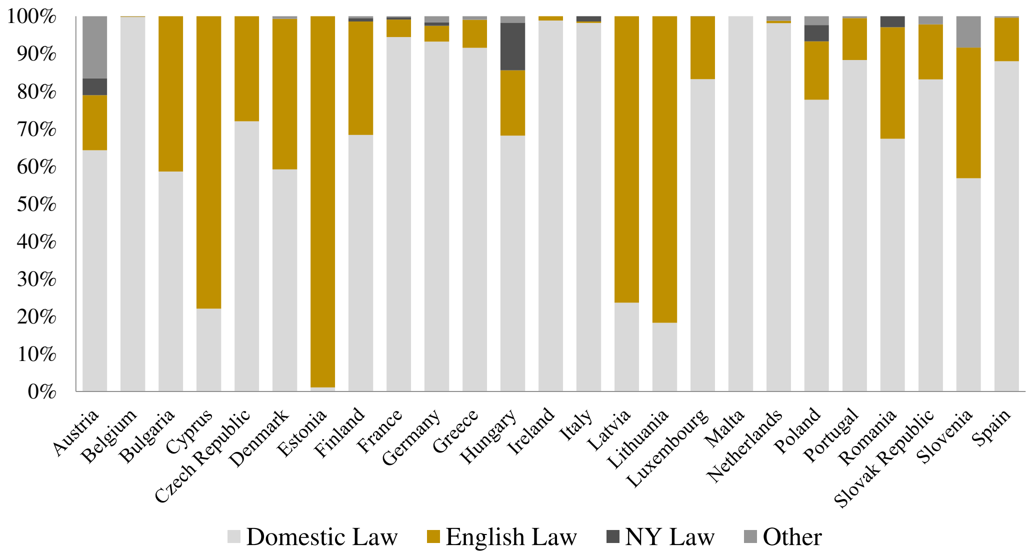
[1]See IMF (2013); Frankel (2014); Hébert and Schreger (2017); Schumacher, Trebesch and Enderlein (2018)

[2]Greek law no. 4050/2012 "Rules of amendment of titles issued or guaranteed by the Hellenic Republic with the Bondholder's agreement", see Hellenic Parliament, online available at `http://www.hellenicparliament.gr/Nomothetiko-Ergo/Anazitisi-Nomothetikou-Ergou?law_id=3b426740-db7b-471a-9829-80a89a6518b5,accessed6March2018.`.

[3]Holdouts amounted to EUR 6.4bn in face value or 3.1% of total debt exchanged (Zettelmeyer, Trebesch and Gulati, 2013).

Figure 1: Foreign-law bonds in European countries

This figure shows the share of foreign-law bonds in total public sector bond issuance between 2003 and July 2014 for EU countries and according to the Dealogic database. The shares are based on issuance amounts in USD and are calculated from sovereign and quasi-sovereign debt, i.e. bonds placed by the central government and by government owned companies. Only instruments with maturity above 1 year are included.



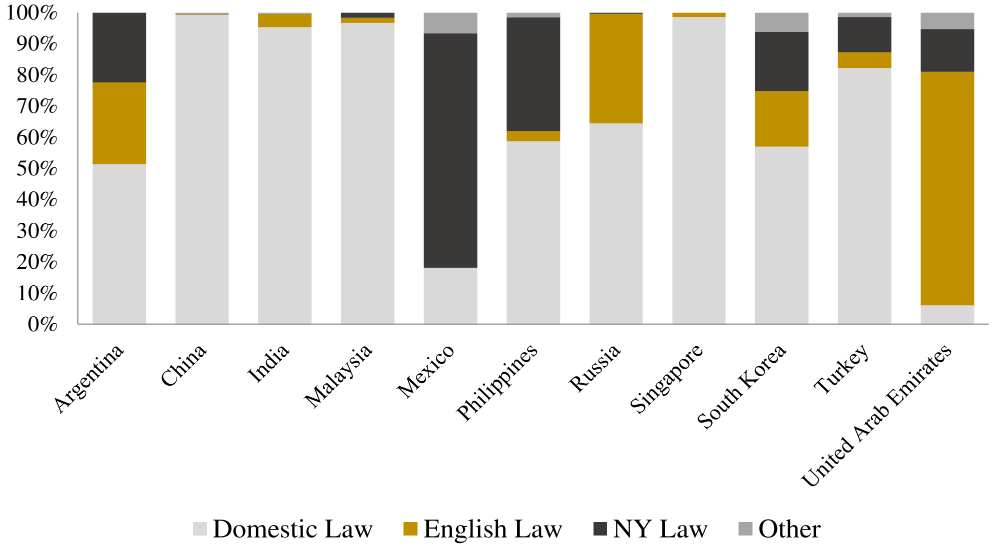
After the Greek experience of 2012, many observers argued that bonds with foreign governing laws are preferable from a creditor perspective.[4] Gulati and Zettelmeyer (2012) even suggest to use differences in governing law as a policy tool to address the debt overhang problem in crisis countries. Specifically, they propose voluntary debt restructurings in which holders of local-law bonds swap these against foreign-law bonds with longer maturities, i.e. with a present value haircut. Such voluntary swaps could be mutually beneficial since investors receive a safer asset while countries achieve debt relief. A first application of this idea was the Greek debt exchange proposal itself, since all Greek-law bonds were exchanged into new English-law bonds – a carrot to induce investors' participation in the exchange.

The potential advantages of foreign-law bonds have also come to the attention of debt managers. Cyprus, Greece and Portugal all returned to the international bond market by issuing English-law instruments in 2014, and other small "non-core" euro area countries, such as Latvia or Slovenia also shifted their sovereign bond issuance patterns from domestic to foreign law, according to primary market data by Dealogic. We generally find foreign-law bonds to account for a substantial share of public sector borrowing in the last decade, both in Europe and in Emerging Markets (see Figures 1 and 2).

[4]For example, an article in the New York Times reported that "investors might think twice before investing in those local law bonds, no matter how high the yield" (Thomas, 2012). Similarly, the Wall Street Journal reported analyst recommendations to sell domestic-law Portuguese government bonds and buy foreign-law ones instead (Stevis, 2012).

Figure 2: Foreign-law bonds in EMEs

This figure shows the share of foreign-law bonds in total public sector bond issuance between 2003 and July 2014 for selected emerging markets and according to the Dealogic database. The shares are based on issuance amounts in US$ and are calculated from sovereign and quasi-sovereign debt, i.e. bonds placed by the central government and by government owned companies. Only instruments with maturity above 1 year are included. The Argentina numbers include the 2005 restructured bonds.



Despite the widespread use of foreign-law bonds, there is still limited evidence on the effect of legal clauses and governing law on pricing in sovereign debt markets.[5] Few rigorous empirical studies exist and theory is ambiguous on whether and how sovereign bond contract design matters. On the one hand, Roubini (2000) and Weinschelbaum and Wynne (2005) argue that contractual bond clauses such as CACs or governing law are likely to be irrelevant, both ex-ante and once the country enters financial distress.[6] On the other hand, the work by Bolton and Jeanne (2007, 2009) suggests that debt which is harder to restructure, in legal terms, will effectively be senior and therefore have lower yields ex-ante (a similar argument is made by Pitchford and Wright, 2007).[7] Our paper informs this debate empirically by applying standard fixed income valuation techniques to a large sample of bonds to understand whether foreign-law debt is indeed priced at a

[5]A larger literature exists on the distinction between domestic and external debt by residency of creditors, see for instance Reinhart and Rogoff (2011). For a discussion about the different dimensions along which domestic and foreign debt can be distinguished, see Panizza (2008).

[6]Roubini (2000) argues that initial contractual terms are likely to be irrelevant since creditors and sovereigns can find ways to work around them ex-post, as shown by a number of actual cases. Weinschelbaum and Wynne (2005) emphasise that governments have a variety of different debt contracts outstanding and that the relevance of contract design in individual portions of the debt will decrease the more diversified the debt stock is. Moreover, they argue that the implicit guarantee of official sector bailouts in case of distress makes investors ignore contractual clauses.

[7]There is a large related theory literature studying the ex-ante and ex-post effects of easy versus hard to restructure debt and the economic consequences of sovereign bond contracts and creditor behavior during debt crises, see Miller and Zhang (2000), Ghosal and Miller (2003), Gai, Hayes and Shin (2004), Haldane et al. (2005), Engelen and Lambsdorff (2009), Bi, Chamon and Zettelmeyer (2011), Pitchford and Wright (2012) and Ghosal and Thampanishvong (2013).

premium, and how large this premium is across countries and time.[8]

Ideally, we would estimate the premium on foreign-law bonds by comparing two otherwise identical bonds that were issued in different jurisdictions - that is, "twin bonds" that share the same currency, maturity, coupon and other features except that one was issued under domestic law while the other was issued under a foreign jurisdiction. Unfortunately, such "twin bonds" are very rare (we could only identify one pair for Argentina and construct another for Russia by interpolating two bonds). As an alternative, we therefore rely on standard fixed income valuation approaches to compare bonds with different currencies, maturity and coupon structure to infer the premium associated with foreign-law bonds. We use the euro area sovereign debt crisis as a laboratory since it provides the cleanest setting for such an exercise by allowing us to deal with currency risk in a straightforward way. In emerging markets, it is very difficult to find local-law and foreign-law bonds denominated in the same currency. Disentangling the currency risk premium from a jurisdiction premium is further complicated because there is no domestic currency risk-free yield curve (see Du and Schreger, 2016). This is not a problem in the euro area because Germany issues credit risk-free bonds in EUR which can be used to separate currency from credit risk. The identification of a foreign-law premium in our paper thus comes from comparing bonds by the same sovereign issued under different jurisdictions, e.g. an Italian local law bond and one under New York law, and using risk-free benchmark yield curves to correct for currency risk. More generally, our approach accounts for term structure effects, bond liquidity, currency risk, and country-level default risk. We also include bond fixed effects to account for time-invariant bond characteristics such as coupon size, maturity, or legal bond features such as CACs or negative pledge clauses. Our time window is 2006-2013 and we cover the near-universe of actively traded foreign-law bonds in the euro area.

As an add-on to our main analysis, we also show two simpler case studies from emerging market countries based on the Argentina and Russia "twin bonds" mentioned above (identical domestic-law and foreign-law bonds by the same government issued in USD) to proxy the jurisdiction premium, although in a more simplistic way than for the euro area.

Our main result is that a foreign-law premium exists, but it only becomes sizable and relevant in periods of debt distress. We document a large increase in that premium during the crisis, particularly for Greece where the premium reached over 1,000 basis points as default became imminent. Portugal also experienced a large spike in the

[8] Note that our focus is on debt issued under foreign law, and not debt issued to foreigners. The resulting premium is likely to be the result of differences in a restructuring technology associated with foreign law, but may also be affected by differences in the willingness to impose different losses on creditors situated in different jurisdictions. There have been cases in which governments discriminated against foreign investors in favor of domestic creditors. But this is not a general pattern, and there have been numerous cases in which the opposite was true (Erce, 2012). A number of papers have investigated the strategic discrimination of foreign versus domestic investors (e.g. Guembel and Sussman, 2009; Broner, Martin and Ventura, 2010; Broner et al., 2014). The European debt restructurings in Cyprus and Greece both discriminated against domestic-law bonds. The market assessment of the risk of discrimination is therefore ex-ante unclear, and this paper attempts to estimate investors' valuation of this risk empirically.

premium, which at times reached levels well above 500 basis points. During non-crisis times and in less vulnerable countries, however, the premium can be slightly negative, implying that governments incur a small cost when issuing foreign-law bonds outside of distress episodes. We document that the premium rises with credit risk. A rise in the credit default swaps (CDS)-implied risk-neutral default probability of 10 percentage points is associated with a 0.2 percentage point increase in the premium. However, this effect is stronger in countries experiencing deeper financial crises: for Greek bonds, the effect is more than twice as large. Furthermore, our estimates point to a non-linear relationship, with a non-negligible foreign-law premium emerging only for elevated levels of CDS spreads. These effects are economically meaningful, at least in comparison to related studies on the effect of legal terms on sovereign borrowing costs. On the back of an envelope, our results imply that, at an annual default probability of 10%, foreign governing law has a comparable effect on yields as introducing a CAC into the bond of a BBB-rated sovereign in Bardozzetti and Dottori (2014).[9]

The foreign-law premium also allows us to distinguish between the risk of default and the risk of a *selective* default, in which the government only ceases to service domestic debt. The main focus of our analysis is on the foreign-law premium as the dependent variable, since it is a measure of the cost of issuing foreign-law bonds, to which debt managers and investors can more directly respond to. But the extent to which the market prices a probability of differential treatment of foreign-law bonds can be derived directly from the observed premium. The yield on foreign-law bonds can be interpreted as a weighted-average of the return of a risk-free bond, in case the government does not default on its foreign obligations, and the return of a risky domestic-law bonds, in case the government defaults on both foreign and domestic debt. We can solve for this implied risk-neutral probability that foreign bonds are not restructured in the event of a default.[10]

That implied probability of differential default was typically very low during tranquil times, but rose significantly to levels above 20% for the four vulnerable countries during 2011-12. Our estimates indicate that the differential default probability increases with credit risk, but the slope is relatively flat when the relationship is estimated in levels. Notably, even a constant probability of differential default still implies that the foreign-law premium rises with credit risk: the higher the probability of default, the higher the premium creditors are willing to pay to be protected against the risk that foreign-law bonds will not be restructured in the event of a default. When that relationship is estimated in differences, the results suggest a stronger relationship, with bond markets more markedly pricing a higher probability of differential default as credit risk rises. These differences could arise because measurement error in prices due to illiquidity has a stronger effect on the estimates in levels than in differences.

We conclude that the legal features of sovereign bonds are not a major driver of bond

[9] Our results in the pooled sample of all countries imply a ca. 20 basis points lower yield on a foreign-law bond for a ten percentage point-rise in the risk-neutral default probability.

[10] The observed premium can also be consistent with an expectation that foreign-law bonds will also be restructured, but at more favorable terms than domestic law bonds.

prices and debt servicing costs in normal times, but they matter in periods of distress and for countries with a high risk of default. Thus, we find that the ex-ante pricing effects of easy versus hard to restructure debt are limited, and only become relevant during crises. These results could be of relevance for debt managers, as well as investors holding distressed government bonds.

One interpretation of our findings is that investors switch to bonds that are perceived to be safer in the run up to a default or debt restructuring.[11] In a high-risk environment, investors start valuing contractual terms, in particular the choice of jurisdiction. With increasing default risk, more and more investors are willing to pay a premium for bonds issued in a foreign country, which may be less likely to be restructured, or subject to other legal actions reducing the value of a bond, such as currency redenomination (see De Santis, 2015; Kriwoluzky, Müller and Wolf, 2015; Krishnamurthy, Nagel and Vissing-Jorgensen, 2014). The result is a widening foreign-law premium as default approaches. Another closely related interpretation of our findings is a change in the investor base. As yields continue to rise, some buy-and-hold investors exit the market and professional distressed debt funds enter. These specialised investors may target foreign-law bonds (which may be seen as more suitable for potential holdouts), driving up their premium. Finally, there may also be a dilution effect at play, to the extent that foreign-law bonds are harder to restructure than their domestic-law counterparts (Bolton and Jeanne, 2007, 2009).

The paper contributes to research in international macroeconomics and in law and finance, in particular to the literature studying how the legal framework of sovereign debt affects borrowing decisions, bond pricing and default risk.[12] Almost all previous studies on the legal terms in sovereign bonds focus on one specific contractual dimension: CACs.[13] Early studies on the effect of CACs on bond yields exploit the cross-sectional variation in emerging market bonds, by comparing primary or secondary market yield spreads of English law bonds, which typically contain CACs, to those of New York law bonds, which did not contain CACs prior to 2003. Using this strategy and different data sources and samples, Becker, Richards and Thaicharoen (2003), Richards and Gugiatti (2003) and Tsatsaronis (1999) do not find significant a pricing impact of bonds that include CACs. In contrast, Eichengreen and Mody (2000, 2004), and the more recent bond-by-bond analyses by Bradley and Gulati (2014) and Bardozzetti and Dottori (2014) find that CACs significantly reduce bond yields, but that this result depends on the creditworthiness of countries.

To our knowledge, only four previous studies analyze the effect of governing law

[11] A related empirical argument for a "flight-to-safety" behavior of investors during the period before the financial crisis is made by Beber, Brandt and Kavajecz (2009).

[12] A large literature in finance studies how debt contract design, bond covenants and creditor rights influence borrowing and bond yields of corporate borrowers. Two recent examples include Haselmann, Pistor and Vig (2010) and Miller and Reisel (2012) (see also references cited therein).

[13] Bradley, Cox and Gulati (2010) show evidence that bonds containing a pari passu provisions increased in price following the Elliott vs. Peru court ruling that implied a novel, creditor-friendly interpretation of the pari passu clause.

choice on sovereign bond yields. Choi, Gulati and Posner (2011) compare yields of a single pair of Greek bonds: one bond issued under English law (maturing in April 2016 and with a floating coupon of 6m EURIBOR + 0.075%) and one issued under Greek law (maturing in July 2016 with a coupon of 3.6%). They find that the English law bond trades at a yield about 200 basis points lower than its English law twin in mid-2009 and up to 400 basis point lower in mid-2010, and interpret this as evidence that markets price in a smaller likelihood of default for English-law governed bonds. The study by Clare and Schmidlin (2014), written in parallel to our paper, uses a large sample of 400 European bonds, of which 64 are governed by foreign law, including bonds from non-euro area countries such as the Czech Republic, Sweden or Turkey. They then run cross-sectional regressions of bond yields on a set of explanatory variables, in particular a dummy for foreign-law bonds, for each quarter between Q3 2008 and Q4 2012. Identification in the paper largely comes from cross-country variation, since 7 out of the 14 countries in the sample issue only foreign-law bonds. Nordvig (2015), also written concurrently with our analysis, uses a wider set of issuers by also including corporate bonds, but restricts the sample of bonds to EUR denominated securities only. While the findings by Nordvig (2015) on the effects of credit risk on the foreign-law premium are broadly in line with our results, he puts a greater emphasis on distinguishing between redenomination risk and differential default risk. For the purpose of our paper, this distinction is less relevant, since – from most investors' perspective – it should not matter if identical losses arise from a reduction in principal, extension of maturity, or a redenomination of the currency in which the principal is repaid. Finally, a recent paper by Bradley, De Lira Salvatierra and Gulati (2016) finds that governments' cost of capital in the primary market is significantly lower when bonds are issued under foreign governing laws.

We add to this literature by being the first to apply established asset valuation techniques from the finance literature to disentangle currency from credit risk to study the yield premium associated with contractual bond features in sovereign debt markets. This allows us to take into account the contribution of currency risk and maturity (given the country's yield curve) to the price of each foreign bond at every point in time when constructing the jurisdiction premium.[14] We use a large, representative sample of euro area sovereign bonds and identify effects from the within-country variation in sovereign bond issues. This reduces potential selection and endogeneity effects, such as the choice of governing law.

[14] Importantly, we do not aim to identify any pricing anomalies in distressed sovereign bond markets, as recent papers by Buraschi, Menguturk and Sener (2015), Corradin and Rodriguez-Moreno (2016) or Trebesch and Zettelmeyer (2014). Instead, our theoretical prior and results are very much in line with standard theory for pricing sovereign credit risk, as the next section illustrates.

2 Theoretical prior

This section gives a more formal representation of our hypothesis by comparing the risk-neutral prices for a bond governed by domestic law with an otherwise equivalent bond that is subject to the courts of a foreign jurisdiction. It serves as a simple illustration of the arguments presented in the introduction, in particular the implication that the premium on harder-to-restructure debt should increase with credit risk. Furthermore, it provides an explanation under which circumstances a negative premium could arise, and derives an expression for the probability of a selective default on domestic-law bonds.

Consider 2 types of discount bonds: a domestic bond and a foreign-law bond that are issued in the same currency. For simplicity, consider a two-period setting where the bonds are purchased in the first period by risk-neutral investors and mature in the second period. There are three states of the world that can materialize in the second period: (i) both domestic and foreign-law bonds pay in full; (ii) there is a default on domestic bonds but not on foreign-law bonds; and (iii) both bonds default.[15] The probability of default is p, the probability that foreign-law bonds are not restructured in a default is π, and the recovery rate after a default is δ. Finally, we assume a liquidity cost associated with these bonds, which reduces the price of the foreign-law and of the domestic bonds by l_F and l_D, respectively. Under these assumptions, the prices P_F and P_D of a foreign-law and domestic bond with face value of 1 can be expressed as:

$$P_F = (1-p) + p\pi + p(1-\pi)\delta - l_F \quad (1)$$

$$P_D = (1-p) + p\delta - l_D \quad (2)$$

The price difference between foreign-law and domestic bonds is given by:

$$P_F - P_D = p(1-\delta)\pi - (l_F - l_D) \quad (3)$$

which is increasing in the default probability p and the probability π of a differential default that spares foreign-law bonds, but decreasing in the relative illiquidity $l_F - l_D$ of foreign bonds compared to domestic bonds.

Furthermore, we can isolate the probability of selective default π. Substituting (2) into (1) yields:

$$P_F = \pi + (1-\pi)(P_D + l_D) - l_F, \text{ or} \quad (4)$$

$$\pi = \frac{(P_F + l_F) - (P_D + l_D)}{1 - (P_D + l_D)} = \frac{P_F - P_D + l_F - l_D}{1 - P_D - l_D} \quad (5)$$

[15]We are grateful to an anonymous referee for suggesting this simple three-state approach for quantifying the probability of differential treatment. In principle, the model could also consider a probability of differential default that treats domestic bonds more favorably. For simplicity, we ignore this case since it was not a relevant or viable alternative during the euro area sovereign debt crisis (the bulk of the debt was domestic, so that is where the bulk of the relief would need to come from in any debt restructuring).

The simple result above can be generalized to multi-period bonds. We continue to assume risk neutral investors, and that foreign-law and domestic bonds are risky, but that there is a probability that only domestic bonds are defaulted on. Let P_{rf} denote the price of a risk-free bond which does not carry a liquidity cost, and has the same currency and coupons as the risky domestic and foreign-law bonds. The simplest extension is to suppose that the payment stream of the foreign-law bond is the same as that of the risk-free bond with probability π, and the same as the domestic bond with probability $1-\pi$. That assumption implies:

$$P_F = \pi P_{rf} + (1-\pi)(P_D + l_D) - l_F, \tag{6}$$

which is a general version of (4). As before, the probability of default enters implicitly in the equation through its effect on P_D and P_F. This equation yields:

$$\pi = \frac{P_F - P_D + l_F - l_D}{P_{rf} - P_D - l_D} \tag{7}$$

which again implies that a higher $P_F - P_D$ should go in line with a higher probability of discriminatory default, relative to the domestic bond risk premium.[16]

If the probability of selective default and credit risk are large (π is large and P_D is lower than P_{rf}) they will dominate the differences in liquidity $l_F - l_D$ and foreign-law bonds will trade at a premium (i.e. foreign-law bonds will have lower yields). But if π is small, or credit risk is small (and both P_F and P_D are close to P_{rf}), lower liquidity can actually cause foreign-law bonds to be traded at a discount vis-á-vis domestic bonds (we discuss this in more detail in in Section 3). We can control for relative liquidity in a regression by using the differences in the bid-ask spreads for foreign-law and domestic bonds as a measure of $l_F - l_D$. But to the extent that illiquidity affects the price of foreign-law bonds itself, it is difficult to disentangle that effect from π without direct measures of l_F and l_D. And since π is defined as a ratio, any noise in the foreign-law premium (numerator in 7) will be magnified if the risk premium (denominator) is small. For these reasons, we present our main empirical estimates based on the premium measured by the differences in yield (which is a more standard way of expressing spreads), and in addition estimates based on the implied differential default probability π.

[16] An observed foreign-law premium can be consistent with a range of combinations for the risk-neutral probability of differential default and differential haircut. For simplicity, we focus on the polar case where the entire premium can be attributed to the differential default probability. That is, foreign-law bonds are either never restructured, or are restructured under the same terms as domestic-law bonds. A risk-neutral investor would be indifferent between a reduction in that probability combined with a sufficiently lower haircut in the event of a restructuring. But since the goal of this section is to provide an alternative illustration of the magnitude of the observed foreign-law premium, for simplicity, we focus on the polar case where the premium derives from a differential default probability only.

3 Data and exploratory analysis: euro area 2006-2013

In this section we bring this simple theoretical prior to the data. We start with a data description and then explain how we extract the foreign-law premium.

3.1 Data

We compile our sample from a list of all foreign-law bonds issued by euro area member countries. We begin by considering all 101 foreign-law fixed-coupon bonds available on Bloomberg that are issued by euro area governments with maturity between January 2006 and September 2013.[17] We then clean the sample from 20 illiquid bonds for which no reliable price quotes are available on Bloomberg. These comprise 18 Japanese law bonds denominated in Japanese Yen, and the two most volatile bonds whose quoted yield standard deviation exceeds the sample standard deviation by more than 300%.[18] Finally, we drop observations on bonds 30 days prior to maturity.[19] 50% of the bonds in our analysis are issued by "non-core" countries that were perceived as vulnerable during the euro area sovereign debt crisis: Greece, Italy, Portugal and Spain. But the sample also includes foreign-law bonds issued by Austria, Belgium, Finland, and Slovakia for which there are reasonable price quotes available through Bloomberg. For all other euro area countries, e.g. Germany, France or Ireland, we could not identify foreign-law bonds to be included in the analysis.[20]

The data frequency is daily, ranging from January 2006 until September 2013. Bond price data are based on mid prices (average of bid and ask) at market closing time. In addition, we collect bid and ask quotes to compute the bid-ask spread on the foreign-law bonds, relative to the mid price. Wherever possible, we rely on actual dealer price quotes posted on Bloomberg's trading platform (pricing source CBBT). If these are not available, we use generic Bloomberg pricing data, i.e. the default pricing source (BGN) used in most other studies. These are computed as an average of price quotes across dealers reporting to Bloomberg, but the quotes are indicative only and therefore do not necessarily actual reflect actual market conditions.

We also collect data on domestic benchmark yield curves. For domestic yields, we rely on the benchmark zero-coupon curves constructed by Bloomberg and based on the most liquid bonds, which are all domestic bonds. For each country in our sample, the benchmark curve is available at a 3, 6, 9, 12 and 18 month maturities, and 2, 3, 4, 5, 10, 15, 20 and 30 year maturities. Based on these benchmark curves we discount the

[17]We do not consider the foreign-law bonds issued by Greece in the context of the 2012 restructuring, since the entire government debt stock was governed by foreign laws after the exchange. Hence, no spread can be estimated anymore.

[18]These are two Greek bonds, one issued under English law (XS0110307930) and one under Swiss law (CH0018062676).

[19]Table A1 in the appendix shows the resulting sample of 79 fixed-rate foreign-law bonds outstanding by euro area countries between 2006 and 2013.

[20]The only foreign-law bond issued by Ireland for which pricing data is available matures in early 2010, dropping Ireland from most of our sample period.

Table 1: Descriptive statistics main regression variables

Variable	No. Obs.	Mean	Std.Dev.	Min	Max	Unit
Premium	57,761	-0.105	0.822	-3.141	11.240	%
Pi	57,123	8.511	19.92	0	100	%
Premium (swap method)	51,265	-0.167	1.193	-3.228	14.130	%
CDS spread	57,325	1.536	2.673	0.019	50.470	%
Implied PD	57,325	10.490	12.9	0.160	98.510	%
S&P rating (numerical)	58,972	17.940	2.908	1	21	Score
Bid-ask spread	57,128	0.470	0.944	0.002	29.950	%
Liquidity spread (bid-ask spread difference)	54,049	0.185	1.094	-28.290	21.0	Percentage points
Time to maturity	58,972	71.890	78.66	0.986	420.7	Months
ECB eligible	58,972	0.231	0.421	0	1	Indicator

theoretical price of the bonds in the sample countries. We also use the US, UK, Germany, and Switzerland benchmark curves when pricing bonds issued in foreign currency, as described in the following subsection. In addition, we compute the bid-ask spread in the domestic government bond market based on the bid and ask quotes for the 10-benchmark bonds.[21] We compute the difference between the foreign-law bonds' bid-ask spread and the domestic benchmark bonds' bid-ask spread to measure the relative illiquidity of the foreign-law bonds.

As our primary measure of default risk, we use 5-year CDS spreads from Markit and Bloomberg. The 5-year tenor is the most liquid horizon in CDS markets and therefore provides a reasonable measure of credit risk (Chen and Sarkar, 2011). CDS insure the default of underlying reference issuers according to an industry standard (International Swaps and Derivatives Association, 2002). For our purposes, it is important to note that standard CDS as quoted in our dataset do not distinguish between domestic and foreign-law obligations of a sovereign issuer. In fact, after the 2012 Greek debt restructuring, the accompanying CDS auction explicitly referenced domestic and foreign-law bonds as eligible for delivery in the payout settlement auction (International Swaps and Derivatives Association, 2012). The CDS quotes we use are for swap contracts that promise payout in USD if a credit event occurs. This is because the market for EUR-denominated CDS on euro area sovereigns is very illiquid, due to the implied "wrong-way" correlation of credit and exchange risk.[22] Table 1 provides summary statistics of all variables used in the analysis.

[21]For Slovakia, we use the 5-year benchmark bond to compute the domestic bid-ask spread, as there is no continuous Slovakian 10-year benchmark bond series in our sample period.

[22]In fact, Bloomberg does not provide any price quotes on EUR-denominated CDS on euro area sovereigns due to the lack of depth of this market. Likewise, no quotes on USD-denominated CDS for protection against a default by the US government are available. Other financial data providers, such as Markit or Reuters, only have quotes for euro area EUR-denominated sovereign CDS from September 2011 onwards, see De Santis (2015).

3.2 Extracting foreign-law premia

For each of the foreign-law bonds, we estimate the premium by comparing the observed yield to maturity to a hypothetically expected yield of a domestic-law bond with the same characteristics as the foreign-law bond. This requires first computing the appropriate hypothetical yield to discount the cash flows into a theoretical price. Specifically, we discount the stream of payments given the foreign-law bond's maturity, cash flow (coupon and principal payments), and currency using the domestic benchmark yield curve, thus reflecting the country-specific credit risk.[23]

Since the benchmark curve is only available at given maturities we interpolate it to match the observed maturity of the foreign-law bonds. For example, if a bond has a coupon payment 8 months from the current date, the value of that payment is discounted using an interpolation of the 6 and 9 month benchmark yield. Similarly, if that bond matures in 7 years, that payment is discounted using an interpolation of the 5 and 10 year benchmark yield. Hence, the discounting yield is derived as:

$$Y_{i,j,t,m} = \left(1 - \frac{m - \underline{m}}{\overline{m} - \underline{m}}\right) Y_{i,j,t,\underline{m}} + \frac{m - \underline{m}}{\overline{m} - \underline{m}} Y_{i,j,t,\overline{m}} \tag{8}$$

where $Y_{i,j,t,m}$ denotes the interpolated domestic yield for bond i, issued by country j, at date t, maturing on m, and $Y_{i,j,t,\underline{m}}$ and $Y_{i,j,t,\overline{m}}$ represent the corresponding yields on the benchmark curve with the closest available maturities before and after the observed maturity date m of the foreign-law bond.

Because foreign-law bonds are often priced in a foreign currency, we need to adjust the observed yields for the currency premium. Of the 79 foreign-law bonds, only 22% are denominated in EUR.[24] The most common currency is the USD, accounting for 62% of bonds in our sample, while the CHF and GBP bonds account for 11% and 5%, respectively. Bonds which combine foreign law and a non-EUR currency denomination are priced reflecting both the foreign-law premium as well as the implied currency risk. We can adjust for the currency risk by exploiting the fact that there exist credit risk-free benchmark curves in all foreign currencies in our sample as well as in the EUR. Specifically, we rely on Germany as the risk-free EUR issuer; the US as the risk-free USD issuer; Switzerland as the risk-free CHF issuer; and the UK as the risk-free GBP issuer. None of these countries has defaulted on their debt in the post-WW II era, and all are rated AA or above by the major rating agencies.

Under covered interest parity (CIP), the return to investing in a risk-free bond in

[23] One alternative to using that benchmark curve is to directly estimate a yield curve from the available foreign-law bond price data. We tried estimating yield curves using the Nelson and Siegel (1987) and Svensson (1994) approaches, but found the results to be excessively noisy during times of distress. This is partly because the number of outstanding foreign-law bonds per country is too small to robustly estimate the factors on a daily basis. But more generally, Härdle and Majer (2014) and Mesters, Schwaab and Koopman (2014) show that standard yield curve models perform badly during the euro area sovereign debt crisis. Given our focus on distress episodes we therefore prefer using Bloomberg's benchmark curves as a simpler and more transparent way to price the bonds.

[24] In section 4.3, we explore these bonds in more detail.

a foreign currency must be equal to the return of investing in a risk-free bond in the domestic currency. For the purpose of converting EUR-denominated domestic-law bond returns into – for example – USD returns, this means that we need to consider an investor selling USD in the spot market to invest in EUR bonds and selling forward the EUR returns for USD. Hence, the credit risk-free currency return of a foreign currency bond with maturity m is given by $(1 + Y_{FC,m})/(1 + Y_{EUR,m})$, reflecting the forward-to-spot ratio of the foreign currency (FC) to EUR (FC/EUR) exchange rate, and assuming that the EUR-denominated bonds issued by Germany have the identical (zero) credit risk as the FC-denominated bonds issued by the US, UK, or Switzerland. This implied currency return on risk-free bonds also applies to the risky bonds in our sample, so we multiply it with the EUR-denominated, maturity-matched domestic law benchmark yield from eq. (8) to get the implied foreign currency yields. For example, we construct the benchmark USD yield for Spain by multiplying its interpolated benchmark EUR yield by the ratio of the US benchmark yield (risk-free yield in USD) to the German benchmark yield (risk-free yield in EUR). Generally,

$$Y_{i^*,j,t,m} = (1 + Y_{i,j,t,m}) \times \frac{1 + Y_{i,FC,t,m}}{1 + Y_{i,GER,t,m}} - 1 \tag{9}$$

where $Y_{i,FC,t,m}$ denotes the yield to maturity date m for Germany, US, UK, or Switzerland in their respective currencies, and $Y_{i,GER,t,m}$ represents the German yield to maturity in EUR. Note that for EUR denominated bonds, the second term reduces to 1, as no currency correction is necessary.

An alternative way of adjusting for currency risk would be using data from the foreign exchange (FX) derivatives market. However, FX forward contracts are exceedingly illiquid beyond the 1-year horizon and thus do not provide useful information for the much longer maturities of bonds in our sample. To deal with this problem, Du and Schreger (2016) instead suggest to construct fixed-for-fixed cross-currency swap rates to compute the cost of exchanging a fixed cash flow from a local currency into USD. We therefore also computed the foreign-law premium using this swap-based method, but found the results to be highly similar to the CIP approach.[25] Since the number of observations with the swap-based method is reduced by a lack of swap data for some horizons and currencies, we rely on the CIP approach as our benchmark. This also avoids the noise involved with using the swap method during the height of the global financial crisis, when counterparty risk in derivative markets became a serious concern, and the usually very thin spreads in swap markets during normal times suddenly became very pronounced.[26]

[25] See Figure A1 in the appendix. Specifically, we find that the CIP approach slightly underestimates the premium for high levels, relative to the swap-based approach used in Du and Schreger (2016). This could result, for instance, if the implicit assumption of credit risk equality of the "safe" rates in the CIP approach does not hold. However, the deviations we find are very small, and the two premia are highly correlated (coefficient of 0.79). Our main results in the empirical analysis hold using either approach.

[26] Both approaches to control for currency risk would not mitigate a possible bias resulting from a

We then use the resulting maturity-matched and currency-adjusted synthetic domestic-law yield to discount the projected cash flow on the foreign-law bond. This net present value corresponds to the expected price of the hypothetical bond:

$$P_{i,j,t}^{\text{hypothetical}} = \text{Present Value}_{i,j,t} = \sum_{k=t}^{m} \frac{\text{Cash Flow}_k}{(1 + Y_{i^*,j,t,m})^k} \tag{10}$$

Since the benchmark yield curve is based on domestic-law bonds, the estimated net present value corresponds to the theoretical price of a hypothetical domestic-law bond with the same characteristics as the observed foreign-law bond.[27] By comparing the price of such a hypothetical domestic-law bond with the observed price of a foreign-law bond, we obtain a measure of the premium (or discount) associated with a foreign jurisdiction. Similarly, we can compute the yield to maturity based on that theoretical price and compare it to the yield to maturity based on the observed price. This difference in yield to maturity represents the annual premium placed on the foreign jurisdiction:

$$\text{Premium}_{i,j,t} = Y_{i,j,t,m}^{\text{hypothetical}} - Y_{i,j,t,m}^{\text{observed}} \tag{11}$$

This premium is our variable of interest.[28] It represents the interest rate that countries "save" on their foreign-law bonds, vis-à-vis a hypothetical identical bond placed under domestic jurisdiction. To mitigate the risk that outliers distort the estimates, we take a conservative approach and clean the resulting dataset along four dimensions. First, we remove price spikes where the premium exceeds the average of a 5-day window centered on t by more than 400%. Second, we remove irrational price observations where the risk-free $P_{i,j,t}^{\text{risk-free}}$ is smaller than $P_{i,j,t}^{\text{hypothetical}}$. Third, we drop stale price observations where the quoted price does not change over five consecutive trading days. Altogether, this removes less than 14% of initial observations in our sample. Finally, we winsorize the foreign-law premium at the 1st and 99th percentile. Importantly, our results do not depend on this data cleaning; on the contrary, some of the main coefficient estimates are considerably larger in the full sample.

Table 2 presents summary statistics on the premium. On average, it amounts to -10 basis points; however, there are considerable differences between countries, currencies, jurisdictions, and time periods.[29] For Austria, Belgium, Finland, Italy and Spain, the mean premium is negative, ranging between -15 (Belgium) and -25 basis points (Italy); only for Greece, Portugal, and Slovakia we observe a positive average premium of between

depreciation of the EUR exchange rate following a default of a euro area member (see e.g. Mano, 2013). However, we can replicate our main results in the subsample of only EUR denominated bonds, which is not affected by these concerns, see Table 7.

[27] Note that even when we use benchmark curves of third countries, these are only used to adjust the risk-free currency risk between the euro and a foreign currency. Credit risk is entirely determined by the domestic benchmark yield curve.

[28] Note that we express the premium in terms of yields rather than prices.

[29] In particular, bonds issued in Japanese Yen stand out from the rest of the sample. All our empirical findings in the subsequent sections are robust to excluding these bonds.

Table 2: Foreign-law premium – descriptive statistics

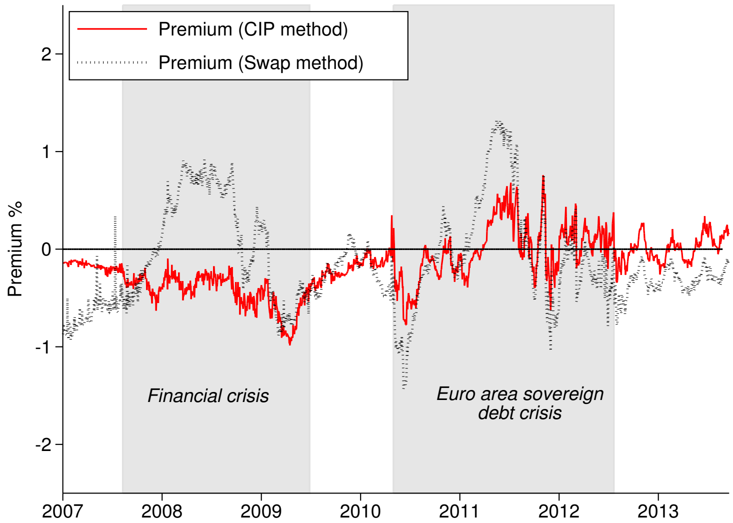
		Premium		
		Observations	Mean	SD
Country	Austria	13,266	-0.136	0.327
	Belgium	1,510	-0.146	0.296
	Finland	3,463	-0.135	0.348
	Greece	3,908	0.181	1.805
	Italy	19,840	-0.247	0.410
	Portugal	2,780	0.455	2.463
	Slovakia	6,319	0.153	0.366
	Spain	6,675	-0.236	0.409
Currency	CHF	4,866	0.120	0.738
	EUR	10,563	0.109	0.953
	GBP	3,822	0.131	2.086
	USD	38,510	-0.215	0.476
Governing law	Switzerland	2,303	0.213	1.034
	Germany	97	0.339	0.149
	England	32,492	-0.032	0.987
	France	799	-0.110	0.144
	Luxembourg	158	1.071	0.339
	New York	21,912	-0.256	0.412
Year	2006	8,360	-0.114	0.288
	2007	7,401	-0.237	0.232
	2008	6,765	-0.325	0.342
	2009	7,027	-0.362	0.496
	2010	7,612	-0.168	0.476
	2011	7,598	0.267	1.300
	2012	7,571	0.173	1.471
	2013	5,427	-0.119	0.587
CDS spread	Below 3%	49,002	-0.172	0.383
	Between 3-5%	4,234	-0.230	0.748
	Between 5-7%	1,346	-0.015	0.700
	Between 7-10%	728	0.601	1.963
	Above 10%	865	3.636	3.903

15 (Slovakia) and 45 basis points (Portugal). We also find some variation with respect to different jurisdictions. Bonds governed by Swiss, German, and Luxembourg law all carry positive premia throughout the sample period; bonds under French, English or New York law have slightly negative premia on average. However, this masks substantial variation over time and between countries, with Greece driving the bulk of the averages and variation. During the height of the euro area debt crisis in 2011 and 2012, the premium turns positive on average, as well as for the different jurisdictions individually. This is also visible in Figure 3, which shows the volume-weighted aggregate foreign-law premium throughout the sample period. The premium only turns positive during the height of the financial crisis in 2008/09 as well as during the euro area debt crisis.

Figure 4 shows this variation over time more carefully, by plotting the average premium by country (weighted by the bonds' nominal amount) during the height of the European sovereign debt crisis 2010-13. For the early period of the crisis in 2010, the premium is close to zero for all countries and does not change much. However, the premium increases in line with the rising distress in the coming months, evidenced

Figure 3: Foreign-law premium over time

This figure shows the average estimated legal premia, both weighted by issue-size and excluding Greek bonds. The shaded areas indicate the global financial crisis from August 9th, 2007 (BNP halts redemptions in some of its investment funds) to June 30th, 2009 (end of NBER recession), as well as the euro area debt crisis from May 3rd, 2010 (first Greek bailout) and July 26th, 2012 (Mario Draghi's "whatever it takes" speech). The premium only turns significantly positive during these high-distress episodes.

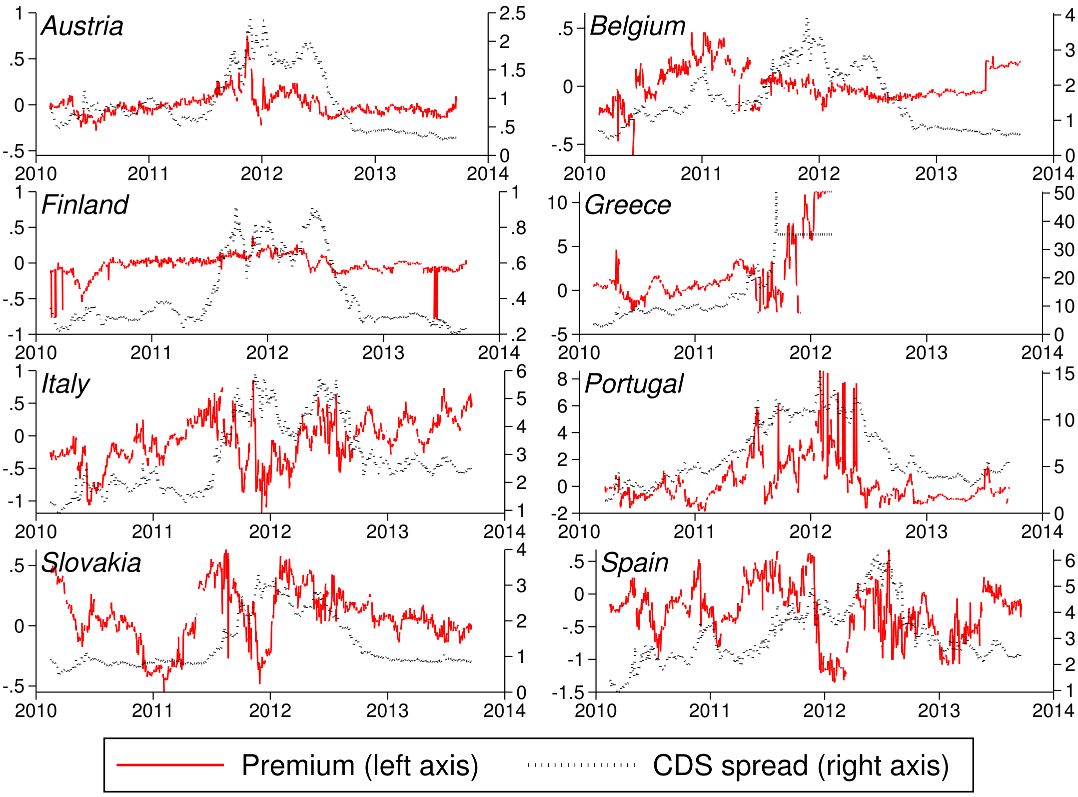


by rising CDS spreads especially during 2011-12. The co-movement is particularly pronounced for Greece, Italy, Portugal, Slovakia and Spain; the premium changes much less for Austria, Belgium, and Finland. This is consistent with the high-risk brackets as indicated by the CDS spreads in Table 2.

The instances of a negative premium as well as the considerable variance, both within as well as between countries, suggests that not only credit risk is driving the premium. Non-EUR denominated foreign-law bonds make up only a small segment of most euro area government borrowing (see Figure 1). This suggests that they are less actively traded than their domestic-law benchmark counterparts and subject to a liquidity premium, reducing the observed yield difference. Indeed, for foreign-law bonds, we find an average bid-ask spread of around 46 basis points relative to the mid-quote. This is considerably above the bid-ask spreads of around 31 basis points in euro area domestic-law benchmark government bonds in our sample. Outside of crisis episodes, Beber, Brandt and Kavajecz (2009) show that domestic-law benchmark bonds rarely exhibit bid-ask spreads above 1-2 basis points in calm times. The negative premia observed for parts of our samples are therefore likely the effect of such liquidity differences between domestic and foreign markets. In addition, foreign currency bonds were not eligible for use as collateral with the ECB during a large part of our sample period (see Eberl and Weber, 2014). This further reduces the value of foreign-law bonds for market participants. Both market liquidity risk and the lack of ECB eligibility should lead us to underestimate the jurisdiction premium we find, which we take into account in the robustness analysis.

Figure 4: Foreign-law premia and CDS spreads

This figure shows the estimated legal premium on foreign-law bonds (country averages weighted by issue amount) and the country-level CDS spread. The foreign-law premium is shown on the left axes (in %), and the CDS spread (in %) on the right axes.



4 Econometric approach and main results

4.1 Econometric approach

As a first step, we estimate the following linear regression for the panel of foreign-law bonds:

$$\text{Premium}_{i,j,t} = \alpha_j + \beta_1 \text{Default risk}_{j,t} + \beta_2 \text{Rel. bid-ask}_{i,j,t} + \beta_3 \text{Time to Maturity}_{i,j,t} + \theta_{i,j} + \epsilon_{i,j,t} \quad (12)$$

where *Premium* is the absolute spread between the observed and hypothetical yield to maturity on the foreign-law bond.[30] i, j and t indicate the bond, country and day, respectively. $\theta_{i,j}$ is a bond-level fixed effect and $\epsilon_{i,j,t}$ represents an uncorrelated error term. We measure the country default risk with the CDS spread, either in levels or transformed

[30]Our main result also holds if we consider the absolute spread relative to the hypothetical yield (unreported).

into the risk-neutral probability of default, assuming a fixed recovery rate of 40%.[31] Our prior is that the foreign-law premium is positively associated with default risk since the legal protection can only make a difference in the event of a default.

To control for the relative illiquidity of foreign-law bonds, we include the difference between the foreign-law bonds' bid-ask spread and the domestic benchmark bonds' bid-ask spread. We expect a negative relationship with the difference in bid-ask spreads since, all else equal, a relatively less liquid bond is less attractive. Finally, in the case of a compounding default probability, a foreign-law bond with a longer time to maturity should have a larger premium. As a default becomes eminent, the premium should be larger for shorter-term bonds.[32]

There are potential concerns that the relation between CDS spreads and the legal premium might be spurious, if both series are generated by a non-stationary process. The default of the Greek government in 2012 implied an explosive behavior of the Greek CDS spread series, strongly suggesting a non-stationary process. Even though Fisher-type panel unit root tests lead us to reject the hypothesis that the series in all panels possess a unit root, this is an overly permissive null (Ng, 2008), especially in the presence of the Greek CDS series. Since the foreign-law premium is fairly persistent, and we cannot exclude that it is integrated of order one I(1), we also estimate equation (12) in differences:

$$\begin{aligned}\Delta\text{Premium}_{i,j,t} = \alpha_j + \beta_1\Delta\text{Default risk}_{j,t} + \beta_2\Delta\text{Rel. bid-ask}_{i,j,t} \\ + \beta_3\text{Time to Maturity}_{i,j,t} + \theta_{i,j} + \epsilon_{i,j,t}\end{aligned} \tag{13}$$

A large increase in the premium, in the absence of a proportional adjustment in the CDS spreads, is likely to be reversed over time. In order to allow the specification to capture a richer dynamic relationship between these two variables, we include the lagged levels of the premium and CDS spread in the regression in differences to estimate a simplified error correction model:

$$\begin{aligned}\Delta\text{Premium}_{i,j,t} = \alpha_j + \beta_1\text{Premium}_{i,j,t-1} + \beta_2\Delta\text{Default risk}_{j,t} + \beta_3\text{Default risk}_{j,t-1} \\ + \beta_4\text{Rel. bid-ask}_{i,j,t} + \beta_5\text{Time to Maturity}_{i,j,t} + \theta_{i,j} + \epsilon_{i,j,t}\end{aligned} \tag{14}$$

[31]The recovery rate assumption is calibrated to the recovery rate in the Greek debt restructuring in 2012 (Zettelmeyer, Trebesch and Gulati, 2013). We extract the risk-neutral default probability as $PD_{j,t} = 1 - exp\left(-\text{CDS}_{j,t} * \frac{5}{100\%-40\%}\right)$ from the 5-year tenor CDS spreads. This approach is commonly referred to as the credit triangle approximation, and assumes a constant instantaneous default probability over the swap's maturity. See Hébert and Schreger (2017) for a succinct derivation of this approach and a discussion of related data issues in the sovereign CDS context; for a comparison with alternatives such as bootstrapping, see Andritzky and Singh (2006) and Andritzky (2006).

[32]For example, consider a case where creditors expect a 50% haircut on domestic bonds, but no restructuring of foreign bonds. If a default is eminent, domestic bond prices will converge to 50 cents on the dollar, and a 1 or a 10 year domestic bond will have similar prices if investors expect both to be accelerated and receive the same haircut. But the premium on short-term foreign bonds will be much larger than on long-term bonds. For example, a 1 year bond that is expected to be excluded from the restructuring could trade at a premium close to 1,000 basis points, whereas a 10 year zero-coupon bond could at most trade at a premium of 720 basis points (since that premium 12 is compounded over a longer maturity).

This model yields the same point estimates as a regression in first differences with a lagged error correction term from the residuals of a regression of the level of the premium on the level of the default risk measure, but estimates the coefficients in a single equation (Keele and De Boef, 2008).

4.2 Main estimation results

The econometric analysis confirms the descriptive results and theoretical prior of a positive and significant relationship between country default risk and the legal premium. Table 3 reports the results pooling all bonds from all countries in the sample. Using the plain CDS spread as the country default risk measure in model (12) indicates that a rise in a country's CDS spread by one percentage point is associated with a 14 basis points larger premium (Column 1).

This finding is very similar when using the swap-based currency correction approach instead. Column 2 presents the results with the premium using the method suggested by Du and Schreger (2016). Similar to our benchmark measure of the foreign-law premium, a one-percentage point increase in the CDS spread relates to a 12 basis points higher premium. However, the number of bonds and observations is slightly lower, since we do not observe all swap rates in the required currencies and time horizons.

The relationship between the premium and spreads may be non-linear.[33] The results indicate that the relationship indeed becomes stronger at higher levels of CDS spreads. Column (3) captures that non-linearity by including cubic terms of the spread. The coefficients show significant decreasing effects in the linear term, increases in the quadratic term, and small decreases in the cubic term. This confirms the impression from the descriptive statistics and non-parametric results that the effect of an increase in the default probability on the foreign-law premium becomes more relevant for higher levels of credit risk. Indeed, the marginal effect of a one-percentage point increase in the CDS spread is not significant at the 5% confidence level for low risk levels (CDS spread = 1%), about 0.09 percentage points for heightened risk (CDS spread = 5%), and 0.25 percentage points for very high credit risk (CDS spread = 15%). In the pooled sample, the marginal effect peaks with 0.27 percentage points at a CDS spread of ca. 20% before declining again.

Our finding also holds when using the risk-neutral CDS-implied probability of default as a credit risk measure (Column 4). However, this transformation mutes the non-linearity in the data. Since the default probability is a concave function of the CDS spread, while the CDS-premium relation exhibits a convex form, the coefficient on the default probability is lower than on the CDS spread. For a one-percentage point higher implied default probability, the premium increases by 2 basis points.

The relative illiquidity of foreign-law bonds compared to domestic-law bonds issued

[33] In the appendix, we provide evidence for this conjecture on the basis of non-parametric and semi-parametric models.

Table 3: Pooled results

The table reports results from regressions based on equations 12 and 13. All models include bond fixed effects, and Hubert-White standard errors are reported in parentheses below the coefficients. The dependent variable in column 1-3 is the legal premium in levels as in eq. 12, and credit risk is measured by CDS spreads. Column 1 presents pooled results of all countries. Column 2 uses the premium computed using the swap-based method suggested by Du and Schreger (2016). Column 3 has a cubic specification to accommodate a potential non-linearity in the relationship. Column 4 replaces the plain CDS spread with the implied default probability. In columns 5 and 6, the dependent variable is the first difference of the premium as in eq. 13.

	Premium				ΔPremium	
	CDS spread	Swap-based premium	Cubic specification	Implied PD	Δ CDS	Δ PD
	(1)	(2)	(3)	(4)	(5)	(6)
CDS spread	0.14***	0.12***	-0.06			
	(0.02)	(0.03)	(0.05)			
CDS spread^2			0.02**			
			(0.01)			
CDS spread^3			-0.00**			
			(0.00)			
Implied PD				0.02***		
				(0.01)		
Liquidity spread	-0.09***	-0.17***	-0.03	-0.17***		
	(0.02)	(0.03)	(0.02)	(0.03)		
ΔCDS spread					0.17**	
					(0.08)	
ΔImplied PD						0.06***
						(0.01)
ΔLiquidity spread					-0.00	-0.00
					(0.00)	(0.00)
Time to maturity	0.00	-0.00	-0.00**	0.00	-0.00**	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.43***	-0.16	0.09	-0.39***	0.00***	0.00***
	(0.09)	(0.17)	(0.12)	(0.14)	(0.00)	(0.00)
R2 B	0.39	0.05	0.12	0.35	0.18	0.15
R2 W	0.24	0.17	0.28	0.17	0.03	0.05
R2 O	0.25	0.15	0.19	0.20	0.03	0.05
Obs	51809	46011	51809	51809	50613	50613
No. Bonds	76	73	76	76	76	76

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

by the same government significantly reduces the premium. Specifically, a one-percentage point higher liquidity spread between a foreign-law bond and the domestic benchmark bond is associated with a 17 basis points smaller premium. This implies that with a 50 basis points difference in bid-ask spreads between foreign and domestic-law bonds, the implied default probability would have to rise by 5 percentage points to induce a positive premium. The relatively strong effect of bond illiquidity can explain why we observe negative absolute values for our main dependent variable in large parts of our sample and especially during low-risk episodes. While the bond fixed effects included in all regressions should account for any bond-specific average liquidity risk premia, the significant negative coefficient on the relative illiquidity measure is in line with the view that liquidity risk compensation is time-varying (Beber, Brandt and Kavajecz, 2009; Brunnermeier and Pedersen, 2009). The estimated coefficient on the residual time to maturity is small and statistically insignificant.

The results are comparable when estimating the first differenced model (13). A one-percentage point change in the CDS spread is associated with a 17 basis points rise in the legal premium, while the same increase in the default probability implies a 6 basis points change in the premium (Columns 5 and 6). The larger size of the estimated effect in the first-differenced model (13) than in the levels model (12) could derive from additional unobserved, but potentially time-varying differences in liquidity between the domestic and foreign-law bonds.

While we control for the relative illiquidity of foreign-law bonds with the difference in bid-ask spreads, that may not be sufficient to capture all dimensions of liquidity differences. If additional liquidity differences exist, they are less problematic in the first-differenced model, where a shift in an unobserved time-varying parameter would affect only a single observation in the time-series of differences whereas they would have a permanent effect on the premium in levels. The stronger effects in the first differenced model therefore lend further support to the significant and positive correlation found in levels.

Our results do not depend on individual countries and are robust when considering within-country variation only. While Belgium, Finland and Portugal have only 3-5 foreign bonds outstanding, other countries have up to 19 (Austria, Italy). Besides the time-series variation, this allows exploiting cross-sectional variation even within countries. Table 4 shows regressions of model (12) in levels within countries. For bonds issued by Greece, Portugal, Spain, and Belgium, the coefficient on default risk is positive and significant, ranging from a 1 to 5 basis points increase in the premium for a one-percentage point rise in the implied default probability. Only for Italian bonds, the estimated correlation in levels is negative. To some extent, this is due to the fact that the default risk for Italy even at the peak of the crisis remained below other vulnerable countries, with narrower CDS spreads. Non-parametric estimations (shown in the appendix) indicate a non-linear relation between credit risk and the foreign-law premium with stronger effects for higher CDS spread levels. These would not be captured in the Italian sample. Furthermore, since the Italian domestic government bond market is the largest sovereign bond market in the euro area, and arguably the most liquid of the four vulnerable countries in our sample,[34] any downward bias resulting from not fully controlling for relative illiquidity premia on foreign law bonds are likely to be strongest in the Italian sample. Pelizzon et al. (2016) provide evidence for secular shifts in market liquidity of Italian government bonds through the crisis. This explanation is corroborated by the results in the first-differenced model discussed below, which show that the correlation between changes in credit risk and changes in the foreign-law premium are also consistently positive and significant for Italian bonds.

The result can also be replicated in substance for the less vulnerable countries in

[34] The average bid-ask spread on Italian domestic-law bonds is 14 basis points, the lowest of the four "non-core" countries.

Table 4: Country results (levels)

The table shows results from country-by-country regressions in levels as in equation 12. The dependent variable is the foreign-law premium in levels. All regressions include bond fixed effects, and Hubert-White standard errors are reported below the coefficients.

	Premium							
	Greece	Italy	Portugal	Spain	Austria	Belgium	Finland	Slovakia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Implied PD	0.05***	-0.01***	0.01***	0.01**	0.01	0.02**	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)
Liquidity spread	-0.18***	0.23***	-0.23***	-0.00	0.16	0.31*	-0.01	-0.03
	(0.03)	(0.04)	(0.00)	(0.02)	(0.12)	(0.10)	(0.01)	(0.08)
Time to maturity	0.02**	-0.01***	0.01**	0.00	-0.00**	-0.01*	0.01	0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-2.09***	0.39***	-0.54***	-0.89	-0.02	0.48*	-0.74	0.12
	(0.47)	(0.13)	(0.05)	(0.52)	(0.11)	(0.16)	(0.36)	(0.13)
R2 B	0.95	0.07	0.07	0.69	0.65	0.94	0.74	0.57
R2 W	0.33	0.11	0.28	0.04	0.05	0.16	0.19	0.01
R2 O	0.29	0.01	0.19	0.19	0.18	0.31	0.44	0.00
Obs	3475	19062	1894	6669	11967	1115	2804	4823
No. Bonds	6	19	4	9	19	3	5	11

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

our sample, albeit the estimated effect size is smaller and lacks statistical significance in most cases. The estimated effect of a one-percentage point rise in the implied default probability ranges from less than 1 to 2 basis points for Austria, Belgium, Finland and Slovakia. Together with non-parametric estimation results (reported in the appendix) and the cubic model described in Table 3 this suggests that the foreign-law premium is mainly relevant for countries experiencing significant financial distress; in "normal" times, and for perceived safe issuers, the relation between default risk and jurisdiction premium is weaker.

The country-specific estimates of the first-differenced model (13) confirm and strengthen the results in levels. Table 5 shows that a one-percentage point increase in the CDS-implied default probability results in a change in the legal premium of between 0.06 and 0.14 percentage points for the more vulnerable countries, with the strongest effect coming from the Portuguese bonds. The effect in the Italian subsample are comparable in size and statistical significance to the other three "non-core" countries. This result provides further support that the estimated negative effect in levels may be due to unaccounted level shifts in market liquidity which are not adequately controlled for in model (12). The estimated effect in the less vulnerable countries is smaller in size, but still statistically significant.

The sharper results from the regression in differences are consistent with the descriptive evidence from the summary plots. Those plots showed a strong tendency for co-movement between the premium and CDS spreads, particularly for higher-risk countries, which is consistent with the results in the differences regressions. However, those plots also point to periods where the premium was high (or low) regardless of the evolution of the CDS spreads, e.g. when the two lines (in different scales) would cross.

Table 5: Country results (first differences)

The table shows results from country-by-country regressions in levels as in equation 12. The dependent variable is the foreign-law premium in levels. All regressions include bond fixed effects, and Hubert-White standard errors are reported below the coefficients.

	ΔPremium							
	Greece	Italy	Portugal	Spain	Austria	Belgium	Finland	Slovakia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔImplied PD	0.06***	0.07***	0.14***	0.06***	0.01**	0.03***	0.03**	0.01
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
ΔLiquidity spread	-0.01*	0.01	-0.00***	-0.00	-0.00	0.04	-0.02***	0.01
	(0.00)	(0.01)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)	(0.01)
Time to maturity	-0.00	-0.00**	-0.00	-0.00	-0.00	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.02*	0.00**	0.01	0.00	0.00**	0.00	-0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
R2 B	0.05	0.03	0.01	0.68	0.11	0.54	0.03	0.22
R2 W	0.02	0.11	0.15	0.10	0.00	0.06	0.01	0.00
R2 O	0.02	0.11	0.15	0.10	0.00	0.06	0.01	0.00
Obs	3386	18725	1852	6490	11726	1065	2724	4645
No. Bonds	6	19	4	9	19	3	5	11

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

This is consistent with the weaker results for the level regressions.

Results from the error correction model (14) suggest a significant error-correction rate and a positive equilibrium relationship between credit risk and the legal premium. Notably, the results with respect to the relation between changes in the CDS-implied default probability and changes in the foreign-law premium remain almost identical to those obtained from equation (13), both in the pooled sample as well as in the country-by-country regressions. Column 1 of Table 6 shows the estimation in the pooled sample. A change in our default risk measures is significantly related to a change in the premium, indicating a stable association in the short run after taking into account dynamic effects. The significantly positive relation of changes in the default risk with the legal premium are also confirmed for the four "non-core" countries individually, reported in Columns 2–5. The short-term effect is of similar size for Greece, Italy, and Spain, while it is somewhat stronger in Portugal.

4.3 Robustness analysis of main results

Multiple robustness checks show that our main result does not depend on the currency correction we employ, collateral eligibility with the ECB, specific time windows, or ratings as alternative credit risk measures. Table 7 reports the results in levels in the pooled sample of all countries and bonds and using the CDS-implied default probability as the benchmark default risk measure.[35] In all specifications, the estimated coefficient points to a statistically significant increase of 0.02-0.04 percentage points in the level of the premium for a one-percentage point increase in the implied PD.

[35] The full results on a country-by-country level are available upon request.

Table 6: Error correction model

The table shows results from country-by-country regressions in first differences as in equation 13. The dependent variable is the foreign-law premium in first differences. All regressions include bond fixed effects, and Hubert-White standard errors are reported below the coefficients.

	ΔPremium				
	Pooled	Greece	Italy	Portugal	Spain
	(1)	(2)	(3)	(4)	(5)
ΔImplied PD	0.06***	0.06***	0.07***	0.15***	0.06***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
Premium_{t-1}	-0.03***	-0.02	-0.06***	-0.07***	-0.06***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Implied PD_{t-1}	0.00	0.00*	-0.00***	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ΔLiquidity spread	-0.00	-0.01**	0.01	-0.00***	-0.00
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Time to maturity	-0.00	0.00	-0.00***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.00	-0.04	0.05***	-0.04**	-0.02
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)
R2 B	0.00	0.03	0.01	0.03	0.27
R2 W	0.07	0.02	0.14	0.18	0.13
R2 O	0.06	0.02	0.05	0.17	0.12
Obs	50613	3386	18725	1852	6490
No. Bonds	76	6	19	4	9

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

First, to ensure our main result does not depend on residual and unaccounted currency risk, we can exploit the fact that some European governments have issued foreign-law bonds denominated in EUR. One dimension of currency risk which the CIP approach cannot correct for is a possible correlation of the exchange rate between the EUR and foreign currencies with a default or exit of one of the euro area member states. If such an event triggered a depreciation of the EUR against the foreign currencies, our estimate of the synthetic foreign-law bond yields would be biased. Our sample contains 17 foreign-law bonds denominated in EUR, for which no currency correction according to equation (9) is necessary and to which these concerns do not apply.[36]

These bonds exist primarily for two reasons. First, several countries maintain active international issuance programmes under which they can flexibly issue new or tap existing bonds according to changing market conditions (often called "euro medium term notes", EMTN). EMTN and similar programmes are used to issue bonds outside the typically pre-scheduled issuance cycles for benchmark government bonds via auctions.[37]

[36]The sample of EUR-denominated foreign-law bonds contains 2 securities issued by Austria, 2 by Belgium, 1 by Finland, 2 by Greece, 3 by Portugal, 6 by Slovakia, and 1 by Spain.

[37]For instance, Austria's debt management office explains the reason for maintaining its EMTN programme governed by English law and as follows: "International capital market participants are facing increasing demands for transparency, flexibility and speed of response. The Republic of Austria meets these requirements by standardising its products to the greatest extent possible. The EMTN programme provides for a broad range of transaction types and allows a period of time between launch and payment date of only three days, thus enabling the Republic to react quickly to specific market situations and opportunities." See the website of the Austrian Treasury (OeBFA), `http://www.oebfa.at/en/FinancingInstruments/Pages/EuroMediumTermNoteProgramme.aspx`, accessed on 6

Table 7: Robustness checks

The table reports results from exposing the regressions as in (12) to a series of robustness checks. Column 1 uses only EUR denominated foreign-law bonds which do not need to be adjusted for currency risk relative to their domestic-law benchmarks. Column 2 uses only non-EUR denominated bonds. Column 3 includes a binary monthly indicator capturing whether the bond was included in the ECB list of eligible collateral instruments at each point in time. Column 4 reports results restricting the sample period to pre-March 2012 observations, and column 5 reports the equivalent for the post-March 2012 sample. Column 6 replaces the CDS spread with credit ratings by Standard and Poor's, linearly transformed to a numerical scale. All regressions include bond fixed effects, and Hubert-White standard errors are reported below the coefficients.

	Premium					
	EUR bonds	Non-EUR bonds	ECB eligibility	Pre-March 2012	Post-March 2012	Ratings
	(1)	(2)	(3)	(4)	(5)	(6)
Implied PD	0.04***	0.02***	0.02***	0.02***	0.01***	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	
Liquidity spread	-0.16***	-0.14**	-0.17***	-0.17***	-0.02	-0.17***
	(0.01)	(0.06)	(0.02)	(0.02)	(0.03)	(0.03)
Time to maturity	0.00*	0.00	-0.00	0.00**	-0.01	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
ECB collateral eligible			-0.24			
			(0.21)			
Rating						-0.11***
						(0.04)
Constant	-0.64**	-0.34**	-0.02	-0.63***	0.25	1.88***
	(0.23)	(0.15)	(0.27)	(0.18)	(0.49)	(0.61)
R2 B	0.38	0.12	0.10	0.35	0.21	0.22
R2 W	0.25	0.12	0.20	0.18	0.04	0.16
R2 O	0.26	0.10	0.11	0.16	0.01	0.14
Obs	8302	43507	24453	41223	10586	52964
No. Bonds	17	59	50	68	39	78

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

Most of these framework specify that any bonds issued under the agreement are governed by English law. While the programmes are primarily used to issue non-EUR denominated debt, they are also used to issue EUR-denominated bonds which then fall under foreign jurisdiction. Second, there are still a number of bonds outstanding that were issued by European governments in predecessor currencies of the EUR. These bonds were issued during the 1990s to tap what were at the time foreign-currency markets, such as the German DEM or the French Franc, and were governed by the laws of the countries whose currencies the bonds were denominated in. With the introduction of the EUR, the bonds' currency was redenominated, but the other clauses of the bond contracts were left untouched, including the governing laws.

Restricting the sample to foreign-law bonds denominated in EUR yields a considerably larger coefficient on credit risk than in our benchmark estimation, suggesting that our currency correction introduces a conservative downward bias on the premium. Column 1 shows the results restricting the sample to EUR denominated bonds only. The coefficient is twice as large than in the full sample, and more than doubles compared to the results from estimating using non-EUR denominated bonds only (Column 2). This indicates

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that the true correlation between default risk and the legal premium may be even stronger than our main estimates suggest. This is especially the case for the Greek bonds: the estimated coefficient using only the EUR-denominated bonds rises to 0.07. The same coefficient is 0.02 in the Spanish subsample, and not statistically significant in the Portuguese subsample.[38]

Second, eligibility as collateral in credit operations with the central bank does not affect the main result. As discussed above, foreign-law bonds tend to be less liquid than domestic-law bonds, which we partly capture by including the difference in bid-ask spreads of the foreign-law bond and the domestic-law benchmark bond. However, there is another important dimension of liquidity that is not captured by the bid-ask difference measure, namely whether the bonds are eligible for as collateral for the ECB's credit operations and for its asset purchase programmes.[39] The eligibility as ECB collateral could have a substantial effect on the demand for, and hence the premium, of foreign-law bonds. Relatedly, Corradin and Rodriguez-Moreno (2016) show that a large spread emerged between EUR and USD denominated bonds issued by the same euro area country. They attribute that spread to ECB liquidity facilities and non-standard monetary policy measures that impacted EUR and foreign currency denominated bonds differently.

We re-estimate the regression controlling for whether a bond was eligible as collateral based on publicly available ECB data. Specifically, we use the encompassing list of eligible marketable assets that were eligible as collateral in credit operations with the ECB as released between April 2010 and September 2013.[40] The resulting monthly binary indicator takes the value one if a bond is listed as eligible by the ECB at that point in time and zero otherwise.[41] As expected, the estimated coefficient on the dummy (Column 3) is negative, although not significantly so. The size and significance of the coefficient on the implied default probability does not change.

Third, the results are not affected by dividing the sample at the time of the Greek debt restructuring, where the government discriminated between foreign- and domestic-law bonds. Columns 4 and 5 show results estimated in the period before and after 8 March 2012, the closing date of the Greek bond exchange. While the exchange offer also extended to foreign-law bonds, these were not affected by the retroactive insertion of collective action clauses, and foreign-law bondholders who refused to tender their securities into the exchange could expect to be paid in full and on time (Zettelmeyer, Trebesch and Gulati, 2013). Although this brought the possible value of holding foreign-

[38]We cannot estimate the coefficient for Italy since there are no Italian EUR foreign-law bonds in our sample.

[39]In our sample, only the Securities Market Program (SMP) after May 2010 was active in government bond markets. The bigger and more recent Public Sector Purchase Programme (PSPP) was implemented only from March 2015 onwards.

[40]The lists were retrieved from the ECB's website. Data before April 2010 is unfortunately not publicly available. No Italian foreign-law bond in our sample was listed as eligible, which is why we cannot estimate the adjusted model in the Italian sample only.

[41]Since the eligibility criteria were amended in response to the increasing funding pressure of banks relying on peripheral bonds as collateral, the dummy coincides with the height of the crisis and thus captures a lot of variation in the data. This collinearity potentially reduces our chances of finding significant results.

law bonds to greater public attention, the results suggest that the market pricing of the bonds had incorporated the effect already before.

Finally, Column 4 shows that our finding remains robust when using credit ratings as a measure of credit risk instead of CDS spreads. To this end we transform the sovereign ratings to a linear scale. The results show that higher ratings are associated with a decrease in the foreign-law premium. A one-notch upgrade reduces the foreign-law premium by 11 basis points.

4.4 Probability of differential default

This section turns to the implied risk-neutral probability of a country defaulting on its domestic-law bonds while continuing to service foreign-law bonds as described in eq. (5).[42] The average selective default probability π is 9% in our sample. However, we observe considerable variation across time: Figure 5 plots the average implied π for Greece, Italy, Portugal, and Spain. Before the euro area sovereign debt crisis began in 2010, the market-implied risk of a selective default was close to zero, barely rising even during the height of the global financial crisis in 2008/09. In contrast, from 2010 onwards, π rose considerably in response to events that could be seen as increasing the risk of a debt restructuring, reaching levels in excess of 20 percent at times and even higher levels in a subsample of Greek bonds.

We investigate the drivers of π more systematically using the same framework applied in the previous section.[43] We estimate the model in the pooled sample of all countries as well as in country-specific sub-samples. Notably, illiquidity has a stronger effect on the estimate of π than of the foreign-law premium, since even small pricing errors can significantly distort the variable through the scaling to the bonds' spread over risk-free rates. This is because the denominator of the expression for the implied probability involves the difference between the risk-free price and the domestic bond price. As that denominator becomes small, it amplifies the effect of foreign-law bond premium on the implied probability π. Our estimates of π are therefore considerably more sensitive to data quality issues. However, as in the previous section, such effects are of greater concern for the results in levels than for the estimates in first differences.

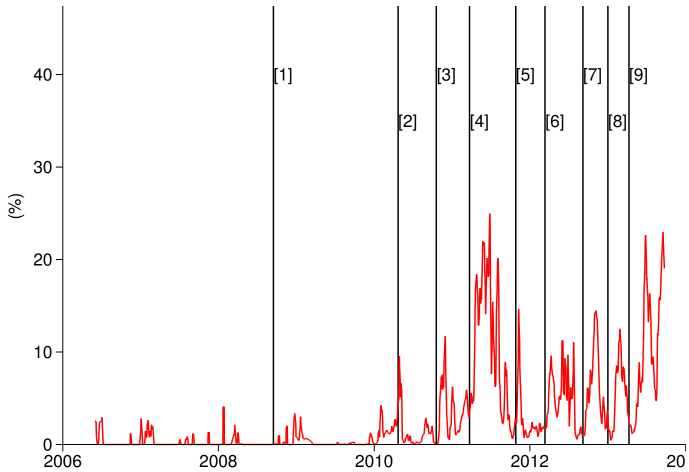
The left panel of Table 8 reports the results in levels. Using the pooled sample (Column 1), we find that a one-percentage point rise in the default probability significantly increases the probability of a differential default by 0.1 percentage points. While the estimated effect is also positive in all country sub-samples except for Italy, the coefficient

[42]When the foreign law bond trades at a discount vis-á-vis the domestic bond (negative foreign-law premium), (5) implies a negative value for π. We censor those observations at $\pi = 0\%$. When the foreign-law premium is smaller than the risk-premium (the difference in prices between the foreign-law and domestic bonds is smaller than the difference between the risk-free bond and the domestic bond, which is relatively rare in our sample), (5) implies $\pi > 100\%$. We censor those observations at $\pi = 100\%$.

[43]Note that since the probability π is bounded between zero and one, an econometric model accounting for limited dependent variables may be more appropriate than the linear probability model (LPM) that we apply here. Our main results also hold with a Tobit or fractional response model (unreported). For simplicity and to preserve the comparability with the previous sections, we show only the LPM here.

Figure 5: Average selective default probability π in Greece, Italy, Portugal Spain

The figure plots average level of the probability of selective default on domestic-law bonds 8 (5-day moving average, weighted by issued amounts). Black lines indicate a number of key events that were followed by temporary spikes in π: [1] 9/15/2008 Lehman collapse; [2] 4/23/2010 Greece requests IMF assistance; [3] 10/19/2010 Deauville meeting; [4] 3/24/2011 EU agrees on establishing ESM; [5] 10/27/2011 PSI proposal published; [6] 3/12/2012 Greek debt restructuring; [7] 9/6/2012 ECB announces OMT; [8] 1/1/2013 Euro CACs introduced; [9] 4/10/2013 First leak about Cyprus debt restructuring of domestic bonds only.



size and statistical significance vary considerably (Columns 2-5). The constant (and bond fixed effects) capture important information in these regressions for the probability of differential default, unlike in the regressions with the foreign-law premium as the dependent variable.[44] The constant coefficient in the regressions implies a sizable probability of selective default for Greece and Italy (8 and 17%, respectively) even when spreads are low.[45]

This significant slope estimate is consistent with the markets perceiving differential default as a more likely prospect when credit risk is higher. However, even if the probability remained constant over time, we would still observe an increase in the foreign-law premium as credit risk increases: that probability would translate into a negligible premium when credit risk is low, but foreign-law bonds would become relatively more attractive as credit risk rises.

As in the previous sections, estimating the relationship in differences can attenuate sources of noise related to illiquidity or other idiosyncratic bond characteristics. The results in differences, shown in the right panel of Table 8, imply a much stronger relationship between credit risk and the implied probability of differential default than the results in levels (Columns 6-10). For example, the point estimate of 0.77 in the pooled sample implies that a 10 percentage point increase in the probability of default is

[44]In the regressions where the dependent variable is the foreign-law premium, the constant is not very important since in principle that premium should be negligible in the absence of credit risk. However, the implied probability of differential default can be substantial at commensurately small levels of foreign-law premium and credit risk since eq. (5) involves the ratio of former to the latter.

[45]Note that the bond-level fixed effects are estimated under the constraint that the average fixed effect (weighted by the number of observations) is zero.

associated with a 7.7 percentage point increase in the probability of differential default. The relationship is also stronger in the individual country samples, with the point estimates implying that a one-percentage point increase in the probability of default is associated with an increase in the implied probability of differential default ranging from 0.48 in the case of Greece to 1.11 in the case of Italy.

Table 8: Differential default probability π

The table shows results from pooled and country-by-country regressions with the differential default probability π as the dependent variable. The left panel (Columns 1-5) shows results in levels as in eq. (12). The right panel (Columns 6-10) shows results in first differences as in eq. (13). All regressions include bond fixed effects, and Hubert-White standard errors are reported below the coefficients.

	π					$\Delta\pi$				
	Pooled	Greece	Italy	Portugal	Spain	Pooled	Greece	Italy	Portugal	Spain
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Implied PD	0.10**	0.08	-0.24***	0.05***	0.23***					
	(0.05)	(0.04)	(0.07)	(0.00)	(0.04)					
Liquidity spread	0.30	0.33***	3.08***	-0.55***	-0.24					
	(0.20)	(0.05)	(0.91)	(0.02)	(0.23)					
ΔImplied PD						0.77***	0.48***	1.11***	0.87***	1.00***
						(0.12)	(0.08)	(0.10)	(0.03)	(0.21)
ΔLiquidity spread						0.15	0.00	-0.09	0.12***	-0.07
						(0.17)	(0.02)	(0.23)	(0.00)	(0.04)
Time to maturity	-0.01	-0.09*	-0.15***	0.04	0.04***	-0.00	0.00**	-0.00**	0.00	-0.00
	(0.04)	(0.04)	(0.03)	(0.03)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Constant	7.57**	7.89*	16.75***	1.24	-4.89***	0.03	-0.09**	0.04**	-0.03	0.00
	(3.55)	(3.75)	(3.00)	(0.76)	(1.22)	(0.03)	(0.03)	(0.02)	(0.18)	(0.05)
R2 B	0.02	0.26	0.07	0.05	0.74	0.01	0.01	0.42	0.28	0.77
R2 W	0.00	0.13	0.15	0.01	0.05	0.00	0.02	0.04	0.00	0.04
R2 O	0.00	0.01	0.00	0.01	0.10	0.00	0.02	0.04	0.00	0.04
Obs	52855	3549	19399	1930	6828	52450	3508	19320	1914	6769
No. Bonds	76	6	19	4	9	76	6	19	4	9

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

5 Emerging Markets: the case of Argentina and Russia

We do not attempt to estimate foreign-law premia in emerging market (EME) bonds under the same approach used for the euro area. Disentangling currency risk from legal risk is challenging, if not impossible, in these countries. Moreover, most emerging markets lack a domestic benchmark yield curve, especially in the 1990s and early 2000s, when most EME crises occurred.[46]

In light of these complications, we conducted an extensive search for "twin bonds", i.e. bonds issued in the same currency and with a similar maturity and coupon structure, but with different governing laws. To do so, we gathered a dataset of all EME sovereign bonds issued since 1990 as contained in the comprehensive Dealogic database and used Bloomberg to search for yield data of promising bond pairs. Ultimately, we only found "twin bonds" with reasonable pricing data in two countries: Argentina and Russia. Both countries issued domestic-law bonds in USD in the wake of sovereign debt restructuring agreements. This allows us to extract approximate foreign-law premia directly from the yields. Specifically, for Russia, we focus on an English-law, USD-denominated Eurobond issued in 1997 and maturing in 2007 (ISIN: US78307AAB98) and compare its yield to the average yield of two Russian-law, USD denominated instruments due in 2006 and 2008: the "MinFin5" and "MinFin6" bonds with ISINs of RU0001337966 and RU0004146083, respectively. For Argentina, we use an even cleaner bond pair, since the country issued exactly the same instruments in both domestic and foreign law in its 2005 bond restructuring. Specifically, we compare the yields of the so called "Discount Bonds" under New York law with the yield of that same series under Argentinian law (both due 2033 and with ISINs: US040114GL81 and ARARGE03E097, respectively). Another perfect "twin" pair are the USD "Par Bonds" due 2038, which were also partly issued under New York law and partly under Argentinian law.

The resulting yield differences between local law and foreign-law USD bonds are plotted in Figure 6. The upper panel shows the premium of the Russian foreign-law Eurobond vis-à-vis the respective domestic-law instruments. The approximate foreign-law premium is largest in 2000-2003, a period with high yields in which Russia was still recovering from its own 1998-1999 default. The premium then decreases from more than 400 basis points to close to zero in the boom years of 2004-2006. For Argentina, the lower two panels show the evolution of the foreign-law premium by comparing the yields of New York law bonds with those of their domestic-law twin. The premium is highest after the outbreak of the 2008 financial crisis, reaching up to 600 basis points. It then decreases strongly and even turns negative after Oct. 26, 2012, when the New York Second Circuit Court of Appeals announced a surprise ruling in favor of the hedge fund NML (a subsidiary of Elliott) which made forwarding payments on the New York law

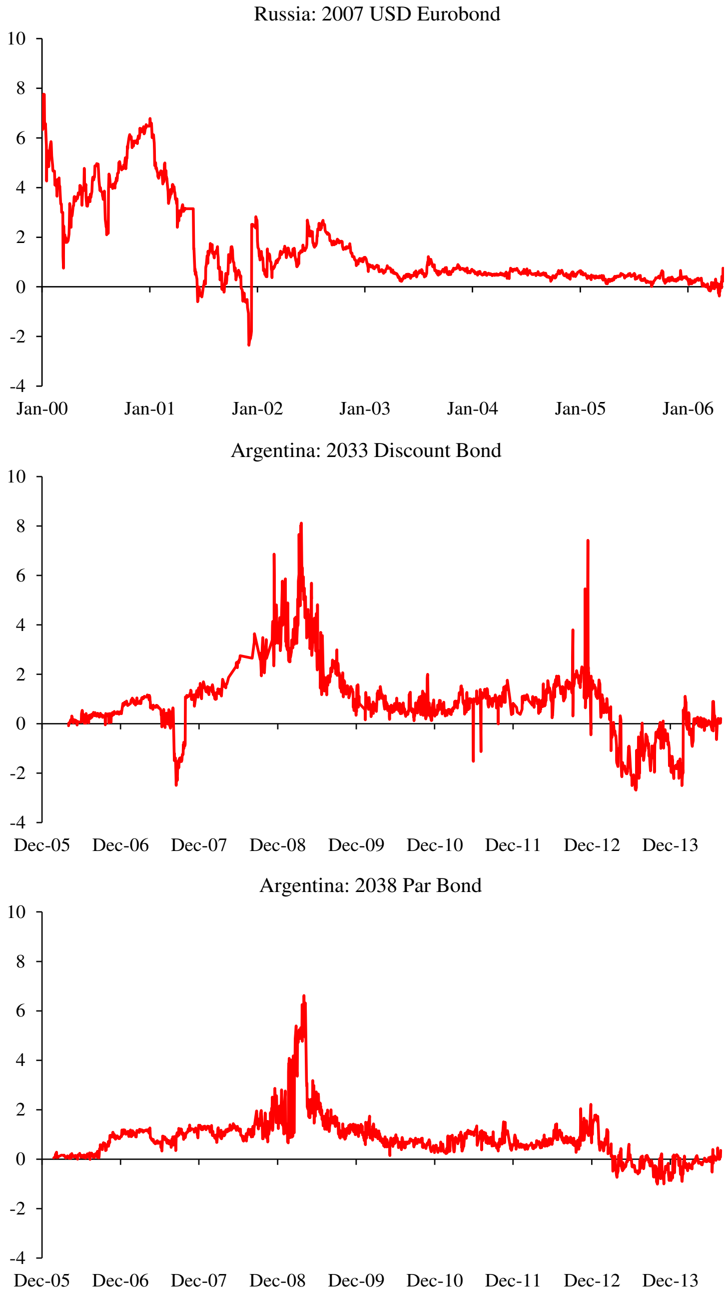
[46] Du and Schreger (2016) estimate local currency risk-free curves for Emerging Markets beginning in 2005. In theory, their analysis could be extended to the late 1990s/early 2000s. But the noise involved is likely larger than the jurisdiction premium we are trying to recover (particularly since debt crises tend to coincide with currency crises).

bonds illegal for US intermediaries, resulting in a default on those bonds in August 2014.

Taken together, these two case studies thus confirm our findings for the euro area: the foreign-law premium is typically small, but it can become quite sizable during periods of debt distress.

Figure 6: Foreign-law premia in Russia and Argentina

This figure shows the yield difference between bonds issued by the same government under different jurisdictions. For Russia, the yield difference is computed between the English-law, USD-denominated Eurobond (US78307AAB98, due 2007) and the respectively imputed yields of Russian-law, USD denominated MinFin6 (RU0001337966, due 2006) and MinFin5 (RU0004146083, due 2008) bonds. The bonds for Argentina are the USD denominated exchange bonds from the 2005 debt restructuring (Discounts due 2033: local law ARARGE03E113, New York law US040114GL81; Par due 2038: local law ARARGE03E097, New York law US040114GK09).



6 Conclusion

This paper estimates the yield premium associated with issuing sovereign bonds in foreign jurisdictions. Our results for euro area countries indicate that the premium is small or even negative when credit risk is low, but it can become sizable in crisis times. As the market-implied risk-neutral probability of default increases, the relative value of foreign-law bonds also rises. Furthermore, we find a notable foreign-law premium following the sovereign debt restructurings of Russia in 2000 and of Argentina in 2005.

Our results thus suggest that countries can borrow, at the margin, at more favorable terms by selling bonds in a foreign jurisdiction in episodes of distress, although they may have to pay slightly more during normal times. As we have stressed above, the finding may be due to a portfolio rebalancing of investors into harder to restructure debt when a default becomes likely. Foreign-law bonds can also protect against other legal risks, such as the redenomination of the payment currency. Moreover, distressed debt investors may enter the market and push up the price for foreign-law bonds which are more suitable for holdout strategies.

Furthermore, we present evidence that the probability of a selective default on domestic-law obligations tends to increase with rising levels of credit risk. The estimated relationship is fairly flat when the regression is estimated in levels, but becomes steeper when estimated in first differences.

The findings are consistent with the view that issuing foreign-law bonds provides the possibility of commitment in crisis times: by issuing under foreign jurisdictions and thereby making the debt harder to restructure, sovereigns send a signal that they are unlikely to default on such bonds. Dilution considerations also contribute to a lower yield of foreign-law bonds. As shown by Bolton and Jeanne (2009), the larger the stock of harder to restructure debt (e.g. foreign-law bonds) the higher the expected haircut on the easier to restructure debt (e.g. domestic-law bonds). However, there are limits to a dilution strategy, since the higher the share of foreign-law debt, the lower the likelihood that it will be spared in the event of a default. In that regard, the estimated premium for peripheral Europe, where the bulk of the debt was issued domestically, may be larger than what we would observe for an emerging market, where the share of foreign-law debt is higher to begin with.

In normal times, however, countries do not seem to pay more when issuing debt with easier to restructure debt. The small or even negative foreign-law premium that we observe for low to moderate levels of credit risk suggests that issuing hard to restructure debt brings negligible benefits outside of crisis times, or could indeed be costly. These results speak to the literature on sovereign default and debt restructuring procedures, in which ex-ante vs. ex-post considerations play a central role (see e.g. Dooley, 2000; Pitchford and Wright, 2007; Bolton and Jeanne, 2007, 2009).

References

Andritzky, Jochen. 2006. *Sovereign Default Risk Valuation. Implications of debt crises and bond restructurings.* Springer.

Andritzky, Jochen, and Manmohan Singh. 2006. "The Pricing of Credit Default Swaps During Distress." IMF Working Paper No. 06/254.

Bardozzetti, Alfredo, and Davide Dottori. 2014. "Collective action clauses: How do they affect sovereign bond yields?" *Journal of International Economics*, 92(2): 286–303.

Beber, Alessandro, Michael W. Brandt, and Kenneth A. Kavajecz. 2009. "Flight-to-Quality or Flight-to-Liquidity? Evidence from the Euro-Area Bond Market." *Review of Financial Studies*, 22(3): 925–957.

Becker, Torbjörn, Anthony Richards, and Yunyong Thaicharoen. 2003. "Bond restructuring and moral hazard: are collective action clauses costly?" *Journal of International Economics*, 61(1): 127–161.

Bi, Ran, Marcos Chamon, and Jeromin Zettelmeyer. 2011. "The Problem that Wasn't: Coordination Failures in Sovereign Debt Restructurings." IMF Working Paper No. 11/265.

Bolton, Patrick, and Olivier Jeanne. 2007. "Structuring and Restructuring Sovereign Debt: The Role of a Bankruptcy Regime." *Journal of Political Economy*, 115(6): 901–924.

Bolton, Patrick, and Olivier Jeanne. 2009. "Structuring and Restructuring Sovereign Debt: The Role of Seniority." *The Review of Economic Studies*, 76(3): 879–902.

Bradley, Michael, and Mitu Gulati. 2014. "Collective Action Clauses for the Eurozone." *Review of Finance*, 1–58.

Bradley, Michael, Irving Arturo De Lira Salvatierra, and Mitu Gulati. 2016. "A Sovereign's Cost of Capital: Go Foreign or Stay Local." mimeo, Duke University.

Bradley, Michael, James Cox, and G. Mitu Gulati. 2010. "The Market Reaction to Legal Shocks and their Antidotes: Lessons from the Sovereign Debt Market." *Journal of Legal Studies*, 39(1): 289–324.

Broner, Fernando, Aitor Erce, Alberto Martin, and Jaume Ventura. 2014. "Sovereign debt markets in turbulent times: Creditor discrimination and crowding-out effects." *Journal of Monetary Economics*, 61: 114–142.

Broner, Fernando, Alberto Martin, and Jaume Ventura. 2010. "Sovereign Risk and Secondary Markets." *American Economic Review*, 100(4): 1523–1555.

Brunnermeier, M., and L. H. Pedersen. 2009. "Market Liquidity and Funding Liquidity." *Review of Financial Studies*, 22(6): 2201–2238.

Buraschi, Andrea, Murat Menguturk, and Emrah Sener. 2015. "The Geography of Funding Markets and Limits to Arbitrage." *Review of Financial Studies*, 28(4): 1103–1152.

Chen, Kathryn, Michael Fleming John Jackson Ada Li, and Asani Sarkar. 2011. "An Analysis of CDS Transactions: Implications for Public Reporting." Federal Reserve Bank of New York Staff Reports No. 517.

Choi, Stephen J., Mitu Gulati, and Eric A. Posner. 2011. "Pricing terms in sovereign debt contracts: a Greek case study with implications for the European crisis resolution mechanism." *Capital Markets Law Journal*, 6(2): 163–187.

Clare, Andrew, and Nicolas Schmidlin. 2014. "The Impact of Foreign Governing Law on European Government Bond Yields." mimeo, Cass Business School.

Corradin, Stefano, and Maria Rodriguez-Moreno. 2016. "Violating the law of one price: the role of non-conventional monetary policy." ECB Working Paper No. 1927.

De Santis, Roberto. 2015. "A measure of redenomination risk." ECB Working Paper No. 1785.

Dooley, Michael P. 2000. "International financial architecture and strategic default: can financial crises be less painful?" *Carnegie-Rochester Conference Series on Public Policy*, 53(1): 361–377.

Du, Wenxin, and Jesse Schreger. 2016. "Local Currency Sovereign Risk." *Journal of Finance*, 71(3): 1027–70.

Eberl, Jakob, and Christopher Weber. 2014. "ECB Collateral Criteria: A Narrative Database 2001–2013." Ifo Working Paper No. 174.

Eichengreen, Barry, and Ashoka Mody. 2000. "What Explains Changing Spreads on Emerging Market Debt?" In *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies.* , ed. Sebastian Edwards, 107–134. University of Chicago Press.

Eichengreen, Barry, and Ashoka Mody. 2004. "Do Collective Action Clauses Raise Borrowing Costs?" *Economic Journal*, 114(495): 247–264.

Engelen, Christian, and Johann Lambsdorff. 2009. "Hares and stags in Argentinean Debt Restructuring." *Journal of International Economics*, 78(1): 141–148.

Erce, Aitor. 2012. "Selective Sovereign Defaults." Federal Reserve Bank of Dallas Working Paper No. 127.

Fan, Jianqing. 1992. "Design-adaptive Nonparametric Regression." *Journal of the American Statistical Association*, 87(420): 998–1004.

Frankel, Jeffrey. 2014. "It takes more than two to tango: Cry, but not for Argentina, nor for the holdouts." *VoxEU*.

Gai, Prasanna, Somon Hayes, and Hyun Song Shin. 2004. "Crisis Costs and Debtor Discipline: the Efficacy of Public Policy in Sovereign Debt Crises." *Journal of International Economics*, 62(2): 245–262.

Ghosal, Sayantan, and Kannika Thampanishvong. 2013. "Does Strengthening Collective Action Clauses (CACs) Help?" *Journal of International Economics*, 89(1): 68–78.

Ghosal, Sayantan, and Marcus Miller. 2003. "Co-ordination Failure, Moral Hazard and Sovereign Bankruptcy Procedures." *Economic Journal*, 113(487): 276–304.

Guembel, Alexander, and Oren Sussman. 2009. "Sovereign Debt without Default Penalties." *Review of Economic Studies*, 76: 1297–1320.

Gulati, Mitu, and Jeromin Zettelmeyer. 2012. "Making a Voluntary Greek Debt Exchange Work." *Capital Markets Law Journal*, 7: 169–183.

Haldane, Andrew, Adrian Penalver, Victoria Saporta, and Hyung Shin. 2005. "The Analytics of Sovereign Debt Restructuring." *Journal of International Economics*, 65(2): 315–333.

Härdle, Wolfgang K., and Piotr Majer. 2014. "Yield curve modeling and forecasting using semiparametric factor dynamics." *The European Journal of Finance*, 1–21.

Haselmann, Rainer, Katharina Pistor, and Vikrant Vig. 2010. "How Law Affects Lending." *Review of Financial Studies*, 23(2): 549–580.

Hébert, Benjamin, and Jesse Schreger. 2017. "The Costs of Sovereign Default: Evidence from Argentina." *American Economic Review*, 107(10): 3119–3145.

IMF. 2013. *Sovereign Debt Restructuring. Recent Developments and Implications for the Fund's Legal and Policy Framework.* Washington D.C:IMF.

International Swaps and Derivatives Association. 2002. *2002 Master Agreement.* New York, London:ISDA.

International Swaps and Derivatives Association. 2012. *Final List of Deliverable Obligations.* New York, London:ISDA, available online at http://dc.isda.org/cds/the-hellenic-republic-3/, last access March 27, 2015.

Keele, Luke J., and Suzanna De Boef. 2008. "Taking Time Seriously: Dynamic Regression." *American Journal of Political Science*, 52: 184–200.

Krishnamurthy, Arvind, Stefan Nagel, and Annette Vissing-Jorgensen. 2014. "ECB Policies involving Government Bond Purchases: Impact and Channels." mimeo, University of Michigan.

Kriwoluzky, Alexander, Gernot Müller, and Martin Wolf. 2015. "Exit and default premia in currency unions." CEPR Discussion paper 10817.

Mano, Rui. 2013. "Exchange Rates upon Sovereign Default." mimeo, University of Chicago.

Mesters, Geert, Bernd Schwaab, and Siem Jan Koopman. 2014. "A Dynamic Yield Curve Model with Stochastic Volatility and Non-Gaussian Interactions: An Empirical Study of Non-Standard Monetary Policy in the Euro Area." Tinbergen Institute Discussion Paper, 14-071/III.

Miller, Darius, and Natalia Reisel. 2012. "Do Country-level Investor Protections Affect Security-level Contract Design? Evidence from Foreign Bond Covenants." *Review of Financial Studies*, 25(2): 408–438.

Miller, Marcus, and Lei Zhang. 2000. "Sovereign Liquidity Crises: The Strategic Case for a Payments Standstill." *Economic Journal*, 110(460): 335–362.

Nelson, Charles R., and Andrew F. Siegel. 1987. "Parsimonious Modeling of Yield Curves." *Journal of Business*, 60(4): 473–489.

Ng, Serena. 2008. "A Simple Test for Nonstationarity in Mixed Panels." *Journal of Business & Economic Statistics*, 26(1): 113–127.

Nordvig, Jens. 2015. "Legal Risk Premia During the Euro-Crisis: The Role of Credit and Redenomination Risk." Discussion Papers on Business and Economics, University of Southern Denmark, 10/2015.

Panizza, Ugo. 2008. "Domestic and external public debt in developing countries." UNCTAD Discussion Papers No. 188.

Pelizzon, Loriana, Marti G. Subrahmanyam, Davide Tomio, and Jun Uno. 2016. "Sovereign credit risk, liquidity, and European Central Bank intervention: Deus ex machina?" *Journal of Financial Economics*, 122(1): 86–115.

Pitchford, Rohan, and Mark L. J. Wright. 2007. "Restructuring the Sovereign Debt Restructuring Mechanism." mimeo, UCLA.

Pitchford, Rohan, and Mark L. J. Wright. 2012. "Holdouts in Sovereign Debt Restructurings: A Theory of Negotiations in a Weak Contractual Environment." *Review of Economic Studies*, 79(2): 1–26.

Randl, Otth, and Josef Zechner. 2016. "Sovereign Reputation and Yield Spreads: A Case Study on Retroactive Legislation." CFS Working Paper No. 545.

Reinhart, Carmen, and Kenneth Rogoff. 2011. "The Forgotten History of Domestic Debt." *Economic Journal*, 121(552): 319–350.

Richards, Anthony, and Mark Gugiatti. 2003. "Do Collective Action Clauses Influence Bond Yields? New Evidence from Emerging Markets." *International Finance*, 6(3): 415–447.

Roubini, Nouriel. 2000. "Bail-In, Burden-Sharing, Private Sector Involvement (PSI) in Crisis Resolution and Constructive Engagement of the Private Sector. A Primer: Evolving Definitions, Doctrine, Practice and Case Law." mimeo, New York University.

Schumacher, Julian, Christoph Trebesch, and Henrik Enderlein. 2018. "Sovereign Defaults in Court." ECB Working Paper No. 2135.

Stevis, Matina. 2012. "Greek Legal Maneuvers Raise Fear of Eurozone Debt Fallout." *Wall Street Journal*, February 23, 2012.

Svensson, Lars E. 1994. "Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994." IMF Working Paper No. 94/114.

Thomas, Landon. 2012. "Given Greek Deal, Investors May Reconsider Sovereign Debt." *New York Times*, February 24, 2012.

Trebesch, Christoph, and Jeromin Zettelmeyer. 2014. "ECB Interventions in Distressed Sovereign Debt Markets: The Case of Greek Bonds." CESifo Working Paper No. 4731.

Tsatsaronis, K. 1999. "The effect of collective action clauses on sovereign bond yields." *BIS Quarterly Review: International Banking and Financial Market*, November(22-23).

Weinschelbaum, Federico, and Josef Wynne. 2005. "Renegotiation, collective action clauses and sovereign debt markets." *Journal of International Economics*, 67(1): 47–72.

Yatchew, Adonis. 1998. "Nonparametric Regression Techniques in Economics." *Journal of Economic Literature*, 36: 669–721.

Zettelmeyer, Jeromin, Christoph Trebesch, and Mitu Gulati. 2013. "The Greek Debt Restructuring: An Autopsy." *Economic Policy*, 28(75): 513–563.

A Appendix

Table A1: Foreign-law bonds

Country	ISIN	Issue date	Maturity date	Coupon (%)	Amount issued (USD m)	Governing law	Currency
Austria	XS0092819753	01/05/1999	10/05/2009	5.25	1,700	England	USD
Austria	CH0006111394	04/21/1999	08/21/2009	3	1,287	Switzerland	CHF
Austria	XS0096779417	04/28/1999	04/28/2006	5.5	1,000	England	USD
Austria	XS0136383733	09/28/2001	12/04/2006	4.5	750	England	USD
Austria	CH0013587024	01/25/2002	01/25/2012	3.375	1,120	England	CHF
Austria	XS0143275252	02/22/2002	02/22/2012	5.5	600	England	USD
Austria	XS0143683612	03/07/2002	08/31/2007	5	600	England	USD
Austria	CH0014100918	05/14/2002	05/14/2007	3	560	England	CHF
Austria	XS0153786974	08/30/2002	08/30/2010	4.375	1,200	England	USD
Austria	XS0155222671	10/04/2002	10/04/2006	3	750	England	USD
Austria	XS0163904617	03/06/2003	03/30/2007	2.625	400	England	USD
Austria	XS0167894616	05/12/2003	05/12/2010	3.5	500	England	USD
Austria	XS0170724479	06/25/2003	06/25/2013	3.25	3,100	England	USD
Austria	XS0186999743	03/03/2004	05/27/2011	3.625	1,250	England	USD
Austria	US052591AR54	05/19/2004	05/19/2014	5	1,300	England	USD
Austria	XS0372004761	06/25/2008	06/25/2013	3.25	300	England	USD
Austria	CH0103325715	07/14/2009	07/14/2016	2.5	1,008	England	CHF
Austria	US052591AW40	06/17/2011	06/17/2016	1.75	1,000	England	USD
Austria	XS0749005186	02/21/2012	10/19/2029	3.56	148	England	EUR
Austria	XS0749005343	02/21/2012	10/19/2029	2.452	29	England	EUR
Belgium	XS0026163435	06/28/1990	06/28/2010	9.2	500	England	USD
Belgium	BE0364162249	04/05/2002	04/05/2022	0	68	England	EUR
Belgium	BE6254011339	06/14/2013	06/17/2048	3.6	68	Germany	EUR
Finland	US317873AY36	02/29/1996	02/15/2026	6.95	300	New York	USD
Finland	US317873BD89	03/06/2002	03/06/2007	4.75	1,500	New York	USD
Finland	XS0410355365	01/27/2009	05/16/2011	1.5	2,000	England	USD
Finland	US31788DAA28	10/19/2010	10/19/2015	1.25	2,000	England	USD
Finland	US31788DAB01	03/17/2011	03/17/2016	2.25	2,000	England	USD
Finland	FI4000068663	09/04/2013	09/15/2018	1.125	6,802	Germany	EUR
Greece	GB0000766039	09/06/1985	09/06/2010	10.75	128	England	GBP
Greece	US423324AC66	03/04/1998	03/04/2008	6.95	1,750	New York	USD
Greece	XS0085654068	03/31/1998	03/31/2008	5.75	2,720	England	EUR
Greece	XS0191352847	04/30/2004	07/17/2034	5.2	1,360	England	EUR
Greece	CH0021839524	07/05/2005	07/05/2013	2.125	728	Switzerland	CHF
Greece	XS0372384064	06/25/2008	06/25/2013	4.625	1,500	England	USD
Italy	US465410AH18	09/27/1993	09/27/2023	6.875	3,500	New York	USD
Italy	US465410AW84	02/22/2001	02/22/2011	6	2,000	New York	USD
Italy	US465410AX67	04/05/2001	04/05/2006	5.25	2,000	New York	USD
Italy	XS0137815246	10/25/2001	10/25/2006	4.375	5,000	New York	USD
Italy	US465410BA55	03/01/2002	06/15/2012	5.625	3,000	New York	USD
Italy	US465410BD94	09/04/2002	09/14/2007	3.625	3,000	New York	USD
Italy	US465410BG26	02/27/2003	06/15/2033	5.375	2,000	New York	USD
Italy	US465410BF43	02/27/2003	06/15/2013	4.375	2,000	New York	USD
Italy	US465410BH09	07/03/2003	07/15/2008	2.5	2,000	New York	USD
Italy	US465410BK38	03/03/2004	05/15/2009	3.25	2,000	New York	USD
Italy	US465410BM93	06/30/2004	12/14/2007	3.75	2,000	New York	USD
Italy	US465410BN76	01/21/2005	01/21/2015	4.5	4,000	New York	USD
Italy	US465410BP25	05/09/2005	06/16/2008	4	3,000	New York	USD
Italy	US465410BQ08	01/25/2006	01/25/2016	4.75	2,000	New York	USD
Italy	US465410BS63	06/12/2007	06/12/2017	5.375	2,000	New York	USD

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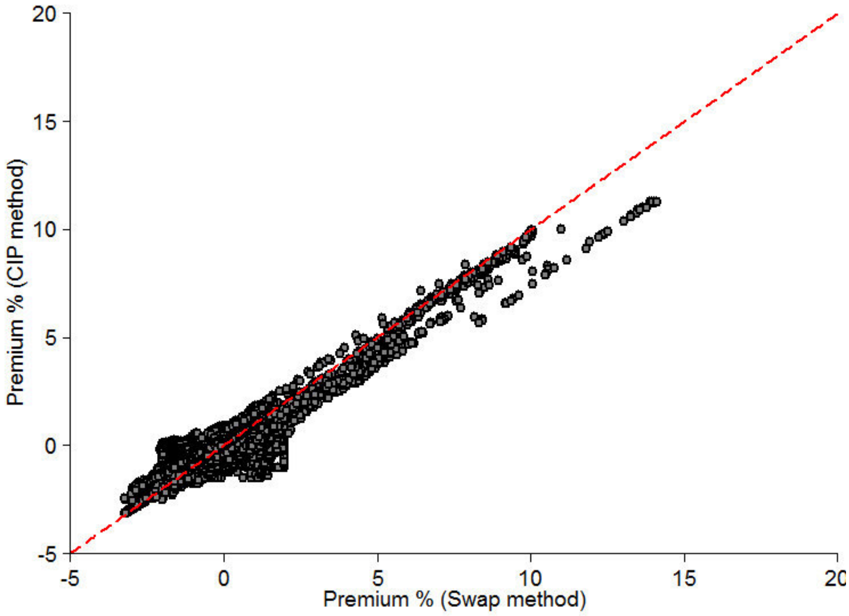
Table A1: Foreign-law bonds (continued)

Country	ISIN	Issue date	Maturity date	Coupon (%)	Amount issued (USD m)	Governing law	Currency
Italy	US465410BT47	06/04/2008	07/15/2011	3.5	2,500	New York	USD
Italy	US465410BU10	10/05/2009	10/05/2012	2.125	2,500	New York	USD
Italy	US465410BV92	01/26/2010	01/26/2015	3.125	2,500	New York	USD
Italy	US465410BW75	09/16/2010	09/16/2013	2.125	2,000	New York	USD
Portugal	GB0006964760	05/20/1986	05/20/2016	9	257	England	GBP
Portugal	FR0000108359	05/13/1996	05/13/2008	6.625	829	France	EUR
Portugal	FR0000583429	04/03/1997	04/03/2007	5.625	1,114	France	EUR
Portugal	XS0082026054	11/20/1997	03/26/2008	5.75	617	England	EUR
Portugal	XS0498724888	03/25/2010	03/25/2015	3.5	1,250	England	USD
Slovakia	DE0003525804	09/28/1999	09/28/2006	9.5	163	Luxembourg	EUR
Slovakia	DE0001074763	04/14/2000	04/14/2010	7.375	680	England	EUR
Slovakia	XS0192595873	05/20/2004	05/20/2014	4.5	1,360	England	EUR
Slovakia	XS0249239830	03/27/2006	03/26/2021	4	1,360	England	EUR
Slovakia	XS0299989813	05/15/2007	05/15/2017	4.375	1,360	England	EUR
Slovakia	XS0430015742	05/21/2009	01/21/2015	4.375	2,720	England	EUR
Slovakia	CH0181915585	04/25/2012	04/25/2022	2.75	196	Switzerland	CHF
Slovakia	CH0181379774	04/25/2012	04/25/2018	2.125	364	Switzerland	CHF
Slovakia	US831588AB47	05/21/2012	05/21/2022	4.375	1,500	England	USD
Slovakia	CH0206594498	04/16/2013	10/16/2019	1.375	448	Switzerland	CHF
Slovakia	CH0206594506	04/16/2013	10/16/2023	2.125	196	Switzerland	CHF
Spain	GB0008326562	02/27/1985	03/24/2010	11.75	103	England	GBP
Spain	XS0089378938	07/28/1998	07/28/2008	5.875	1,500	England	USD
Spain	XS0096272355	04/06/1999	04/06/2029	5.25	342	England	GBP
Spain	XS0225227528	07/20/2005	07/20/2010	4.125	1,000	England	USD
Spain	XS0363874081	05/14/2008	06/17/2013	3.625	2,000	England	USD
Spain	XS0416150950	03/05/2009	03/05/2012	2.75	1,000	England	USD
Spain	US84633PAA12	09/17/2009	09/17/2012	2	2,500	England	USD
Spain	XS0619977258	05/06/2011	05/06/2036	5.6	456	England	EUR
Spain	US84633PAB94	02/27/2013	03/06/2018	4	2,000	England	USD

Figure A1: Comparing CIP-based vs. swap-based premium

This figure plots the foreign-law premium computed using the CIP assumption explained in the text, against the foreign-law premium with currency risk adjustment according to Du and Schreger (2016). Both methods lead to very similar results (the correlation is 0.88). The red line marks a 45 degree line. The 1st and 99th percentile outlier observations are omitted from the graph.



Non-parametric analysis

We do not have a theoretical prior for the shape of the relationship between credit risk and the legal premium. In this section, we therefore present a visual exploration of the data by plotting non-parametrically and semi-parametrically estimated relationships to justify the parametric econometric analysis in Section 4. The analysis in this part is conducted in the full sample, without the data cleaning steps outlined in the main text.

In order to explore potential non-linearities, we first estimate the relationship between the foreign-law premium and CDS spreads non-parametrically. Suppose that relationship is given by a function $f(\cdot)$:

$$\text{Premium}_{i,j,t} = f(CDS_{j,t}) + \varepsilon_{i,j,t} \tag{15}$$

where $\text{Premium}_{i,j,t}$ is the foreign-law premium at which bond i issued by country j trades at date t, and $\text{CDS}_{j,t}$ is the 5-year CDS spread for country j at t. We estimate $f(\cdot)$ using Fan's (1992) locally weighted regression, with quartic kernel weights. Our estimates at a point with CDS spread CDS_1 are based on a linear regression that weights an observation with spread CDS_2 by:

$$w_{\text{CDS}_1}(\text{CDS}_2) = \begin{cases} \frac{15}{16}\left(1 - \left(\frac{\text{CDS}_1 - \text{CDS}_2}{\lambda}\right)^2\right)^2 & \text{if } |\text{CDS}_1 - \text{CDS}_2| < \lambda \\ 0 & \text{otherwise} \end{cases} \tag{16}$$

We estimate this non-linear regression for each country, pooling observations from all of their bonds. We also estimate that relationship in a semi-parametric specification, controlling for differences in time to maturity (in years) and the difference in the bid-ask spreads on the foreign-law bond and the domestic-law benchmark bond:

$$\text{Premium}_{i,j,t} = f(\text{CDS}_{j,t}) + \beta_{BA}\text{Rel. bid-ask}_{i,j,t} + \beta_{TM}\text{Time to Maturity}_{i,j,t} + \epsilon_{i,j,t} \tag{17}$$

We estimate the parametric terms β_{BA} and β_{TM} using the differencing method described in Yatchew (1998). We initially order the observations in increasing order of CDS. Let k denote that ordering. Under the assumption that $f(CDS_k) - f(CDS_{k-1}) \approx 0$, we can difference (17) in order to eliminate the non-parametric term and estimate:

$$\begin{aligned} &\text{Premium}_k - \text{Premium}_{k-1} = \\ &\quad \beta_{BA}(\text{Rel. bid-ask}_k - \text{Rel. bid-ask}_{k-1}) + \beta_{TM}(\text{Time to Maturity}_k - \text{Time to Maturity}_{k-1}) + v_k \end{aligned} \tag{18}$$

Once $\widehat{\beta}_{BA}$ and $\widehat{\beta}_{TM}$ have been estimated, we are ready to estimate the non-parametric term:

$$f(CDS_{i,t}) = \text{Premium}_{i,j,t} - \widehat{\beta}_{BA}\text{Bid-Ask}_{i,j,t} - \widehat{\beta}_{TM}\text{Time to Maturity}_{i,j,t} \tag{19}$$

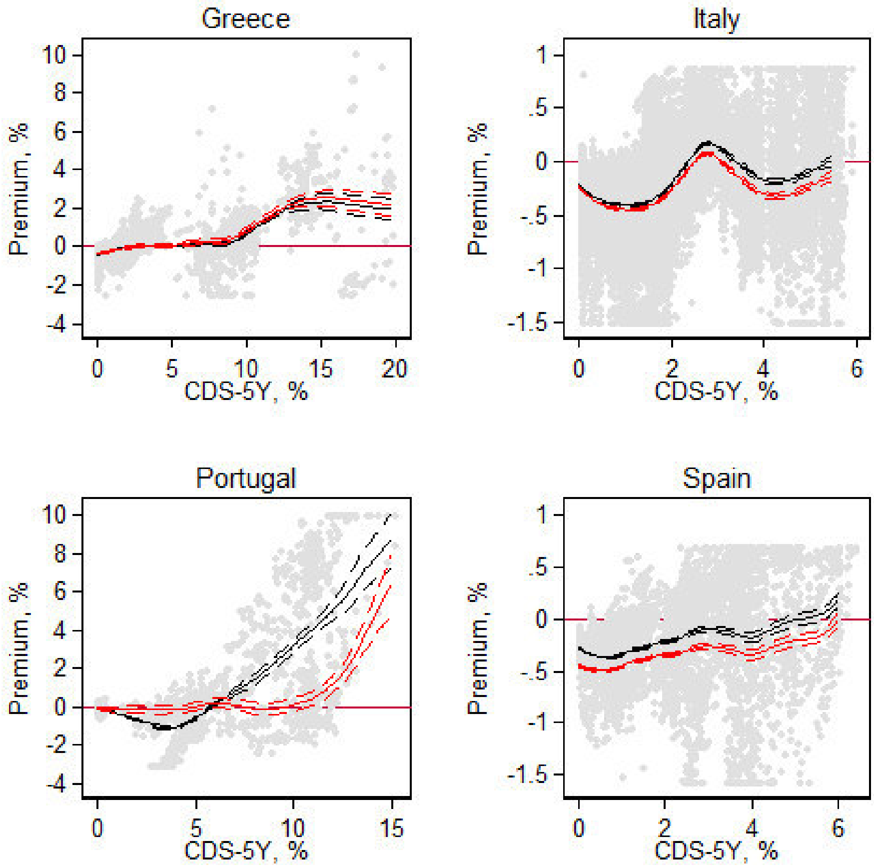
Figure A2 reports the results for Greece, Portugal, Spain and Italy. Each panel presents a scatter plot of the foreign-law premium and the CDS spreads, the estimated non-parametric relationship (solid black line) and the semi-parametric relationship that controls for differences in the bid-ask spread and time to maturity across bonds (solid red line). The dashed lines correspond to the bootstrapped 95% confidence interval.

The plot for Greece indicates a relatively flat relationship for low levels of the CDS spread. The premium starts to rise only after the CDS spread passes 7.5%. That relationship seems fairly linear until CDS spreads of about 12.5%. Past that threshold, the plot points again to a flat relationship. The error bands are fairly tight around the central estimates except for large values of the CDS spread (where we have relatively few observations, and as a result, the error bands become fairly wide). The two estimated specifications move closely in parallel to each other (with most of the difference between the two being a level effect).

The plot for Portugal also indicates no relationship between the foreign-law premium and CDS spreads for low levels of the latter, but a positive relationship once the CDS spread reaches around 5% for the non-parametric curve (black line), and around 12.5% for the semi-parametric curve that controls for changes in the relative bid-ask spreads and time to maturity (red line). As

Figure A2: Non-parametric relationship between foreign-law premium and CDS spread

This figure shows non-parametric estimates of the relationship between the foreign-law premium and the CDS spreads using a locally-weighted linear regression with quartic kernel weights for Greece, Italy, Portugal and Spain, respectively (black line). The red line corresponds to a semi-parametric estimation that controls for differences in the bid-ask spread and time to maturity. Estimates for Greece, Portugal, Spain and Italy based on a bandwidth of 600, 100, 250, and 100 basis points, respectively. Dashed line corresponds to the bootstrapped 95% confidence interval. Scatter plot excludes some outlier observations.



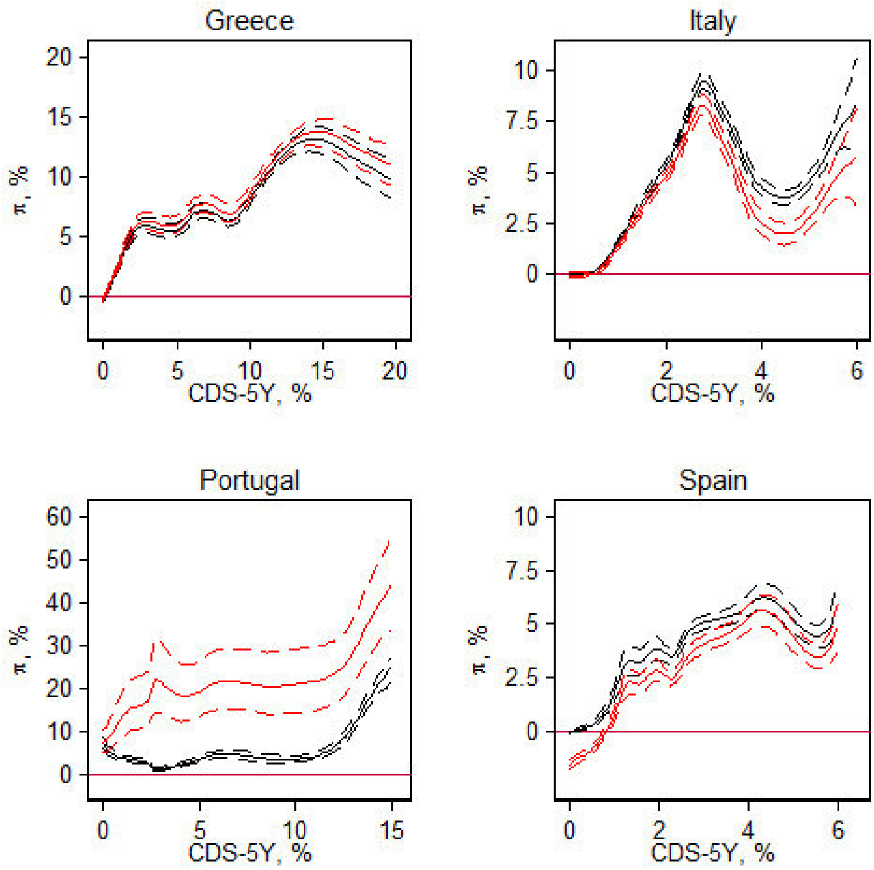
discussed in the data section, our sample includes only four foreign-law bonds for Portugal, one of which had a substantially larger premium than the other (as illustrated by the separate clusters of points in the scatter plots for large values of the CDS premium). The non-parametric results (black line) yield a curve that is essentially an averaging of these two clusters. The semi-parametric results (red line) follow the lower cluster of points more closely, as part of the higher premium for the bonds is attributed to bond-specific effects. The latter specification, however, points to a steeper relationship once it picks up. Whereas moving the CDS spread from 10 to 15% would raise the premium by 377 basis points along the black curve, it raises it by 530 basis points along the red line.

For Italy and Spain, the results point to an essentially flat relationship (note the difference in the scale of the premium relative to the previous figures). However, the CDS spread for Spain and Italy remained relatively contained throughout the crisis and never exceeded levels of 6.5%, considerably below the level at which we identify an upward slope in the Greek and Portuguese sub-samples. Thus, the lack of a relationship between the foreign-law premium and the spreads for these countries is consistent with our previous results for Greece and Portugal, where a clear relationship did not emerge until spreads reached higher levels.

We also detect a broadly increasing relationship between CDS spreads and the estimated

Figure A3: Non-parametric relationship between selective default probability π and CDS spread

This figure shows non-parametric estimates of the relationship between the selective default probability π and the CDS spreads using a locally-weighted linear regression with quartic kernel weights for Greece, Italy, Portugal and Spain, respectively (black line). The red line corresponds to a semi-parametric estimation that controls for differences in the bid-ask spread and time to maturity. Estimates for Greece, Portugal, Spain and Italy based on a bandwidth of 600, 100, 250, and 100 basis points, respectively. Dashed line corresponds to the bootstrapped 95% confidence interval.



selective default probability π, although the suggested functional form is somewhat more consistent across countries. For Greece, Italy, and Portugal, the results hint at an inverted S-shaped relationship. π increases relatively strongly as CDS spreads start to rise, but the relationship flattens relatively soon (or even turns negative in the case of Italy) at CDS spreads of around 3%. Only once spreads rise significantly higher does π also start to increase again. For Spain, there is less evidence of such a non-linear relationship; the selective default probability \$ implied in bond prices rises relatively linearly over the observed CDS spread support.