Limits to arbitrage: Empirical evidence from Euro area sovereign bond markets

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Abstract

In this paper, we document the occurrence of a large pricing anomaly in the Euro area sovereign bond market between 2008 − 2013. A large yield spread, a basis, developed between EUR- and USD-denominated comparable bonds issued by the same country. USD-denominated bonds became substantially cheaper (higher yield-to-maturity) than those denominated in Euro, once the foreign exchange rate risk is hedged in the USD-EUR currency swap market. Bond specific liquidity and funding costs and security lending frictions do not explain the observed elevated basis. We find that the European Central Bank (ECB) liquidity facilities and non-standard monetary policy measures play a key role in explaining the basis, using ECB proprietary data on all sovereign bond purchases and all sovereign collateral pledged in the euro area during this period. Because EUR-denominated bonds could be used as collateral for liquidity operations with the ECB at lower haircuts, a monetary funding premium is embedded in these bonds yields. Moreover, this funding premium might also vary over time, depending on the credit spreads of the sovereign issuer, on the one hand, and the general liquidity supply conditions partly determined by the ECB policy stance, on the other.

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1 Introduction

Since the beginning of 2010 Euro area sovereign bond markets have experienced significant strains as reflected in an increasingly widening yield spread across its member states from the already high spreads which had been observed in earlier stages after the collapse of Lehman Brothers in the second half of 2008. The increased dispersion of bond yields was caused by differential impacts of changing liquidity and funding conditions and changing market perceptions of the creditworthiness of sovereign issuers. This period is also characterized by the activation of a set of non-standard measures by the ECB. The President of the ECB Mario Draghi justified these interventions in July 2012 as follows: "To the extent that the size of these sovereign premia hampers the functioning of the monetary policy transmission channel, they come within our mandate."

In this paper, we document the occurrence of a large pricing anomaly in the Euro area sovereign bond market during this period. We show that a large yield spread, a basis, developed between USD- and EUR-denominated comparable bonds issued by the same country. We document that the pricing anomaly is a feature of bonds issued by Austria, Belgium, Finland, Italy and Spain for whom USD-denominated bonds are available.

We focus on fixed-rate coupon bonds denominated in USD traded on a daily basis. We select a comparable bond issued by the same sovereign in EUR in order to create a list of pair bonds in such a way that every USD-denominated bond has a comparable EUR-denominated bond in terms of issuer, issue date and maturity. For each USD-denominated bond, we create an equivalent synthetic EUR bond swapping the future cash flows in the USD-EUR currency swap market. For each pair, we construct a yield spread basis between the synthetic and cash bond. Figure 1 depicts the weekly average basis across the bond pairs analyzed for each euro area sovereign country for the period January 2008 to February 2013.

[INSERT FIGURE 1 HERE]

Before September 2008, the basis for each country is negligible. Over the period September 2008 - April 2010, the size of the anomaly was large, persistent and similar across the countries considered. The finding is consistent with Buraschi, Sener and Menguturk (2014), who find that USD-denominated bonds issued by Turkey traded at a cheaper level than the EUR-denominated bonds over the same time period. In May 2010 the intensification of the euro area sovereign bond impacted further on the size of the basis and significant differences emerged across the countries. The basis that we document widened (i.e., became more positive) in the second half of 2010 for countries whose sustainability of fiscal positions became a concern for market investors. Over this period, the weekly average basis across the bond pairs for Austria reached 93 bps, while the basis for Belgium, Italy and Spain reached 199 bps, 152 bps and 402 bps.

There are several reasons why one might expect the basis to be positive and to become even more positive during strongly distressed periods. Because natural buyers of euro area sovereign bonds are the European banks, three main factors make holding USD-denominated euro area sovereign bonds unattractive for them. Under the terms of the ECB liquidity facilities, European banks could not pledge USD-denominated bonds for liquidity from January 2011 to September 2012.[1] Second, under Basel rules, EUR-denominated domestic sovereign bonds have zero capital weightings for domestic banks, while the USD-denominated domestic sovereign bonds do not, so holding these bonds would incur capital charges (see Acharya, Engle and Pierret (2013)). Third, an additional margin is required in a repo operation, when an European bank finances holdings of USD-denominated bonds.

In this paper, we proceed by first describing the USD- and EUR-denominated bond arbitrage strategy. In order to exploit the pricing anomaly, we expect traders to buy a cheap USD-denominated bond, to convert the USD-denominated bond into a synthetic EUR-denominated bond, and sell an expensive EUR-denominated bond. Due to the long term horizon in bond cash-flows, currency swaps should be use to transform the cash-flows instead of forward contracts that are less liquid beyond one year. Thus, we perform a feasible trading strategy by means of a cross-currency asset swap to exchange the fixed coupons of the USD-denominated bond at the Euribor rate plus a spread, the cross currency basis or cross currency spread, and getting into a floating-fixed interest rate swap to exchange that EUR-denominated stream of floating inflow into a fixed coupon rate. By getting into this strategy, we create a synthetic fixed-rate EUR-denominated bond. Then, we estimate the yield to maturity by applying standard bond valuation techniques. One contribution of this paper is to deal with the mismatch in coupon rates and payment dates between bonds and swaps and to document that other less precise alternatives have a substantial impact on the calculation of the basis affecting the level and the dynamics of the basis itself.[2]

Our empirical investigation seeks to identify what the main drivers of the basis were. First, we divide the period January 2008 - February 2013 into two main subsamples: a "Pre European Sovereign Debt" crisis period that starts on January 1, 2008 and ends on May 9, 2010, and an "European Sovereign Debt" crisis period starting on May 10, 2010. The beginning of the latter period coincides with the activation of the Security Market Programme (SMP) by the European Central Bank (ECB), when it decided to intervene in the secondary markets of public and private EUR-denominated debt securities markets.

[1] European banks could pledge USD-denominated bonds for liquidity from 14 November 2008 to 31 December 2010, when the dollar swap lines were activated between the ECB and the Federal Reserve, and after 9 November 2012. However, USD-denominated bonds have an additional haircut in comparison to the EUR-denominated and USD-denominated bonds do not systematically fulfill other eligibility criteria as the one related to area to be held and settled.

[2] The existing literature that applies cross currency swap directly subtracts par swap rates from yields on coupon bearing bonds not necessarily traded at par.

The creation of the SMP is related to the Greek debt crisis, which triggered later the sovereign debt crisis in the rest of the continent. Then, we analyze the determinants of the basis on the two subsamples to uncover which factors have a predictive impact on the basis.

Our empirical strategy considers an extensive list of factors that might affect the ability of traders to profit from this strategy. In particular, we consider specific bond factors, such as market liquidity, lending activity, differential governing law, macro-financial and country specific factors, political and policy uncertainty factors in the Euro area, and other factors. Although, these factors affect the basis, they are not able to provide a fully satisfactory explanation of the existence of these arbitrage opportunities. In particular, these factors play a limited role during the "European Sovereign Debt" crisis period, when the size of the basis on average widens and significant differences emerged across the countries.

Then, we focus our attention on the ECB's role and on three types of interventions: the SMP, changes in eligibility criteria and ECB liquidity facilities with a special focus on the long term refinancing operations (LTROs). To explore how these factors may be driving the arbitrage, we use ECB proprietary data and we conduct our analysis through regression analysis using as control variables the bond and market risk factors previously mentioned.

We evaluate the impact of the SMP in three different ways: we use data on (i) weekly public available purchases; (ii) purchases at country level; and (iii) purchases at pair level. Since the SMP targeted public and private EUR-denominated debt securities, we expect a widening of the basis around purchases. When we use information on SMP purchases at country level, we find that, over time, a Euro 1 billion of bond purchases on average widens the basis of 2.55 bps. Interestingly, when we estimate the same specification using information on individual bond purchases, we find that, over time, a Euro 1 billion of individual bond purchases on average widens the basis of 27.24 bps. The results clearly indicate that SMP purchases of the targeted EUR-denominated sovereign bonds significantly widen the basis, in particular when the targeted EUR-denominated bonds belong to bond pairs of our analysis. This finding is in line with the reduction of the liquidity premia in the EUR-denominated bonds, suggesting that the interventions had a large impact on the price of individual sovereign bonds (see Ghysels, Idier, Manganelli and Vergote (2013), Eser and Schwaab (2013) and Trebesch and Zettelmeyer (2013)).

Then, we explore the impact of the ECB liquidity facilities. The process mirrors the private repos: the ECB provides funds to the counter-parties against eligible collateral where the amount of funding equals to the market price of the collateral multiplied by one minus the haircut. In particular, we study (i) how changes in eligibility criteria, (ii) the amount of the sovereign debt collateral pledged at the ECB in exchange of liquidity, and (iii) the introduction of long-term refinancing operations had an impact on the basis.

At the beginning of the financial crisis, in the context of the non-standard monetary policy measures, the list of assets accepted as eligible collateral was extended to further ease access to Eurosystem operations in an attempt to reduce asset-side constraints on bank's balance-sheets. On 23 October 2008, in the context of temporary changes to the rules relating to eligibility of collateral, the ECB announced the admission of marketable debt instruments denominated in USD, the pound sterling and the Japanese yen, and issued and held in the euro area, to be eligible collateral in Eurosystem credit operations. This temporal change was in place until the 31 December 2010. Subsequently, the ECB announced the reintroduction of this decision on 6 September 2012 in order to maintain the access to the Eurosystem liquidity-providing operations. We find that this change in the eligibility criteria diminishes the asymmetry between the EUR- and USD-denominated bonds due to the fact that USD-denominated bonds can be used as a collateral in exchange of liquidity. However, this asymmetry does not completely disappear because an additional haircut of 8% is imposed by the Eurosystem on all foreign-currency marketable debt instruments.

Second, we study the effect of the sovereign debt collateral pledged at the ECB in exchange of liquidity using information on the nominal value of all sovereign bonds pledged at the ECB for the countries under study. We find that the size of the basis of a country significantly widens when the same country experiences periods of market stress. The size of the basis for a country is strongly positively related to the amount of sovereign bonds pledged at the ECB, when the credit default swap (CDS) of the same country reaches extreme levels. This is the case for Italy and Spain over the period August 2011 - May 2012. We find that an increase of a 1% of the sovereign debt collateral pledged at the ECB divided by the total outstanding nominal amount of the sovereign debt during distress periods widens the basis approximately by 3.18 bps. Thus, our results suggest that the ECB liquidity facility was priced on those eligible bonds widening the basis for these countries in times of increased sovereign credit spreads.

Third, we focus on the effect of the sovereign debt collateral pledged at the ECB in exchange of liquidity during the 3−year LTROs that consist of 3-year collateralized loan and belong to the set of non-standard measures launched by the ECB. Concretely, the 3-year LTROs provided EUR 489 billion on 21 December 2011 and EUR 523 billion on 29 February 2012. We find that the increase of the sovereign collateral in the context of 3-year operations significantly widens the basis. Specifically, we find that an increase of a 1% of the sovereign debt collateral pledged at the ECB during 3-year LTROs divided by the total outstanding nominal amount of the sovereign debt widens the basis approximately by 2.66 bps. Since only EUR-denominated bonds could be pledged to the Eurosystem in exchange of liquidity for a very long horizon that was not available in private repo market, the widening of the basis reflects the funding premium that EUR-denominated bonds embedded during this non-standard measure.

Finally, we use the basis based on USD- and EUR-denominated bonds issued by Turkey as a control group to further assess the impact of the ECB liquidity facilities on the basis of the Euro area countries under study through a difference-in-differences framework. Since Turkish bonds could not be pledged to the Eurosystem in exchange of liquidity, we use the Turkey's weekly average basis across the bond pairs to control for factors that affected all bond markets at the same time. Our results on the impact of the ECB liquidity facilities are not affected by this exercise.

Recent theory such as Brunnermeier and Pedersen (2009), Ashcraft, Garleanu and Pedersen (2010) and Garleanu and Pedersen (2011) stresses the role that funding constraints may play a key role in propagating mis-pricing in financial markets. Our results provide support for the implications of these friction-based theories, suggesting that a monetary funding premium is embedded in the EUR-denominated bonds because these bonds could be used as collateral for liquidity operations with the ECB during a period of market distress for the Euro area. Moreover, this funding premium might also vary over time, depending on credit spreads of the sovereign issuer, on the one hand, and the general liquidity supply conditions partly determined by the ECB policy stance, on the other.

The paper is organized as follows. In Section 2, we review the literature. In Section 3, we describe the Euro area sovereign pricing anomaly that is the focus of our paper. Section 4 describes the data selection. Section 5 discusses the determinants of the basis and investigates the effects of ECB's policy interventions on the basis. Section 6 concludes.

2 Review of the Literature

This paper contributes to three streams of literature. The first stream relates to "limits to arbitrage" theories who study the economic determinants for observed deviations of the law of one price. Shleifer and Vishny (1997) is a milestone of this literature and discusses how limited availability of risk capital by arbitrageurs leads to persistent deviations of the law of one price when an initial price shock occurs. There are several lines of research, that depart from this seminal paper, who study different sources of frictions that can cause these deviations as (i) short selling restrictions; (ii) funding cost and collateral margins; (iii) institutional and regulatory frictions; and (iv) trading liquidity. Within this literature, there are several recent empirical papers to whom our paper is related. Bai and Collin-Dufresne (2013) investigate the cross-sectional variation in the CDS-bond basis, which measures the difference between credit default swap spread and cash-bond implied credit spread. Fleckenstein, Longstaff and Lustig (2013) document and study the US TIPS-Treasury bond puzzle. Mancini, Ranaldo and Wrampelmeyer (2013) find significant variation in liquidity across exchange rates, substantial illiquidity costs, and strong commonality in liquidity across currencies providing evidence that FX market

liquidity is crucial for arbitrage trading. Buraschi, Sener and Menguturk (2014) find that USD-denominated bonds issued by Turkey traded at a cheaper level than the EUR-denominated bonds, while EUR-denominated bonds issued by Brazil and Korea traded at a cheaper level than the USD-denominated bonds over the same time period. They find evidence that the banks' increased reliance on wholesale funding market and the geographical concentration in sovereign lending play a key role in explaining the miss-pricing in emerging markets.

Our paper is more directly related to the latter one. However, the crucial difference between Buraschi, Sener and Menguturk (2014) paper and our paper is the structure of the data and the main findings. While our findings are consistent with their results in the "Pre European Sovereign Debt" crisis period, we document that the intensification of the Euro area sovereign crisis impacted further on the size of the basis and significant differences emerged across the countries. In particular, the basis that we document widened in the second half of 2010 for countries whose sustainability of fiscal positions became a concern for market investors. Thus, our unique and novel data allow us to directly link the basis evolution with the amount of the sovereign debt collateral pledged at the ECB in exchange of liquidity and to document that investors affected by shocks on their Euro area sovereign bonds holdings were able to absorb these shocks by accessing the ECB liquidity facility and by the non standard monetary policy interventions implemented by the ECB.

Second, we also shed light on the impact of central banks purchases on the markets for sovereign bonds. In particular, there is a recent and growing literature that has analyzed the effects of SMP on sovereign bond yields. De Pooter, Martin and Pruitt (2013) find that weekly ECB purchases had the desired effect of lowering liquidity premia, but such reduction was mainly temporary. Eser and Schwaab (2013) find that SMP purchases have contributed effectively in lowering yields bonds issued by peripheral sovereigns. The impact is stronger in markets which are smaller, less liquid, and where risk premia were higher. Ghysels, Idier, Manganelli and Vergote (2013) analyze the high-frequency dynamics of bond yields and purchases. Their empirical investigation reveals that SMP purchases have contributed to reducing the volatility of targeted bond yields. Moreover, their results confirm that SMP purchases had also an impact on the level of yields. Trebesch and Zettelmeyer (2013) back out the ECB's purchases of Greek bonds in the SMP in 2010, using the fact that the ECB did not participate in the Greek debt exchange of March 2012. They find that bonds bought by the ECB show a much larger drop in yields after the start of the SMP. Overall, their findings support the view that the interventions had a large local impact on the price of individual sovereign bonds. Finally, Nagel, Krishnamurthy and Vissing-Jorgensen (2013) find that ECB actions have been successful in lowering government bond yields, in particular in reducing the solvency risk and in mitigating market segmentation.[3]

[3]There is literature studying the impact of purchases of U.S. Treasuries during 2008-09 within the

The main innovation of our paper is to analyze ECB bond purchases at the level of daily individual bonds purchases. Moreover, our empirical design based on pairs of EUR- and USD-denominated bonds helps us to clearly identify the impact of purchases because the USD-denominated bonds were explicitly not targeted by the ECB.

Finally, we contribute to the recent literature on the role played by the non-standard monetary policy measures implemented by the central banks through the lending facilities. Ashcraft, Garleanu and Pedersen (2010) discuss how the central bank's lending facilities lowering margin requirements can increase asset prices in crises by offering loans and easing funding constraints in the banking sector. They examine empirically the impact of the introduction of the Term Asset-Backed Securities Loan Facility (TALF) lending facility that provided loans with lower haircuts and longer maturities. They document that the programme was quite effective in lowering yields. The results are consistent with the theoretical predictions of Garleanu and Pedersen (2011) who show that margin differences lead to basis between securities with (nearly) identical cash flows during times of funding illiquidity. Drechsler, Drechsel, Marques-Ibanez and Schnabl (2013) document that European banks, which borrowed heavily, also pledged increasingly risky collateral to the ECB during the Euro area sovereign crisis, suggesting that the ECB's liquidity facility was used for risk-shifting due to the lower haircuts. Finally, Acharya and Steffen (2013) document that under-capitalized banks in the peripheral countries used the ECB's LTRO to increase their exposure to risky domestic bonds, thus tightening the feedback loop between banks and sovereigns.

The main contribution of our paper to the previous literature is to document how the central banks' haircuts and willingness to offer loans at longer maturities than otherwise available had an impact on the bond yields of sovereign countries who experienced periods of market stress.

3 Pricing Anomaly

We study deviations between the yield to maturity of bonds issued by the same Euro area sovereign countries in EUR and in a foreign currency. As foreign-currency bonds issued in USD are relatively common among Euro area countries and are also in general relatively actively traded, we restrict our analysis to USD-denominated bonds exclusively. We select five euro area sovereign countries: Austria, Belgium, Finland, Italy, and Spain. We focus on fixed-rate coupon bonds denominated in USD, issued after 1999 and traded on a daily basis. Next, for every single USD-denominated bond we select a comparable EUR-denominated bond in terms of issuer, issue date and maturity and create a list of pair bonds.

Federal Reserve's Large-Scale Asset Purchase (LSAP) program. See Gagnon, Raskin, Remache, and Sack (2011), Cahill, D'Amico, Li, and Sears (2013) D'Amico, English, López-Salido, and Nelson (2012), D'Amico and King (2013), among others.

Nevertheless, for comparability reasons bonds that make up each bond pair should have underlying cash-flows denominated in the same currency. For this reason, we convert the bond denominated in USD into a synthetic bond denominated in EUR. Subsequently, we estimate the yield to maturity ($\widehat{Y}_{i,t}^{USD->EUR}$) of that synthetic bond for the pair i at time t. To conclude, we define the basis for every matched-pair bond as the difference between the yield to maturity of the synthetic bond and the yield to maturity of the bond denominated in EUR ($Y_{i,t}^{EUR}$):

$$Basis_{i,t} = \widehat{Y}_{i,t}^{USD->EUR} - Y_{i,t}^{EUR}. \tag{1}$$

Figure 2 depicts the trading strategy to convert the bond denominated in USD into a synthetic bond denominated in EUR. This strategy involves buying a cross currency asset swap package to exchange the fixed coupons of the USD-denominated bond at the Euribor rate plus a spread, the cross currency spread or cross currency basis, and getting into a floating-fixed interest rate swap to exchange the EUR-denominated stream of floating inflow into a fixed coupon rate. At initiation, the buyer receives the USD-denominated bond in exchange of its cash price valued in EUR at the spot price. Additionally, the trader has to pay/receive an upfront payment to compensate for any premium or discount paid for the USD-denominated bond. This upfront payment ensures that the net position created by the cross currency asset swap package is the same as a USD-denominated bond issued at par. On coupon dates, the buyer pays the coupon of the USD-denominated bond (C_t^{USD}) and receives the Euribor rate plus the cross currency spread. By means of the floating-fixed interest rate swap, this floating cash-flow is exchanged at a fixed EUR-denominated coupon (C_t^{EUR}). On maturity date, the buyer pays the redemption amount of the USD-denominated bond and receives the swapped redemption amount in EUR at the spot price. By getting into this strategy, we create a synthetic fixed EUR-denominated bond. We estimate the yield to maturity by applying standard bond valuation techniques.

[INSERT FIGURE 2 HERE]

Figure 3 depicts the average yield to maturity of the EUR-denominated (Y_t^{EUR}) and the synthetic EUR-denominated ($\widehat{Y}_{i,t}^{USD->EUR}$) bonds at country level from January 2006 to February 2013. Apart from the five European countries, the last panel refers to Turkey in order to highlight the similarities and differences in the behavior of both yields across sub-periods. At the first glance, we observe a large and persistent difference between both yields that is common across all countries, where the yield of the synthetic EUR-denominated bond is almost systematically higher than the yield of EUR-denominated bond. And hence, for most of the sample period we observe that the USD-denominated bonds trade cheaper than the comparable bond denominated in Euro.

[INSERT FIGURE 3 HERE]

At the beginning of the sample period we observe tiny differences between both yields being the average basis close to zero. The period between the Lehman Brothers collapse and March 2009 is characterized by a generalized illiquidity in all markets. As a consequence, we observe an increase in both yields. However, the yields of the synthetic EUR-denominated bond increase faster than the comparable yields of EUR-denominated bond because USD-denominated bonds are more exposed to liquidity shocks due to of their relative illiquidity. In terms of the basis, we observe a generalized increase that is common across the five European countries and Turkey. After that period both yields depict a downward trend and the basis drops but its level is above the observed at the beginning of the sample period. In May 2010 starts a turbulent period for the eurozone countries, characterized by the bailout of Greece, Portugal and Ireland and the strains on the Italian and Spanish debt.

This period is also characterized by the activation of a set of non-standard measures by the ECB. Both yields skyrocket mainly in Italy, Spain and Belgium reaching a peak in December 2011, coinciding with the first 3-year LTRO. Hereafter, the yields perform a constant downward trend. Nevertheless, we observe a large and persistent spread between both yields in all European countries, while Turkey remains unaffected by this turmoil. Hence, this supports the idea that will be tested in the following sections that the ECB interventions generate asymmetries between those ex-ante comparable bonds and explain these large and persistent pricing anomalies.

The trading strategy to convert the USD-denominated bond into a synthetic EUR-denominated bond deserves some comments due to its undeniable importance in the calculation of the basis. In this paper we take the trader's perspective and perform a feasible trading strategy by means of a cross-currency asset swap.[4] Baba and Sakurai (2011) note that due to the long term horizon in bond cash-flows, cross-currency basis swaps have been used as a tool for converting currencies of the liabilities, particularly by issuers of bonds denominated in foreign currencies. Nevertheless, there are alternative ways to convert cash-flows from USD to EUR. One possibility is to use the forward market to hedge each cash-flow. Habib and Joy (2010) note that over short horizons firms may sell foreign currency forward in liquid foreign exchange markets and lock in the current exchange. However, beyond one year, forward contracts become less liquid and currency swaps should be use to transform the cash-flows. Therefore, due to the length of the cash-flows we are interested in, the use of forward market does not result appropriate.

This is also reinforced by the largely documented fact that the covered interest parity (CIP) that equates the return on domestic currency with a full hedged foreign currency return holds under short term maturities. For longer maturities, the CIP is violated. As a result, the difference in the term structure of the credit spreads of two different countries

[4] According to the TriOptima Interest Rate Trade Reporting Repository, the total notional outstanding of cross-currency asset swap was around USD $8,854$ billion in March 2010.

and the currency basis swap are needed in order to hedge foreign currency denominated cash-flows. Alternatively, Tuckman and Porfidio (2003) propose a strategy to create an adjusted forward rate that takes into account violations of the CIP in the long run on the basis of the spot exchange rate, the local and foreign LIBOR and the cross-currency basis. This strategy presents a lot of similarities with the one implemented in this paper, in the sense that both are based on a combination of a currency swap and an interest rate swap. However, this strategy is very costly to implement in our context because we need to enter in a combination of currency swaps and interest rate swap to discount every single cash-flow of a bond.

Appendix A documents the impact of using alternative approaches on the calculation of the basis.

4 Data and Variables

The main datasets of this paper correspond to the sovereign bond prices and yields collected from Bloomberg and to ECB proprietary data. There are a number of possible factors that might influence the size of USD- and EUR-denominated bonds basis over time. Following the more recent 'limits to arbitrage' literature we control for the short-selling activity and market based factors collected from Data Explorers and Datastream. Appendix B details these control variables. In this section, we discuss whether variation in the pricing anomaly might be linked to a number of variables motivated by the discussion on the ECB interventions. We discuss each of these in turn and describe the specific variables to be used in the regression analysis.

4.1 Bond and Pair Characteristics

We focus on all European Monetary Union (EMU) countries that issue fixed-rate coupon bonds denominated in US Dollars (USD). Using information from Dealogic database we select all bonds issued in USD before 1999 and with maturity after 2008. For those bonds we find a comparable bond denominated in Euro in terms of the same issuer, similar issue date and maturity. In those cases in which more than one bond was subject to eligibility we select the one with the closer duration. On the contrary, we rule out those USD-denominated bonds for which we do not find a comparable EUR-denominated bond.

4.1.1 *Bond Data*

Bond level information is gathered from Bloomberg. We retrieve daily bid, mid and ask prices and yields as weighted averages based on the number of sources who price at

2nd and 3rd best pricing levels among the qualifying deals (Bloomberg CBBT).[5] When these prices are not available, we use the Bloomberg BGN, a weighted average of the quotes contributed to Bloomberg by a minimum of five brokers and dealers, and as a last source, we use Bloomberg BVAL prices which provide a theoretical price of the bond. The sample covers information about five EMU countries: Austria, Belgium, Finland, Italy, and Spain for which we use 47 fixed-rate coupon bonds of which 25 are USD and 22 EUR-denominated. The Appendix C reports the information about the 55 specific bonds. As a robustness check, we also construct the basis for the Turkish sovereign bonds using 8 fixed rate coupon bonds (4 USD- and 4 EUR-denominated).

4.1.2 *Pair Characteristics*

Our sample is composed of 25 different pairs belonging to the five EMU countries. Table 1 reports the main characteristics of these pairs. The first two columns report the starting and the last day in the sample. In order to avoid systematic convergence in the basis around the maturity date due to the convergence of the price to the face value, we rule out the last year of the bond life. Therefore, a bond that matured in May 2012 is only considered in the sample until May 2011.

[INSERT TABLE 1 HERE]

The third column reports the country that issued the pair under study. The most active country in issuing debt denominated in foreign currencies is Italy issuing 10 out of the 25 pairs and thus represents a large part of our sample. Spain and Austria have 5 pairs each, followed by Belgium (3) and Finland (2).

The fourth column reports the average basis, which is consistently positive for all pairs and over the whole sample period. Focusing on those pairs that cover most of the sample we observe that on average Italy, Spain and in lower extent Belgium have larger deviations than in Austria and Finland, but these bases are on average higher than 25 bps for all pairs. We also report the relative size of the USD-denominated bond to its EUR-denominated comparable bond in the fifth column. We observe that the outstanding amount of the EUR-denominated bond is significantly larger, ranging from the 5% to the 22%. However, the minimum size we observe in the sample for a USD-denominated bond is above 600 million which means that although smaller, USD-denominated bonds are sizable.

The last column refers to the governing law of the USD-denominated bonds given that all EUR-denominated bonds are issued under the local law. We observe that Austria, Finland and Spain issue USD-denominated debt under English law and Belgium under local law. Italy is the only country issuing under different regimes. It issues most of the

[5] CBBT requires at least three executable pricing sources with prices and size on both sides on the market. Prices must be within five minutes.

USD-denominated bonds under the New York legislation as well as issuing under local and English law. We also control by other bond specific covenants such as *negative pledge* and *cross default clauses* which could potentially explain differences across comparable bonds.

4.2 European Central Bank

In the context of exceptional circumstances prevailing in the financial markets, the European Central Bank (ECB) complemented its regular operations (i.e., main refinancing operations (MRO) and 3-month long term refinancing operations (LTRO)) with Euro liquidity providing operations with 6-month, 1-year and 3-years maturity as well as US-dollar liquidity providing operations.[6] The MROs consist of one-week Euro liquidity-providing operations and serve to steer short-term interest rates, to manage the liquidity situation, and to signal the stance of monetary policy in the Euro area while the LTROs aim to provide additional, longer-term refinancing to the banking sector.

In addition the ECB launched the covered bond purchase programme (CBPP), the second covered bond purchase programme (CBPP2) and the securities market programme (SMP).[7,8] The SMP was designed to conduct outright interventions in the Euro area public and private debt securities market EUR-denominated with the objective of (i) addressing the malfunctioning of securities markets; and (ii) restoring an appropriate monetary policy transmission mechanism. To assess the impact of the ECB policy actions on the basis we employ information relative to the SMP and the central government debt collateral pledged at the ECB in exchange of liquidity. Figure 4 depicts a time line of the ECB policy actions under study in this paper.

[INSERT FIGURE 4 HERE]

4.2.1 *Securities Market Programme (SMP)*

The ECB launched the securities market programme (SMP) in May 2010. This programme consisted in purchasing debt securities in the open market and remaining them on the balance sheet of the ECB up to the payment of all the cash flows of the securities

[6] In response to continued strains in short-term US dollar funding markets, the ECB in conjunction with the Federal Reserve, launched a USD liquidity-providing operation under the USD Term Auction Facility to increase the of US dollar liquidity provided to the counter-parties of the Eurosystem against ECB eligible collateral. This special facilities were available from October 2008 to January 2009 in the format of 7-day, 28-day and 84-day term auctions.

[7] See "Decision of the European Central Bank of 2 July 2009 on the implementation of the covered bond purchase programme" (ECB/2009/16); "Decision of the European Central Bank of 3 November 2011 on the implementation of the second covered bond purchase programme " (ECB/2011/17); and "Decision of the European Central Bank of 14 May 2010 establishing a securities markets programme" (ECB/2010/5).

[8] The CBPP and CBPP2 are designed to purchase eligible covered bonds outright with the objective of (i) easing funding conditions for credit institutions and enterprises; and (ii) encouraging credit institutions to maintain and expand their lending to clients.

(hold-to-maturity strategy). Some distinctive features of this programme are related in particular to the disclosure of the composition of the portfolio. The ECB did not disclose the total amounts which would be spent, the time frame over which the program would be active, or the set of securities that would be targeted. Data on the outstanding value of the holding portfolio were only published weekly without any reference to the time during the week when the securities had been bought. Moreover, the ECB did not provide a breakdown describing the composition of assets by national origin of issuance.[9]

Figure 5 plots the accumulated book value over time. Clearly, purchases are not evenly spread out over time. The largest purchases occurred after the introduction of the SMP on 10 May 2010 in the context of the central bank reactions to the Greek debt crisis and after its reactivation on 8 August 2011 which seems to be related to the strains registered in the Spanish and Italian sovereign bond market. The chart also suggests that there have been long periods during which the SMP has been open but inactive. From the week ending in 25 March 2011 until 8 August 2011 the SMP was inactive for 19 weeks. Purchases stopped on January 2012 when the uncertainty linked to political climate in Italy, due to the change of government on 16 November 2011, and in Spain, due to the November 2011 elections, decreased.

[INSERT FIGURE 5 HERE]

We include the SMP information in three different ways: we use data on (1) weekly public available purchases (SMP_t); (2) weekly purchases at country level ($SMP_{j,t}$); and (3) weekly purchases at pair level ($SMP_{i,j,t}$). Purchases at pair level refer to the weekly purchases of the EUR-denominated bonds given that only EUR-denominated bonds were targeted.[10]

4.2.2 *ECB Liquidity Facility and Collateral Management*

In line with central bank practice worldwide, the ECB requires counterparties to pledge adequate collateral in exchange of liquidity.[11] Figure 6 depicts the total collateral pledged at the ECB broken down by type of asset. The collateral is a mix of central government

[9] On 21 February 2013, the ECB provided details on securities holdings acquired under the programme revealing a country-by-country breakdown. Italian debt accounts for roughly half of the total: 103 billion Euros ($136 billion) out of 218 billion Euros. Spain ranks second, with 44 billion euros of its debt purchased by the Euro area's central bank, followed by Greece (34 billion Euros), Portugal (23 billion Euros) and Ireland (14 billion Euros).

[10] In order to carry out the SMP interventions, Eurosystem central banks may purchase the following: (i) on the secondary market, eligible marketable debt instruments issued by the central governments or public entities of the Member States whose currency is the Euro; and (ii) on the primary and secondary markets, eligible marketable debt instruments issued by private entities incorporated in the Euro area.

[11] Adequate collateral means the need to satisfy eligibility criteria regarding the type of assets, credit standards, place of issue, type of issuer, currency, asset marketability and other characteristics which are applied uniformly across the Euro area. By doing that the ECB seeks to require high-quality collateral hedging against losses in its credit operations. In the same line, the ECB applies differential haircuts to collateral depending on the credit quality.

securities (CG), regional government securities (RG), uncovered bank bonds (UB), covered bank bonds (CB), corporate bonds (CorpB), asset-backed securities (ABS), other marketable assets (OMA) and non-marketable assets (NMA). From 2008 to 2012 the collateral pledged at the ECB has increased from 1,579 to 2,478 EUR billion as the result of the implementation of the 1year-LTROs in 2009 and 3year-LTROs in 2011 and 2012. Interestingly, we observe two sizable increases in 2009 and 2012. The effect of the first 3year-LTRO is not captured in 2011 although it took place on 21 December 2011, because depicted figures represent the averages of end of month data over each year. The types of pledged assets have significantly changed over time. In 2008 UB and ABS accounted for the 56% of the total collateral (440 and 444 EUR billion, respectively), followed by NMA, CB and GC whose total size is around 170 EUR billion each (i.e., each category represents 11% of the total). We observe that the size of the UB and ABS have dropped more than half of their size accounting for the 27% of the total collateral in 2012. On the contrary, NMA, CB and CG have undergone a constant and sizable increase over time representing the 26%, 20% and 15% each in 2012.

[INSERT FIGURE 6 HERE]

We study the effect of the liquidity provision provided by the MROs and the LTROs through the collateral CG holdings at the ECB. That is, we test whether the possibility of getting liquidity from the ECB using as a collateral the eligible sovereign bonds explains the behavior of the basis. There are three aspects that potentially explain differences across USD- and EUR-denominated bonds: (1) USD-denominated bonds are not eligible during the whole sample period;[12] (2) USD-denominated bonds are subject to an additional haircut of 8% in comparison to the EUR-denominated;[13] and (3) USD-denominated bonds do not systematically fulfill other eligibility criteria as the one related to area to be held and settled.

The ECB collateral management procedure collects with a weekly frequency information at bond level from the National Central Banks (NCBs), who are responsible for submitting information to the ECB on eligible assets listed in their respective national markets.[14] Our data contains the nominal amount of all individual sovereign bonds pledged at the ECB. We compute the total nominal amount of sovereign bonds held by the ECB at country level. Additionally, we scale these amounts by the total nominal

[12] In the context of temporary changes to the rules relating to eligibility of collateral, the ECB admits US dollars, pounds sterling or Japanese yen as eligible collateral subject to the fulfillment of the relevant eligibility criteria from the 25th of October 2008 to the 31st of December 2009 and from the 9th of November 2012 onwards.

[13] ECB/2008/18

[14] NCBs operate their systems for collateral management using either pooling or earmarking arrangements, or a combination of both. Under the earmarking system, each and every asset put forward (including pre-deposited assets) by a counterparty to the relevant central bank is specifically associated with a certain amount of credit obtained from the Eurosystem. In pooling systems, it is the pool as a whole, and not the specific assets, that secures all of the credit extended to a counterparty.

sovereign debt outstanding by each country ($Sov.\ Collateral_{j,t}$ *to Tot. Sov.* $Debt_{j,t}$) in order to account for the proportion of the total debt that is actually pledged at the ECB.

5 What Drives the Pricing Anomaly?

5.1 Empirical Strategy

Our empirical strategy seeks to identify the main drivers of the basis. To such aim we implement a panel regression analysis in which we explain the basis on a set of factors classified in three categories: (1) bond information; (2) market factors; and (3) ECB interventions. In our baseline analysis, we employ a Prais-Winsten regression specification with country fixed-effects, correlated panels, corrected standard errors (PCSEs) and robust to heteroskedasticity, contemporaneous correlation across panels and serial autocorrelation within panels. The correlation within panels is treated as a first-order autocorrelation AR(1) and the coefficient of this process is common to all the panels. Our panel regression model is described by the following equation:

$$\begin{aligned} \text{Basis}_{i,j,t} &= \alpha + \delta_j + \beta \times \text{Bond Information} + \upsilon \times \text{Market Factors} \\ &\quad + \pi \times \text{ECB} + \varepsilon_{i,j,t}, \end{aligned} \tag{2}$$

where the dependent variable is the estimated basis for each pair i and j refers to the issuer country. *Bond Information* is a matrix that contains pair-specific information about the bond liquidity, lending activity and bond covenants. Following the definition of the basis, we construct pair-specific information as the difference between the USD- and the EUR-related variables. *Market Factors* is matrix that contains country and global market factors. Finally, *ECB* is a matrix that contains variables relative to the SMP purchases, the collateral eligibility, sovereign debt collateral and 3-year LTROs.

We split our analysis in three parts. First, we focus on the bond information and markets factors in order to determine to what extent traditional factors help to explain the basis during turmoil periods. We next study the impact of the ECB interventions using as control variables the bond information and the market factors. Finally, we redefine the dependent variable as the difference between the basis of pair i and the average basis of Turkey in order to assess the impact of the ECB liquidity facilities through a difference-in-difference framework.

5.2 Bond Information and Market Factors

Table 2 reports the estimation of Equation (2) when *Bond Information* and *Market Factors* are used as dependent variables. The first column contains the result for the whole sample period while Columns (2) and (3) report the results for the "Pre European Sovereign Debt" and "European Sovereign Debt" crisis sub-periods.

[INSERT TABLE 2 HERE]

The $Bid - Ask\ Spread_{i,j,t}$ refers to the difference between the bid-ask spread in the USD- and EUR-denominated bonds and proxies the relative illiquidity of the EUR-denominated bond. In general terms, USD-denominated bonds present wider bid-ask spreads (i.e., they are generally more illiquid) and hence, the $Bid - Ask\ Spread_{i,j,t}$ is most of the time positive. We document that as the illiquidity of the EUR-denominated bonds gets closer to illiquidity of the USD-denominated bond, the basis decreases by 3.887 bps. Thus, differences in the relative illiquidity explain the widening of the basis: the larger the differences in the relative illiquidity, the wider the basis. Additionally, this effect is only significant during the "Pre European Sovereign Debt Crisis" period.

We next study the role of the lending activities on the basis by means of the $No.\ Transactions_{i,j,t}$ and $Fees_{i,j,t}$ variables which are described in Appendix B. We systematically observe that EUR-denominated bonds are expensive in comparison to the comparable USD-denominated bond, which is consistent with Buraschi, Sener and Menguturk (2014). In order to exploit this anomaly, we expect traders to buy cheap (USD-denominated) and sell expensive (EUR-denominated) in such a way that relative increases of the number of transactions or of the lending cost of the EUR-denominated bonds should decrease the basis. However, the empirical results do not support this possible explanation. On the contrary, we find that an increase in the relative number of transactions of the EUR-denominated bonds (i.e., $No.\ Transactions_{i,j,t}$ becomes more negative) significantly widens the basis. Additionally, by sub-periods we observe that this effect is only significant during the "European Sovereign Debt" crisis period. Interestingly, we were advised in private conversations with practitioners that the increase of lending activity of EUR-denominated bonds is likely to be related to the increasing demand of collateral securities that could be pledged by banks to the ECB in exchange of liquidity. This would support the existence of a monetary funding premium in the EUR-denominated bonds that will be discussed in the next section.

Then, we study whether the bond covenants could explain the pricing anomaly. To do that we consider two dummies related to the law jurisdictions: $England\ Law_{i,j}$ takes 1 when a USD-denominated bond is issued under that the UK law and $NY\ Law_{i,j}$ takes 1 when a USD-denominated bond is issued under the New York law. In addition, we control for additional covenants in the USD-denominated bond in the dummy called *Additional Clauses*.[15] We expect to have a larger basis for those pairs issued under the local law than in those pairs issued under international laws, because the sovereign bond issued under international laws should guarantee a higher recovery rate in case of sovereign default. In fact, we find that the basis is on average smaller when the USD-denominated bond is

[15] *Negative pledge* and *cross default clauses* are two covenants that appear simultaneously in some of the USD-denominated bonds so we control by them in one variable called "Additional Clauses" that takes 1 when the USD-denominated bond is issued under those covenants.

issued under the New York law, in both sub-periods, suggesting that a USD-denominated bond issued under New York law is more attractive than a comparable USD-denominated bond issued under the local law.[16] However, this effect is not supported across jurisdictions by the data due to the fact that countries tend to issue under the same law jurisdiction and so it is very hard to disentangle the law and country effect.

We then address the impact of the country and global market factors described in Appendix B. The *Quanto CDS*, defined as the differential of CDSs USD-denominated versus EUR-denominated on the same underlying, has been used as a proxy of the expected devaluation of the Euro relative to the USD, conditional on the country's default (see Ehlers and Shönbucher (2006)). Thus, buying Euro CDS is a less attractive hedge, as the value of that protection is likely to diminish as the referenced sovereign approaches default. According to this definition, we would expect that the Quanto CDS has a negative impact on the basis because, as the expected devaluation increases, USD-denominated bonds should become more attractive than EUR-denominated bonds. Nevertheless, we do not find empirical support on this economic intuition. On the contrary, we find a positive and significant effect of the $Quanto\ CDS_{j,t}$. Buraschi, Sener and Menguturk (2014) argue that the Quanto CDS contracts gained great popularity during the 2010 European sovereign crisis, as market participants feared a substantial devaluation of the Euro as a consequence of the default of one of its member countries. Before 2010, however, expected devaluation values were close to zero and the Quanto CDS prices were then trading at only a few basis points. Interestingly, we were advised in private conversations with practitioners that the liquidity in Quanto CDS has been fairly limited and investors' demand for Quanto CDS was the defining factor in Quanto CDS pricing. In particular, the main source of supply stemmed from credit-linked notes, where investors buy government bonds and sell the relevant CDS to enhance the yield. In this instance, having an exact profile match between the currency of the bond and the CDS was preferable for investors.

The development of the secured market funding has dramatically changed during the crisis. According to Hördahl and King (2008), during the first part of the crisis, the Eurepo-OIS spread was marginally affected in the Euro area, and subsequently moved upwards as the crisis progressed due to a combination of factors. In the "Pre European Sovereign Debt" crisis period, we observe that increases in the $Eurepo - OIS\ Spread_{j,t}$ significantly widen the basis, suggesting that the shift from unsecured to secured funding made EUR-denominated bonds more attractive than USD denominated bonds, because the latter ones are subject to an additional haircut in repo transactions due to the currency risk. Instead, in the "European Sovereign Debt" crisis period, we observe that decreases in the Eurepo activity significantly increase the basis. In this period, secured funding

[16] Choi, Gulati and Posner (2011) document that the yield premium of the Greek sovereign debt governed by local law versus foreign law was discernible before November 2009 but then increased, reaching a peak of 400 bps, as the news about Greece's financial state emerged and the probability of a restructuring increased.

in the Euro area was affected by several factors. Large increases were observed of the interest rates on repos, general collateral rates, for countries under market stress affecting the bank funding. In addition, the repo market experienced a large decline in its activity due to the effect of the ECB's 3-year LTROs (see Mancini, Ranaldo and Wrampelmeyer (2013b)).

We also control by a global risk factor proxied by the VIX_t. We find that increases in the global risk significantly tighten the basis during the second period while it is not significant during the first one. This finding suggests that increases in the basis are due to the country or regional specific situations and global shocks affect both bonds in a similar way do not increasing the asymmetry between them.

Finally, we find that the increase of the policy uncertainty index (EPI_t) in the Euro area significantly widens the basis.

5.3 European Central Bank

In the previous sub-section, we document that the relative illiquidity, the lending activities and the market risk factors significantly affect the basis. Although, these factors affect the basis, they are not able to provide a fully satisfactory explanation of the existence of these arbitrage opportunities. In particular, these factors play a limited role during the "European Sovereign Debt" crisis period, when the size of the basis on average widens and significant differences emerged across the countries. In fact, the R^2 of our regressions fairly drops from 33.8% ("Pre European Sovereign Debt" crisis period) to 10.5% "(European Sovereign Debt" crisis period). Moreover, these results also support the idea that the ECB interventions play a fundamental role to explain the relation between USD- and EUR-denominated comparable sovereign bonds. In this section we explore this impact. So, we estimate Equation (2) focusing on the ECB interventions and using the bond information and market factors as control variables. We divide this analysis in two parts. First, we assess the impact of the Securities Market Programme and then we study the impact of the collateral management, focusing on changes in the eligibility criteria and in the liquidity facilities.

5.3.1 Securities Market Programme (SMP)

As discussed in section 4.2.1 we consider the SMP information in three different ways: we use data on (1) weekly public available purchases (SMP_t); (2) weekly purchases at country level ($SMP_{j,t}$); and (3) weekly purchases at pair level ($SMP_{i,j,t}$). Table 3 summarizes the results using the SMP information at different disaggregate levels. The sample starts in May 2010 coinciding with the launch of the programme. Since the SMP targeted public and private EUR-denominated debt securities, we expect a widening of the basis around purchases.

[INSERT TABLE 3 HERE]

When we estimate Equation (2) using information on SMP purchases at country level, we find that over time a Euro 1 billion of bond purchases on average widens the basis of 2.55 bps (see Column (2)). Interestingly, when we estimate the same specification using information on individual bond purchases, we find that over time a Euro 1 billion of individual bond purchases on average widens the basis of 27.24 bps (see Column (3)). Our results clearly indicate that SMP purchases of the targeted EUR-denominated sovereign bonds significantly widen the basis, in particular when the targeted EUR-denominated bonds belong to bond pairs of our analysis. This finding is in line with the reduction of the liquidity premia in the EUR-denominated bonds, suggesting that the interventions had a large impact on the price of individual sovereign bonds (see Ghysels, Idier, Manganelli and Vergote (2013), Eser and Schwaab (2013) and Trebesch and Zettelmeyer (2013)).

5.3.2 ECB Liquidity Facility and Collateral Management

We next analyze the impact of the liquidity facilities provided by the ECB. This process mirrors the private repos in the sense that the ECB provides funds to the counterparties against eligible collateral where the amount of funding equals to the market price of the collateral multiplied by one minus the haircut.

First, we pay attention to the changes in the eligible collateral. As described in section 4.2.2, the ECB requires counterparties to pledge adequate collateral in exchange of liquidity where this collateral needs to satisfy certain eligibility criteria. In the context of the non-standard monetary policy measures, the list of assets accepted as eligible collateral was extended to further ease access to Eurosystem operations in an attempt to reduce asset-side constraints on bank's balance-sheets. On the 23rd of October 2008, in the context of temporary changes to the rules relating to eligibility of collateral, the ECB announced the admission of marketable debt instruments denominated in USD, the pound sterling and the Japanese yen, issued and held in the Euro area, to be eligible collateral in Eurosystem credit operations. This first temporal change was in place until the 31st of December 2010. Subsequently, the ECB announced the reintroduction of this decision the 6th of September 2012 in order to maintain the access to the Eurosystem's liquidity-providing operations.

We expect that this change in the eligibility criteria diminishes the asymmetry between the EUR- and USD-denominated bonds due to the fact that EUR-denominated bonds can be used as a collateral in exchange of liquidity. However, this asymmetry shouldn't completely disappear because an additional haircut of 8% is applied by the Eurosystem on all foreign-currency marketable debt instruments and not all USD-denominated bonds fulfill other eligibility criteria as the one related to area to be held and settled.

We explore the impact of changes in the eligibility criteria by introducing two dummies

that take 1 during the first and the second eligibility windows ($1st\ Eligibility\ Window_t$ and $2nd\ Eligibility\ Window_t$, respectively). Additionally we interact these variables with a dummy that takes 1 for those pair where the USD-denominated bonds fulfill all the eligibility criteria. The results are reported in Column (1) of Table 4. As expected, we find a significant decrease of the basis in those eligible pairs during the eligibility windows. Thus, changes in the eligibility criteria diminishes the asymmetry between USD- and EUR-denominated bonds because both can be pledged at the ECB in exchange of liquidity.

[INSERT TABLE 4 HERE]

Column (2) reports the effect of the sovereign debt collateral pledged at the ECB in exchange of liquidity by means of the $Sov.\ Collateral_{j,t}\ to\ Tot.\ Sov.\ Debt_{j,t}$ variable that captures the proportion of the total sovereign debt that is actually pledged at the ECB. We find that during non-distress periods the level of sovereign collateral pledged at the ECB does not play a significant role. To investigate the effect during distress periods, we interact this variable with a dummy that takes 1 when the CDS of the same country reaches extreme levels (i.e., the CDS is above the 90th percentile).[17] When we estimate the full specification (see Column (3)), we find that an increase of a 1% of the sovereign debt collateral pledged at the ECB divided by the nominal total outstanding amount of the sovereign debt during distress periods widens the basis approximately by 3.18 bps. The fact that the $Sov.\ Collateral_{j,t}\ to\ Tot.\ Sov\ Deb_{j,t} \times Dum.\ High\ CDS_{j,t}$ variable obtains a positive and significant effect supports the idea that the ECB liquidity facility was priced on the EUR-denominated bonds widening the basis for these countries in strong distress.

Additionally, we take into account the conditions under which the ECB offers liquidity. As we described in section 4.2.2, the main refinancing operations (MRO) consist of one-week euro liquidity-providing operations and belong to the regular operations of the ECB. These regular operations serve to steer short-term interest rates, to manage the liquidity situation, and to signal the stance of monetary policy. On the contrary, the long term refinancing operations (LTROs) consist of longer term liquidity operations and belong to the set of non-standard measures launched by the ECB in the context of exceptional circumstances. Concretely, the 3-year LTROs provided EUR 489 billion on 21 December 2011 in three years loans and EUR 523 billion on 29 February 2012, succeeding in supporting the provision of bank lending to the economy, avoiding an abrupt dry-up of credit supply and decreasing funding risk (see Darracq-Paries and De Santis (2013)).

[17] The introduction this interaction is consistent with Pelizzon, Subrahmanyam, Tomio, and Uno (2013) who document a strong and dynamic relationship between changes in Italian sovereign credit risk and liquidity in the secondary bond market, conditional on the Italian sovereign CDS spread and demonstrate the existence of a threshold of 500 basis points in the CDS spread, above which there is a structural change in this relationship.

In order to capture the difference in the spirit of between the regular operations and the 3y-LTROs we interact the $Sov.\ Collateral\ to\ Tot.\ Sov.\ Debt_{j,t}$ variable with a dummy variable that takes value 1 in the implementation weeks of the 3y-LTROs. We find that an increase of a 1% of the sovereign debt collateral pledged at the ECB during 3-year LTROs divided by the nominal total outstanding amount of the sovereign debt widens the basis approximately by 2.66 bps. The fact that the $Sov.\ Collateral_{j,t}\ to\ Tot.\ Sov\ Debt_{j,t} \times Dum.\ 3y - LTRO_t$ variable obtains a positive and significant effect reflects the funding premium that the EUR-denominated bonds embedded during the implementation of the non-standard measures.

Finally, similar to Buraschi, Sener and Menguturk (2014), in order to highlight the impact of the ECB liquidity facilities on the basis we conduct a difference-in-difference analysis in which we estimate Equation (2) using as dependent variable the difference between the estimated basis of each pair and the average basis of Turkey:

$$\begin{aligned} \text{Basis}_{i,j,t} - \overline{\text{Basis Turkey}}_t \;=\; & \alpha + \delta_j + \beta \times \text{Bond Information} + \upsilon \times \text{Market Factors} \quad (3) \\ & + \pi \times \text{ECB} + \varepsilon_{i,j,t}. \end{aligned}$$

Since sovereign bonds issued by Turkey cannot be pledge to the ECB in exchange of liquidity, this difference allows us to control for factors that affected all bonds at the same time. Table 5 reports the results. Column (1) reports the estimates on the collateral eligibility, Column (2) on the amounts of sovereign collateral pledged to the ECB. Column (3) reports the joint result of all these determinist. The results are in line with the reported in the baseline specification. So, our findings support the existence of the funding liquidity premium that is priced during period of special distress.

[INSERT TABLE 5 HERE]

6 Conclusions

In this paper, we document the occurrence of a large pricing anomaly in the Euro area sovereign bond market between $2008 - 2013$. A large yield spread, a basis, developed between EUR- and USD-denominated comparable bonds issued by the same country. USD-denominated bonds became substantially cheaper (higher yield-to-maturity) than those denominated in Euro, once the foreign exchange rate risk is hedged in the USD-EUR currency swap market.

The existence of these large and persistent pricing anomalies are not fully explained by the traditional channels used in the limits-to arbitrage literature such as time-varying funding costs affecting capital, short selling constraints and liquidity risk. Apart from these factors, we find that country specific factors help to explain cross-sectional differences in the basis.

Overall, our results suggest that the ECB liquidity facilities and non-standard monetary policy measures play a key role in explaining the basis. Because EUR-denominated bonds could be used as collateral for liquidity operations with the ECB at lower haircuts, a monetary funding premium is embedded in these bonds yields. Moreover, this funding premium might also vary over time, depending on credit spreads of sovereign issuer, on the one hand, and the general liquidity supply conditions partly determined by the ECB policy stance, on the other.

Further investigation is needed to shed light on the role played by the ECB liquidity facilities and non-standard monetary policy measures. A thorough analysis of the impact of these actions would also require detailed information on banks' collateral policy. In fact, the monetary funding premium might also depend on banks' funding needs. We plan to address these issues in the next version of this paper.

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Figures

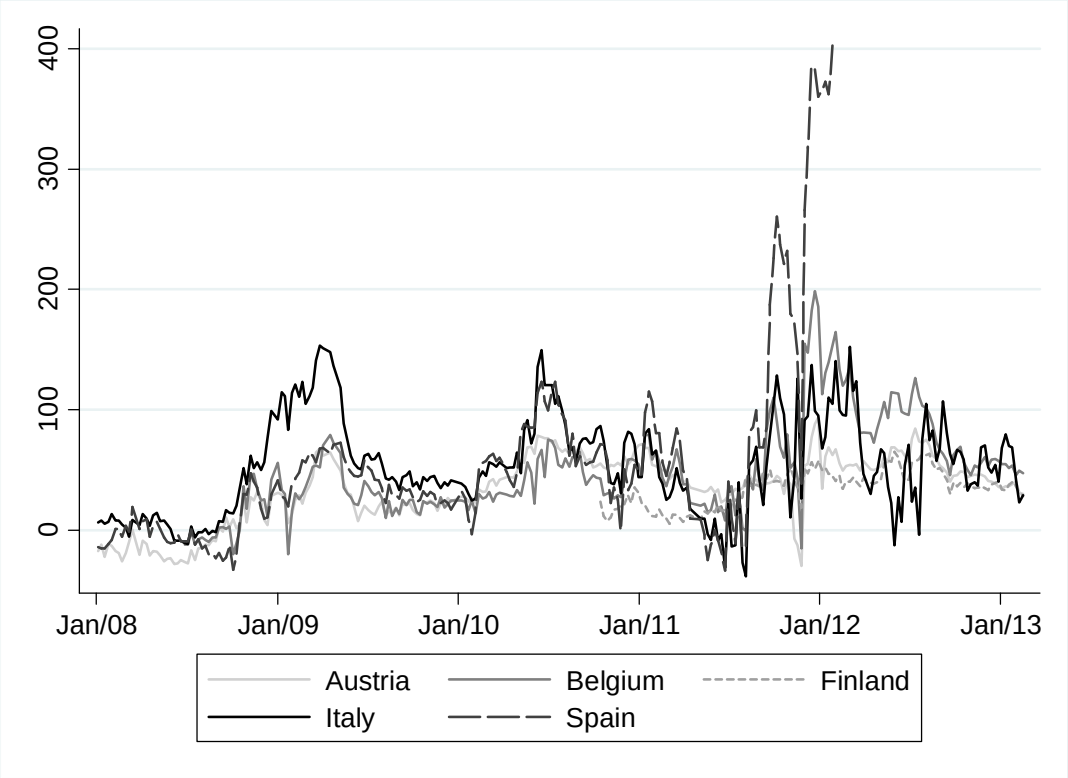


Figure 1: This figure depicts the average basis across pair bonds of the five considered countries: Austria, Belgium, Finland, Italy and Spain. For every bond pair, the basis is defined as the difference between the yield to maturity of the USD-denominated bond after the conversion of the bond cash flows from US-Dollar to Euro ($\widehat{Y}_{i,t}^{USD->EUR}$) and the EUR-denominated bond ($Y_{i,t}^{EUR}$). The sample spans from January 2008 to February 2013. Bases are reported on weekly basis and measured on basis points.

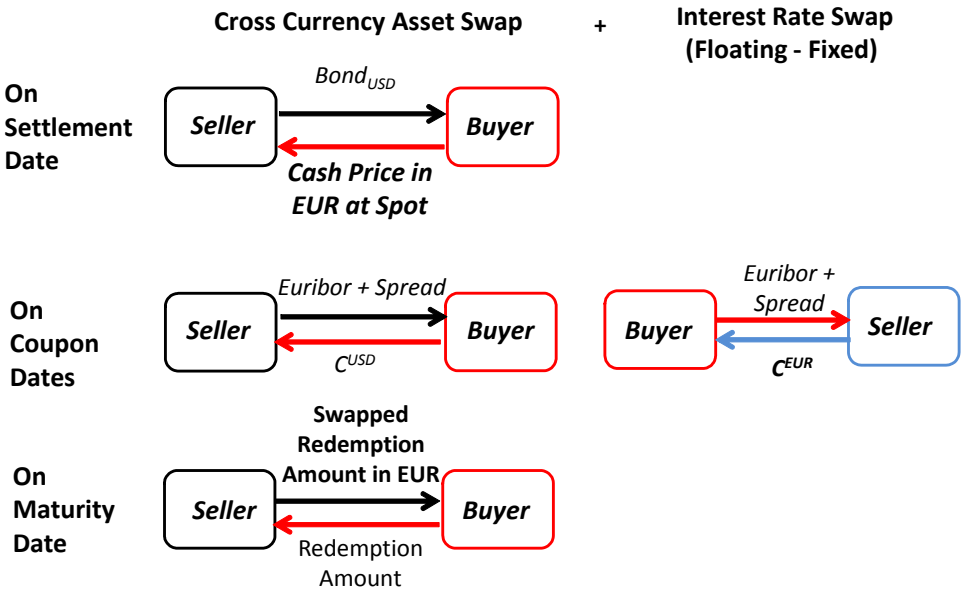


Figure 2: This figure depicts the trading strategy to convert the bond denominated in USD into a synthetic bond denominated in EUR. This strategy involves buying a cross currency asset swap package to exchange the fixed coupons of the USD-denominated bond at the Euribor rate plus a spread and getting into a floating-fixed interest rate swap to exchange that EUR-denominated stream of floating inflow into a fixed coupon rate.

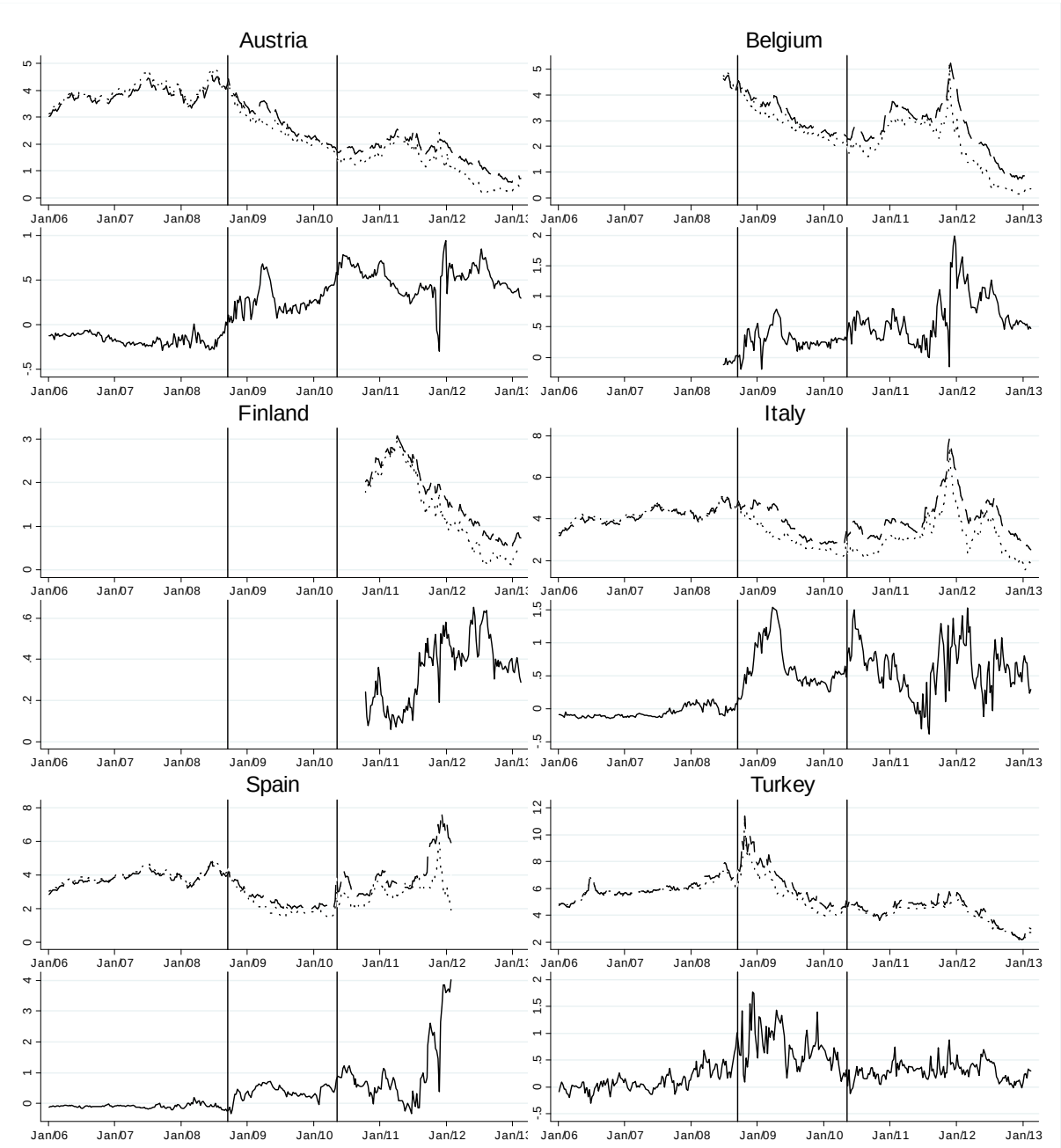


Figure 3: This figure shows the average yield to maturity of the USD-denominated bonds ($\widehat{Y}_{i,t}^{USD->EUR}$), the EUR-denominated ($Y^{EUR}$) and the average basis, defined as the difference between those yields. For every country in the sample, the upper panel contains the average yield of the EUR-denominated bonds (dot line) and the average yield of the USD-denominated bonds after converting the cash flows in EUR (dashed line). The bottom panel contains the average basis, which is the dependent variable in our analysis. The sample spans from January 2006 to February 2013 and the y-axis is measured in percentage. Vertical lines refer to the Lehman Brothers collapse (September 2008) and the starting date of the Securities Market Programme (May 2010).

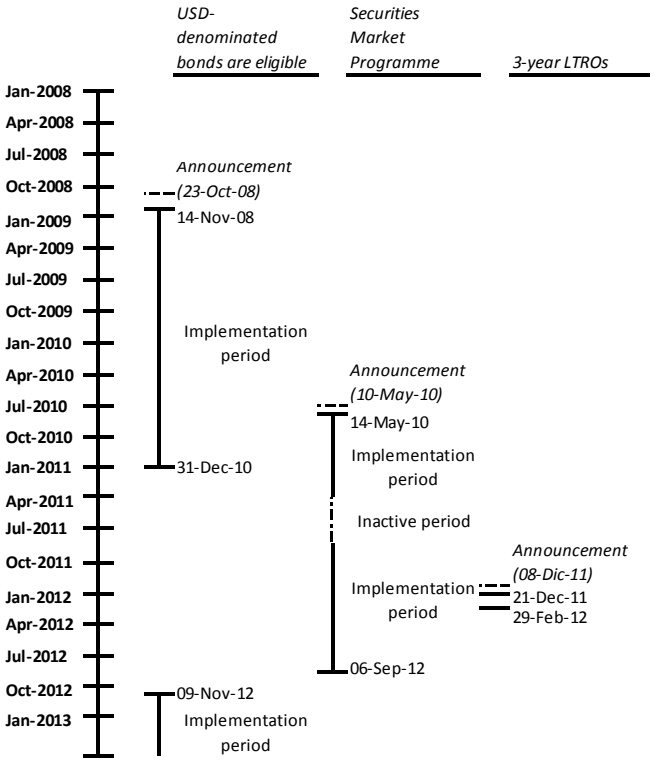


Figure 4: This figure depicts a time line of the ECB interventions under study. The first column refers to the windows during which USD-denominated bonds were eligible as collateral at the ECB; Columns (2) reports the Securities Market Programme (SMP); Column (3) presents the 3-year Long Term Refinancing Operations (3y-LTROs).

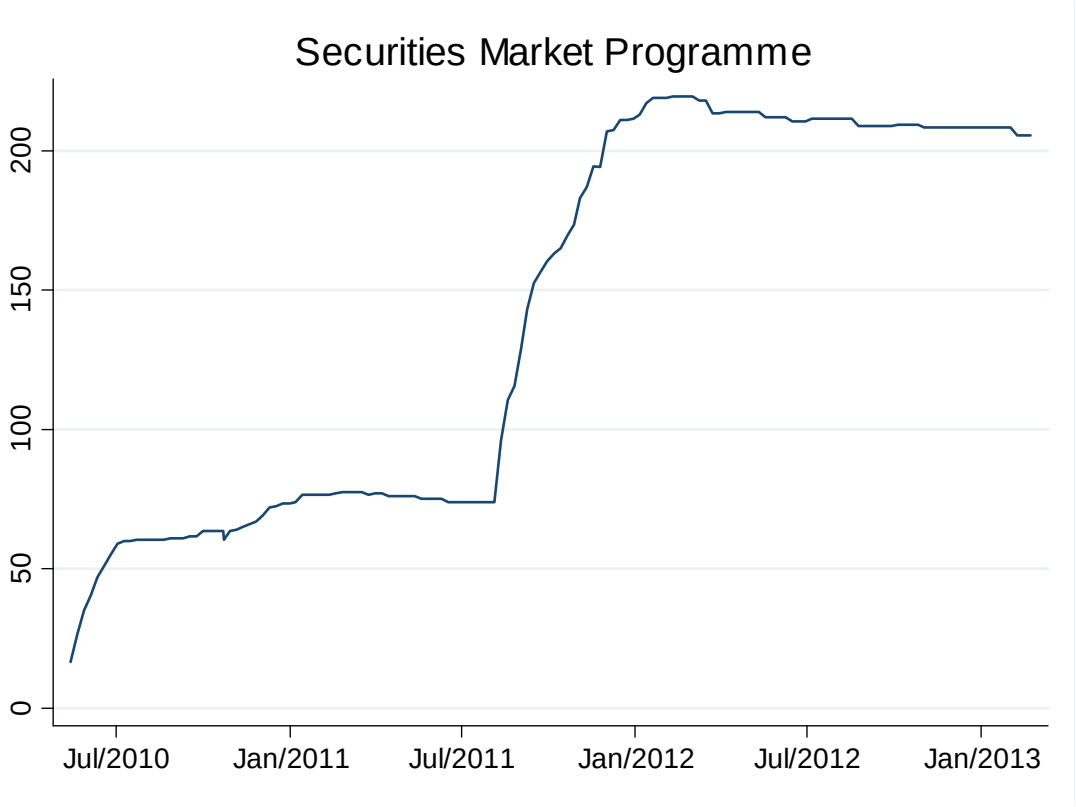


Figure 5: This figure depicts the publicly available information of the Securities Market Programme (SMP). It contains the accumulated book value in EUR billion corresponding to the SMP.

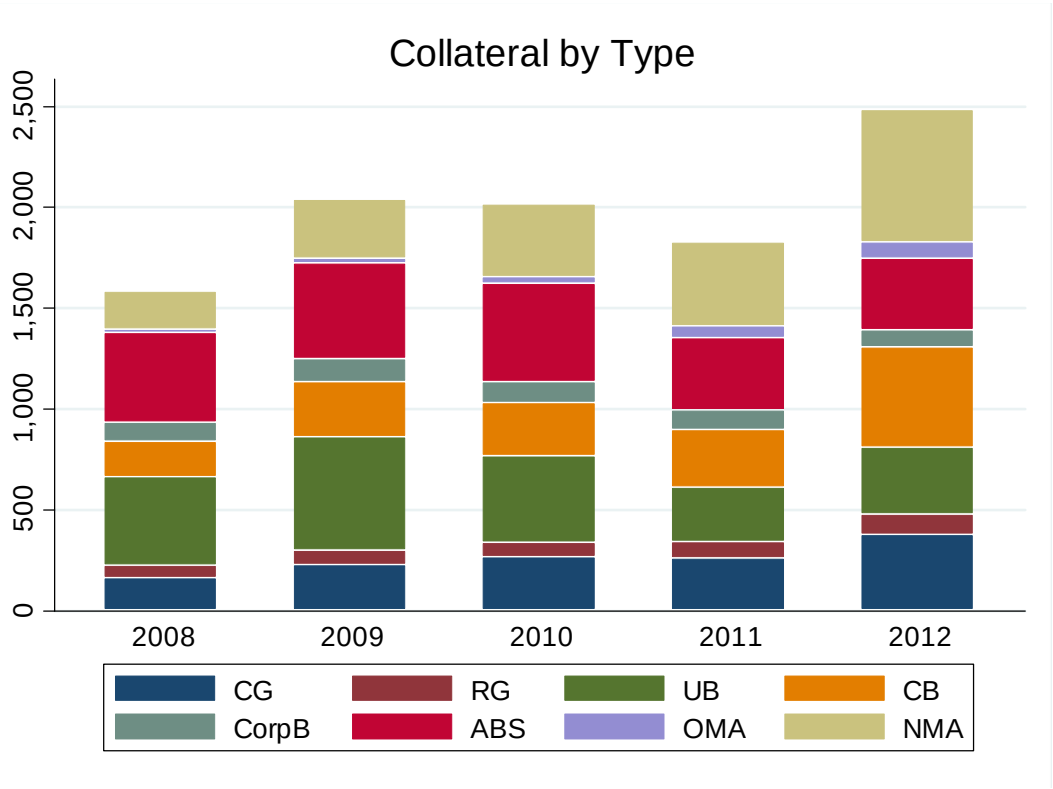


Figure 6: This figure depicts the collateral pledged at the ECB in EUR billion after valuation and haircuts, broken down by type of assets. The considered categories are: central government securities (CG), regional government securities (RG), uncovered bank bonds (UB), covered bank bonds (CB), corporate bonds (CorpB), asset-backed securities (ABS), other markable assets (OMA) and non-markable asstes (NMA).

Tables

Table 1: This table reports the main descriptive statistics at pair bond level. We report the starting and ending date in sample, country, mean basis during the sample period, the ratio between the amount outstanding in USD- and EUR-denominated bonds and the governing law of the USD-denominated (bonds EUR-denominated are issued under the local law).

Starting	*End*	*Country*	*Mean Basis*	*Ration Am. Out*	*Gov. Law USD*
11/Jul/08	31/Aug/12	Belgium	39.07	0.10	Local
18/Sep/09	15/Feb/13	Belgium	96.38	0.05	Local
9/Apr/10	15/Feb/13	Belgium	37.43	0.15	Local
18/May/07	17/Jul/09	Spain	18.35	0.05	England
16/May/08	27/Jan/12	Spain	79.84	0.09	England
22/May/09	30/Apr/10	Spain	41.28	0.08	England
13/Mar/09	4/Mar/11	Spain	53.34	0.07	England
8/Jan/10	16/Sep/11	Spain	8.59	0.11	England
18/May/07	22/Jun/12	Austria	25.76	0.20	England
18/May/07	15/Feb/13	Austria	31.34	0.10	England
18/May/07	25/Mar/11	Austria	21.81	0.09	England
25/Sep/09	15/Jul/11	Austria	50.98	0.10	England
24/Jun/11	15/Feb/13	Austria	24.17	0.07	England
22/Oct/10	15/Feb/13	Finland	33.90	0.22	England
18/Mar/11	15/Feb/13	Finland	40.14	0.22	England
3/Sep/10	4/Feb/11	Italy	100.95	0.12	New York
18/May/07	15/Jun/12	Italy	27.32	0.08	New York
18/May/07	15/Feb/13	Italy	37.21	0.14	New York
18/May/07	15/Feb/13	Italy	73.05	0.06	New York
18/May/07	15/Feb/13	Italy	60.72	0.09	Local
15/Jun/07	15/Feb/13	Italy	75.85	0.06	England
12/Sep/08	16/Jul/10	Italy	37.46	0.09	New York
22/Jan/10	7/Oct/11	Italy	30.56	0.09	New York
5/Feb/10	15/Feb/13	Italy	26.35	0.09	New York
26/Nov/10	14/Sep/12	Italy	4.89	0.09	New York

Table 2: This table reports the estimation of Equation (2) in which we study the impact of the Bond Information and Market Factors on the basis. We employ a Prais-Winsten regression with country fixed-effects, correlated panel, corrected standard errors and robust to heterokedasticity and contemporaneous correlation across panels and serial autocorrelation within panels. The correlation within panels is treated as a first-order autocorrelation AR(1) and the coefficient of this process (ρ) is common to all the panels. Bond Information refers pair-specific information about the bond liquidity (Bid-Ask Spread), lending activity (Fees and No. Transaction) and bond covenants (Dum. England Law, Dum. NY Law and Dum. Additional Clauses). Following the definition of the basis, we construct pair-specific information as the difference between the USD- and the EUR-related variables. Market Factors refers to the Quanto CDS, Euro-OIS Spread, VIX and the European Policy Uncertainty (EPI). The sample spans from January 2008 to February 2013 and it is composed of 25 pairs of bonds that belong to 5 European countries. Column (1) refers to the whole sample. Columns (2) and (3) refer to the "Pre European Sovereign Debt" and "European Sovereign Debt" crisis period, respectively. j denotes country specific variable and i, j denotes bond specific variable. The regression is conducted on weekly basis.

	(1)	(2)	(3)
Bid-Ask Spread$_{i,j,t}$	3.887***	13.543***	2.880
	(1.459)	(3.303)	(1.804)
Fees$_{i,j,t}$	-42.427	110.725	-22.218
	(128.488)	(101.342)	(174.239)
No. Transactions$_{i,j,t}$	-0.187***	-0.022	-0.271***
	(0.057)	(0.053)	(0.083)
Dum. England Law$_{i,j}$	19.387*	12.064	26.718*
	(10.119)	(8.616)	(14.437)
Dum. NY Law$_{i,j}$	-24.539***	-18.294***	-23.972**
	(8.432)	(6.837)	(11.712)
Dum. Additional Clauses$_{i,j}$	1.549	-1.522	-1.077
	(7.408)	(5.377)	(10.509)
Quanto CDS$_{j,t}$	75.978***	68.460***	69.439***
	(6.803)	(8.471)	(9.742)
Eurepo-OIS$_{j,t}$	6.805	56.012***	-73.102***
	(9.136)	(8.320)	(15.106)
VIX$_t$	-0.368***	-0.044	-0.982***
	(0.079)	(0.069)	(0.145)
EPI$_t$	0.527***	0.539***	0.510***
	(0.040)	(0.039)	(0.057)
Constant	-69.442***	-69.803***	-64.606***
	(12.026)	(10.565)	(17.705)
ρ	0.836	0.829	0.807
Num. Obs.	3763	1470	2293
R^2	0.110	0.338	0.105

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: This table reports the estimation of Equation (2) in which we study the impact of the Securities Market Programme (SMP) on the basis using Bond Information and Market Factors as control variables. We employ a Prais-Winsten regression with country fixed-effects, correlated panel, corrected standard errors and robust to heterokedasticity and contemporaneous correlation across panels and serial autocorrelation within panels. The correlation within panels is treated as a first-order autocorrelation AR(1) and the coefficient of this process (ρ) is common to all the panels. Column (1) reports the results using the weekly public available SMP purchases; Column (2) reports the results using weekly purchases at country level; and Column (3) reports the results using weekly purchases at pair level. The sample spans from May 2010 to February 2013 and it is composed of 25 pairs of bonds that belong to 5 European countries. j denotes country specific variable and i, j denotes bond specific variable. The regression is conducted on weekly basis.

	(1)	(2)	(3)
SMPt_t	1.926***		
	(0.168)		
$\text{SMP}_{j,t}$		2.550***	
		(0.367)	
$\text{SMP}_{i,j,t}$			27.245**
			(11.296)
Constant	-52.673***	-65.929***	-64.949***
	(17.501)	(17.177)	(17.671)
Country FE	Yes	Yes	Yes
ρ	0.813	0.806	0.808
Num. Obs.	2293	2293	2293
R^2	0.156	0.132	0.109

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: This table reports the estimation of Equation (2) in which we study the ECB facilities and collateral management on the basis using Bond Information and Market Factors as control variables. We employ a Prais-Winsten regression with country fixed-effects, correlated panel, corrected standard errors and robust to heterokedasticity and contemporaneous correlation across panels and serial autocorrelation within panels. The correlation within panels is treated as a first-order autocorrelation AR(1) and the coefficient of this process (ρ) is common to all the panels. The sample spans from January 2008 to February 2013 and it is composed of 25 pairs of bonds that belong to 5 European countries. Column (1) reports the impact of changes in the eligibility criteria by introducing two dummies that take 1 during the first and the second eligibility windows (1st Eligibility Window and 2nd Eligibility Window). We interact these variables with Eligible Pair, a dummy that takes 1 for those pairs where the USD-denominated bonds fulfill all the eligibility criteria. Column (2) reports the effect of the sovereign debt collateral pledged (Sov. Collateral to Tot Sov. Debt). We interact this variable with Dum. High CDS, a dummy that takes 1 when the CDS of the same country reaches extreme levels, and with Dum. 3y-LTROs, a dummy variable that takes value 1 in the implementation of the 3y-LTROs. Column (3) reports their joint impact. j denotes country specific variable and i, j denotes bond specific variable. The regression is conducted on weekly basis.

	(1)	(2)	(3)
1st Eligibitity Window$_t$	21.758***		19.333***
	(4.001)		(4.031)
2nd Eligibitity Window$_t$	18.859***		16.395**
	(6.497)		(6.636)
Eligible Pair$_{i,j}$	24.586***		19.079**
	(7.842)		(8.014)
1st Eligibitity Window$_t$ x Eligible Pair$_{i,j}$	-11.484**		-8.521*
	(4.862)		(4.810)
2nd Eligibitity Window$_t$ x Eligible Pair$_{i,j}$	-22.786**		-19.772**
	(9.403)		(9.191)
Sov. Collateral to Tot. Sov Debt$_{j,t}$		-71.088	-126.150*
		(67.870)	(69.852)
Sov. Collateral to Tot. Sov Debt$_{j,t}$ x Dum. High CDS$_{j,t}$		216.164*	318.436**
		(123.444)	(124.585)
Sov. Collateral to Tot. Sov Debt$_{j,t}$ x Dum. 3y-LTRO$_t$		278.094**	266.889**
		(131.188)	(131.377)
Dum. High CDS$_{j,t}$		-29.302***	-29.669***
		(6.238)	(6.213)
Dum. 3y-LTROs$_{j,t}$		0.533	0.855
		(4.579)	(4.614)
Constant	-100.338***	-74.111***	-97.127***
	(13.817)	(11.586)	(13.835)
Country FE	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes
Num. Obs.	3763	3763	3763
R^2	0.128	0.134	0.148

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

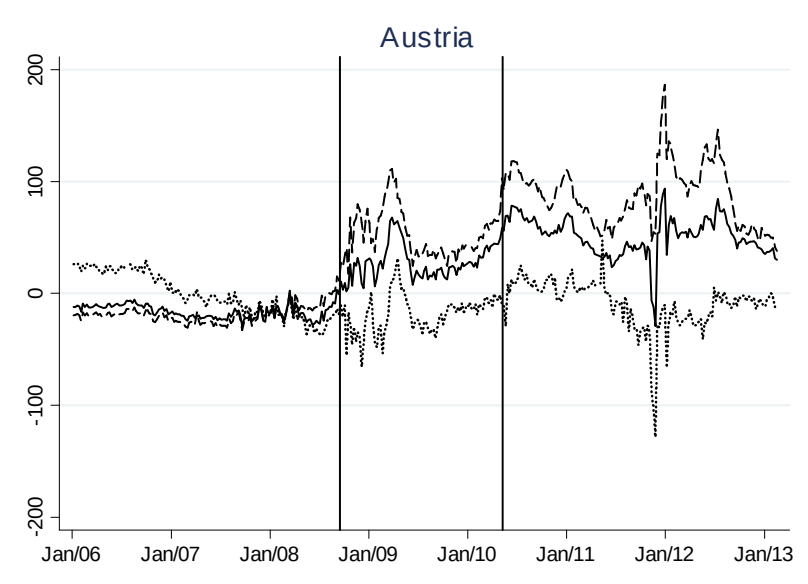
Table 5: This table reports the estimation of Equation (3) in which we study the ECB facilities and collateral management on the new basis using Bond Information and Market Factors as control variables. The new basis is the difference between the estimated basis of each pair and the average basis of Turkey. We employ a Prais-Winsten regression with country fixed-effects, correlated panel, corrected standard errors and robust to heterokedasticity and contemporaneous correlation across panels and serial autocorrelation within panels. The correlation within panels is treated as a first-order autocorrelation AR(1) and the coefficient of this process (ρ) is common to all the panels. The sample spans from January 2008 to February 2013 and it is composed of 25 pairs of bonds that belong to 5 European countries. Column (1) reports the impact of changes in the eligibility criteria by introducing two dummies that take 1 during the first and the second eligibility windows (1st Eligibility Window and 2nd Eligibility Window). We interact these variables with Eligible Pair, a dummy that takes 1 for those pairs where the USD-denominated bonds fulfill all the eligibility criteria. Column (2) reports the effect of the sovereign debt collateral pledged (Sov. Collateral to Tot Sov. Debt). We interact this variable with Dum. High CDS, a dummy that takes 1 when the CDS of the same country reaches extreme levels, and with Dum. 3y-LTROs, a dummy variable that takes value 1 in the implementation of the 3y-LTROs. Column (3) reports their joint impact. j denotes country specific variable and i, j denotes bond specific variable. The regression is conducted on weekly basis.

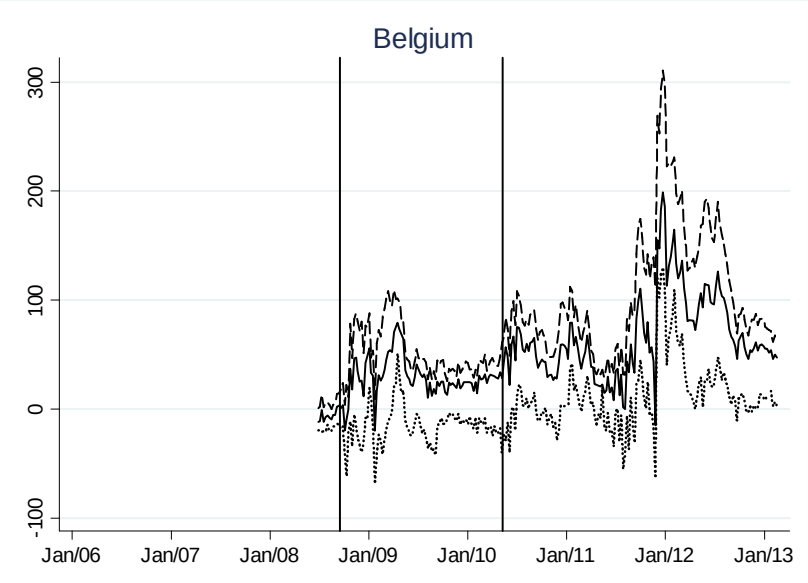
	(1)	(2)	(3)
1st Eligibitity Window$_t$	11.286***		9.000**
	(4.366)		(4.384)
2nd Eligibitity Window$_t$	26.602***		26.297***
	(6.953)		(7.159)
Eligible Pair$_{i,j}$	13.180		5.146
	(10.807)		(10.806)
1st Eligibitity Window$_t$ x Eligible Pair$_{i,j}$	-10.957*		-7.348
	(5.861)		(5.759)
2nd Eligibitity Window$_t$ x Eligible Pair$_{i,j}$	-23.668**		-22.651**
	(10.648)		(10.348)
Sov. Collateral to Tot. Sov Debt$_{j,t}$		-160.024**	-241.023***
		(79.957)	(81.567)
Sov. Collateral to Tot. Sov Debt$_{j,t}$ x Dum. High CDS$_{j,t}$		351.172***	464.502***
		(132.901)	(134.944)
Sov. Collateral to Tot. Sov Debt$_{j,t}$ x Dum. 3y-LTRO$_t$		241.901*	237.000
		(145.929)	(147.668)
Dum. High CDS$_{j,t}$		-37.341***	-38.053***
		(6.717)	(6.726)
Dum. 3y-LTROs$_{j,t}$		-2.130	-1.830
		(5.557)	(5.661)
Constant	-151.062***	-136.148***	-143.289***
	(16.556)	(13.137)	(16.405)
Country FE	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes
Num. Obs.	3763	3763	3763
R^2	0.115	0.122	0.135

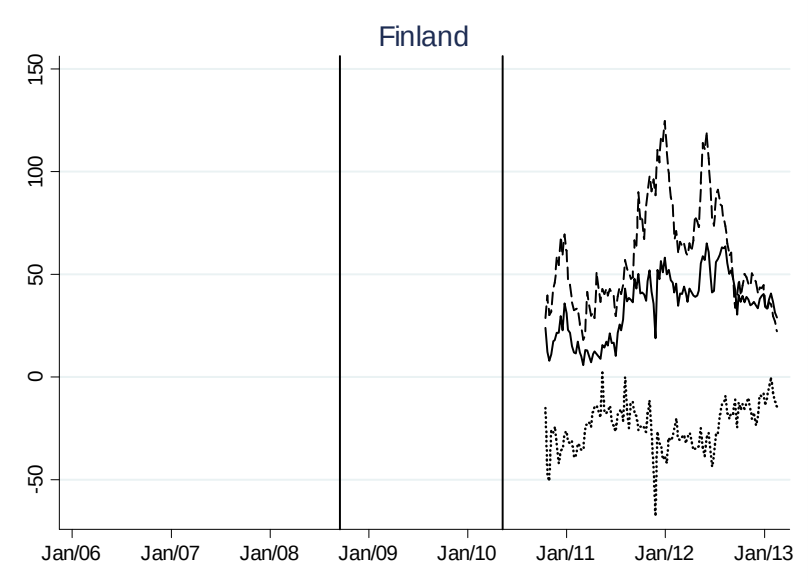
t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix A

These figures show the average basis using three different approaches to convert the USD-denominated cash flows in EUR. The solid line depicts the trading strategy considered in the paper. It involves buying a cross currency asset swap package to exchange the fixed coupon of the USD-denominated bond at the Euribor rate plus a spread and getting into a floating-fixed interest rate swap to exchange that EUR-denominated stream of floating inflow into a fixed coupon rate. The dashed line depicts the Tuckman and Porfidio's (2003) strategy to create an adjusted forward rate that takes into account violations of the covered interest parity in the long run. The dotted line depicts the trading strategy that involves the use of forward contracts to convert the USD-denominated cash flows. The sample spans from January 2006 to February 2013 and the y-axis in measure in basis points. Vertical lines refer to the Lehman Brothers collapse (September 2008) and the starting date of the Securities Market Programme (May 2010)



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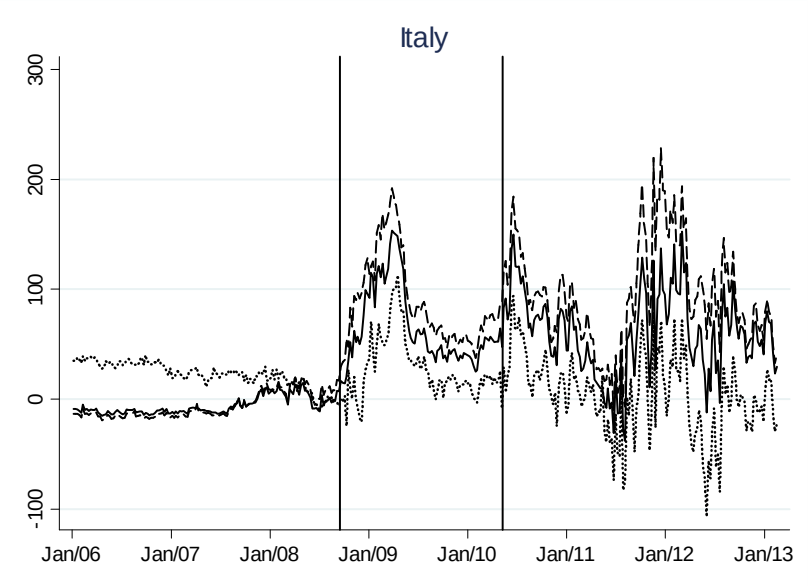
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Jan/06
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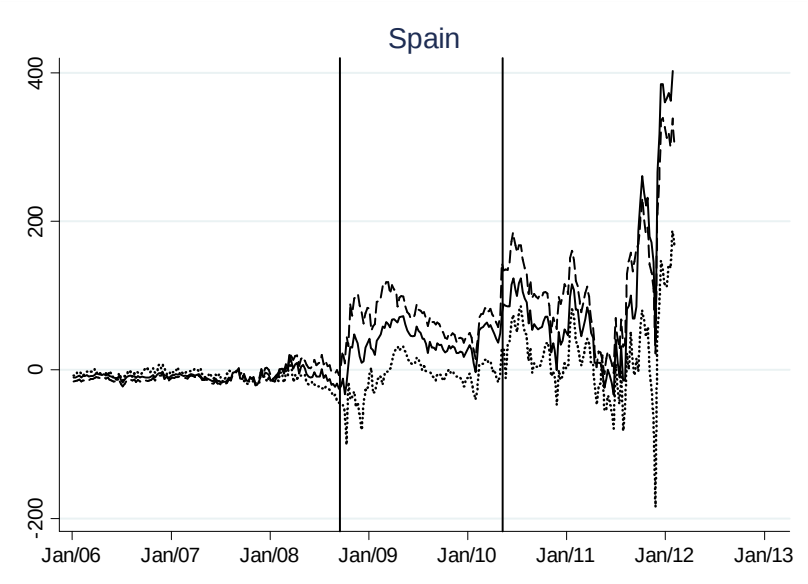
Spain
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-200
Jan/06
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Jan/09
Jan/10
Jan/11
Jan/12
Jan/13

Appendix B

Lending Activity

Bond level information is complemented with information about short selling activity provided by Data Explorers database. This database offers bond-specific loan trading information and encompasses more than the 85% of global transactions. All bonds Data Explorers does not have information for are ruled out from the sample. We explore the effect of two variables: *No. of Transactions* and *Fees*. The *No. of Transactions* refers to the number of open securities lending transactions. The *Fees* denotes the average fee of the borrowing transactions.

Market Risk Factors

Quanto Credit Default Swap Quanto Credit Default Swaps ($Quanto\ CDS_{j,t}$) refers to the differential of CDSs on the same underlying, but quoted in different currencies. Ehlers and Shönbucher (2006) propose a simple estimator for the devaluation fraction as one minus the ratio between the average YEN-denominated CDS spread and the average USD-denominated CDS spread and found that observed devaluation fractions cannot be considered as simple noise in the data. We follow their approach and measure the $Quanto\ CDS_{j,t}$ as one minus the ratio between the average EUR-denominated CDS spread and the average USD-denominated CDS spread capturing the expected devaluation of the Euro relative to the USD conditional on the country's default. We collect information from Thompson Reuters about EUR- and USD-denominated CDS spreads with maturities of 6m, 1y, 2y, 3y, 4y, 5y, 7y, 10y, 20y and 30y.

VIX Information referring to global risk is represented by the implied volatility index (VIX_t) from the Chicago Board Options Exchange (CBOE) which is obtained from Datastream. This index captures the expected volatility and volatility risk premium (Bai and Collin-Dufresne (2013)) and it is a good proxy for the global risk factor (Lustig, Roussanov and Verdelhan (2011)).

Funding Risk We use the spread between the country specific Eurepo general collateral rate 3-month and the OIS both EUR-denominated ($Eurepo - OIS_{j,t}$). The repo markets are a key source of secured funding for banks and financial institutions. A repo is a sale of a security coupled with an agreement to repurchase the same security at a specified price. Despite of being a collateralized instrument, repo rates are mainly affected by the market risk (Hördahl and King (2008)). On the other hand, OIS is equivalent to the average of the overnight interest rates expected until maturity and is almost riskless. Therefore, the Eurepo-OIS spread over the same term quantifies the premium that banks pay when borrowing collateralized funds for a pre-determined period relative to the expected interest

cost from a repeatedly rolling over funding in the overnight market. The information is obtained from the European Banking Association (EBA) and Datastream.

The development of the secured market funding has dramatically changed during the crisis. According to Hördahl and King (2008), during the first part of the crisis, the Eurepo-OIS spread was marginally affected in the euro area, and subsequently moved upwards as the crisis progressed due to a combination of factors, as the type of participants, and the relative availability of sovereign collateral. During the second part of the crisis, the secured market becomes strongly distressed as the economic conditions in Europe worsen and high quality collateral becomes scarce. As a consequence, the behaviuor of the Eurepo-OIS spread changes from trading at positive values to very negative before and after 2010, respectively.

Economic Policy Uncertainty To proxy the economic uncertainty at European level we use the Economic Policy Uncertainty index proposed by Baker, Bloom and Davis (2013) (EPI_t). To measure European policy-related economic uncertainty the authors construct an index from two types of underlying components: newspaper coverage of policy-related economic uncertainty and disagreement among economic forecasters uncertainty.[18]

[18] This variable is available available at http://www.policyuncertainty.com/index.html.

Appendix C

Table 6: Bond descriptive statistics. This table reports the main descriptive statistics at bond level. We report the ISIN, issuer country, settlement and maturity dates, coupon (all bonds are fixed rate), currency, and outstanding amount in millions of EUR (for those bonds USD-denominated we apply the spot exchange rate of the settlement date).

ISIN	*Country*	*Settlement Date*	*Maturity Date*	*Coupon*	*Currency*	*Amount Out.*
AT0000385356	Austria	15/Jan/02	15/Jul/12	5	EUR	10000
AT0000385992	Austria	28/May/03	20/Oct/13	3.8	EUR	13127
XS0170724479	Austria	25/Jun/03	25/Jun/13	3.25	USD	2687
AT0000386073	Austria	15/Jan/04	15/Jul/14	4.3	EUR	9560
XS0192781150	Austria	19/May/04	19/May/14	5	USD	998
XS0211055891	Austria	26/Jan/05	30/Mar/12	4	USD	918
XS0453795824	Austria	23/Sep/09	15/Nov/12	2	USD	1018
AT0000A0GLY4	Austria	15/Jan/10	20/Feb/17	3.2	EUR	9877
XS0638878461	Austria	17/Jun/11	17/Jun/16	1.75	USD	699
BE0000314238	Belgium	24/Apr/08	28/Mar/14	4	EUR	13000
BE0934531337	Belgium	1/Jul/08	3/Sep/13	4.25	USD	1266
BE6000356335	Belgium	15/Sep/09	15/Sep/14	2.875	USD	682
BE6000673598	Belgium	5/Mar/10	5/Mar/15	2.75	USD	1468
BE0000319286	Belgium	16/Mar/10	28/Mar/16	2.75	EUR	9594
FI4000018049	Finland	21/Sep/10	15/Apr/16	1.75	EUR	6500
XS0550739535	Finland	19/Oct/10	19/Oct/15	1.25	USD	1448
XS0605995561	Finland	17/Mar/11	17/Mar/16	2.25	USD	1426
IT0003190912	Italy	1/Feb/02	1/Feb/12	5	EUR	28303
XS0144129649	Italy	1/Mar/02	15/Jun/12	5.625	USD	3467
US465410BF43	Italy	27/Feb/03	15/Jun/13	4.375	USD	1861
IT0003472336	Italy	2/May/03	1/Aug/13	4.25	EUR	24696
IT0003719918	Italy	1/Sep/04	1/Feb/15	4.25	EUR	21350
US465410BN76	Italy	21/Jan/05	21/Jan/15	4.5	USD	3075
IT0003844534	Italy	2/May/05	1/Aug/15	3.75	EUR	25809
US465410BQ08	Italy	25/Jan/06	25/Jan/16	4.75	USD	1634
IT0004019581	Italy	1/Mar/06	1/Aug/16	3.75	EUR	26738
US465410BR80	Italy	20/Sep/06	20/Sep/16	5.25	USD	2364
IT0004164775	Italy	2/Jan/07	1/Feb/17	4	EUR	25598
US465410BS63	Italy	12/Jun/07	12/Jun/17	5.375	USD	1503
US465410BT47	Italy	4/Jun/08	15/Jul/11	3.5	USD	1621
IT0004404973	Italy	1/Sep/08	1/Sep/11	4.25	EUR	18199
US465410BU10	Italy	5/Oct/09	5/Oct/12	2.125	USD	1706
IT0004564636	Italy	4/Jan/10	15/Dec/12	2	EUR	18686
IT0004568272	Italy	15/Jan/10	15/Apr/15	3	EUR	20404
US465410BV92	Italy	26/Jan/10	26/Jan/15	3.125	USD	1776
US465410BW75	Italy	16/Sep/10	16/Sep/13	2.125	USD	1530
IT0004653108	Italy	1/Nov/10	1/Nov/13	2.25	EUR	17819
ES00000120E9	Spain	12/Apr/05	30/Jul/10	3.25	EUR	16183
XS0225226710	Spain	20/Jul/05	20/Jul/10	4.125	USD	823
ES00000120Z4	Spain	15/Jan/08	30/Apr/11	4.1	EUR	15542
ES0000011660	Spain	8/Apr/08	31/Jan/13	6.15	EUR	13606
XS0363874081	Spain	14/May/08	17/Jun/13	3.625	USD	1292
XS0376589288	Spain	16/Jul/08	18/Jul/11	3.375	USD	1264
ES00000121I8	Spain	13/Jan/09	30/Apr/12	2.75	EUR	11939
XS0416150950	Spain	5/Mar/09	5/Mar/12	2.75	USD	797
XS0452149072	Spain	17/Sep/09	17/Sep/12	2	USD	1696
ES00000121T5	Spain	6/Oct/09	30/Apr/13	2.3	EUR	14894
US900123AS92	Turkey	24/Sep/03	15/Jan/14	9.5	USD	1523
DE000A0AU933	Turkey	10/Feb/04	10/Feb/14	6.5	EUR	788
XS0245387450	Turkey	1/Mar/06	1/Mar/16	5	EUR	629
US900123AZ36	Turkey	26/Sep/06	26/Sep/16	7	USD	1577
XS0285127329	Turkey	2/Feb/07	2/Apr/19	5.875	EUR	965
US900123BA75	Turkey	3/Oct/07	3/Apr/18	6.75	USD	1597
US900123BH29	Turkey	18/Mar/10	30/Mar/21	5.625	USD	1470
XS0503454166	Turkey	22/Apr/10	18/May/20	5.125	EUR	1505