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The Euro Government Bond Lending Market

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Abstract

Short-term funding markets were severely disrupted during the global crisis, and the inherent risks continue to be of concern to policymakers. The securities lending market is a core short-term funding market that not only provides critical liquidity to the financial markets but also facilitates collateral upgrading from low-quality securities to high-quality safe assets. Using a unique dataset of European government bond loans, we find that during the financial crisis, borrowing fees for high-quality government bonds increased due to the flight to quality. Given the high demand for cash during stress times, the use of noncash collateral also increases. We provide evidence showing a link between borrowing high-quality bonds in the securities lending market and obtaining financing in the repo market. Our analysis shows that the purchase of peripheral country government bonds by the European Central Bank (ECB) stimulated borrowing of these lower-quality bonds in the securities lending market, and reduced the lending fee for these bonds. Our results suggest that injections of liquidity into the government bond market by the ECB contributed to the proper functioning of the securities lending market that played an important role in the transmission of monetary policy.

JEL: E44, E58, G24

Keywords: securities lending, short-term funding, European government bonds, financial crisis, safe assets, collateral upgrading, repo

"A *major source of unaddressed risk emanates from the large volume of short-term securities financing transactions (SFTs) in our financial system, including repos, reverse repos, securities borrowing, and lending transactions*." [1]

Janet L. Yellen, Chair, Board of Governors of the Federal Reserve System

1. Introduction

The ability of core funding markets to operate at all times is essential to the proper functioning of financial markets and financial institutions and therefore to the wider economy. Well-functioning core funding markets are also critical for the transmission of monetary policy. For most countries, core funding markets include those for sovereign bonds, repo, securities lending, money markets, and foreign exchange.[2] These core funding markets allow financial institutions to raise financing, and enable market makers to finance long positions and cover short positions to facilitate transactions. Funding markets were severely disrupted during the global financial crisis and the subsequent sovereign debt crisis in Europe. To counter the disruption in funding markets, the U.S. Federal Reserve in March 2008 introduced the so-called Term Securities Lending Facility (TSLF) that allowed banks to borrow U.S. Treasuries while posting collateral that had become impaired during the financial crisis. In May 2010, the European Central Bank (ECB) introduced the Securities Markets Programme (SMP) which involved the direct purchases of public and private debt securities to ensure depth and liquidity in these markets. The proper functioning of short-term funding markets continues to be a major source of concern for regulators, as indicated by Chair Yellen's comment and Stein (2013).

The securities lending market in government bonds allows borrowers to transform collateral by exchanging low-quality and less liquid securities for high-quality and liquid collateral that can

[1] Speech at the International Monetary Conference on June 3, 2013, titled "Regulatory Landscapes: A U.S. Perspective."
[2] See Fontaine, Selody, and Wilkins (2009).

then be used to obtain cash in the repo market or as collateral for swap and derivative transactions. In addition to facilitating access to high-quality and liquid collateral, the securities lending market facilitates the borrowing of securities for settlement and short selling purposes As of July 2015, the global lendable inventory of all securities stood at $15 trillion, and the amount borrowed was $2 trillion.[3] Lendable inventory for European government bonds was $978 billion, with the amount borrowed at $362 billion as of March 2014.[4]

Our paper is the first to examine the functioning of the securities lending market in government bonds and show its importance in accessing high-quality collateral that can more easily be used to obtain financing in the repo market.[5] Given the high demand for cash during crises, we also examine the use of cash versus noncash collateral during periods of financial stress. In addition, we examine the role of the securities lending market for government bonds in transmitting relation between purchases of peripheral country government bonds by the ECB.

We use a unique data set to analyze borrowing of government bonds from 11 European countries that have activity in the securities lending market during the period July 2006 through December 2014. This period covers both the U.S. and the European crisis. The proprietary daily data set is comprised of lendable inventory, value on loan, and borrowing fee for each government bond. Austria, Belgium, Finland, France, Germany, and the Netherlands are classified as core countries, and Greece, Ireland, Italy, Portugal, and Spain as peripheral countries.

We find an increased interest in using the securities lending market to upgrade collateral during crises, hence increasing borrowing fee of high-quality government bonds issued by core

[3] https://www.markit.com/product/pricing-data-securities-finance
[4] Markit Securities Finance Review 2014 Q1.
[5] In one of the few papers examining securities lending in sovereign bonds, Bris (2014) finds the securities lending market anticipates downgrades of sovereign bonds.

countries. We find that borrowers are less likely to use cash and instead pledge noncash collateral in the securities lending market to borrow high-quality government bonds of core countries during periods of market stress. In normal times, we find borrowing fees is lower for government bonds issued by high-quality countries, however, during crises, borrowing fees increases more for high-quality bonds issued by core countries relative to low-quality bonds issued by peripheral countries. High-quality bonds from core counties are borrowed using more of noncash collateral during stress periods. These findings are consistent with an increase in demand for high-quality government bonds, borrowed against lower-quality collateral, to obtain better quality collateral in a crunch.

We also identify a link between the securities lending market and the repo market at the bond level. During crises, more borrowing of government bonds in the securities lending market relates to more usage of the same bond as collateral in the repo market to obtain cash. This result is consistent with an upgrading of collateral to obtain cash in the repo market. Peripheral country government bonds suffered increased default risk during the crisis. Our analysis shows that the purchase of peripheral country government bonds by the ECB stimulated borrowing of these lower-quality bonds in the securities lending market, and lowered the lending fees of these bonds. The results suggest that the ECB injections of liquidity into the government bond market restored a proper functioning of the securities lending market in these bonds, hence we conclude that this market played an important role in the transmission of monetary policy.

Our study shows the importance and the role of the securities lending market, and can help guide current policy debates on the regulation of these markets. Understanding and bringing more transparency to short-term funding markets is of ongoing interest to policymakers.[7] In addition, current derivatives reforms aimed at reducing complexity by moving to central counterparties have

[7] Speech by Stanley Fischer, "Nonbank Financial Intermediation, Financial Stability, and the Road Forward," March 30, 2015.

focused attention on collateral transformation and management. Basel III has also increased the need for high-quality liquid government bonds for use as collateral. Regulators and market participants are concerned about the scarcity of "good" collateral, and estimates of collateral shortfall range from $500 billion to $8 trillion.[8]

Although no academic studies have directly examined the role of the securities lending market in government bonds, our paper dovetails with the literature on other short-term financing markets. In analyzing tri-party repos, Copeland, Martin, and Walker (2014) discuss the significant role of securities lenders who, similar to money market funds, reinvest the cash obtained from securities lending in tri-party repo. Corradin and Maddaloni (2015) likewise find the scarcity premium to be higher in the repo market for bonds when the lendable supply is lower in the securities lending market for sovereign bonds, showing the link between repo and securities lending. The special collateral repo market, in which forward agreements are security-specific, is examined by D'Amico, Fan, and Kitsul (2014). They show that the repo rate falls in response to a reduction in the supply of the specific U.S. Treasury collateral. In addition, they find that the impact of the scarcity premium passes to the Treasury cash market. The focus of these studies is not on the securities lending market. However, they do show the important linkages between the securities lending market in sovereign bonds and the repo market, and eventually the cash market, and hence the interconnectedness of the securities lending market with large parts of the financial system.

Our paper relates to the recent literature on the shortage of safe assets, which frequently serve as collateral to back loans. Gorton and Ordonez (2013) show that the production of safe assets by the government (i.e., government debt) provides large incentives for the private sector to produce information about the quality of collateral, while Krishnamurthy and Vissing-Jorgenson

[8] The Tabb Group, "Optimizing Collateral: In Search of a Margin of Oasis," 2012.

(2012) show that changes in the supply of safe assets have large effects on the yields of privately-created near-safe assets.

Gorton and Metrick (2012) show the important role of subprime mortgages in causing a run in the repo market and leading to a crisis. They find that concerns about declining values and liquidity in asset-backed securities used as collateral led to increases in repo haircuts. Krishnamurthy, Nagel, and Orlov (2014) document that repo volume backed by asset-backed securities falls to near zero during the crisis. They argue that, even though the repo contraction is small, it disproportionately affected a few dealer banks, leading to a run. Their analysis shows how a relatively small market can have severe consequences during a crisis. Similarly, a number of other studies have examined the importance of short-term funding markets, see, for example, Covitz, Liang and Suarez 2013; Acharya, Schnabl, and Suarez 2013; Martin, Skeie, and von Thadden (2014); Stein (2012); and Hanson, Kashyap, and Stein (2011).

Our paper also relates to the literature on the impact of nonstandard monetary policies during the crisis, such as those of the Federal Reserve and ECB (e.g., Duygan-Bump et al. 2013; Fratzscher, Duca, and Straub 2014; and Eser and Schwaab 2015). These studies quantify the impact of nonstandard monetary policies, mainly through bond yields, market liquidity, and international contagion channels. We propose a new channel for central bank interventions: restoring the proper functioning of short-term funding markets that are critical for the transmission of monetary policy. We show that the direct purchase of government bonds in the cash market by the ECB stimulates borrowing demand for the bonds of the targeted countries. The results imply that the ECB intervention had positive effects on the functioning of the securities lending market, thereby improving access to short-term funding and enhancing the transmission of monetary policy

The paper proceeds as follows. Section 2 provides the institutional background on the securities lending market in government bonds. Section 3 describes the data on securities lending market, government bond secondary market, and the repo market. Section 4 examines two roles of securities lending market: collateral upgrading and accessing repo markets. Section 5 provides evidence of the securities lending market serving as a new channel for the transmission of ECB's monetary policy. Section 7 concludes.

2. Institutional Background on Securities Lending

The securities lending market for government bonds is *sui generis* in short-term funding markets. Beyond facilitating repo and cash markets, it has a unique role in transforming low-quality assets into high-quality liquid assets (HQLA), a process called collateral transformation. This extraordinary feature makes the government bond lending market irreplaceable by alternative markets. In this section we introduce the institutional setting of the securities lending market with a focus on its special features, and the difference as well as connection to the repo market.

Figure 1 shows a schematic description of the securities lending market for government bonds. There are three parties in a government bond lending transaction: a) the lender, also called the beneficial owner, normally large institutional investors such as pension fund, insurance company, mutual fund, or sovereign wealth fund; b) the borrower such as banks or hedge funds; and c) the financial intermediaries like brokers and dealers, and custodian banks. The lender agrees to lend the holding securities to the borrower in exchange for collaterals consisting of cash, other securities, or both. Although lenders refer to these lending securities as being "on loan," the lender actually transfers ownership, and therefore the borrowed securities can be transferred to a third party as part of another securities lending transaction. The lender keeps the coupons or dividends on

securities loaned, while the borrower retains the right to the coupons or dividends on collateral securities.

According to Finglas (2015), sovereign wealth funds and central banks account for 22% of all government bond loans in Europe, mutual funds and pension funds account for 31%, and insurance companies account for 10%. The motivation for lending securities is to increase the return on holding assets by earning low-risk lending fees. In addition, if cash collateral is used, the lender can further earns a spread through the collateral investment vehicles which are often in the money market, but the lender needs to give part of the additional spread, called rebate fee, to the borrower. Securities lending loans are generally standardized contracts with a stable haircut ranging from 102% for domestic securities to 105% for international securities. The lending fee captures the risks embedded in collaterals and counterparties.

The risks for the lender in receiving cash or noncash collateral are similar because the transactions are marked to market daily and are collateralized by more than 100% of the value. A cash-collateralized transaction adds reinvestment risk for the lender, which is the risk that the value of the invested cash may be less than the principal invested. In a noncash-collateralized transaction, the lender charges a fee and does not pay a rebate.

If cash collateral is used, repo and securities lending are economically equivalent, although repo transactions are driven by a need to borrow or to invest cash, while lending transactions result from the need to borrow specific securities. However, there is a lot more flexibility in acceptable collateral in the securities lending market, including corporate bonds, equities, asset-backed securities, or other assets. Borrowers such as banks thus can use these lower-quality securities on their balance sheets as collateral in the securities lending market to upgrade collateral to government bonds.

Noncash collateral indeed has been the dominant form of collateralization in European government bond lending market. The percentage of European government bonds on loan against noncash collateral has increased from 52.4% in 2006 to 72.7% in 2014. In contrast, noncash collateral amounted only to 4.6% of government bond loans in 2006 and 17.6% in 2014 in the United States.[10] The securities lending market therefore plays an even bigger role in Europe in allowing market participants to upgrade collateral to high-quality government bonds.

Consistently, the main motivation for borrowers in the European government bond lending market is collateral transformation, which further serves cash needs and meeting regulatory requirements. This also distinguishes from the motivation for borrowing equities or corporate bonds in the securities lending market, where short selling is the main purpose. In European government bond lending market. short selling also exists but not the main driver, especially not during the global financial crisis. With the increasing demand for high-quality liquid assets in stressed market conditions, we elaborate in future sections that flight-to-quality through upgrading collaterals is the essential function provided by the securities lending market. This novel function differentiates from conventional roles of securities lending market for equities or corporate bonds, and has not yet been studied in the literature.

The demand to borrow high-quality government bonds in Europe is at least driven by two factors: financing in the repo market and meeting regulatory requirements. First, the Euro repo market mostly uses high-quality liquid bonds as collateral. According to a survey on the European repo market, government bond collateral accounts for about 80% of EU-originated repo

[10] The use of cash collateral has been the norm in the U.S., partly driven by regulations such as the Employee Retirement Income Security Act or 1940 Act, and partly by the incentive to gain yield pickup by reinvesting the cash collateral. However, even in the U.S., the use of noncash collateral is increasing in the recent years.

collateral.[11] In order to get financing in the repo market, borrowers short of cash can first raise high-quality government bonds through upgrading low-quality collaterals on their balance sheets, such as stocks, corporate bonds, and mortgage-backed securities, in the securities lending market. This is in particular important in the crises when cash is so scarce and funding liquidity constraint tightens.

Second, regulations have increased the focus on the securities lending market, particularly on high-quality liquid government bonds. Market participants are concerned that there is not enough good-quality collateral available to meet the post-crises regulatory requirements. The increasing demand for collateral transformation emerges from two types of recent regulations, including i) changes in derivatives trading rule under the Dodd-Frank Act in the United States and the European Markets Infrastructure Regulation (EMIR), and ii) liquidity coverage ratios under Basel III as well as capital charges for insurers.[12] The first type of regulations requires the use of central clearing for derivatives transactions. Central counterparties (CCPs) request collateral from their customers in the form of government bonds or cash. For example, ICE Clear Europe, operated by the Intercontinental Exchange, publishes a list of permitted collateral that only includes cash and government bonds from selected countries such as Austria, Belgium, Germany, France, the Netherlands, the United States, and United Kingdom.[13] Thus, in order to conduct derivative transaction, the prerequisite is to have high-quality collateral, and the securities lending market for government bond serves this role.

[11] Source: International Capital market Association Semi-Annual Survey 2014. http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/short-term-markets/Repo-Markets/frequently-asked-questions-on-repo/6-what-types-of-asset-are-used-as-collateral-in-the-repo-market/

[12] See Singh (2013a, 2013b) for further discussion on the use of collateral.

[13] https://www.theice.com/publicdocs/clear_europe/list-of-permitted-covers.pdf

Under Basel III, 60% of a banks' liquidity coverage ratio (LCR) must comprise of cash or government debt in the Level 1 category, with the remainder given over to Level 2 assets, which include lower-rated sovereign bonds, covered bonds, and high-quality corporate debt. The LCR is designed to ensure that a bank maintains an adequate level of unencumbered high-quality collateral that can be converted into cash to meet liquidity needs for a 30-day horizon under an acute liquidity stress scenario. Banks may resort to collateral upgrading to help meet the regulatory capital requirement. An advantage of using securities lending market to upgrade collateral is that banks can reduce leverage by collateralizing borrowings with pledged securities, hence allowing netting and permitting the transactions to be taken off the balance sheet.[14]

3. Data Description

3.1 Securities Lending Market in Government Bonds

We obtain proprietary securities lending data from Markit for the period July 1, 2006, to December 31, 2014. Markit collects securities lending information daily from 125 large custodians and 32 prime brokers, covering more than 85% of the securities lending market. Our sample focuses on government bonds from 11 euro area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. Other euro area countries such as Cyprus, Estonia, Latvia, Lithuania (as of 2015), Luxembourg, Malta, Poland, Slovakia, and Slovenia are not included due to a lack of activity in the securities lending market. In our sample, government bonds comprise sovereign bonds issued by the central governments and bonds issued by regions, states, and central banks as well as bonds issued by government-owned institutions.

[14] http://www.statestreet.com/content/dam/statestreet/documents/SecFinance/SL_InView_Non-Cash.pdf

As is common in the literature, we classify Austria, Belgium, Finland, France, Germany, and the Netherlands as *core* countries, and Greece, Ireland, Portugal, Italy, and Spain as *peripheral* countries.

Securities lending activities are captured by a few key variables. On a daily basis, for each bond, *FEE,* is the lending fee the beneficial owner receives from the borrower in return for lending its securities, and is calculated as the average transaction-weighted annualized rate expressed in basis points (bps) for all open transactions. *ONLOAN* for each bond is the value on loan as a percentage of bond issue size, *INVENTORY* is the aggregate lendable inventory value as a percentage of bond issue size, and *UTILIZATION* is value on loan expressed as a percentage of lendable inventory. For value on loan, we also know the composition of collateral by cash versus noncash securities. For each bond, *NONCASH* is the ratio of noncash collateral to the sum of both cash and noncash collateral. The tenure of the loan, *TENURE,* is the weighted average number of days from the beginning of the contract to present for all open transactions, and the difference between the daily highest and lowest lending fee is *FEE SPREAD*, which captures the bond-level trading liquidity in the securities lending market.

The security lending market in government bonds is far more active than the lending market for equities or corporate bonds. For example, the demand to borrow European government bonds, relative to the supply of lendable bonds, is much higher in our sample, 37% for core countries and 20% for peripheral countries, in comparison to 7% for corporate bonds, as reported by Asquith, Au, Covert, and Pathak (2013), and 18% for equities, as reported by Aggarwal, Saffi, and Sturgess (2015).

After country filtering, our sample consists of 4,203,116 bond-day observations representing 7,298 unique bonds issued by 11 euro area countries during the period July 1, 2006 to December 31, 2014.

3.2 Government Bond, Cash Market, and Macro Variables

We obtain information on bond characteristics and secondary-market bond prices from Datastream and Bloomberg. Bond characteristics include issue amount, issue date, maturity date, coupon rate, and coupon type (floating, fixed, and zero). The reporting currency in the security lending data is U.S. dollars, but the issue amount in Datastream is in the issuance currency, often in euros but sometimes in British pounds and other currencies. We convert the value of relevant securities lending variables and bond characteristics into euros.

The risks associated with lending/borrowing a government bond also depend on risk and liquidity of the bond in the secondary market. We use yield-to-maturity to measure bond credit risk. For proxies of liquidity, we consider the conventional bid-ask spread as well as bond size and time to maturity. A bond tends to have lower liquidity if the issue size is small, and/or if the bond was issued earlier because significant holdings of such bonds are in the hands of buy-and-hold investors and are not available for trading in the cash market. Merging the securities lending data with Datastream and removing stripped bonds and bonds with missing issue size result in 3,198,162 bond-day observations for 5,809 unique bonds.

Similar to previous studies, for example, Beber, Brandt, and Kavajecz (2009), we control for country-level credit risk by using the five-year credit default swap spread (*CDS*) denominated in U.S. dollars with a cumulative restructuring document clause. Compared with other country characteristics such as GDP growth rate, the ratio of debt to GDP, the ratio of current account to

GDP, *CDS* is a high-frequency market variable that captures country-level risk more accurately and in a timely manner.

We obtain from Bloomberg two benchmark interest rates in the euro area, the three-month euro interbank offer rate (Euribor), and the overnight interest rate swap in euro (OIS), both interest rates are *unsecured* lending rates. We then use the spread, *Euribor-OIS*, as proxy for funding liquidity in the European market. The Euribor-OIS spread, similar to its counterpart, Libor-OIS in the U.S. market, is closely watched as an indicator of market stress, an important measure of risk and liquidity in the money market. Gorton and Metrick (2012) use the Libor-OIS spread as the indicator for market stress. We proceed similarly, using the Euribor-OIS spread as the proxy for funding liquidity risk. The three-month Euribor-OIS spread significantly widened both during the global financial crisis of 2008–2009 and at the peak of European sovereign crisis.

We also collect data on the European stock market index STOXX50 and the European stock market volatility index VSTOXX and use market volatility, noted as *EURO VIX*, as an additional proxy for market stress.

3.3 Government Bond Repo Market

To examine the linkage of the securities lending market to the repo market, we use data from the MTS repo trading platform during the period of July 1, 2006, to December 31, 2014. The MTS repo platform covers 90% of the Italian repo market backed by Italian government bonds, but the coverage is limited for other countries. Hence, we use the Italian repo market as a pilot to test the linkage between borrowing activity in Italian government bonds and the repo market. According to Corradin and Maddaloni (2015), European repo market transactions are generally agreed on a bilateral basis. A transaction can be initiated by the sell side, which uses securities as

collateral to get cash, or by the buy side, which uses cash as collateral to get a specific security. We refer to sell-side contracts as financing repo and buy-side contracts as reverse repo transactions.

We calculate the following main bond-level variables: (i) *REPO AMOUNT*, defined as the log of total par value of a bond collateralized in the repo market; (ii) *SPECIALNESS*, defined as the spread between the general collateral repo rate and the special repo rate of the same bond with matching collateral classes and terms; and (iii) *FINANCING RATIO*, total par value of sell-side contracts as a percentage of sum of par value from both sell-side ("financing repo") and buy-side contracts ("reverse repo"), thus measuring the percentage of the underlying security used for the purpose of financing.

The currency for repo contracts is the euro. We match the repo data to the securities lending data using the ISIN code of each government bond. After matching, we examine the relation between borrowing demand and lending fee in the securities lending market, and financing activities in the repo market.

3.4 Securities Lending Descriptive Statistics

Table 1 shows the sample distribution across countries. The country with the largest number of government bonds available to lend is Germany (2,258), followed by France (1,044). Italy, the Netherlands, and Spain also have relatively large number of bonds with lendable inventory. Greece and Ireland have the smallest number of lendable government bonds, 142 and 44, respectively. On any day, Germany has 634 government bonds available for lending, with a lendable value of €179.39 billion and a value on loan of €81.24 billion; Ireland only has 12 bonds available, with a lendable value of €4.23 billion and a value on loan of €0.77 billion. This turnover

is sizeable relative to the total amount of government bonds outstanding. For instance, the value on loan for Germany is 4% of the total amount of government debt outstanding.

The utilization rates for bonds issued in core countries (Austria, Belgium, Finland, France, Germany, and the Netherlands) range from 30% to 45%, much higher than those for peripheral countries (Greece, Ireland, Portugal, Italy, and Spain), which range from 17% to 24%. Bonds issued by the core countries also have relatively low and stable borrowing costs, ranging from 12 bps to 19 bps, whereas bonds issued by peripheral countries have higher and more volatile borrowing costs, except for Italy. For example, Greek bonds on average have an annualized fee of 135 bps, with a standard deviation of 213 bps. Italy's gross government debt both in euros and as a percentage of GDP is one of the highest in Europe. Therefore, it is not surprising that lendable supply for Italy is higher than all countries except France and Germany. The availability of ample lendable inventory results in low lending fee for Italy. Table A1 in the appendix provides additional summary statistics of the securities lending market in European government bonds, including the annual number of bonds and average daily value by year during 2006-2014.

Figure 2 plots aggregate lendable inventory (i.e. securities available for loan) and value on loan for government bonds used in our sample. The inventory of European government bonds increases slightly from 2006 to 2008, drops during the U.S. crisis due to heightened credit risk of borrowers, and then rises before dropping again during the peak of the European crisis. The value on loan shows a similar pattern but has still not recovered to the peak levels of 2007.

Table 2 reports the mean and standard deviation for key securities lending variables for core and peripheral countries for the full sample period of 2006 through 2014 and also for four sub-periods. The sub-periods are pre-U.S. subprime crisis (July 2006-June 2007), U.S. subprime crisis (August 2008-June 2009), pre-European sovereign debt crisis (July 2009-April 2010), and

the peak of the European sovereign debt crisis (August 2011-June 2012). Over the full sample period, the average borrowing cost is not much different for bonds issued by core or peripheral countries. During the U.S. crisis, lending fee increases much more for core countries than for peripheral countries, suggesting a flight to quality. The average fee for peripheral countries is higher during the peak of the European crisis, partly driven by contraction in the lendable supply and value on loan for their government bonds. The very limited borrowing of peripheral country bonds during the peak of the European crisis is likely driven by short selling.

Panels B, C, and D of Table 2 show that, on average, 12.66% of the total outstanding value of the bond issued in the primary market is available for lending for core country bonds, while 7.40% of the total outstanding is available for lending for peripheral country bonds.[23] Almost all government bonds in the primary market are available in the lending market, though the demand varies significantly. On average, 4.21% of the total outstanding value of a bond is borrowed and is on loan for core countries, and 1.93% for peripheral countries. The demand for government bonds issued by core countries increases slightly during the peak of European crisis, relative to the pre-European crisis period. In contrast, the demand for government bonds issued by peripheral countries shows a downward trend since the U.S. crisis and severely drops to 0.81% at the peak of European sovereign debt crisis. The proportion of value on loan to lendable value, that is, the utilization rate, has a mean of 34.41% for bonds from core countries and 26.22% for bonds from peripheral countries. These utilization rates for government bonds are much higher than those for equities or corporate bonds and highlight the differences in the purpose served by these markets.

4. Flight to Quality

[23] These statistics are based on bonds that are available for lending in the securities lending market.

We examine the cost of borrowing high-quality versus low-quality bonds during crises. Government bonds issued by core countries are assumed to be high-quality and those issued by peripheral countries are assumed to be of lower quality. Therefore, we create a dummy variable, *DCORE* that equals one if a bond is issued by a core country (Austria, Belgium, Finland, France, Germany, and the Netherlands), and zero otherwise. We examine fee for core versus peripheral country bonds during periods of financial stress. The dependent variable is *FEE*. We report results for three specifications. In column (1) of Table 3, the main explanatory variables are *EURIBOR-OIS*, *EURIBOR-OIS*DCORE*, and *DCORE*. Column 2 adds *OIS* and *EURO RETURN*. These two specifications include country fixed effects and clustering is at the country-level. In column 3, we repeat the analysis with bond characteristics included as control variables.

As shown in Panel A, Table 3, the coefficient of *DCORE* is negative and significant, indicating that high-quality government bonds issued by core countries generally have lower fee. The coefficient of *EURIBOR-OIS* is not significant in any of the specifications.

The key coefficient of interest is the coefficient of the interaction term, *EURIBOR-OIS*DCORE*. In each specification, the coefficient is significant and positive. The three regressions demonstrate that, when the Euribor-OIS spread is large, that is, during financial stress, the lending fee is higher for high-quality government bonds issued by core countries. In Panel B of Table 3, we use an alternative proxy for financial stress, *EURO VIX*. Using this alternative measure, we again find that during periods of financial distress, borrowing cost is higher for bonds issued by core countries. Our results suggest that market participants are willing to pay a higher fee to borrow high-quality bonds during a crisis, presumably because there is flight to quality and these bonds become more valuable to use as collateral for obtaining cash.

In the earlier analysis, the dummy variable *DCORE* identifies government bonds issued by core countries and is a proxy for bond quality. Next, we repeat the analysis using country-level CDS spreads as a proxy for quality, and the results are reported in Table 4. All government bonds from the same country will have the same value for *CDS*. The dependent variable is *FEE*. The dummy variable *HIGH(CDS)* takes the value of one if the country-level CDS spread is above the median spread, and zero otherwise. The coefficient of the interaction term *EURIBOR-OIS*HIGH CDS* in columns (1)-(3) of Table 4 is negative and significant in each specification. The result implies that fee increased more during the crisis for countries that had less credit risk. We also examine whether the preference of market participants changes with respect to the maturity of the bond, and the results are reported in columns 4, 5 and 6 of Table 4. We create a dummy variable *HIGH(TTM)* that takes the value of one if the bond maturity is higher than the median for all bonds in the sample. We find that borrowers are willing to pay a higher fee for shorter maturity bonds during periods of stress. Finally, in columns 7 and 8 we include both interaction terms *EURIBOR-OIS*HIGH(CDS)* and *EURIBOR-OIS*HIGH(TTM)* in the estimations. Both coefficients continue to be negative and significant.

We further examine the extent to which there is an increase in the demand for high-quality collateral as demonstrated by the demand to borrow government bonds of certain countries. We create a flow measure of demand, RELATIVE DEMAND, defined as the proportion of the aggregate value on loan for a specific country k relative to the aggregate value on loan for all countries:

$$RELATIVE\ DEMAND_k = \frac{ONLOAN\ AMOUNT_k}{\sum ONLOAN\ AMOUNT_k}.$$

A higher ratio implies there is relatively more demand for government bonds of country k, conditional on the aggregate demand for all countries in our sample. Panel A of Figure 4 plots RELATIVE DEMAND for each of the core countries and Panel B for peripheral countries. Relative demand spikes for Germany during the European crisis.

5. Collateral Upgrading and Financing

Our objective is to examine the role of the securities lending market in collateral transformation, especially during periods of financial stress. During a crisis, cash becomes king, and it becomes difficult to obtain financing. Therefore, borrowers might prefer to use noncash collateral to borrow securities. Both borrowers and lenders may have preference for cash in stressed market conditions. However, it is also possible that because reinvestment risk of cash collateral increases during a crisis, lenders might not want cash. The question is whether high-quality collateral is borrowed during crisis by pledging low-quality collateral or by using cash. The answer is theoretically ambiguous.

Borrowers in the securities lending market, for example, hedge funds and banks, hold assets including stocks, corporate bonds, asset-backed securities, and convertibles on their books. Meanwhile, these borrowers need high-quality collateral for several purposes, including obtaining financing in the repo market, conducting derivative transactions, and meeting regulatory capital requirements. If the motivation is to upgrade collateral, then borrowers are more likely to use noncash collateral, particularly during crises. Lenders holding high-quality securities, however, may become more risk averse and may not be willing to accept low quality collateral. Lenders need to weigh the decision to accept noncash collateral versus the risk of investing cash collateral that must be rebated to the borrower.

Traditionally such collateral upgrade trades involve the exchange of corporate bonds and asset-backed securities for sovereign bonds but during the European sovereign debt crisis, when the quality and liquidity of peripheral bonds deteriorated, they also involved the exchange of low-quality sovereign bonds from peripheral countries for high-quality sovereign bonds from core countries.

5.1 Noncash versus Cash Collateral

We estimate the proportion of noncash collateral to total collateral, denoted as *NONCASH*:

$$NONCASH = \frac{Noncash\ Collateral}{(Noncash\ Collateral + Cash\ Collateral)} * 100$$

Our proxy for funding liquidity risk and financial stress is the spread, *EURIBOR-OIS*. As shown in Figure 2, this spread widens considerably during both the U.S. and the European crisis. The figure also plots *NONCASH* over our sample period of 2006 through 2014 separately for government bonds issued by core and peripheral countries. Three patterns are evident. First, more noncash collateral is used when there is a financing crunch--especially for peripheral bonds--as demand for cash and the reinvestment risk of cash increased. Second, the use of noncash collateral to borrow peripheral country government bonds spikes in 2011 when the ECB launches its program to buy Italian and Spanish bonds. The securities lending market in Italian bonds is the largest after Germany and France. The impact of the ECB's actions are discussed in more detail later. Third, the use of noncash collateral has continued to increase in 2013 and 2014 even when though the EURIBOR-OIS spread has declined to its pre-2008 level. As discussed earlier, the increase in the usage of noncash collateral in 2013 and 2014 was driven by regulatory changes. There is increased demand from borrowers to upgrade to high-quality liquid securities in order to meet Basel III and EMIR requirements (see Section 2). Table 5 presents the summary statistics for the noncash ratio in various subsample periods, confirming the patterns illustrated in the graph. *NONCASH* before the U.S. crisis was 56.12% and 42.45% for core and peripheral countries, respectively. Post-CCP regulations the ratio has increased to 74.39% for core countries and 55.15% for peripheral countries.

We use the earlier framework to examine changes in the use of noncash collateral during stress periods for core versus peripheral countries. The time period is limited to July 2006 to June 2012, a period not impacted by the new regulations.[24] We use *NONCASH* as the dependent variable:

$$NONCASH_{itj} = \alpha + \beta\ Market\ Stress_t * DCORE + \beta\ Market\ Stress_t * DPERI + \Sigma\theta_k * CONTROL_{kjt} + \varepsilon_{ijt} \quad (2)$$

Our proxy for funding liquidity risk and financial stress is the spread, *EURIBOR-OIS*. For robustness, we repeat the analysis by replacing Euribor-OIS with an alternative proxy for financial stress, *EURO VIX*. For control variables, we include the interest rate proxy, *OIS*, and European stock market returns *EURO RETURN*. We also control for the bond characteristics discussed in Section 3.5, including loan tenure, lending fee spread, bond size, time to maturity, and a floating rate dummy but do not report the coefficients.

The use of country fixed effects, instead of bond fixed effects, is motivated by the collateral rules of central counterparties under the Dodd-Frank Act and EMIR, which categorize government bonds at the country-level. That is, any government bond issued by a sovereign country is treated equally in serving as eligible collateral.[25] One of our main hypothesis is that the securities lending market plays a crucial role in upgrading collateral from low-quality securities (equities, corporate bonds, mortgage-backed securities, etc.) to high-quality government bonds. Therefore, we include country-level fixed effects and cluster standard errors at the country-level. Clustering at the country-level increases the dispersion and hence lowers the *t*-statistic, compared to clustering at the bond-level, which elevates the bar of statistical significance for our tests.

[24] On July 4, 2012, the EMIR Regulation on OTC Derivatives, Central Counterparties and Trade Repositories was adopted in Europe. As discussed in Section 2, this is a major development that requires standard derivative contracts to be cleared through central counterparties (CCPs), which creates a huge demand for high-quality collateral.

[25] For the list of eligible collateral, see https://www.theice.com/publicdocs/clear_europe/list-of-permitted-covers.pdf

Panel A, Table 6 reports the results using *EURIBOR-OIS* to measure funding liquidity risk, and the results are shown in columns (1)–(3). Columns 1 and 2 report results with country fixed effects and clustering at the country-level. Column 3 reports results with bond characteristics included. The coefficient of *EURIBOR-OIS*DCORE* is positive and significant in each specification suggesting that the tightening funding constraint is associated with more use of noncash collateral in exchange for high-quality government bonds in core countries. However, the coefficient of *EURIBOR-OIS*DPERI* is not significant in two of the three specifications and only significant at 10% in the third specification. The results are consistent with the motivation of collateral upgrading during periods of stress. Government bonds in peripheral countries are not targeted for the purpose of collateral upgrading. Therefore, it is not surprising that the results are significant only for core country bonds but not for peripheral country bonds.

For robustness we repeat the analysis using *EURO VIX* as the proxy for stress and the results are similar. In unreported results, we also repeat the analysis for the full period of 2006 through 2014. As discussed earlier, the need for collateral has increased in 2013 and 2014 due to new regulatory requirements. For the full period, the association between financial stress and the use of noncash collateral becomes insignificant, possibly due to the increased use of noncash collateral in the last two years which is irrelevant to market stress. This finding is consistent with the pattern observed in Figure 3. The use of noncash collateral for high-quality bonds is high during periods of markets stress; in addition, recent years have also seen increased use of noncash collateral due to new regulations, even though the financing markets have stabilized.

In Europe, noncash securities have been the dominant form of collateral, while in the United States, loans of securities have traditionally been collateralized by cash, partly due to

regulatory restrictions. The function of upgrading collateral provided by the securities lending market thus is particularly important for European financial markets.

5.2 Securities Lending and Financing in Repo Market

We hypothesize that government bonds borrowed in the securities lending market are often used to obtain financing in the repo market. If this is true, then more borrowing in the securities lending market for a particular bond should be associated with more activity for the same bond in the repo market. The data coverage from the MTS Repo platform is comprehensive for Italy but not for other countries in our sample. Therefore, we use the repo data for Italian government bonds to examine the link between borrowing in the securities lending market and financing in the repo market. One may be concerned that Italy is classified as a peripheral country. Thus the motivation to borrow Italian bonds in the lending market may not be consistent with financing in its repo market.

Our dependent variable is the log of the par value collateralized in the repo market for each Italian bond, *REPO AMOUNT*. We use the log of value on loan, *ONLOAN AMOUNT*, as an explanatory variable. To mitigate the noise of market microstructure, we follow convention and use weekly values in the repo market by averaging daily observations. We include week fixed effects and cluster at the bond-level. As shown in Table 7, the coefficient of *ONLOAN AMOUNT* is positive and highly significant, indicating a positive association between amount borrowed in the securities lending market and overall activity in the repo market.

More evidence supporting the linkage between the securities lending market and the repo market is seen from market prices. We use the dependent variable, *SPECIALNESS*, defined as the spread between the general collateral repo rate and the special repo rate, a proxy for the scarcity of a bond. Because the lending fee also measures the relative scarcity of a bond, it is not surprising

that we observe a significant positive relation between *SPECIALNESS* in the repo market and *FEE* in the securities lending market: a 1% increase in lending fee is associated with a 0.657% increase in the specialness rate.

The link established so far might simply be driven by the fact that there is more activity for the same bonds in the primary market, in the securities lending market, and the repo market. After documenting the linkage between the two markets, we now analyze the extent to which obtaining financing in the repo market relates to the amount borrowed in the securities lending market, particularly during a crisis. Again, our analysis here is limited to Italian bonds. We can identify sell-side contracts ("financing repo") that represent exchanging collateral for cash, and buy-side contracts that use cash to obtain a specific security ("reverse repo"). Therefore, we define the dependent variable. *FINANCING RATIO*, as the percentage of total par value of sell-side contracts to the sum of par value of both sell-side and buy-side contracts. The variable measures the percentage of the underlying security used for the purpose of financing.

Column 1 of Table 8 reports the results with only *ONLOAN* as the explanatory variable. The coefficient of *ONLOAN* is negative and significant at the 1% level, implying that, in general, Italian government bonds borrowed in the lending market are not being used for financing. In column 2, we include the dummy variable, *DCRISIS*, which equals one for the period of the U.S. crisis, and zero otherwise. During the U.S. crisis, Italian government bonds were considered quite safe. The interaction of *ONLOAN* DCRISIS* is positive and significant at the 1% level, indicating that, during the U.S. crisis, borrowing of Italian government bonds is motivated by the objective of upgrading collateral for possibly obtaining financing in the repo market.

Column 3 reports results for the European crisis. The interaction of *ONLOAN* DCRISIS* is positive and significant only at the 10% level, indicating that, during the European crisis, there

is less interest in borrowing Italian government bonds for collateral upgrading to obtain financing in the repo market. Indeed, Italian sovereign debt markets did experience severe stress starting in the summer of 2011. However, they were still accepted as collateral by ICE Clear Europe. Finally, in column 4, the definition of crisis period includes both the U.S. and European crisis. The coefficient of the interaction term *ONLOAN*CRISIS* is positive and significant at the 1% level. These results suggest that borrowing of Italian government bonds in the securities lending market during stressed times is positively associated with bonds being collateralized in the repo market to obtain financing. Although Italian bonds are accepted by ICE Clear Europe for collateral purposes, their haircuts are much larger than that of bonds from core countries, reflecting the higher risk. For example, the haircut on German bonds is in the range of 3%-10%, whereas the haircut for Italian bonds is in the range of 6%-15%.

6. ECB Intervention and Activity in the Securities Lending Market

Earlier we discussed the importance of the securities lending market and its role in contributing to collateral upgrading for various purposes, including financing in the repo market. In this section, we examine whether the securities lending market also serves as a transmission channel of monetary policy. Since the onset of the European sovereign debt crisis, the ECB has implemented unconventional monetary policy measures (alongside standard measures) to ensure depth and liquidity in dysfunctional markets, especially in the European government bond market whose proper functioning is crucial for the transmission of monetary policy. Given its natural linkage to the government bond market and its specific function in enhancing liquidity, the securities lending market in government bonds also serves as a transmission channel for ECB policies. Specifically, we examine the influence of the ECB's Securities Market Programme (SMP)

on securities lending activities. The ECB adopted other unconventional measures such as main refinancing operations (MRO) and long-term refinancing operation (LTRO). But these operations were targeted at banks and not directly aimed at government bonds, and thus they are not clearly related to the securities lending market in government bonds.

In May 2010, several euro area financial markets including money markets, foreign exchange markets, and peripheral country bond markets became increasingly impaired.[26] In particular, the yield spreads of sovereign bonds from peripheral countries relative to German bunds widened, liquidity evaporated, and volatility increased sharply. In response to these market conditions, on May 10, 2010, the ECB announced several measures, the most significant being the SMP program, which involved direct purchases of government bonds in the secondary market. In the first phase of the program, starting in May 2010, purchases were limited to Greek, Irish, and Portuguese government bonds. In the second phase, which started in August 2011, the ECB extended the SMP to Italian and Spanish government bonds. The ECB's purchase of these bonds amounted to a significant portion of the outstanding bonds. As the markets stabilized, the ECB stopped purchasing bonds in early 2012. Earlier studies, including those by Fratzscher, Duca, and Straub (2014) and Eser and Schwaab (2015), have quantified the impact of the SMP on bond yields.

We examine the impact of SMP purchases on government bond lending price via the following regression:

$$Fee_{itj} = \alpha + \beta\, SMP_t + \beta\, SMP_t{*}TARGET + \beta\, EURIBOR\text{-}OIS_t + \beta\, EURIBOR\text{-}OIS_t\, {*}TARGET + \beta TARGET + \Sigma\theta_k * CONTROL_{kjt} + \varepsilon_{ijt}\ , \qquad (3)$$

Where *SMP* is the ECB's weekly purchase amount of government bonds issued by targeting peripheral countries. The SMP was characterized by a high degree of opacity, with little or no

[26] See ECB Monthly Bulletin, June 2010.

disclosure about amount decomposition or maturity structure of the purchases; only the aggregate amount of purchases were disclosed. *TARGET* is a dummy variable with a value of 1 if a bond is issued by a sovereign country targeted by ECB securities market programme (SMP). The targeting countries in Phase I are Greece, Ireland, and Portugal, and those in Phase II are Italy and Spain.

In both Phase I (May 2010 to March 2011) and Phase II (August 2011 to March 2012), as shown in Table 9, the SMP purchase of targeting country government bonds helped boost the market's confidence and hence reduce the lending price of government bonds issued by the targeting countries. The coefficient on the interaction of SMP and TARGET is significantly negative, indicating that government bonds in targeting coutries have relative lower price than those in core countries. This result remains robust after controlling for the money market interest rate and European stock market return, and remains robust even after controlling for the funding market condition, EURIBOR-OIS, and its interaction with the dummy variable TARGET. It's worth noting that the coefficient for TARGET alone is significant positive, suggesting that on average targeting country bonds have higher price.

These results indicate that ECB's intervention were effective in boosting demand for securities lending of government bonds of peripheral countries and in reducing the lending fees associated with such lending.

7. Conclusion

The securities lending market is a core funding market that provides critical liquidity to the financial markets. However, the market is opaque, and little is known about the market in and of itself, or its linkages to other markets. The securities lending market is of ongoing interest to policymakers because of its connections to other markets and its inherent systemic risk. New regulations such as Basel III, the Dodd-Frank Act, and EMIR have increased the demand for high-

quality liquid collateral and have focused attention on the securities lending market for government bonds because the market allows for collateral transformation.

Using a unique data set of European government bond loans, we find that, during crises lenders prefer to hold onto high-quality government bonds unless the lending fee is excessively high. We also find that borrowers are less likely to use cash and instead pledge noncash collateral to borrow high-quality government bonds of core countries during crises. However, they are not willing to borrow bonds of peripheral countries, possibly because this does not allow them to upgrade collateral or obtain financing. More borrowing of a bond in the securities lending market relates to more activity for that bond in the repo market for the purpose of obtaining financing. The securities lending market allows borrowers to upgrade to high-quality liquid collateral that can then be used to obtain financing, for example, in the repo market as shown by the findings. The ability to upgrade collateral and use it in the repo market for financing purposes is particularly important during crisis.

We show that the purchase of peripheral country government bonds by the European Central Bank during the crisis is associated with increased borrowing of these bonds in the securities lending market. Our results indicate that the securities lending market for government bonds also served as a channel for the transmission of the ECB's monetary policy: the SMP program contributed to restore a proper functioning of the securities lending market for government bonds, a funding market that is critical for the functioning of short-term funding markets and the transmission of monetary policy. Our study can help guide ongoing discussions regarding unaddressed risks from short-term financing transactions, and concerns about the scarcity of high-quality collateral.

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Figure 1
Illustration of the Securities Lending Market for Government Bonds

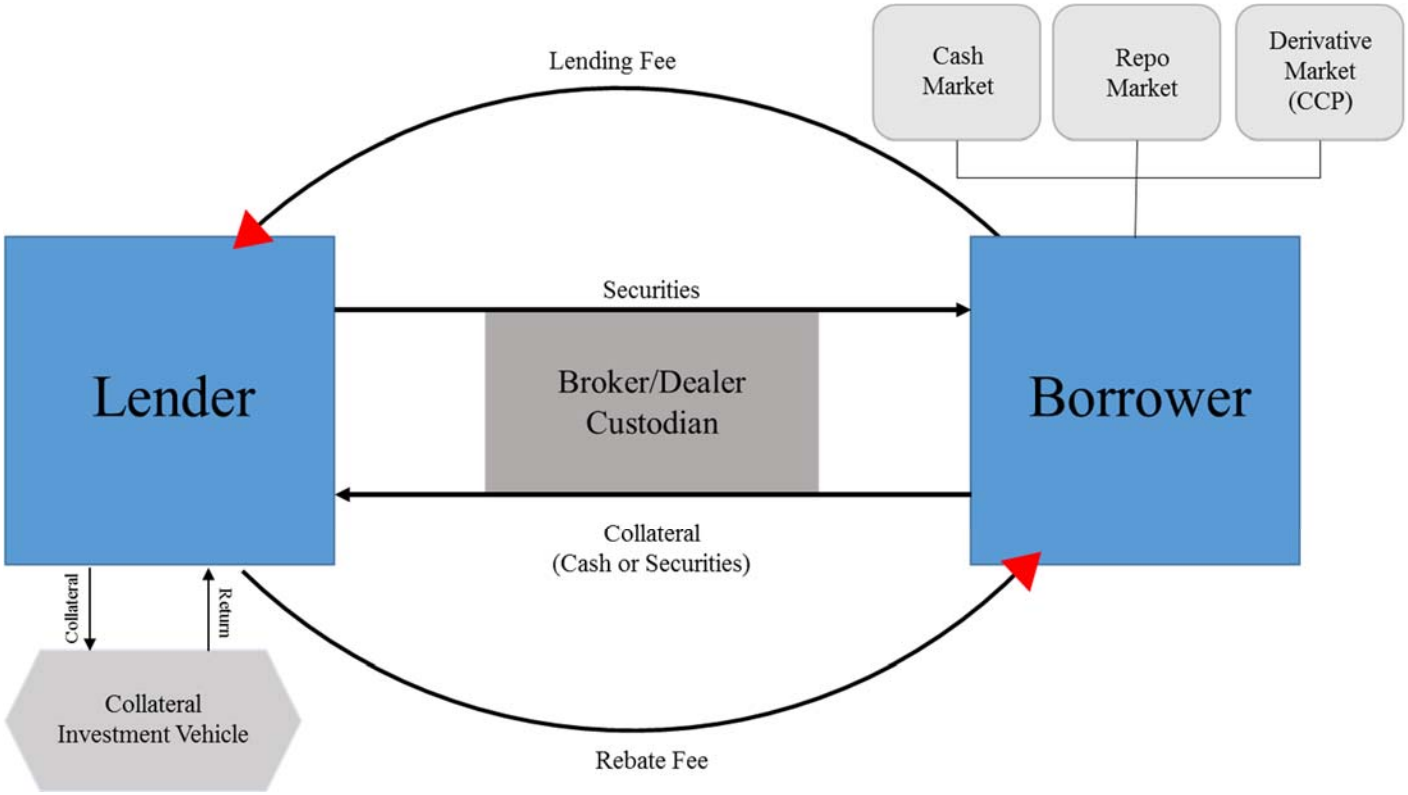


Figure 2
Lendable Inventory and OnLoan Values in Securities Lending Market for European Government Bonds

The graph shows the weekly aggregate lendable inventory and value on loan in billions for government bonds from eleven countries in our sample for the time period of July 1, 2006 to December 31, 2014. The eleven euro countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain.

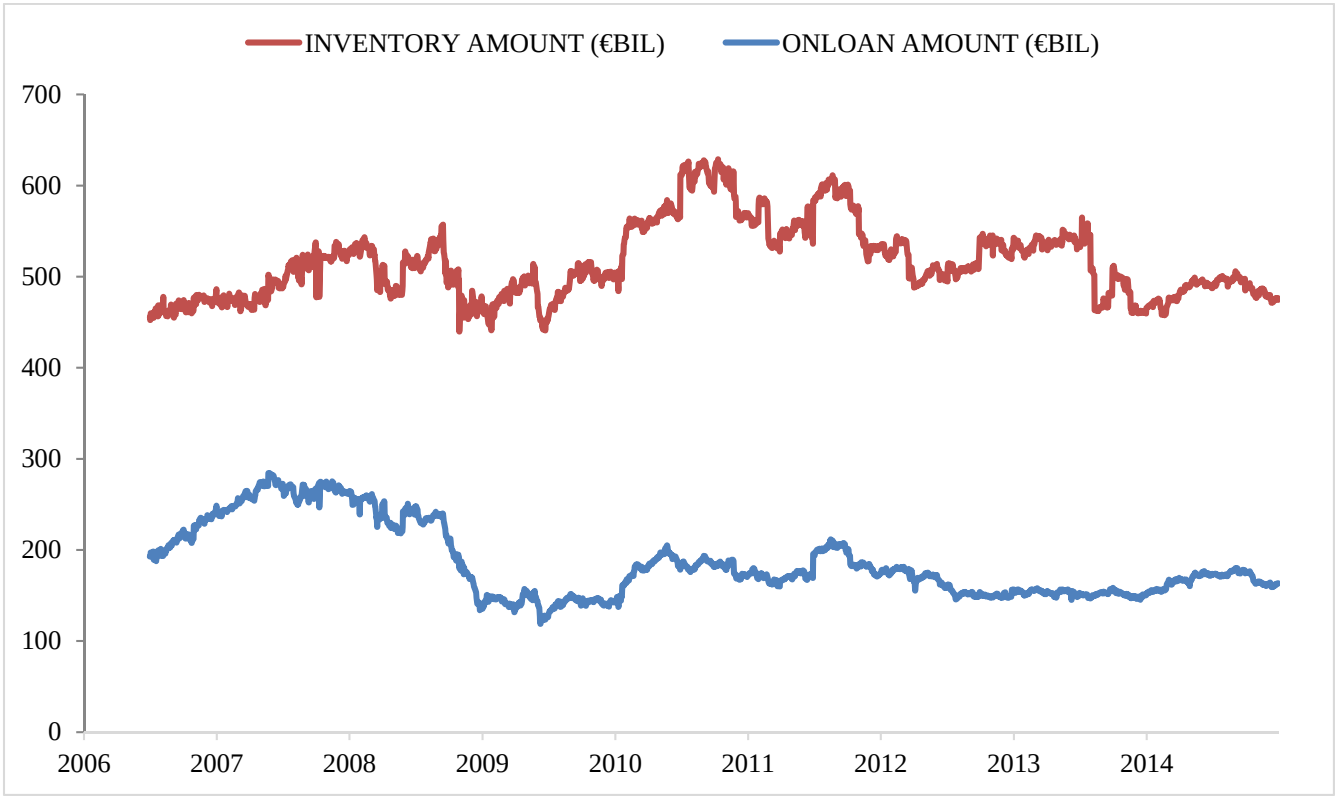


Figure 2
Noncash Collateral and Funding Liquidity Condition

In the securities lending market, borrowers can pledge cash or non-cash collateral to borrow government bonds. Non-cash collateral may include securities such as equity, corporate bonds, asset-backed or mortgage-backed securities. The figure plots the ratio of noncash collateral to total collateral for core and peripheral countries from July 2006 to December 2014. Core countries are Austria, Belgium, Finland, France, Germany, Netherlands, and the peripheral countries are Greece, Ireland, Italy, Portugal, and Spain. The figure also plots, *EURIBOR-OIS*, a proxy for funding market condition, on the right-axis.

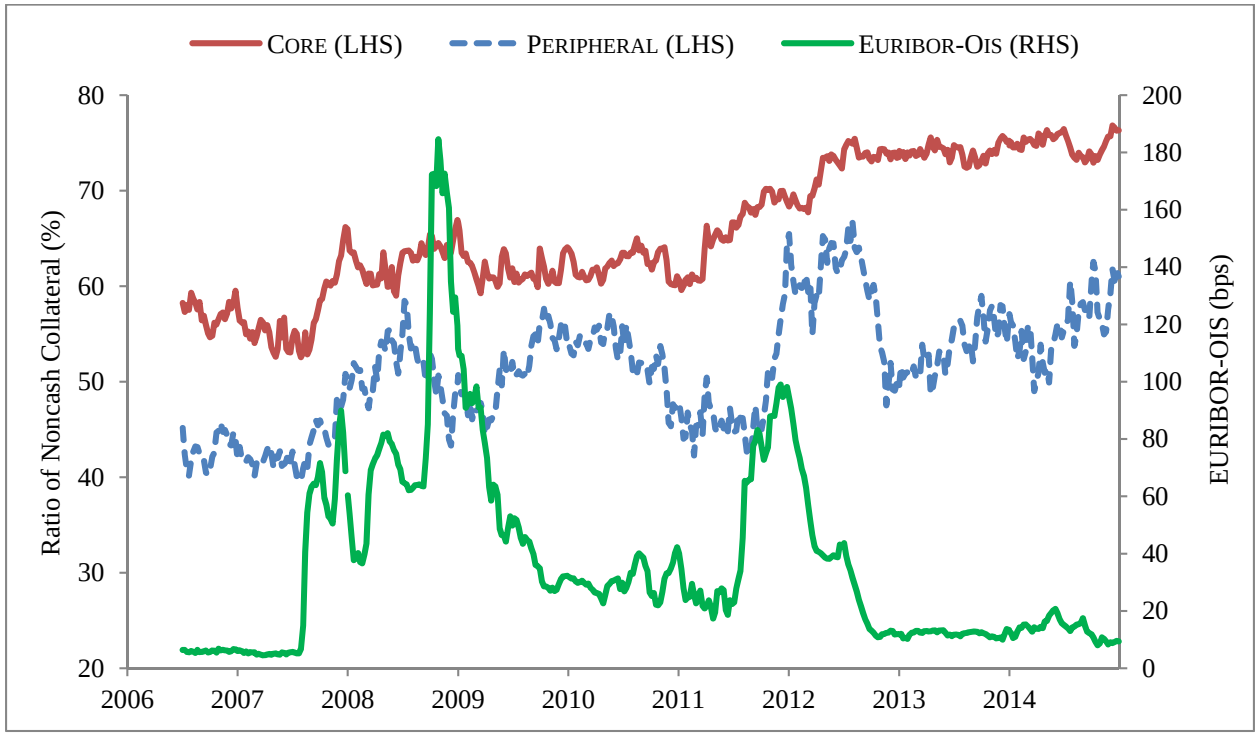
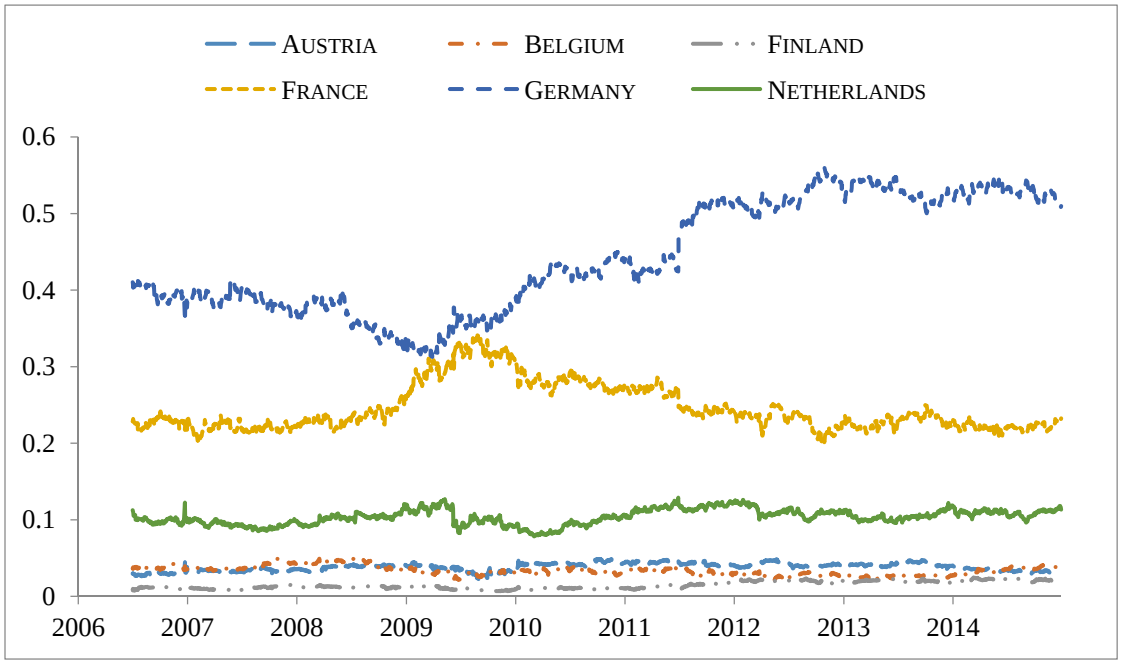


Figure 3
Relative Demand of European Government Bonds by Country

Relative demand is the ratio of the total lending amount of government bonds in a particular country to the sum of lending amount of all bonds across 11 countries.



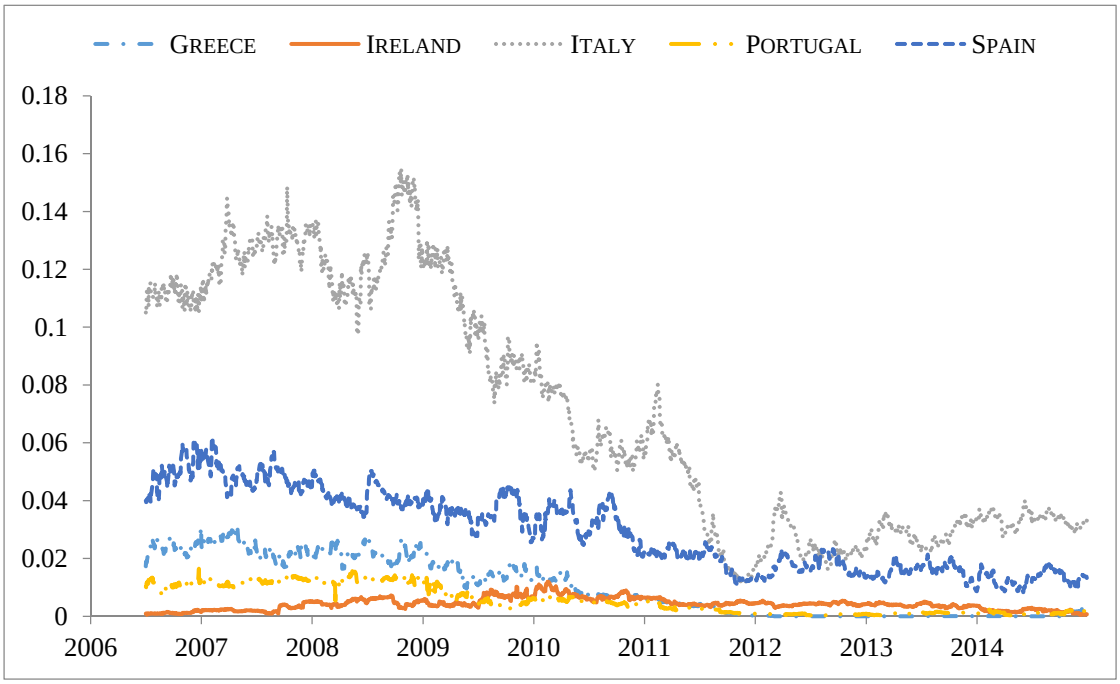


Table 1
Securities Lending Market in European Government Bonds

Our sample includes a total of 5809 government bonds issued by 11 European countries that are available for lending in the securities lending market during the period of July 2006 to December 2014. For each country, the table reports the daily average values and time-series standard deviation (SD) for lending inventory, value on loan, utilization defined as the percentage of value on loan to lendable inventory, and fee calculated as the average transaction-weighted annualized rate expressed in basis points.

Country	**2006-2014** Total # of Lendable Bonds	**Daily Average**								
		# of Lendable Bonds	Lendable Inventory (€billion)		Value on Loan (€billion)		Utilization (%)		Fee (bps)	
		Mean	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Austria	256	86	21.54	3.55	7.07	1.46	33.51	8.53	16.63	4.75
Belgium	159	41	22.87	4.06	6.45	2.45	29.66	13.44	11.79	5.97
Finland	156	41	8.14	2.08	2.67	0.77	33.27	8.68	17.40	8.68
France	1044	249	123.44	19.87	45.21	8.33	37.49	9.09	13.37	6.85
Germany	2258	634	179.39	22.37	81.24	15.60	45.22	7.09	18.83	7.15
Netherlands	526	148	51.42	9.91	19.14	3.58	39.17	13.00	14.83	7.56
Greece	142	35	8.80	7.90	2.30	2.36	16.73	10.75	134.48	213.11
Ireland	44	12	4.23	1.97	0.77	0.38	19.68	9.24	33.76	34.93
Portugal	101	26	5.09	2.08	1.17	1.18	20.99	18.99	35.88	39.71
Italy	607	141	64.36	16.56	14.16	10.74	19.96	12.11	9.02	4.61
Spain	516	149	26.13	4.56	5.83	3.77	24.13	18.08	18.43	9.70

Table 2
Lending and Borrowing Before and During Crises

The table presents summary statistics for the key variables in the securities lending market for core and peripheral countries in five subsample periods. The five time-periods are Full Sample: July 2006-December 2014, Pre-U.S. Crisis: July 2006-June 2007, U.S. crisis: August 2008-June 2009, pre-European Crisis: July 2009-April 2010, and peak European crisis: August 2011-June 2012. *FEE* is average transaction-weighted annualized rate expressed in basis points (bps), *INVENTORY* is the aggregate lendable inventory value as a percentage of bond issue size, *ONLOAN* is value on loan as a percentage of bond issue size, , and *UTILIZATION* is ratio of lendable inventory to value on loan. For these four variables, we first calculate the bond-level weekly average based on the daily observations, then we report the mean and standard deviation across bonds issued in core or peripheral countries in each time period.

	Full Sample Jul 2006-Dec 2014		Pre-U.S. Crisis Jul 2006-Jun 2007		U.S. Crisis Aug 2008-Jun 2009		Pre-European Crisis Jul 2009-Apr 2010		Peak European Crisis Aug 2011-Jun 2012	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel A: *FEE (bps)*										
CORE	17.77	8.10	6.77	1.93	25.73	5.76	15.93	1.29	22.78	1.39
PERIPHERAL	18.14	14.54	6.31	1.55	11.98	4.27	11.54	1.11	41.24	5.27
Panel B: *INVENTORY (%)*										
CORE	12.66	2.03	10.14	0.25	11.66	0.46	13.90	0.63	15.09	0.69
PERIPHERAL	7.40	0.60	8.01	0.29	7.18	0.45	7.56	0.37	6.88	0.51
Panel C: *ONLOAN (%)*										
CORE	4.21	1.25	6.13	0.51	3.69	0.64	3.14	0.10	3.68	0.20
PERIPHERAL	1.93	0.97	3.17	0.27	2.29	0.53	1.39	0.13	0.81	0.15
Panel D: *UTILIZATION (%)*										
CORE	34.41	8.99	48.42	4.07	31.47	3.33	27.65	0.77	28.75	1.32
PERIPHERAL	26.22	8.62	37.74	5.93	26.27	5.76	19.98	0.96	19.80	2.63

Table 3
Government Bond Lending in Market Stress: Core vs Peripheral

This table reports regression results of the relationship between government bond lending price and market stress. The dependent variable is *LENDING FEE*, the transaction-weighted annualized rate in bps. Market stress is measured by the spread of three-month Euribor and OIS rates, *EURIBOR-OIS* in Panel A, and European stock market volatility *EURO VIX* from Euro Stoxx 50 in Panel B. Control variables include the three-month *OIS* rate, and European stock market return based on the Euro Stroxx 50 index, *EURO RETURN*. In column (3), we also control for bond characteristics consisting of loan tenure, lending fee spread, bond size, bond time-to-maturity, and floating rate dummy. *DCORE* is a dummy variable that equals one if a bond is issued by a core country (Austria, Belgium, Finland, France, Germany, and Netherlands), and zero otherwise. The sample period is July 2006 to December 2014. The estimations are based on weekly values averaged from daily observations.

Panel A: Using *EURIBOR-OIS* as the proxy for market stress

	(1)	(2)	(3)
OIS		-3.149***	-2.984***
		[-3.60]	[-3.99]
EURIBOR-OIS	-3.456	3.121	-3.056
	[-0.98]	[0.01]	[-1.46]
*EURIBOR-OIS * DCORE*	11.120***	12.833***	11.426***
	[2.93]	[2.94]	[4.41]
DCORE	-8.135***	-8.755***	-7.994***
	[-5.62]	[-5.27]	[-7.26]
EURO RETURN		-19.102*	-13.150
		[-1.70]	[-1.09]
Country Dummy	Y	Y	Y
Cluster(Country)	Y	Y	Y
Bond Characteristics	N	N	Y
Observation	362135	362135	339605
Adj R-square	0.0361	0.0523	0.0897

Panel B: Using *EURO VIX* as the proxy for market stress

OIS		-2.527***	-2.631***
		[-2.74]	[-2.98]
EURO VIX	0.009	0.009	-0.107*
	[0.13]	[0.12]	[-1.67]
*EURO VIX*DCORE*	0.299***	0.347***	0.342***
	[3.63]	[3.65]	[5.88]
DCORE	-11.572***	-12.725***	-12.356***
	[-5.49]	[-5.26]	[-8.74]
EURO RETURN		0.997	-1.534
		[0.06]	[-0.07]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Characteristics	N	N	Y
Observation	362135	362135	339605
Adj R-square	0.0371	0.0489	0.0883

Table 4
Government Bond Lending in Market Stress: High vs Low CDS and Time-To-Maturity

This table reports regression results of the relationship between government bond lending price and market stress for government bonds with higher credit risk or with longer time-to-maturity. The dependent variable is *LENDING FEE*, the transaction-weighted annualized rate in bps. Market stress is measured by the spread of three-month Euribor and OIS rates, *EURIBOR-OIS*. *HIGH(CDS)* is the dummy variable which equals 1 if the bond issue country has the CDS spread higher than the median in week t, and equals 0, otherwise. *HIGH(TTM)* is the dummy variable which equals 1 if a bond's time-to-maturity is longer than the median of all bonds in week t, and equals 0, otherwise. Control variables include the three-month *OIS* rate, and European stock market return based on the Euro Stroxx 50 index, and bond characteristics such as loan tenure, lending fee spread, bond size, time-to-maturity, and floating rate dummy. The sample period is from July 2006 to December 2014. The estimations are based on weekly values averaged from daily observations.

	HIGH (CDS)			HIGH (TTM)			HIGH(CDS and TTM)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OIS		-3.129***	-2.989***		-3.087***	-3.026***	-3.044***	-2.907**
		[-3.48]	[-3.80]		[-3.60]	[-3.76]	[-4.03]	[-4.16]
EURIBOR-OIS	9.483***	14.660***	9.694***	9.571***	14.392***	9.295***	18.304***	13.662***
	[13.74]	[11.07]	[8.12]	[3.18]	[4.99]	[2.81]	[11.74]	[11.61]
*EURIBOR-OIS*HIGH(CDS)*	-8.342***	-8.943***	-7.392***				-7.692***	-6.122***
	[-4.12]	[-3.39]	[-3.30]				[-3.81]	[-3.22]
HIGH(CDS)	3.700*	1.731	0.192				0.637	-0.750
	[1.74]	[0.73]	[0.08]				[0.94]	[-0.99]
*EURIBOR-OIS*HIGH(TTM)*				-9.322***	-9.597***	-8.878***	-7.976***	-8.711***
				[-4.31]	[-5.00]	[-4.84]	[-4.55]	[-5.44]
HIGH(TTM)				2.130**	2.223**	1.506**	1.470	2.345***
				[2.03]	[2.50]	[2.14]	[1.21]	[2.83]
EURO RET		-16.619	-11.726		-17.505*	-11.146	-25.060*	-18.383
		[-1.39]	[-0.96]		[-1.65]	[-1.12]	[-1.96]	[-1.61]
Country Dummy	Y	Y	Y	Y	Y	Y	Y	Y
Cluster(Country)	Y	Y	Y	Y	Y	Y	Y	Y
Bond Characteristics	N	N	Y	N	N	Y	N	Y
Observation	362135	362135	339605	362135	362135	361834	339749	339465
Adj R-square	0.0356	0.0514	0.0890	0.0364	0.0520	0.0955	0.0408	0.0921

Table 5
Summary Statistics for the Ratio of Using Noncash Securities as Collateral

The table shows the mean and standard deviation of *NONCASH*, which is defined as the proportion of using noncash assets as collateral to the sum of both cash and noncash collateral for four subsample periods: Pre-U.S. Crisis: July 2006-June 2007, U.S. Crisis: August 2008-June 2009, Peak European crisis: August 2011-June 2012, and Post CCP Regulation: July 2013-December 2014.

	CORE	PERIPHERAL
Pre-U.S. Crisis		
Mean	56.12	42.45
SD	1.73	1.36
U.S. Crisis		
Mean	62.95	49.01
SD	1.79	2.68
Peak European Crisis		
Mean	70.31	56.61
SD	2.30	7.44
Post CCP Regulation		
Mean	74.39	55.15
SD	0.99	3.82

Table 6
Use of Noncash Collateral in Market Stress: Core vs Peripheral

The table reports regression results of the relationship between using noncash collateral and market stress. The dependent variable is *NONCASH*, which is the ratio of noncash collateral to the sum of cash and noncash collateral in government bond lending transactions. Market stress is measured by the spread of three-month Euribor and OIS, *EURIBOR-OIS* in Panel A, and European stock market volatility *EURO VIX* from Euro Stoxx 50 in Panel B. Control variables include the three-month OIS rate, and European stock market return based on the Euro Stroxx 50 index, and bond characteristics such as loan tenure, lending fee spread, bond size, time-to-maturity, and floating rate dummy. The sample period is July 2006 to June 2012, before the implementation of central counterparty regulation. All variables take the weekly value averaged from daily observations.

Panel A

	(1)	(2)	(3)
OIS		-1.478**	-1.490***
		[-2.39]	[-2.95]
*EURIBOR-OIS * DCORE*	3.810***	4.752***	4.164***
	[6.79]	[4.57]	[4.60]
*EURIBOR-OIS * DPERI*	1.997	2.101	3.211*
	[0.90]	[0.87]	[1.95]
DCORE		7.618***	9.385***
		[5.76]	[10.17]
EURO RET			
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Characteristics	N	N	Y
Observation	248262	248262	242091
Adj R-square	0.0396	0.0434	0.1302

Panel B

OIS		-1.276**	-1.312***
		[-2.28]	[-2.62]
*EURO VIX * DCORE*	0.148***	0.113***	0.087***
	[3.95]	[4.23]	[2.81]
*EURO VIX * DPERI*	0.043	-0.009	0.032
	[0.60]	[-0.13]	[0.50]
DCORE		5.398**	8.206***
		[2.20]	[3.95]
EURO RET			
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Characteristics	N	N	Y
Observation	248262	248262	242091
Adj R-square	0.0398	0.0425	0.1293

Table 7
Government Bond Lending and Repo Market

This table examines the relation between lending activities and repo transactions for Italian bonds. *REPO AMOUNT* is the log of total par value collateralized in the repo market for each Italian bond, based on MTS repo market data. *SPECIALNESS* is the spread of GC repo rate and special repo rate. *ONLOAN AMOUNT* is the log of value on loan. All values before taking log are in $million. The sample period is July 2006 to December 2014. All variables take the weekly value averaged from daily observations.

	REPO AMOUNT		*SPECIALNESS*	
	(1)	(2)	(3)	(4)
ONLOAN AMOUNT	0.314***		0.100	
	[16.40]		[0.18]	
LENDING FEE		0.001		0.657***
		[0.53]		[9.56]
INTERCEPT	5.137	6.727	18.134	16.466
	[41.21]	[83.27]	[4.86]	[7.97]
Week FE	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y
Observation	26748	26748	26748	26748
Adj R-square	0.3730	0.1347	0.1338	0.3142

Table 8
Borrowing in Lending Market and Financing in Repo Market during the Crisis

Results show the relation between borrowing government bond in the lending market and financing in the repo market for Italian bonds during the crisis. The dependent variable is *FINANCING RATIO*, the ratio of total par value of sell-side contracts to the sum of par value from both sell-side and buy-side contracts, which measures the percentage of underlying bond values used for the purpose of financing. *ONLOAN* is the value of on loan as a percentage of bond issue size. The crisis dummy, *DCRISIS*, applies to three subsamples: the U.S. crisis (August 2008-June 2009), the peak of the European crisis (August 2011-June 2012), and the U.S. and EU crisis combined sample. The full sample period is July 2006 to December 2014.

	FULL PERIOD	CRISIS (U.S.)	CRISIS (EU)	CRISIS (U.S. & EU)
	(1)	(2)	(3)	(4)
ONLOAN	-0.009***	-0.012***	-0.009**	-0.012***
	[-3.57]	[-5.10]	[-3.62]	[-5.21]
*ONLOAN*DCRISIS*		0.017***	0.021*	0.018***
		[4.35]	[2.00]	[4.89]
DCRISIS		0.086***	-0.207***	-0.206***
		[3.51]	[-6.91]	[-7.07]
Week Dummy	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y
Observation	26748	26748	26748	26748
Adj R-square	0.2280	0.2300	0.2283	0.2304

Table 9
Government Bond Lending and ECB Intervention

This table examines the influence of ECB security purchases on government bond lending price. The dependant variable is *LENDING FEE*, the transaction-weighted average lending fee. SMP is the ECB's weekly total purchase amount of sovereign bonds issued by targeting countries. *TARGET* is a dummy variable with a value of 1 if a bond is issued by a sovereign country targeted by ECB securities market programme (SMP), and with a value of 0 if a bond is issued by core countries. SMP has two phases: Phase I targets the purchase of government bonds in Greece, Ireland, and Portugal; Phase II targets the purchase of government bonds in Italy and Spain. The control variables include the three-month OIS rate and European stock market return. All variables take the weekly value averaged from daily observations.

	Panel A: SMP Phase I (May 2010 - March 2011)		Panel B: SMP Phase II (August 2011 - March 2012)	
SMP	-0.075	0.094	-0.161***	-0.139***
	[-0.81]	[0.86]	[-3.23]	[-2.67]
*SMP*TARGET*	-1.142***	-1.152***	-0.280*	-0.280*
	[-3.87]	[-3.90]	[-1.90]	[-1.90]
EURIBOR-OIS	-7.314	-0.171	5.488***	5.416***
	[-1.62]	[-0.03]	[6.84]	[7.01]
*EURIBOR-OIS*TARGET*	-37.595***	-37.362***	-15.547***	-15.544***
	[-4.98]	[-4.94]	[-2.84]	[-2.85]
TARGET	26.758***	26.756***	16.290***	16.289***
	[11.95]	[12.04]	[3.55]	[3.55]
OIS		3.519		-0.544
		[1.19]		[-0.26]
EURO RET		-41.473***		12.249
		[-2.78]		[1.61]
Cluster (Country)	Y	Y	Y	Y
Country Dummy	Y	Y	Y	Y
Week Dummy	Y	Y	Y	Y
Observations	45922	45922	32023	32023
Adj R2	0.1198	0.1208	0.0199	0.0198

Appendix

Table A1
Summary Statistics of the Securities Lending Markets in European Government Bonds

Panel A: Number of Sovereign Bonds

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Number of Lendable Bonds	709	1814	2158	2368	2436	2644	2573	2594	2538
Number of OnLoan Bonds	488	1130	1359	1460	1538	1653	1613	1642	1600
Percent of OnLoan Bonds to Lendable Bonds	0.69	0.62	0.63	0.62	0.63	0.63	0.63	0.63	0.63

Panel B: Average Daily Value of Sovereign Bonds (in $Billions)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Outstanding Value of Lendable Bonds	595	675	730	653	741	764	654	678	642
Outstanding Value of OnLoan Bonds	273	357	326	195	236	251	207	202	222
Percent of OnLoan Bonds to Lendable Bonds	46	53	45	30	32	33	32	30	35