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Sovereign Debt, Securities Lending, and Financing During Crisis

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Abstract

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-grade securities to high-quality safe assets. Using a unique data set for European government bond loans, we find that during crises, borrowing costs increase more for high-quality liquid bonds issued by core countries compared to bonds from peripheral countries due to flight to quality. Borrowers are more likely to use noncash collateral and pay high fees to upgrade collateral in stressed market conditions. We provide evidence showing the link between borrowing in the securities lending market and financing in the repo market. In addition, purchase of peripheral country bonds by the European Central Bank stimulates borrowing of these low-grade bonds, implying that the securities lending market serves as a channel to transmit monetary policy.

JEL: E44, E58, G24

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

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"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) which allowed banks to borrow U.S. Treasuries while posting collateral that had become impaired during the financial crisis, while the ECB in May 2010 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.

The securities lending market for government bonds allows borrowers to upgrade collateral by exchanging risky assets such as corporate bonds, equities, or other products for high-quality

[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).

liquid government bonds (i.e., safe assets) that are acceptable in the repo market and by central counterparties. Borrowed bonds are recycled back into the market, serving as a source of financing, for example, in the repo market, and the (cash) collateral can be reinvested in the money market. Both the borrowing and lending components of securities lending transactions enhance market liquidity. There is no easy substitute for the securities lending market. As of July 2015, the global lendable inventory of all securities stood at $15 trillion, and the value on loan amounted to $2 trillion.[3] Lendable inventory for European government bonds was $978 billion, with a value on loan 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 during crisis periods and show its importance in obtaining financing in the repo market.[5] We examine the use of cash versus noncash collateral during periods of financial stress. We also study the relation between purchases of peripheral country government bonds by the European Central Bank (ECB) and activity in the lending market. We analyze lending and borrowing of government bonds from 11 European countries that have activity in the securities lending market during the period July 2006 through December 2014. We use a proprietary daily data set comprised of lendable inventory, value on loan, and associated borrowing fees. 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 overall lendable inventory and value on loan are higher and the fees are lower for government bonds issued by high-quality countries. However, during crises, fees increase for high-quality bonds issued by core countries but not for peripheral country bonds indicating flight

[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.

to quality. Moreover, we find that borrowers are less likely to use cash and instead pledge noncash collateral to borrow expensive high-quality government bonds of core countries during periods of market stress. There is no increase in the use of noncash collateral for sovereign bonds from peripheral countries. More borrowing in the securities lending market relates to more activity for those bonds in the repo market for the purpose of obtaining financing. The securities lending market in government bonds allows borrowers to transform collateral by exchanging low-quality securities on the balance sheet for high-quality, liquid collateral that can then be used to obtain financing in, for example, the repo market. Our results indicate that there is flight to quality and increased interest in using the lending market to upgrade collateral during crises.

Our analysis shows that the purchase of peripheral country government bonds by the European Central Bank is associated with increased borrowing of these bonds in the securities lending market. The results show that the securities lending market in government bonds served as a channel for transmission of the ECB's actions.

Our study can help guide current policy debates on the regulation of securities lending markets. Understanding and bringing more transparency to the securities lending market is of ongoing interest to policymakers.[6] In addition, current derivatives reforms aimed at reducing complexity by moving to central counterparties have 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.[7] As discussed by Stein (2013), actions by regulators, such as acceptance of "bad"

[6] Speech by Stanley Fischer, "Nonbank Financial Intermediation, Financial Stability, and the Road Forward," March 30, 2015.
[7] The Tabb Group, "Optimizing Collateral: In Search of a Margin of Oasis," 2012.

collateral by central bankers, alleviated some of the problems during the crisis but may have had unintended consequences.[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. But 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.

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

[8] Speech by Jeremy Stein, "Overheating in Credit Markets: Origins, Measurement, and Policy Responses," February 7, 2013.

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, Martin, Skeie, and von Thadden (2014), Stein (2012), and Hanson, Kashyap, and Stein (2011).

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

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., 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 the transmission of monetary policy: government bond lending. 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 effects of ECB intervention also operate through the lending channel.

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 shows the changes in borrowing demand and fees over time and across countries. Section 5 examines two roles of securities lending market: collateral upgrading and boosting financing. Section 6 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

There is no substitute for the securities lending market for government bonds. It facilitates well-functioning repo and cash markets. In securities lending, the beneficial owner of the security, normally a large institutional investor such as a pension fund, insurance company, mutual fund, or sovereign wealth fund, agrees to lend the securities that they hold to a borrower such as a bank or a hedge fund, in exchange for collateral consisting of cash, other securities, or both.[9] The market, particularly in equities and corporate bonds, allows borrowing of securities for short selling. 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%. Although lenders refer to these shares 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. The lender charges a fee and earns a spread by investing the collateral. The fee earned generates additional income for the lender. In a typical loan, the collateral is 102% for domestic securities and 105% for international securities.

If cash collateral is used, repo and securities lending are economically equivalent, with a few key differences. Repo transactions are driven by a need to borrow or to invest cash, while lending transactions result from the need to borrow specific securities or upgrade collateral. The

[9] The securities lending process is shown graphically, with a numerical example of cash flows and fees, in Appendix A.

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 collateral.[10] However, there is a lot more flexibility in acceptable collateral in the securities lending market, including corporate bonds, equities, asset-backed securities, or other products. Borrowers can use these lower-quality securities on their balance sheets as collateral in the securities lending market to upgrade collateral to government bonds.

There are differences in the European and U.S. securities lending markets. Foremost, noncash collateral has been the dominant form of collateralization in Europe. The securities lending market therefore plays an even bigger role in Europe in allowing market participants to upgrade collateral to high-quality government bonds; the percentage of government bonds on loan against noncash collateral was 52.4% in 2006 and 72.7% in 2014. In the United States, in contrast, noncash collateral amounted to 4.6% of government bond loans in 2006 and 17.6% in 2014. 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.

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. The lender's return nets out the rebate paid to the borrower for providing the cash collateral. In a noncash-collateralized transaction, the borrower pays a fee and does not receive a rebate.

[10] 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/

Securities loans are usually on an open basis with no fixed maturity date, allowing the beneficial owner to recall the securities for various reasons, including concerns about counterparty risk, although there is a movement towards term loans. Repo transactions involve an outright sale with a buyback at a specific price on a specific date.

The securities lending market for government bonds is far more active than the lending market for equities or corporate bonds. 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). Unlike equities, where the demand is primarily driven by short selling, government bonds are heavily borrowed for collateral transformation, which further serves financing needs and meets regulatory requirements.

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 recent regulations, including liquidity coverage ratios under Basel III, changes in derivatives trading under the Dodd-Frank Act in the United States and the European Markets Infrastructure Regulation (EMIR), and capital charges for insurers.[11] These regulations require the use of central clearing for derivatives transactions. Central counterparties (CCPs) collect collateral from their customers. The collateral typically comes 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

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

government bonds from selected less risky countries such as Austria, Belgium, Germany, France, the Netherlands, the United States, and United Kingdom.[12]

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.[13]

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. As is common in the literature, we classify Austria, Belgium, Finland, France, Germany, and the

[12] https://www.theice.com/publicdocs/clear_europe/list-of-permitted-covers.pdf
[13] http://www.statestreet.com/content/dam/statestreet/documents/SecFinance/SL_InView_Non-Cash.pdf

Netherlands as core countries, and Greece, Ireland, Portugal, Italy, and Spain as peripheral countries. 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.[15]

Before June 28, 2006, the securities lending data was only available at a weekly frequency. Therefore, we start our analysis from July 2006. After country filtering, our sample consists of 5,169,426 bond-day observations representing 7,298 unique bonds issued by 11 euro area countries during the period July 1, 2006 to December 31, 2014.

Securities lending is captured by a few key variables. On a daily basis, for each bond, *INVENTORY* is the aggregate lendable inventory value as a percentage of bond issue size, and *ONLOAN* is the value of bond on loan as a percentage of bond issue size. Borrowing cost, *FEE,* is calculated as the average transaction-weighted annualized rate expressed in basis points (bps) for all open transactions. *UTILIZATION* is value on loan expressed as a percentage of lendable inventory. 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. For value on loan, we also know the composition of collateral by cash and noncash securities, separately.

3.2 Government Bond, Cash Market, and Macro Variables

We obtain information on bond characteristics from Datastream and secondary-market bond prices from Bloomberg. Bond characteristics include issue amount, issue date, maturity date, coupon rate, and coupon type (floating, fixed, and zero). The reporting currency in the

[15] For example, in the case of Germany, bonds categorized as government bonds in the Markit lending data include bonds issued by the government and by government-owned entities such as KfW (a government-owned development bank).

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 bonds with missing issue size results in 3,198,162 bond-day observations for 5,795 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 daily data on the European stock market index STOXX50 and the European stock market volatility index VSTOXX and use market volatility 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) *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; (ii) *REPO AMOUNT*, defined as the log of total par value of a bond collateralized in the repo market; 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 lending attributes such as lendable inventory, value on loan, and borrowing fee, and the 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. 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 borrowing 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 during 2006-2014.

Figure 1 plots aggregate lendable inventory 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, 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, borrowing 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 further indicate that, on average, 12.66% of the total outstanding value 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.[17] In terms of bond number, almost all government bonds in the primary market are available in the

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

lending market, though the demand varies significantly. On average, 4.21% of the total outstanding value of a bond 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.

3.5 Bond Characteristics and Securities Lending

We examine the relation between *FEE*, *ONLOAN*, and *INVENTORY* and bond characteristics for European government bonds. The explanatory variables are attributes of the bond in the securities lending and cash markets. Securities lending attributes are *UTILIZATION*, *TENURE*, and *FEE SPREAD*, and bond characteristics are *BYIELD* (bond yield), *BSIZE* (bond issue size in euros), *MATURITY* (time to maturity), and *DFLOATING*, which takes the value of one for bonds with a floating coupon and zero otherwise. We do not include bond rating as an explanatory variable, as used in the corporate bond study by Asquith et.al. (2013), because all sovereign bonds issued by the same country share the same credit rating and other government bonds within a country share similar ratings.

Table 3 reports estimates from three regressions with the dependent variables *FEE*, *ONLOAN*, and *INVENTORY*. We use weekly observations by taking the average of daily values to minimize microstructure noise. In all regressions, we include country fixed effects and week

fixed effects and cluster the standard errors by bonds. For borrowing fee, we find that fee is lower for longer tenure borrowings, suggesting that lenders are willing to charge lower fee if the borrower makes a commitment to borrow for a longer period; the fee is higher for a wider fee spread, a smaller bond issue, and a shorter time to maturity, suggesting that liquidity is related to the cost of borrowing bonds in the securities lending market.

The bond characteristics examined have a similar relation with both lendable inventory and value on loan. Our results show that both *INVENTORY* and *ONLOAN* are higher for high-quality (lower yield) government bonds. This result is consistent with the descriptive statistics earlier showing more activity in the securities lending for government bonds from core countries. For larger bond issues, lendable inventory and value on loan are lower. *INVENTORY* and *ONLOAN* are scaled by issue size, and therefore lendable inventory and value on loan as a proportion of bond size are smaller for large issues. There is more lendable inventory and borrowing of bonds with longer time to maturity and for bonds with floating rates. The utilization rate has a positive relation with *ONLOAN*; this finding is expected because utilization is defined as the ratio of *ONLOAN* to *INVENTORY*.

Most of the aforementioned bond characteristics relate to borrowing fee, the actual amount borrowed, and lendable inventory. Therefore,we use them as control variables in further analysis.

4. Securities Lending During Crisis

Our objective is to examine the functioning of the securities lending market in government bonds as a core funding facility and show this market's linkage to the repo market and the ECB's actions, especially during periods of financial stress. We want to compare lending

and borrowing of high-quality bonds, proxied by government bonds from core countries, relative to low-quality bonds issued by peripheral countries. Our focus is not on the bond-level supply-demand analysis or within-country differences in securities lending.

4.1 Funding Liquidity Risk and Securities Lending

Table 4 reports the results of the relationship between funding liquidity risk and lending activities in government bonds, based on the following regression:

$$\begin{aligned} \textit{Lending Attributes}_{ijt} &= \alpha + \gamma_i + \beta * (\textit{EURIBOR} - \textit{OIS}_t) * \textit{DCORE} + \beta_1 * (\textit{EURIBOR} - \textit{OIS}_t) \\ &\quad + \beta_2 * \textit{DCORE} + \Sigma \theta_k * \textit{CONTROL}_{kjt} + \varepsilon_{ijt} \end{aligned} \quad (1)$$

where *Lending Attributes* $_{ijt}$ refer to *FEE*, *ONLOAN*, or *INVENTORY* of bond i issued by country j at time t. 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. For control variables, we include country-level *CDS* spread to capture country risk, the interest rate proxy, *OIS*, European stock market returns *EURO RETURN*, and market volatility *EURO VIX*. For robustness, we repeat the analysis by replacing Euribor-OIS with an alternative proxy for financial stress, *EURO VIX*.

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.[18] 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

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

at the country-level. Clustering at the country-level increases the dispersion and hence lowers the *t*-statistics, compared to clustering at the bond-level, which elevates the bar of statistical significance for our tests. For robustness, we 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.

As shown in Table 4, the coefficient of *CDS* is positive and significant for the *FEE* regression but negative and significant for both *INVENTORY* and *ONLOAN*, indicating that government bonds issued by countries with higher credit risk tend to have higher borrowing cost and lower lendable inventory as well as lower value on loan. The level of interest rate, *OIS*, is negatively related to borrowing cost but positively related to *INVENTORY* and *ONLOAN*. The coefficient of *DCORE* is negative and significant for the *FEE* regression but positive and significant for both *INVENTORY* and *ONLOAN*, indicating that high-quality government bonds issued by core countries have lower fees, more lendable inventory, and more value on loan.

The key parameter of our interest is β, the coefficient of the interaction term, (*EURIBOR-OIS)*DCORE*. The three regressions demonstrate that, when the Euribor-OIS spread is large, that is, during financial stress, lendable inventory and value on loan is lower and the fee is higher for high-quality government bonds issued by core countries. These results indicate that when there is a financing crunch (mostly in times of crisis), lenders contract the available inventory of high-quality liquid government bonds even if it means forgoing the relatively higher lending fee on these bonds. Given the shrinking supply and higher borrowing cost during times of stress, the overall value on loan also declines. In Table 5, we use an alternative proxy for financial stress, *EURO VIX*. Using this alternative measure, we find similar results.

4.2 Bonds with Excessive Fee

The reduction in borrowing of high-quality bonds during a financing crunch is not intuitively straightforward. One might expect a flight to quality thus increasing demand for high-quality securities under stressed market conditions. We show that in the lending market there are special bonds which are in high demand and therefore have high fee. In general, as fee increases, the value on loan increases; but when borrowing cost is large enough, the value on loan starts to decline. The decline is faster for core countries relative to peripheral countries.

We estimate an OLS model with *ONLOAN* as the dependent variable. We modify the explanatory variables in regression (1) and now include the interaction of (*EURIBOR-OIS*)**DFEE* to examine the differences in borrowing activities when the fee is very high. The dummy variable *DFEE* takes the value of one if *FEE* >=100 bps and zero otherwise. We follow the convention in the securities lending market and choose 100 bps as the cutoff, bonds with lending fee above 100 bps are considered to be "on special" in the market. The analysis is done for the full sample and for subsamples consisting of only core and only peripheral countries. As shown in Table 6, the coefficient of *DFEE* is negative and significant in every regression. The result implies that very high fee is associated with lower borrowing demand. The coefficient of the interaction term (*EURIBOR-OIS*)**DFEE* is significant at the 1% level for all three estimations for the subsample consisting of core countries, however, we do not find similar results for the subsample consisting of peripheral countries. Our findings demonstrate that, during normal times, borrowing demand is low if fee is very high; however, during crisis periods, borrowers are willing to pay the extremely high fee to obtain high-quality bonds issued by core countries but not for bonds issued by peripheral countries. The result is consistent with a flight to quality where market participants are willing to pay the extremely high fee for high-

quality bonds but not for low-quality ones. We repeat the analysis using other cutoffs for a very high fee, and the results are similar.

5. Collateral Upgrading and Financing

5.1 Noncash versus Cash Collateral

So far our results have shown that during periods of financing stress market participants are willing to pay high fees to borrow high-quality government bonds from core countries. A follow-up question is whether the high-quality collateral is borrowed during crisis by pledging low-quality collateral or by using cash that becomes even more valuable during a financing crunch. In this section, we examine the use of noncash versus cash collateral by borrowers of government bonds in the securities lending market. The answer is theoretically ambiguous. Both borrowers and lenders may have preference for cash in stressed market conditions.

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.

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

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

Figure 2 plots *NONCASH* over our sample period of 2006 through 2014 separately for government bonds issued by core and peripheral countries. The figure also plots *EURIBOR-OIS*, our proxy for financing crunch. Two patterns are evident. First, more noncash collateral is used when there is a financing crunch. Second, the use of noncash collateral has continued to increase in 2013 and 2014 even when the EURIBOR-OIS spread 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).

To separate out the use of noncash collateral during stress periods versus its use in recent years due to new regulations, we run our analysis separately for two periods. The first period is from July 2006 to June 2012, a period not impacted by the new regulations,[19] and the full time period is from July 2006 to December 2014. We repeat the earlier setup with *NONCASH* as the dependent variable:

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

The analysis is done separately for the combined group of core and peripheral countries, only core countries, and only peripheral countries. We include country fixed effects and bond characteristics (unreported) and cluster at the country-level.

Panel A of Table 7 reports the results using the shorter sample period from July 2006 to June 2012. We use *EURIBOR-OIS* to measure funding liquidity risk, and the results are shown in columns 1–3 of Panel A. The coefficient of *EURIBOR-OIS* is positive and significant for all

[19] 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.

countries and for core countries but not significant for peripheral countries, suggesting that the tightening funding constraint is associated with more use of noncash collateral in exchange for high-quality government bonds in core countries. This result is 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 not significant for peripheral country bonds.

Panel B of Table 7 reports results of 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 does not exist, possibly due to the increased use of noncash collateral in the last two years due to regulatory changes. This finding is consistent with the pattern seen in Figure 2. 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.

We repeat the above analysis using European stock market volatility, *EURO VIX*, as an alternative proxy for market stress, and the results are reported in Table 8. The coefficient of *EURO VIX* is positive and significant in Panel A for all countries and for core countries but not for peripheral countries for the sample period, July 2006 to June 2012. Once again, the coefficient of the market stress variable is not significant in Panel B of Table 8 for the sample period July 2006 to December 2014. Again, the use of noncash collateral in recent years is not driven by market stress but are more likely to be driven by recent regulatory changes that require additional collateral, and hence the discussions about massive collateral shortfalls.

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 sovereign 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 linkage between securities lending 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 9, 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. We repeat the analysis using the log of lendable value, *INVENTORY AMOUNT*. Again, we find a positive relation between securities lending amount and the repo amount.

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 borrowing fee is associated with a 0.657% increase in the specialness rate. In addition, we find a negative relation between *INVENTORY AMOUNT* and *SPECIALNESS,* suggesting that bonds with more lendable inventory in the securities lending market tend to have smaller spread between general collateral repo rate and special repo rate; that is, they are less scarce in the repo market.

After documenting the linkage between the two markets, we further analyze the extent to which obtaining financing in the repo market relates to the amount borrowed in the securities lending market. 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 Table10 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 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. 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 Securities Lending Market

Earlier we discussed the importance of the securities lending market and its role in contributing to liquidity and 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 nonstandard 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 key for the transmission of monetary policy. Given its natural linkage to the government bond market and its specific function in enhancing liquidity, we hypothesize that 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 nonstandard 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.[20] 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.

[20] See ECB Monthly Bulletin, June 2010.

We examine the impact of SMP purchases on funding markets through the securities lending channel. The explanatory variable is the weekly purchase amount of affected peripheral countries' bonds by the ECB. The SMP was characterized by a high degree of opacity, with little or no disclosure about amount, target, and maturity structure of the purchases; only the aggregate amount of purchases were disclosed. For lending activities, we also consider the country-level variables, *FEE_C* and *ONLOAN_C*, which are borrowing fee and value on loan averaged across bonds within each country. We run regressions separately with *FEE_C* or *ONLOAN_C* as the dependent variable, and we estimate each model separately for the subsample of core and affected peripheral countries.

In Phase I (May 2010 to March 2011), the affected peripheral countries are Greece, Portugal and Ireland. Panel A, Table 11 shows that, during this phase, the coefficient of *ONLOAN_C* for core countries is not significant, indicating that the ECB's actions had little or no impact on the securities lending activities for government bonds in core countries. For affected peripheral countries, that is, Greece, Portugal, and Ireland, the coefficient for *ONLOAN_C* is positive and significant, indicating that ECB's actions were positively transmitted to the securities lending market by spurring more borrowing of government bonds from affected peripheral countries.

In Panel B of Table 11, we report results for SMP Phase II (August 2011 to March 2012). Again, we find that *ONLOAN_C* has a significant and positive coefficient for government bonds in the affected peripheral countries: Italy and Spain. In Phase II, which is the peak of the European sovereign debt crisis, the ECB asset purchases also have a small impact in increasing the demand for core country bonds. The ECB's purchases are associated with a reduction in the lending fee for bonds from both core and peripheral countries.

We also 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. The coefficient of *RELATIVE DEMAND* is positive and significant for the affected peripheral countries but not significant for the core countries in Phase I & II. These findings imply that the asset purchase through SMP is associated with increase in both the demand and relative demand for government bonds in the SMP targeted countries; hence the intervention is effective in the lending channel. Our analysis shows a new channel for the transmission of the ECB's actions.

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 the financial system 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
Lendable Inventory and Value on Loan in Securities Lending Market for European Government Bonds

The graph below 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 July 1, 2006 - December 31, 2014. The eleven euro countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain.

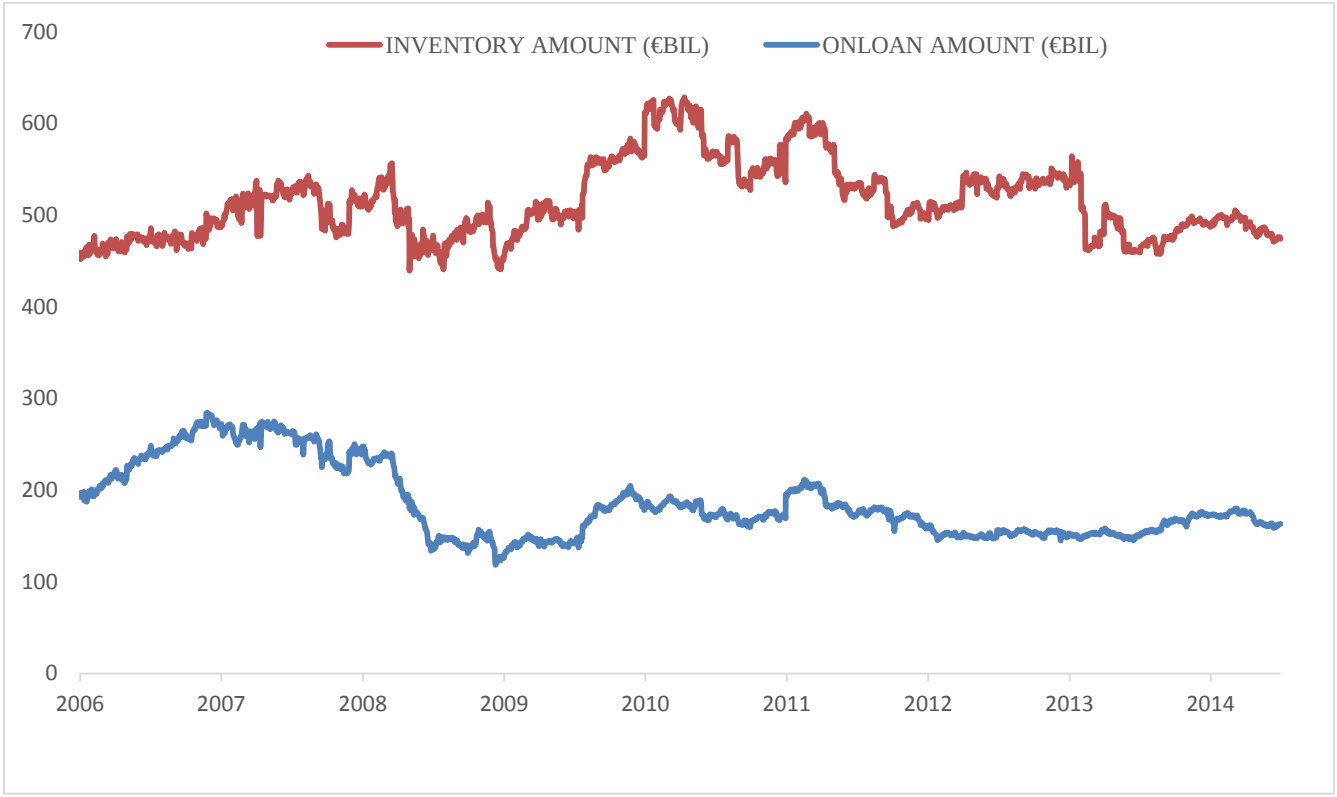

Figure 2
Noncash Collateral and Funding Liquidity Risk

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, and securitized bonds. The figure plots the ratio of noncash collateral to total collateral for core and peripheral countries for our sample period, July 1, 2006 - December 31, 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 liquidity risk, on the right-axis.

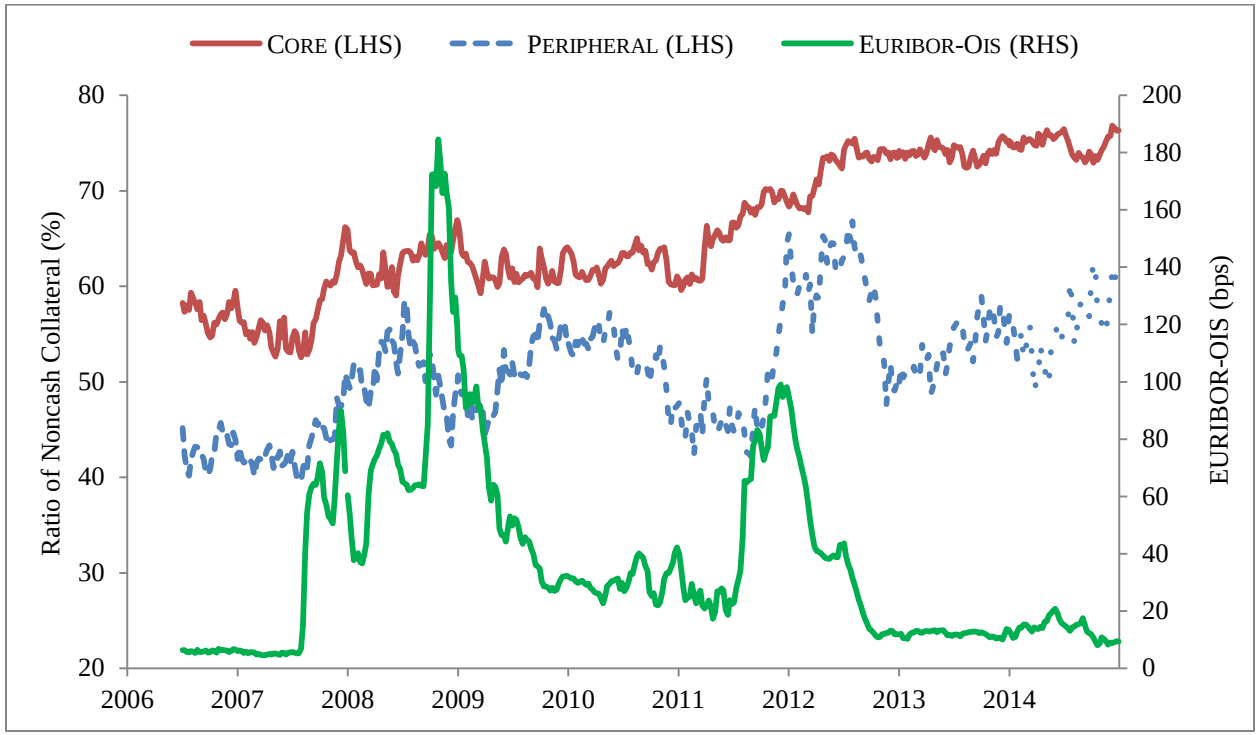

Table 1
Securities Lending Market in European Government Bonds

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 July 1, 2006 to December 31, 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 Crisis

The table presents weekly summary statistics for the key variables in the securities lending market for core and peripheral countries for five time 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. *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, *FEE* is average transaction-weighted annualized rate expressed in basis points (bps), and *UTILIZATION* is ratio of lendable inventory to value on loan.

	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
Bond Characteristics and Securities Lending Activity in Government Bonds

This table reports the regression results showing the relation between securities lending activities in European government bonds and bond characteristics. The dependent variables are *FEE*, average transaction-weighted annualized rate expressed in basis points (bps), *ONLOAN*, value on loan as a percentage of bond issue size, and *INVENTORY*, the aggregate lendable inventory value as a percentage of bond issue size,. There are three groups of explanatory variables: (i) Lending market attributes consist of *UTILIZATION*: value on loan as a percentage of lendable inventory, *TENURE*: tenure of the loan in days, *FEE SPREAD*: lending fee spread (bps); (ii) Cash market attribute is *BYIELD*: bond yield (%); and (iii) Other bond attributes are *BSIZE*: bond size, *MATURITY*: time to maturity, and *DFLOATING*: a dummy that takes the value of one for bonds with a floating coupon, and zero otherwise. The sample period is July 2006 to December 2014. The estimations are based on weekly values averaged from daily observations.

	FEE	*ONLOAN*	*INVENTORY*
UTILIZATION	0.000	0.124***	0.013**
	[-0.39]	[20.33]	[1.58]
TENURE	-0.013***	0.003***	0.011**
	[-8.81]	[3.83]	[6.35]
FEE SPREAD	0.085***	0.008***	0.027***
	[6.26]	[7.54]	[10.31]
BYIELD	2.540***	-0.197***	-0.715***
	[6.83]	[-7.35]	[-9.32]
BSIZE	-4.228***	-0.982***	-3.900***
	[-14.94]	[-8.57]	[-13.21]
MATURITY	-0.189**	0.111***	0.401***
	[-2.23]	[8.23]	[7.28]
DFLOATING	-4.640	3.018***	3.361**
	[-1.44]	[3.31]	[2.13]
Country FE	Y	Y	Y
Week FE	Y	Y	Y
Cluster (Bond)	Y	Y	Y
Observation	298338	298338	298338
Adj R-squared	0.1657	0.3353	0.2539

Table 4
Funding Liquidity and Securities Lending Activities in Government Bonds

This table reports regression results showing the relation between securities lending activities and funding liquidity risk. The dependent variables are *INVENTORY*, lendable inventory value as a percentage of bond issue size, *ONLOAN*, value on loan as a percentage of bond issue size, and *FEE*, average transaction-weighted annualized rate in bps. Funding liquidity is measured by the spread of three-month Euribor and OIS rates, *EURIBOR-OIS*. Control variables include *CDS*, country CDS spread, the three-month *OIS* rate, stock market return based on the Euro Stroxx 50 index, *EURO RETURN*, and stock market volatility from the Euro Stroxx 50, *EURO VIX*. In column (3), (6), and (9), we also control for bond characteristics tested in Table 3, consisting of loan tenure, lending fee spread, bond yield, bond size, 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.

	FEE			*ONLOAN*			*INVENTORY*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CDS		0.031***	0.025***		-0.001***	-0.001***		-0.001***	-0.002***
		[10.72]	[9.54]		[-6.74]	[-5.94]		[-3.23]	[-3.93]
OIS		-1.878***	-1.844***		0.490***	0.516***		-0.330***	0.376
		[-3.03]	[-3.51]		[5.71]	[9.50]		[-1.43]	[1.42]
EURIBOR-OIS	-3.430	-4.051	-6.266**	0.853***	0.322	-0.599***	0.497***	0.025	-1.323**
	[-1.01]	[-0.97]	[-2.07]	[4.59]	[0.91]	[-5.10]	[1.84]	[0.03]	[-2.04]
*EURIBOR-OIS * DCORE*	11.031***	13.861***	12.019***	-0.630*	-0.954***	-0.825***	-1.687	-1.621***	-1.782***
	[2.99]	[2.60]	[3.54]	[-1.24]	[-1.97]	[-4.26]	[-3.42]	[-3.19]	[-2.36]
DCORE	-8.116***	-4.725***	-4.467***	2.582***	2.709***	2.061***	8.865***	8.628***	3.260***
	[-5.76]	[-2.15]	[-2.75]	[12.83]	[14.84]	[27.52]	[46.24]	[47.46]	[8.76]
EURO RETURN		-13.016	-5.993		1.595	4.833**		-6.424	6.354
		[-0.82]	[-0.39]		[0.80]	[2.62]		[-1.63]	[1.31]
EURO VIX		-0.003	0.012		0.002	0.011*		0.042	0.052***
		[-0.05]	[0.19]		[0.15]	[1.93]		[1.88]	[3.13]
Country Dummy	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster (Country)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bond Characteristics	N	N	Y	N	N	Y	N	N	Y
Observation	362189	362042	339497	407676	407528	339497	703766	701992	339497
Adj R-squared	0.0370	0.0915	0.1180	0.0283	0.0395	0.0961	0.0328	0.0329	0.2119

Table 5
Market Stress and Securities Lending Activities

This table reports regression results showing the relation between securities lending activities and market stress. The dependent variables are *INVENTORY*, lendable inventory value as a percentage of bond issue size, *ONLOAN*, value on loan as a percentage of bond issue size, and *FEE*, average transaction-weighted annualized rate in bps. Market stress is measured by stock market volatility from the Euro Stroxx 50, *EURO VIX* . Control variables include *CDS*, country CDS spread, the three-month *OIS* rate, stock market return based on the Euro Stroxx 50 index, *EURO RETURN*. We also control for bond characteristics tested in Table 3, consisting of loan tenure, lending fee spread, bond yield, bond size, 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.

	FEE	*ONLOAN*	*INVENTORY*
CDS	0.025***	-0.001***	-0.002***
	[8.89]	[-6.15]	[-5.19]
OIS	-1.653***	0.436***	0.201
	[-2.90]	[7.45]	[0.82]
EURO VIX	-0.223***	-0.006	0.012
	[-2.50]	[-0.93]	[0.55]
*EURO VIX*DCORE*	0.411***	-0.023***	-0.044*
	[4.81]	[-3.06]	[-1.86]
DCORE	-10.316***	2.332***	3.688***
	[-4.30]	[13.20]	[5.36]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Characteristics	Y	Y	Y
Observations	339497	339497	339497
Adj R-squared	0.1177	0.0949	0.2106

Table 6
Funding Liquidity and Borrowing Conditional on the Level of Borrowing Cost

This table presents regression results of borrowing, *ONLOAN*, as the dependent variable and funding liquidity risk, *EURIBOR-OIS*, conditional on large borrowing fee (*FEE*>=100bps). *DFEE*=1 *if FEE*>=100 bps, and is zero otherwise. The sample period is July 2006 to December 2014. Control variables described in Table 4 are included but the coefficients are not reported. All variables take the weekly value averaged from daily observations.

	All COUNTRIES			CORE			PERIPHERAL		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CDS		-0.018**	-0.015		-0.223	0.094		-0.035***	-0.030***
		[-1.97]	[-1.46]		[-0.66]	[0.20]		[-3.59]	[-2.70]
OIS		0.802***	0.796***		0.789***	0.859***		0.797***	0.737***
		[7.23]	[10.56]		[5.49]	[9.06]		[7.06]	[5.53]
EURIBOR-OIS	0.351	-0.732***	-1.559***	0.113	-0.912***	-2.137***	1.068***	-0.088	-0.345
	[0.77]	[-3.09]	[-3.30]	[0.22]	[-5.20]	[-4.77]	[3.23]	[-1.05]	[-1.52]
*EURIBOR-OIS*DFEE*	0.605	0.590	1.492***	1.597***	1.862***	1.927***	0.082	0.286	0.267*
	[1.05]	[0.85]	[2.99]	[3.73]	[4.55]	[6.79]	[0.19]	[1.58]	[1.94]
DFEE	-3.161***	-3.057***	-4.759***	-4.707***	-5.221***	-5.490***	-1.521***	-0.675***	-1.475***
	[-3.45]	[-2.45]	[-5.15]	[-10.99]	[-12.40]	[-13.47]	[-4.17]	[-2.62]	[-4.45]
EURO RETURN		3.337	6.237**		3.323	7.476**		5.036***	4.179***
		[1.01]	[2.32]		[0.80]	[2.45]		[4.68]	[3.13]
EURO VIX		-0.005	0.004		-0.009	0.003		0.014*	0.012
		[-0.36]	[0.50]		[-0.45]	[0.31]		[1.86]	[1.40]
Country Dummy	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster (Country)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bond Characteristics	N	N	Y	N	N	Y	N	N	Y
Observation	338316	338201	315518	254921	254918	240291	83395	83283	75227
Adj R-squared	0.0321	0.0595	0.1062	0.0104	0.0330	0.0927	0.0209	0.1354	0.2044

Table 7
Use of Noncash Collateral and Funding Liquidity

The results with *NONCASH* as the dependent variable and indicator of financial stress as the explanatory variable are reported. *NONCASH*, is the ratio of noncash collateral to the sum of both cash and noncash collateral. Financial stress is measured as the spread of three-month Euribor and OIS, *EURIBOR-OIS*. In Panel A, the sample period is July 2006 to June 2012, and in Panel B the time period is July 2006 to December 2014. All variables take the weekly value averaged from daily observations.

Panel A: July 2006 - June 2012			
	ALL COUNTRIES	CORE	PERIPHERAL
	(1)	(2)	(3)
CDS	0.403***	3.314*	0.349***
	[5.60]	[1.78]	[4.91]
OIS	-1.279***	-0.437*	-1.719*
	[-2.54]	[-1.16]	[-1.73]
EURIBOR-OIS	3.590***	2.842***	1.921
	[3.54]	[4.02]	[0.94]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Attributes	Y	Y	Y
Observation	241112	178264	59358
Adj R-square	0.1312	0.1058	0.1010
Panel B: July 2006 - December 2014			
CDS	0.388***	1.534	0.377***
	[5.38]	[0.82]	[4.08]
OIS	-1.783***	-1.502***	-1.671**
	[-3.93]	[-5.11]	[-2.53]
EURIBOR-OIS	1.013	0.499	0.946
	[0.85]	[0.54]	[0.35]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Attributes	Y	Y	Y
Observation	339497	260340	79157
Adj R-squared	0.1278	0.0992	0.1099

Table 8
Use of Noncash Collateral and Market Stress

The results with *NONCASH* as the dependent variable and indicator of market stress as an explanatory variables are reported. *NONCASH*, is the ratio of noncash collateral to the sum of both cash and noncash collateral. Market stress is measured as stock market volatility *EURO VIX* from Euro Stroxx 50. In Panel A, the sample period is July 2006 to June 2012, and in Panel B, the time period is July 2006 to December 2014. All variables take the weekly value averaged from daily observations.

	ALL COUNTRIES	CORE	PERIPHERAL
	(4)	(5)	(6)
CDS	0.429***	3.802*	0.365***
	[5.08]	[2.00]	[5.01]
OIS	-1.100**	-0.182	-1.750*
	[-2.24]	[-0.51]	[-1.70]
EURO VIX	0.068*	0.065***	-0.035
	[1.93]	[4.70]	[-0.56]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Attributes	Y	Y	Y
Observation	241112	178264	62848
Adj R-squared	0.1304	0.1055	0.1196
Panel B: July 2006 - December 2014			
CDS	0.416***	2.191	0.395***
	[5.00]	[1.14]	[4.14]
OIS	-1.705***	-1.361***	-1.638***
	[-4.10]	[-4.67]	[-2.67]
EURO VIX	-0.023	-0.040	-0.047
	[-0.55]	[-1.15]	[-0.46]
Country Dummy	Y	Y	Y
Cluster (Country)	Y	Y	Y
Bond Attributes	Y	Y	Y
Observation	339497	260340	79157
Adj R-squared	0.1278	0.0993	0.1100

Table 9
Securities Lending and Repo Market

This table examines the relation between securities lending activities and repo market 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* and *INVENTORY AMOUNT* are the log of value on loan and the log of lendable inventory, respectively. 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)	(5)	(6)
ONLOAN AMOUNT	0.314***			0.100		
	[16.40]			[0.18]		
INVENTORY AMOUNT		0.388***			-1.660***	
		[14.75]			[-3.77]	
LENDING FEE			0.001			0.657***
			[0.53]			[9.56]
INTERCEPT	5.137	3.797	6.727	18.134	33.715	16.466
	[41.21]	[17.86]	[83.27]	[4.86]	[8.46]	[7.97]
Week FE	Y	Y	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y	Y	Y
Observation	26748	40725	26748	26748	40725	26748
Adj R-squared	0.3730	0.4286	0.1347	0.1338	0.1680	0.3142

Table 10
Borrowing in Securities Lending Market and Financing in Repo Market during the Crisis

Results show the relation between borrowing in the securities 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 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-squared	0.2280	0.2300	0.2283	0.2304

Table 11
ECB Policy Actions and Lending Activity

This table examines the influence of weekly ECB security purchases on country-level lending activities, *FEE_C*, *ONLOAN_C*, and *RELATIVE DEMAND*, separately for core and affected peripheral countries. *FEE_C* is the value-weighted average lending fee across all government bonds in a country. *ONLOAN_C* is the proportion of the aggregate value on loan across all bonds in a country to the sum of their total outstanding. *RELATIVE DEMAND* is the ratio of the aggregate value on loan for a country to the sum of aggregate value on loan across all countries. The larger the ratio, the more relative demand for bonds in a particular country. ECB securities market programme (SMP) has two phases. Phase I targets purchase of government bonds in Greece, Ireland, and Portugal, hence the dummy variable, *AFFECTED PERI* equals one for these three countries in Phase 1, and zero otherwise. Phase II targets purchase of government bonds in Italy and Spain, and *AFFECTED PERI* takes the value of one for these two countries, and is zero otherwise.

Panel A: SMP Phase I (May 2010 - March 2011)

	LHS=FEE_C		*LHS=ONLOAN_C*		*LHS=RELATIVE DEMAND*	
	Coeff	Adj R2	Coeff	Adj R2	Coeff	Adj R2
CORE	-0.093	-0.0002	0.030	-0.0000	-0.006	-0.0048
	[-1.05]		[2.01]		[-0.02]	
	Coeff	Adj R2	Coeff	Adj R2	Coeff	Adj R2
AFFECTED PERI	-0.188	-0.0086	0.021***	0.0418	0.015***	0.1326
	[-0.35]		[4.49]		[2.92]	

Panel B: SMP Phase II (August 2011 - March 2012)

	LHS=FEE_C		*LHS=ONLOAN_C*		*LHS=RELATIVE DEMAND*	
	Coeff	Adj R2	Coeff	Adj R2	Coeff	Adj R2
CORE	-0.230***	0.1732	0.011*	0.0127	-0.017	-0.0062
	[-6.20]		[0.70]		[-0.07]	
	Coeff	Adj R2	Coeff	Adj R2	Coeff	Adj R2
AFFECTED PERI	-0.331***	0.1147	0.009***	0.2626	0.040***	0.1548
	[-3.01]		[34.34]		[3.13]	

Appendix

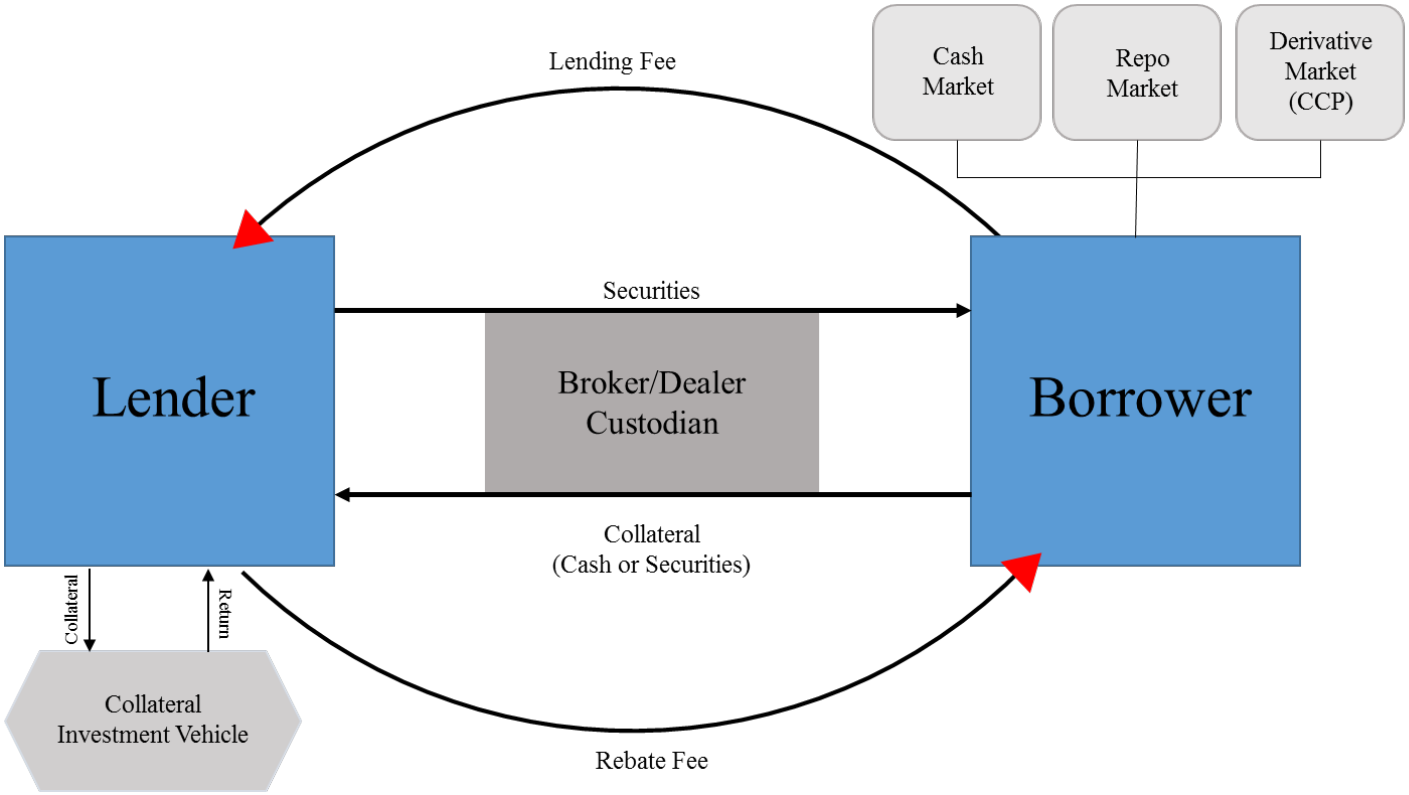

Figure A1. Illustration of Government Bond Lending

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