The Role of the Government Bond Lending Market in Collateral Transformation

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Abstract

The securities lending market for government bonds is an active short-term funding market which not only facilitates repo and cash markets, but also plays a unique role in transforming collateral from low-quality into high-quality liquid assets. We provide strong evidence of an increase in scarcity of safe assets and document the role of the securities lending market in collateral upgrading. During periods of market stress, lending fee increases significantly more for higher quality bonds, consistent with a flight-to-quality effect. In addition, borrowers increase the use of low-quality noncash collateral to upgrade to high-quality securities. Furthermore, there is increased usage of such borrowed securities to obtain cash in the repo market. This evidence is consistent with collateral upgrading in the lending market to obtain cash in the repo market. Finally, we show that central bank purchases of low-quality bonds mitigated disruptions in short-term funding markets by reducing fees of these lower quality bonds.

JEL: E44, E58, G24
Keywords: safe assets, collateral upgrading, securities lending, European government bonds, financial crisis, repo

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1. Introduction

The proper functioning of short-term funding markets at all times is essential to financial markets, the transmission of monetary policy, and the whole economy. For most countries, short-term funding markets include those for sovereign bonds, repo, securities lending, money markets, and foreign exchange.[1] These markets allow financial institutions to raise financing, facilitate price discovery, enhance market liquidity, and enable market making.

The global financial crisis and the subsequent European sovereign debt crisis severely disrupted funding markets, resulting in a generalized scarcity of safe and liquid assets (Gorton and Metrick 2012; Krishnamurthy, Nagel, and Orlov 2014).[2] To counter the disruption in funding markets, the US Federal Reserve in March 2008 introduced the Term Securities Lending Facility (TSLF), allowing 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) embarked on the Securities Markets Program (SMP) that involved the direct purchases of government bonds to ensure depth and liquidity in these markets, and on April 2015, the ECB introduced a securities lending program to make securities purchased under its government bond purchase program available for securities lending. The proper functioning of short-term funding markets and the scarcity of safe assets remain a major concern for policymakers (Yellen 2013; Stein 2013; and Greenwood, Hanson and Stein 2016).

In this paper, we study the securities lending market in European government bonds to (i) provide new evidence of an increase in scarcity of safe assets arising from a flight to quality effect, and (ii) show its importance in upgrading collateral, allowing borrowers short of high-quality liquid assets to obtain financing in the repo market. To the best of our knowledge, this paper is the first to show the role of the securities lending market in collateral upgrading and the existence of such linkage between the securities lending market and the repo market.

[1] See Fontaine, Selody, and Wilkins (2009).
[2] As explained by Gorton and Metrick (2012), the U.S. financial crisis was partly a run on the repo market that provides essential funding for a broad range of securitization activities and financial institutions.

The European government bond lending market is uniquely appropriate to study both effects. First, the European sovereign debt crisis led to a triage of safe bonds in core economies and risky bonds in peripheral countries, providing a natural condition for assessing the significance of flight to quality effects and scarcity of safe assets. Second, European repo markets are primarily collateral driven, as opposed to the US repo market which is primarily cash driven, making it ideal testing ground for assessing the role of collateral upgrading.

The securities lending market is an important short-term funding market. As of July 2015, the global lendable inventory of all securities stood at $15 trillion, and the amount borrowed was $2 trillion.[3] The lendable inventory was $1.04 trillion for U.S. government bonds and $0.98 trillion for European government bonds; the amount borrowed was $412 and $362 billion, respectively. The lending market for government bonds has a unique role in transforming collateral from low-quality assets to high-quality liquid assets (HQLA), a feature that distinguishes it from other short-term funding markets, and an attribute particularly important in light of the increased demand for HQLA since the crisis.

Our analysis uses a unique data set covering bond level securities lending transactions of government bonds from 11 European countries that have activities in the securities lending market during the period July 2006 through December 2014. The daily data set is comprised of aggregate lendable inventory, amount borrowed, and lending fee for each government bond.

We find strong results consistent with a flight-to-quality effect in the securities lending market for government bonds during crisis times. In normal times, lending fee is lower for government bonds issued by high-quality countries. However, during a crises, lending fees increase more for high-quality government bonds relative to low-quality bonds, consistent with an increase in the scarcity of safe bonds. At the same time, the borrowing of high-quality bonds decreases during crises, consistent with a hoarding of safe bonds.[4] We obtain these results both by contrasting the evolution of lending fee and loan on value during crises between high-quality

[3] https://www.markit.com/product/pricing-data-securities-finance

[4] Indeed, during the sovereign debt crisis policymakers expressed concerns frequently indicated that "the hoarding behavior of some investors who seek core-country sovereign bonds as safe-haven assets has led to a scarcity of available core-country collateral" (European Central Bank 2012).

and low-quality government bonds, and by examining fee and value on loan pairs to differentiate shifts in supply and demand.

We also find that borrowers are more likely to pledge noncash collateral to borrow high-quality bonds during periods of market stress when cash becomes scarce. This finding is consistent with collateral transformation being a key motivation for borrowing in the securities lending market during a crisis. We examine the motivation for collateral upgrading by examining Italian government bond market, which is the only market for which we have data on both securities lending and repo transactions at the transaction level. If one of the motivations for collateral upgrading is to be able to access the repo market, then more borrowing of a particular bond in the securities lending market should be associated with more activity for the same bond in the repo market. We find that in normal times, borrowing in the lending market is not positively associated with obtaining financing in the repo market, implying that securities lending market is not needed for upgrading collateral. However, during crises, more borrowing of government bonds in the lending market is significantly associated with more usage of the same bond as collateral in the repo market to obtain financing. Our results suggest that collateral upgrading in the securities lending market plays an important role for borrowers to obtain cash in the repo market during crisis.

Finally, we study the role of central bank policies in addressing disruptions in funding markets and the role of the securities lending market in the transmission of such policies. During the crisis, the ECB introduced the SMP program to purchase low-quality government bonds in order to ensure depth and liquidity in the government bond market. Our analysis shows that ECB purchases of low-quality government bonds under the SMP program stimulated borrowing of these low-quality bonds in the securities lending market, and lowered the lending fees of these bonds. 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.

Our paper builds on the recent literature on the shortage of (high-quality liquid) safe assets. Gorton and Ordoñez (2014) show that the production of safe 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 privately-created near-safe assets. Gorton and Muir (2015) analyze the scarcity of safe debt and its impact on availability of collateral. Duffie, Scheicher, and Vuillemey (2015) examine the impact of new regulations on the demand for collateral. Caballero and Farhi (2016) argue that the shortage of safe assets is tantamount to a liquidity trap that requires strong demand stimulus. We contribute to this literature by showing that the securities lending market essentially allows the access to safe assets, albeit at a cost, and thus that securities lending can relieve the shortage of safe assets.

Our paper also dovetails with the literature on repo markets. Duffie (1996) discusses how securities lending may substitute for repo transactions because repos increase both the assets and liabilities of the borrower and lender, and therefore there are adverse consequences on minimum capital and liquidity requirements especially during a crisis. Gorton and Metrick (2012) show the important role of subprime mortgages in causing a run in the repo market during the crisis. They find that concerns about declining values and liquidity in asset-backed securities used as collateral led to increases in repo haircuts. Similarly, Martin et al. (2014) show that tri-party repo markets are particularly sensitive to expectations-driven runs because of early settlement of repos by clearing banks. Krishnamurthy et al. (2014) document that repo volume backed by asset-backed securities falls to near zero during the crisis. They demonstrate that a relatively small contraction in the repo market had severe consequences because it disproportionately affected a few dealer banks, leading to a run. Mancini et al. (2015) show that the euro interbank repo market acted as a shock absorber for banks during the financial crisis with the volume of repo lending increasing in risk, while margins remained stable. They ascribe the market resilience of the euro area interbank repo market to the use of anonymous central counterparty (CCP) trading backed by safe collateral.[5] We contribute to this literature by providing empirical support for the

[5] In analyzing tri-party repos, Copeland et al. (2014) discuss the significant role of securities lenders who reinvest the cash obtained from securities lending in tri-party repo. Corradin and Maddaloni (2015) find the scarcity premium to be higher in the repo market for bonds when the lendable inventory is lower in the securities lending market for

motivation of collateral upgrading by linking the lending market and the repo market. However, none of these studies focuses on the securities lending market.

Our paper also relates to the literature on the impact of unconventional monetary policies during the crisis (e.g., Acharya et al. (2016), Duygan-Bump et al. 2013; Fratzscher et al. 2014; and Eser and Schwaab 2016). These studies quantify the impact of unconventional 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.

2. Institutional Background on Securities Lending

The securities lending market in government bonds is *sui generis* a short-term funding market. Beyond facilitating repo and cash markets, it has a unique role in transforming low-quality assets into high-quality liquid assets, a process called collateral transformation. 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 funds, insurance companies, mutual funds, or sovereign wealth funds; b) the borrower such as banks or hedge funds; and c) financial intermediaries such as brokers and dealers, and custodian banks. The lender agrees to lend the holding securities to the borrower in exchange for collateral 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. Importantly, this also implies that the borrowed security can be used for collateral upgrading in another

sovereign bonds. D'Amico et al. (2014) examine the special collateral repo market, and show that the repo rate falls in response to a reduction in the supply of the specific U.S. Treasury collateral.

securities transaction. The lender keeps the coupons or dividends on securities loaned, while the borrower retains the right to the coupons or dividends on securities posted as collateral.

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 earn a spread by investing the cash, however, the lender needs to rebate part of the additional spread 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. Copeland, Baklanova, and McCaughrin (2015) provide a reference guide for the U.S. market.

The risks for the lender in receiving cash or noncash collateral are similar because the transactions are marked to market daily and 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 amount invested. In a noncash-collateralized transaction, the lender charges a fee and does not pay a rebate.

The securities lending market has similarities but also important differences to the repo market. Most repo transactions are motivated by the need to borrow and lend cash, whereas securities lending is typically driven by the need to borrow securities. In a repo transaction using bonds, the borrower provides a bond as collateral for the lender, whereas in securities lending, the security borrower receives the bond from the lender. One key distinction is the role of noncash collateral in the securities lending market. 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. During crises, investors generally prefer safe and liquid assets, implying a preference for cash over government securities and for government securities over other

securities. Borrowing a bond against cash collateral in the securities lending market is effectively the flipside of a conventional repo financing of the bond. In a liquidity crunch, the higher cash premium may deter repo financing by requiring high-quality collateral, which is particularly the case in the European market. One of the solutions for borrowers is to first upgrade collateral in the securities lending market by using the low-quality assets on balance sheets and paying a high lending fee.

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 almost 80% now. In contrast, noncash collateral amounted only to 4.6% of government bond loans in 2006 and 17.6% in 2014 in the United States.[6] The securities lending market therefore plays an even bigger role in Europe allowing market participants to upgrade collateral to high-quality government bonds.

One of the major motivations for borrowers in the European government bond lending market is collateral transformation, which further serves cash needs and helps meet regulatory requirements. In order to get financing in the repo market, borrowers short of cash can first raise high-quality government bonds by upgrading low-quality collaterals on their balance sheets, such as stocks, corporate bonds, and mortgage-backed securities, in the securities lending market. This is particularly important in crunch times when cash becomes scarce and funding liquidity constraints tighten. Unlike the securities lending market, European repo markets generally do not accept low-quality collateral. The majority of collateral in European repo transactions consist of high-quality government bonds. According to data from ICMA, government bonds in recent years have made up about 80% of posted collateral. The remaining collateral is mostly high quality as well.[7]

[6] 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.

[7] 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/

The purpose of borrowing government bonds for collateral transformation is different 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 markets, short selling also exists but generally constitutes only a small fraction of transactions.

3. Data Description

3.1 Securities Lending Market in Government Bonds

We obtain 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. Our sample consists of 4,203,116 bond-day observations representing 7,298 unique bonds.

As is common in the literature, we classify Austria, Belgium, Finland, France, Germany, and the Netherlands as *core* countries, and Greece, Ireland, Italy, Portugal, and Spain as *peripheral* countries. The combined amount of government debt outstanding for these 11 euro area countries was 9.4 trillion euros at the end of 2014, having increased from 5.9 trillion euros in 2006. Appendix Table A.1 shows the evolution and distribution across countries of euro area debt over the period 2006 to 2014.

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 calculated as the average transaction-weighted annualized lending fee and 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. We also collect bond characteristics, including bond issue size, bond time-to-maturity, dummy for bonds with floating rate coupon, the tenure of the loan (the weighted average number of days from the beginning of the contract to present for all open transactions), and the liquidity of loan (the difference between the daily highest and lowest lending fee).

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 inventory 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).

3.2 Government Bond, Cash Market, and Macro Variables

We obtain information on bond characteristics and secondary-market bond prices from Datastream, Bloomberg and MTS cash summary database. 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 bond characteristics and lending terms. We include the following control variables: bond issue size, time to maturity, bond tenure (length), bond bid-ask spread, and bond coupon type – floating or fixed. A bond tends to have lower liquidity if the issue size is small, and/or if many years have elapsed since bond issuance 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 results in 3,198,162 bond-day observations for 5,809 unique bonds.

Similar to previous studies, for example, Beber, Brandt, and Kavajecz (2009), we consider alternative proxy of bond quality by using the issue country's credit risk measured by the country-level credit default swap spread (*CDS*), five-year and 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, a closely watched 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 condition. 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 to obtain stock returns, *STOCK RETURN*, and use it as a control variable. We use the European stock market volatility index VSTOXX, 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 for 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 is 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 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*, defined as total par value of sell-side contracts as a percentage of the 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 value on loan 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 (i.e., the percentage of value on loan to lendable inventory) 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%. 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. 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 A.2 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 the value on loan of European government bonds in our sample. The value on loan of both core and peripheral government bonds dropped during the U.S. subprime crisis (August 2008-June 2009). For core bonds, the value on loan then started to increase at the onset of the European sovereign debt crisis (May 2010), reaching new heights during the peak of the European sovereign debt crisis (August 2011-June 2012). For peripheral bonds, value on loan continued to decline following the U.S. subprime crisis, reaching new lows during the peak of the European sovereign debt crisis. Taken together, the evolution of securities lending is consistent with a flight to quality toward core country bonds during the sovereign debt crisis.

Figure 3 shows the evolution of the use of noncash collateral to borrow government bonds in the securities lending market over our sample period of 2006 through 2014 separately for government bonds issued by core and peripheral countries. We compute the proportion of noncash collateral to total collateral, measured as *NONCASH*, as follows:

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

In Europe, noncash securities are the dominant form of collateral, in contrast to the United States, where loans of securities are traditionally collateralized using cash. The function of upgrading collateral provided by the securities lending market thus is particularly important for European financial markets.

Three patterns are evident for the use of noncash collateral in European government bond market. First, more noncash collateral is used when there is a market stress as demand for cash and the reinvestment risk of cash increases. Second, the use of noncash collateral to borrow peripheral country government bonds spikes in 2011 during the European sovereign debt crisis, possibly due to ECB intervention to support peripheral country bonds. Third, the use of noncash collateral has continued to increase in 2013 and 2014 after the financial crisis. The increase in the use of noncash collateral in 2013 and 2014 is due to regulatory changes. Specifically, the European Markets Infrastructure Regulation (EMIR), adopted on July 4, 2012, requires the use of CCP clearing for derivatives transactions, which only accept cash and selected government bonds as collateral. Also under the new Basel III liquidity regulations, banks may resort to collateral upgrading to help meet the liquidity coverage ratio (LCR) requirement in holding sufficient high-quality liquid assets. Both of these developments have increased the demand from borrowers to upgrade to high-quality liquid securities in order to meet regulatory requirements.

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 for three sub-periods. The sub-periods are pre-U.S. subprime crisis (July 2006-June 2007), U.S. subprime crisis (August 2008-June 2009), 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, reflecting a contraction in the lendable inventory and value on loan for their government bonds.

Panels B and C 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.[8] Almost all government bonds in the primary market are available in the lending market, though the value on loan 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 value on loan for government bonds declined during the U.S. crisis in both core and peripheral countries, and continued on a downward path for peripheral countries, dropping to a low of 0.81% at the peak of the European sovereign debt crisis. In contrast, lendable inventories increased for core country bonds during the two crisis episodes and experienced a modest decrease for peripheral bonds. The lendable inventory value as a proportion of bond issue size increased to 15.09% for bonds from core countries and decreased to 6.88% for bonds from peripheral countries during the peak of the European sovereign debt crisis.

Panel D of Table 2 also shows that the noncash collateral ratio increased substantially for both core and periphery countries during the two crisis episodes. Before the U.S. crisis, the average noncash ratio was 56.12% and 42.45% for core and peripheral countries, respectively. During the peak of the European sovereign debt crisis, this ratio had increased to 70.31% for core countries and 56.61% for peripheral countries.

4. Flight-to-Quality and Scarcity of Safe Assets

We now examine the significance of a flight to quality channel in the bond loan market by contrasting the borrowing of high-quality versus low-quality bonds during market stress. One would expect more demand on better quality collateral in the crises, implying that the borrowing fee would go up especially for core country bonds, consistent with a flight-to-quality effect. Government bonds issued by core countries are assumed to be of high quality and those issued by peripheral countries are assumed to be of lower quality. Therefore, we create a dummy

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

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 both fee and value on loan separately for core versus peripheral country bonds during periods of financial stress. Our regression model for *FEE* is as follows:

$$FEE_{ijt} = \alpha + \beta_1 \, Market\ Stress_t + \beta_2 \, Market\ Stress_t \times DCORE + \beta_3 \times DCORE + \Sigma\theta_k \times CONTROL_{kjt} + \varepsilon_{ijt} \quad (1)$$

The regression model for *ONLOAN* (%) simply replaces *FEE* in equation (1) with *ONLOAN* (%). The results for *FEE* are reported in Panel A while the results for *ONLOAN* (%) are presented in Panel B of Table 3. For each dependent variable, we report results for four specifications. In column (2) of Table 3, the main explanatory variables are *EURIBOR-OIS*, *EURIBOR-OIS*×*DCORE*, and *DCORE*. Column (3) adds *OIS* and *STOCK RETURN* and column (4) adds further bond characteristics as control variables. Column (1) does not include the interaction between *EURIBOR* and *DCORE*. All specifications include country fixed effects and standard errors are clustered at the country-level. All results are also robust to including week fixed effects (instead of the variables of *EURIBOR-OIS* and *EURIBOR*, which are highly correlated with time dummy variables) but because we are independently interested in the coefficient of *EURIBOR-OIS* we only report results with this variable included.

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 fees. Moreover, the coefficient on *EURIBOR-OIS* is positive and significant indicating that lending fees increase during periods of market stress.

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 regressions demonstrate that, when the EURIBOR-OIS spread is large, that is, during financial stress, lending fees are relatively higher for high-quality government bonds issued by core countries. Not surprisingly, results are qualitatively similar when using EURIBOR-EONIA spread as an alternative proxy for market stress. For robustness, we also considered the *EURO VIX* as an

alternative proxy for market stress, and again the results are qualitatively similar. The economic effect of this result is substantial: a one-standard deviation increase in the EURIBOR-OIS spread implies an average increase of 11 bps in the fees for borrowing high-quality as opposed to low-quality government bonds in periods of market stress. Given that the average fee over the whole sample is 17.8 bps for core country bonds and 18.1 bps for peripheral country bonds over the whole sample, this increase is substantial.

At the same time, we find that the value on loan decreases for high-quality government bonds issued by core countries during period of financial stress (Panel B of Table 3), consistent with an increase in the scarcity of high-quality collateral. During a liquidity crunch, the opportunity cost of making high-quality government bonds available for borrowing in the securities lending market increases, as there is a general hoarding of safe assets, even though fee increases. The hoarding results in scarcity of high-quality collateral. The results are robust to using the log of value on loan instead of the value on loan as a percentage of bonds outstanding as dependent variable (see Table A.3, Panel A).

Our results indicate that market participants are willing to pay a higher fee to borrow high-quality bonds during a crisis, consistent with a flight-to-quality effect, against the background of an increased scarcity of high-quality collateral. In unreported results, we include the U.K. as a core country, and find the results are similar. The rest of the analysis focuses on the 11 euro countries.

Next, we repeat the analysis in Panel A of Table 3 using country-level CDS spreads as a proxy for bond quality instead of *DCORE*, and the result are reported in Table A.3. All government bonds from the same country will have the same value for CDS. The dependent variable is *FEE*. The dummy variable *LOW (CDS)* takes the value of one if the country-level CDS spread is below the median spread, and zero otherwise. The coefficient of the interaction term *EURIBOR-OIS×LOW (CDS)* in columns (1)-(3) of Table A.3 is positive and significant in each specification. The result implies that fees increased more during the crisis for countries that had lower credit default 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)-(6)

of Table A.3. We create a dummy variable *LOW (TTM)* that takes the value of one if the maturity of the bond is lower than the median for all bonds in the sample. We find that borrowers are willing to pay a higher fee for shorter maturity bonds, which face less rollover risk than longer maturity bonds, during periods of market stress. The results in Table A.3 confirm the earlier findings of a flight-to-quality effect during periods of market stress.

4.1 Additional Evidence from Supply and Demand Shifts

The results in the previous section identify flight-to-quality by measuring changes in lending fee and value on loan during the crisis for high-quality bonds relative to low-quality bonds. However, as discussed by Cohen, Diether, and Malloy (2007), there is a need to examine the competing effects of supply (lendable inventory) and demand (value on loan) to properly capture the effect of flight-to-quality. We employ their price-quantity "pairs" approach to construct fee and value on loan pairs to differentiate shifts in supply and demand. An increase (decrease) in lending fee coupled with an increase (decrease) in value on loan, implies that an increase (decrease) in borrowing demand *must* have occurred and hence an outward shift in demand, *DOUT* (inward, *DIN*). Similarly, if we observe an increase (decrease) in lending fee coupled with an decrease (increase) in the value on loan, there should be a decrease (increase) in supply, and an inward shift in lendable inventory, *SIN*, (outward, *SOUT*). If there is flight-to-quality during the European sovereign debt crisis, we should observe an outward shift in demand for core country bonds, as indicated by a simultaneous increase in lending fee and value on loan.

For each government bond in our sample, we calculate its average fee and value on loan in the subsample right before the European sovereign debt crisis (July 2009 to April 2010) and during the peak of the European sovereign debt crisis (August 2011 to June 2012). The difference in fee and value on loan between the two-subsample periods reflects the shift in supply or demand for this particular bond. We calculate the total number of bonds for each supply-demand type (*DOUT*, *DIN*, *SIN*, *SOUT*) for core and peripheral countries, respectively. The results are presented in Table 4. Panel A presents results using mean values and panel B using median values of the differences between the two-subsample periods.

Panel A of Table 4 shows that 42.4% of core country bonds experienced both an increase in fee and an increase in value on loan during the European sovereign debt crisis, indicating a definite increase in demand for core bonds. The number of price-quantity pairs displaying this increased demand is much larger for core bonds than for periphery bonds, 42.2% relative to 13%. In addition, *DOUT* dominates the other three types of shifts for core bonds, consistent with flight-to-quality.

For peripheral bonds, the dominating shift during the European sovereign debt crisis is a decline in lendable inventory indicating an inward shift in supply (*SIN*): 66.7% of peripheral bonds have an increase in fee and a decrease in value on loan during the European debt crisis. For core bonds, an inward shift in supply is less frequent than an outward shift in demand. Results based on differences in median values are similar as shown in Panel B of Table 4.

These results are consistent with the regression results in Table 3. There we show that core bonds have relatively higher lending fees but less value on loan than peripheral bonds during periods of stress. An increase in lending fee (price) can be due to reduced supply (*SIN*) and/or rising demand (*DOUT*). While both shifts can result in increased lending fee, only *SIN* implies a decrease in value on loan. Here we show that core bonds predominantly experience increase in demand (*DOUT*), followed by reduced supply (*SIN*). The combination of an outward shift in the demand curve together with an inward shift in the supply curve can translate into an increase in lending fees and a decrease in value on loan, as found in the regression results.

Overall, these results provide further evidence that there is a flight-to-quality for high-quality bonds issued by the core countries during the European sovereign debt crisis.

5. Collateral Upgrading and Financing

We have shown that lending fees increase for high-quality government bonds during a crisis due to flight-to-quality. In order to borrow any securities, borrowers need to put up collateral. The question we examine next is whether borrowers pledge low-quality collateral or use cash to borrow high-quality securities.

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. During a crisis, the demand for high-quality liquid assets increases. If the motivation to borrow during crises is to upgrade collateral, then borrowers are more likely to use low-quality noncash collateral. 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.

Lenders holding high-quality securities, however, may become more risk averse and may not be willing to accept low-quality collateral. At the same time, the reinvestment risk of investing the cash collateral increases during a crisis and therefore lenders might not want cash. Lenders weigh the decision to accept low-quality noncash collateral versus the risk of investing cash collateral.

5.1 Noncash versus Cash Collateral

We use the earlier framework to examine changes in the use of noncash collateral during stress market conditions for core versus peripheral countries. The sample period is limited to July 2006 to June 2012, a period not impacted by the new EMIR and Basel III regulations that increased the demand for high-quality liquid assets. We use *NONCASH*, which is the loan transaction-level percentage of noncash collateral to total collateral, as the dependent variable:

$$NONCASH_{ijt} = \alpha + \beta_1 \, Market\ Stress_t + \beta_2 \, Market\ Stress_t \times DCORE + \Sigma\theta_k \times CONTROL_{kjt} + \varepsilon_{ijt} \quad (2)$$

As before, our proxy for funding market stress is the *EURIBOR-OIS* spread. As control variables, we include the interest rate proxy, *OIS*, and European stock market returns *STOCK RETURN*. We also control for the bond characteristics discussed in Section 3.1, including bond

issue size, bond time-to-maturity, a floating coupon dummy, loan tenure, and loan bid-ask spread. To save the space, we do not report the coefficients on the control variables.

Our hypothesis is that during stressed market conditions, the use of noncash collateral increases with a view to upgrade low-quality collateral to high-quality government bonds. During the European sovereign debt crisis, a marked difference emerges between the perceived quality of core and periphery country bonds. We therefore expect that the use of noncash collateral increases especially for core country government bonds during this period.

The results are shown in Table 5. All regressions control for bond characteristics and include country fixed effects and clustering at the country-level. The use of country fixed effects, instead of bond fixed effects, is motivated by the collateral rules of central counterparties under EMIR, which categorize government bonds at the country-level. That is, any government bond issued by a sovereign country receives the same treatment in serving as eligible collateral.[9] 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.

Columns (1) and (2) of Table 5 report the results for the full sample period July 2006 to June 2012. The coefficient of *EURIBOR-OIS* is positive and marginally significant suggesting that the use of noncash collateral increases during stressed market conditions. The coefficient on *EURIBOR-OIS*×*DCORE* is not significant, indicating that over the entire sample period there is no difference in this relations between core and peripheral country bonds. The differences in bond quality between core and peripheral countries was not significant around the U.S. crisis.

Next, we focus on the period June 2009 to June 2012 that excludes the major part of the U.S. crisis. It is during the European sovereign debt crisis when a large difference emerged between the spreads of core and peripheral country bonds. This allows us to test more directly whether the increase in the use of noncash collateral is associated with collateral upgrading. Specifically, if we find that the use of noncash collateral increases only for core country

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

government bonds, which during this period were perceived to be of higher quality than peripheral country bonds, this would be consistent with collateral upgrade trades. We test this by limiting the sample period to the peak of the European sovereign debt crisis and the period immediately preceding this, that is, July 2009 to June 2012. The results are presented in columns (3) and (4).

The coefficient of *EURIBOR-OIS*×*DCORE* is positive and significant in columns 3 and 4, suggesting that the tightening funding constraint during the European crisis is associated with more use of noncash collateral in exchange for high-quality government bonds for core countries. Overall, the results are consistent with the motivation of collateral upgrading during periods of market stress. If the increase in the use of noncash collateral during a crunch simply reflects an increase in the scarcity of cash and not a collateral upgrading, then the effect should not be stronger for core country bonds than for peripheral country bonds because the scarcity of cash increases in both sets of countries during crunch times.

The economic effect of this result is substantial: a one-standard deviation increase in the EURIBOR-OIS spread during the peak of the European sovereign debt crisis implies an increase of 8% in the use of noncash collateral ratio to borrow high-quality government bonds. Our results suggest that the securities lending market plays a crucial role during stress times in upgrading collateral from low-quality securities to high-quality government bonds.

5.2 Securities Lending and Financing in Repo Market

We next examine one potential motivation for upgrading collateral during periods of market stress using noncash collateral. As discussed earlier, there can be several other reasons for upgrading collateral. We analyze whether government bonds borrowed in the securities lending market are 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, therefore, the motivation to borrow Italian bonds in the lending market may not be consistent with financing in its repo market. However, if anything, the use of Italian bonds for this analysis should work against finding any results. Moreover, in the analysis we will distinguish between the US crisis, when Italian government bonds were still widely used as high-quality collateral, and the European sovereign debt crisis, when the collateral value of Italian government bonds had deteriorated.

We examine the relationship of securities lending and financing in the repo market through bond-level regression analysis. First, we examine the general linkage. A bond in the repo market could serve as the collateral in financing repo contracts or serve as the borrowed security in reverse repo contract. *REPO AMOUNT,* the dependent variable in Table 6, is the log of the total trading amount in the repo market for each bond, which is the sum of trading amount when a bond serves both as collateral and as borrowed security. For explanatory variables, we consider the log of value on loan, *ONLOAN AMOUNT*, for the same bond borrowed in the lending market. 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 6, 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 can be observed from market prices. Following Duffie (1996), 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 capture that there is more activity for the same bonds in the primary market, in the securities lending market, and in 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 financing purposes.

Column (1) of Table 7 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 used for financing. In column (2), we include the dummy variable, *DCRISIS*, which equals one for the period of the U.S. subprime crisis, and zero otherwise. During the U.S. subprime crisis, Italian government bonds were considered quite safe and were mostly considered to be of high quality. The interaction of *ONLOAN*×*DCRISIS* is positive and significant at the 1% level, indicating that, during the U.S. subprime crisis, borrowing of Italian government bonds is motivated by the objective of upgrading collateral for possibly obtaining financing in the repo market. The results indicate that, in general, there is a negative association between the amount borrowed and the usage for financing purposes. However, this relation reverses during the crisis period with borrowed government bonds used to obtain financing in the repo market.

Column (3) reports results for the European sovereign debt crisis, where *DCRISIS* now takes on a value of one for the period of the European sovereign debt crisis, and zero otherwise. The interaction of *ONLOAN*×*DCRISIS* is still positive but only marginally significant at the 10% level, indicating that, during the European sovereign debt 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. Although Italian bonds were still accepted by ICE Clear Europe for collateral purposes, their haircuts were much larger than that of bonds from core countries, reflecting the higher risk. For example, the haircut on German bonds during this period was in the range of 3%-10%, whereas the haircut for Italian bonds was in the range of 6%-15%.

These results suggest that borrowing of high-quality government bonds in the securities lending market during periods of market stress is positively associated with the bonds being collateralized in the repo market to obtain financing. The securities lending market in government bonds allows upgrading of collateral to higher quality bonds that are then used to obtain financing in the repo market. It is fair to ask why low-quality bonds are acceptable as collateral in the securities lending market during a crisis but not in the repo market. Duffie (1996) discusses accounting and regulatory differences between the two markets, and we provide some discussion in the conclusions section. We do believe that the linkages between short-term funding markets and pricing differences between these markets deserves deeper examination in future research.

6. Central Bank 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 might also serve as a transmission channel for ECB policies. Specifically, we examine the influence of the ECB's Securities Market Program (SMP) on securities lending activities. The ECB adopted other unconventional measures such as main refinancing operations (MRO) and long-term refinancing operation (LTRO). However,

these operations were targeted at banks and not directly aimed at government bonds, and thus they are not directly 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.[10] In particular, the yield spreads of sovereign bonds from peripheral countries relative to German bonds 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 served as an important signaling device. 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 (2016), have quantified the impact of the SMP on bond yields and found that the SMP substantially compressed bond yields in the targeted countries.

We examine the impact of SMP purchases on government bond lending fees using the following regression:

$$FEE_{ijt} = \alpha + \beta_1 SMP_t + \beta_2 SMP_t \times TARGET + \beta_3 EURIBOR\text{-}OIS_t + \beta_4 EURIBOR\text{-}OIS_t \times TARGET + \beta_5 TARGET + \Sigma\theta_k \times CONTROL_{kjt} + \varepsilon_{ijt}, \quad (3)$$

where *SMP* is ECB's weekly purchase amounts of government bonds issued by targeting peripheral countries. The SMP was characterized by a high degree of opacity, with little or no disclosure about the size decomposition or maturity structure of the purchases; only the aggregate amount of purchases by country was disclosed. *TARGET* is a dummy variable with a value of one if a bond is issued by a sovereign country targeted by the ECB securities market

[10] See ECB Monthly Bulletin, June 2010.

program (SMP) and zero otherwise. The targeted countries in Phase I are Greece, Ireland, and Portugal, and those in Phase II are Italy and Spain.

As seen in Panel A of Table 8, the coefficient of *TARGET* alone is significantly positive, suggesting that on average targeted country bonds are associated with higher fees. This result is consistent with our earlier evidence showing that during normal times lending fees are higher for low-quality bonds. However, in both Phase I (May 2010 to March 2011) and Phase II (August 2011 to March 2012), as shown in Table 8, the SMP purchase of targeted country government bonds helped boost the market's confidence and hence reduces lending fee of government bonds issued by the targeted countries. The coefficient on the interaction of *SMP* and *TARGET* is significant and negative, indicating that government bonds in targeted countries have relatively lower fees than those in core countries during the period of the ECB's intervention. This result remains robust after controlling for the money market interest rate and European stock market return, and even after controlling for the funding market condition, *EURIBOR-OIS*, and its interaction with the dummy variable *TARGET*.

The lending fees for bonds in targeted countries decreased by 1.15 basis points on average relative to bonds in countries that were not targeted during the first phase of the SMP program and by 0.28 basis points during the second phased of the program. These effects are not trivial given that they are obtained after controlling for the flight-to-quality effect. The results are robust to using the logarithm of value on loan instead of the value on loan (as a percentage of total amount of bonds outstanding) as dependent variable (see Table A.4, Panel B).

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

Panel B of Table 8 repeats the analysis with ONLOAN (%) as the dependent variable. The coefficient of TARGET alone is significantly negative, suggesting that on average targeted country bonds are associated with lower values on loan. We find that the coefficient on the interaction of SMP and TARGET is significant and positive during the first phase of the program, indicating that government bonds in targeted countries have relatively higher values on loan than

those in core countries during the first phase of the program. This suggests that the SMP program helped restore market confidence not only by reducing lending fees but also by boosting loan volumes of government bonds issued by the targeted countries.

In addition to bond purchase programs, the ECB also relaxed its collateral policies following the collapse of Lehman Brothers to support functioning of funding markets (see Cassola and Koulischer (2016) for a detailed overview of ECB collateral policy changes). The most notable change occurred on October 22, 2008, when the ECB lowered the credit threshold of collateral from A- to BBB- ratings. The ECB also suspended its minimum rating threshold at various times during the European sovereign debt crisis, starting on May 3, 2010, and therefore sovereign bonds from all countries in our sample remained eligible for collateral in the ECB throughout our sample period.[11] It is possible that these changes in collateral policies impacted our results, in particular our results on the use of noncash collateral. However, these policies should work against our finding of flight to quality during the sovereign debt crisis. In unreported results, we conduct event studies around these actions by the ECB, and find that around the announcement dates, the securities lending market in government bonds does not respond.

7. Conclusions

The securities lending market is a core funding market that provides critical liquidity to the financial markets. The market is of ongoing interest to policymakers because of its connections to other markets and its inherent systemic risk. New regulations such as EMIR, the Dodd-Frank Act, and Basel III 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. In addition, the Financial Stability Oversight Committee (FSOC) in the U.S is considering whether large asset managers, which tend to be

[11] The waiver on Greek debt was suspended in February 2015.

large securities lenders, should be designated as systemically important financial institutions (SIFIs) given the systemic risks they pose to the overall financial system.

Using a unique data set of European government bond loans, we find that during crises, lending fee increases for high-quality government bonds consistent with a flight-to-quality effect resulting in a scarcity of safe assets. We also find that during a crisis borrowers are less likely to use cash and instead pledge lower quality securities as collateral to borrow high-quality government bonds issued by core countries. Moreover, during crises periods, increased borrowing in the securities lending market relates to more activity for that bond in the repo market to obtain financing. The results indicate that securities lending allows borrowers to upgrade to high-quality liquid collateral that can be used to obtain financing in the repo market. The ability to upgrade collateral and use it in the repo market for financing purposes is particularly important during a crisis.

We show that the purchase of peripheral country government bonds by the ECB during the crisis is associated with increased confidence in these bonds as reflected in lower lending fees. 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 the 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 current policy debates on the regulation of short-term funding markets and concerns about the scarcity of high-quality collateral. Understanding and bringing more transparency to short-term funding markets is of ongoing interest to policymakers.[12] In addition, current derivatives reforms aim at reducing complexity by moving to central counterparties have focused attention on collateral transformation. Basel III requirements have also increased the demand for high-quality liquid government bonds. Regulators and market participants are concerned about the scarcity of "good" collateral—the estimates of collateral

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

shortfall range from $500 billion to $8 trillion.[13] Given these ongoing reforms, our analysis suggests that securities lending can offer valuable opportunities for collateral transformation to relax collateral constraints and reduce problems associated with the scarcity of safe assets. Our focus has been on the private market for securities lending. Given the large-scale asset purchases by major central banks, our results imply that the shortage of safe assets could also be reduced through central bank securities lending programs.

There are several venues for future research. The linkage between alternative short-term funding markets needs additional examination. For example, further studies are needed to understand why securities lenders are willing to engage in collateral upgrade trades. Why are low- quality securities acceptable to security lenders but not in the repo market? One reason may be that lenders are compensated sufficiently for taking the risks, for example, we have shown an increase in lending fee during a crisis. In addition, large asset managers may be willing to accept low-quality bonds at a higher lending fee because they face longer investment horizons and are less subject to regulatory constraints than banks. Moreover, in cases where the securities lender is a custodian acting on behalf of a beneficial owner, and thus lending out someone else's bond, the lender may have perverse incentives for risk taking. Consistent with this, several securities lenders lost money for beneficial owners during the crisis due to losses from illiquid collateral or bonds purchased using cash collateral (Wall Street Journal, 2008). Additional research on the role of counterparty risk and haircuts would also be beneficial.

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

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Figure 1
Illustration of the Securities Lending Market for Government Bonds

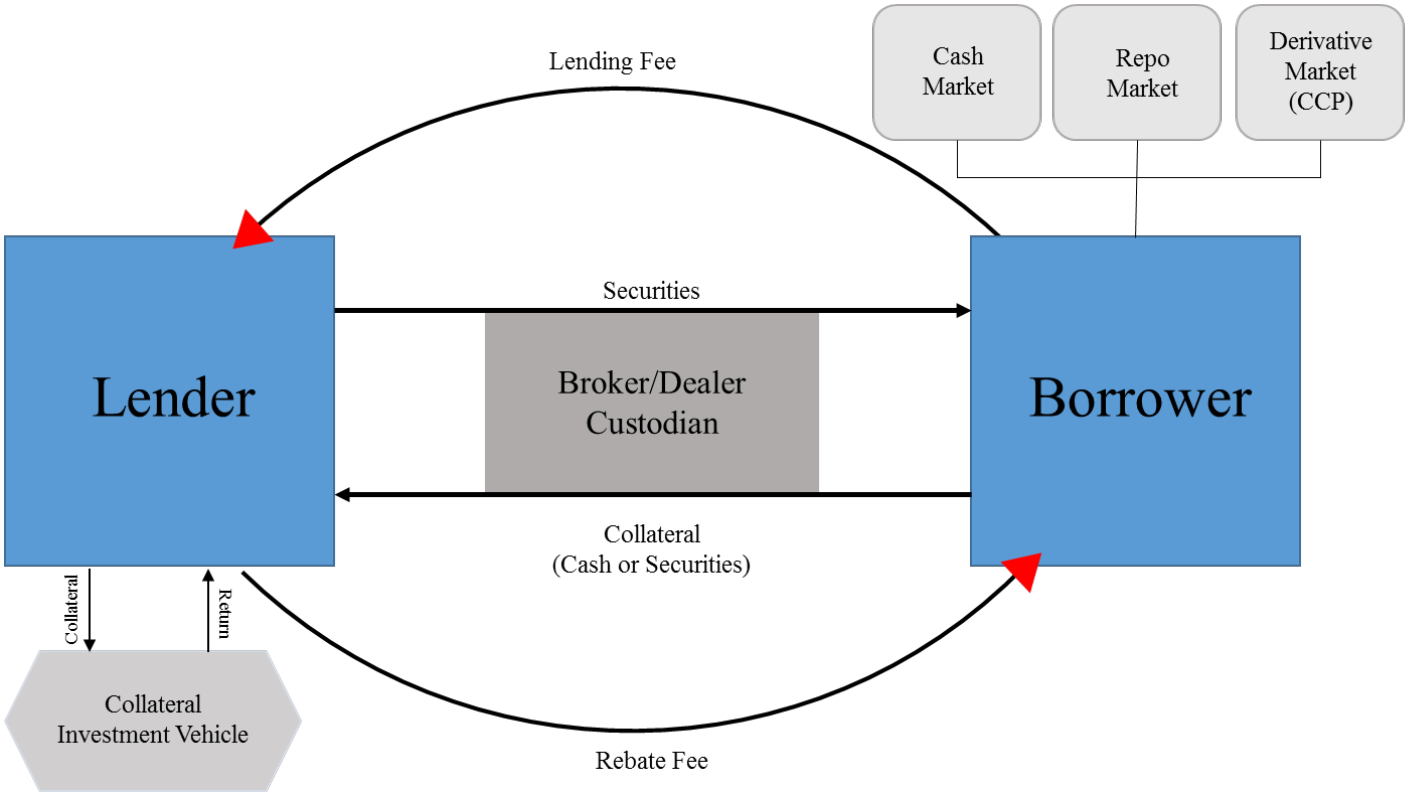

Figure 2
The Value on Loan of European Government Bonds

The graph shows the aggregate value on loan of government bonds issued by core and peripheral countries for the period July 2006 to December 2014. The core countries include Austria, Belgium, Finland, France, Germany, and the Netherlands. The peripheral countries include Greece, Ireland, Italy, Portugal, and Spain. The numbers are weekly average across daily observations in billion euros.

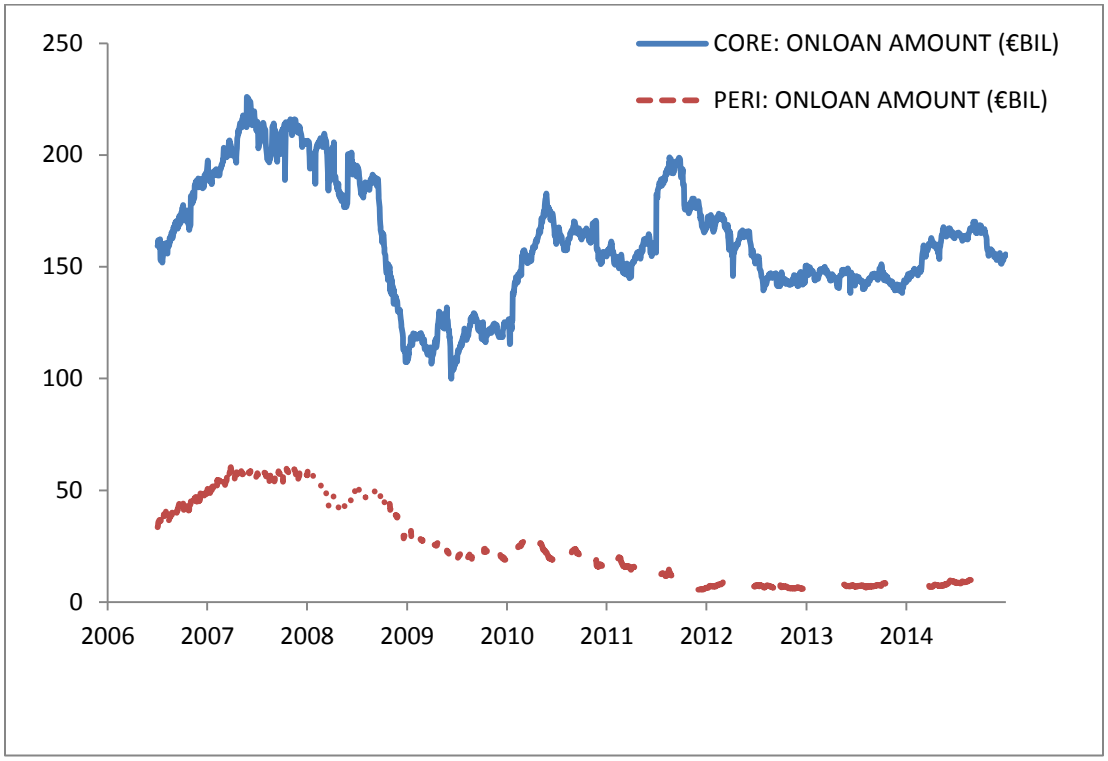

Figure 3
The Ratio of Noncash Collateral

In the securities lending market, borrowers can pledge cash or noncash collateral to borrow government bonds. Noncash collateral may include securities such as equity, corporate bonds, asset-backed or mortgage-backed securities. The figure plots the average ratio of noncash collateral to total collateral for core, peripheral countries, and US 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.

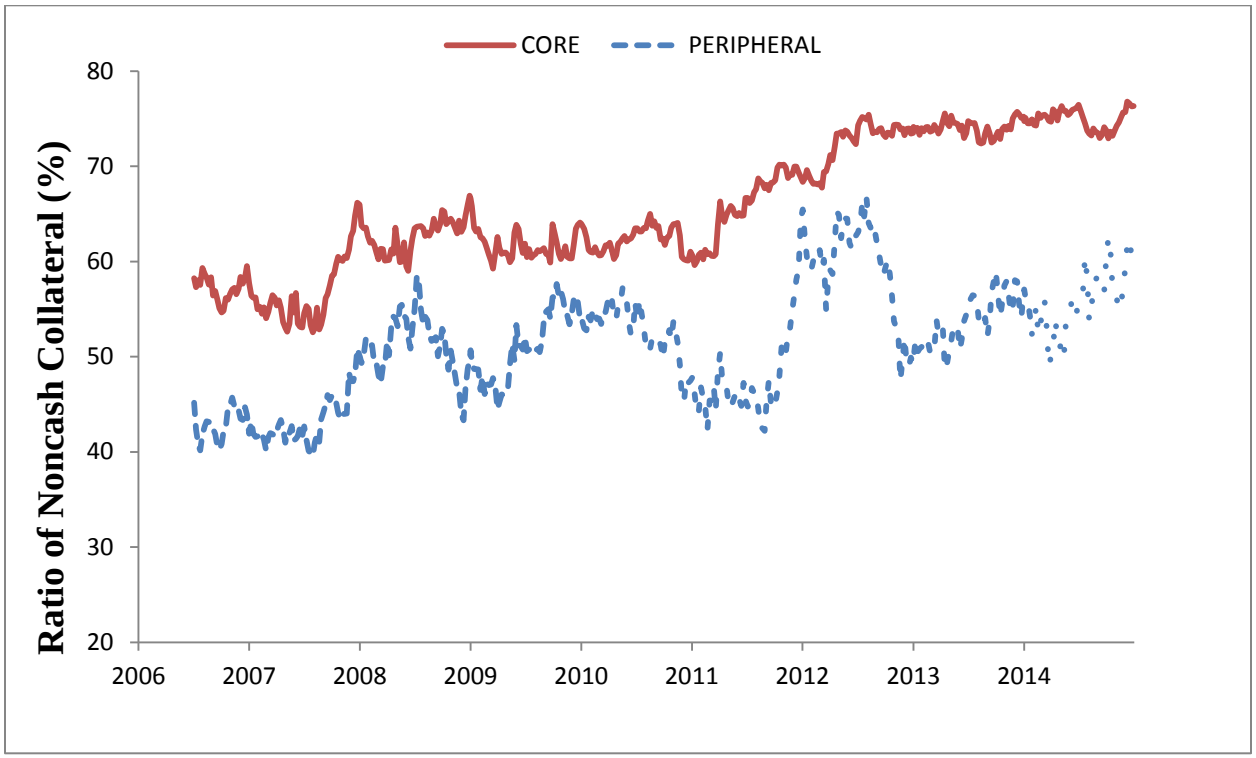

Table 1
Securities Lending Market in European Government Bonds

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 fee 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
Italy	607	141	64.36	16.56	14.16	10.74	19.96	12.11	9.02	4.61
Portugal	101	26	5.09	2.08	1.17	1.18	20.99	18.99	35.88	39.71
Spain	516	149	26.13	4.56	5.83	3.77	24.13	18.08	18.43	9.70

Table 2
Summary Statistics of European Government Bond Lending Market for Core and Peripheral Countries

The table presents summary statistics for the key variables in the securities lending market for core and peripheral countries. The key variables we consider are *FEE* which is average transaction-weighted annualized lending fee expressed in basis points (bps), *INVENTORY* which is the lendable inventory value as a percentage of bond issue size, *ONLOAN* which is value on loan as a percentage of bond issue size, and *NONCASH* which is the ratio of the value on loan using noncash as collateral to the total value on loan. For each variable, 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 the full sample, and in three subsample periods: Pre-U.S. Crisis: July 2006-June 2007, U.S. crisis: August 2008-June 2009, and the peak of European crisis: August 2011-June 2012.

	Full Sample Jul 2006-Dec 2014		Pre-U.S. Crisis Jul 2006-Jun 2007		U.S. Crisis Aug 2008-Jun 2009		Peak European Crisis Aug 2011-Jun 2012	
	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	22.78	1.39
PERIPHERAL	18.14	14.54	6.31	1.55	11.98	4.27	41.24	5.27
Panel B: *INVENTORY (%)*								
CORE	12.66	2.03	10.14	0.25	11.66	0.46	15.09	0.69
PERIPHERAL	7.40	0.60	8.01	0.29	7.18	0.45	6.88	0.51
Panel C: *ONLOAN (%)*								
CORE	4.21	1.25	6.13	0.51	3.69	0.64	3.68	0.20
PERIPHERAL	1.93	0.97	3.17	0.27	2.29	0.53	0.81	0.15
Panel D: *NONCASH (%)*								
CORE	68.50	6.70	56.12	1.73	62.95	1.79	70.31	2.30
PERIPHERAL	53.51	6.56	42.45	1.36	49.01	2.68	56.61	7.44

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

This table reports regression results of the relationship between the price and volume of government bond lending and market stress. The dependent variable is *FEE* in panel A, the transaction-weighted annualized lending fee, and *ONLOAN (%)*, the value on loan as a percentage of bond issue size, in panel B. Market stress is measured by the spread of three-month Euribor and OIS rates, *EURIBOR-OIS*. Control variables include the three-month *OIS* rate, and the return on the Euro Stoxx 50 index, *STOCK RETURN*. In column (4), we also control for bond characteristics consisting of bond issue size, bond time-to-maturity, floating rate dummy, loan tenure, and loan bid-ask spread. *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. Regressions use weekly values averaged from daily observations.

Panel A: Dependent Variable - *FEE*				
	(1)	(2)	(3)	(4)
EURIBOR-OIS×DCORE		11.120***	12.833***	11.426***
		[2.93]	[2.94]	[4.41]
EURIBOR-OIS	9.664**	-3.456	3.121	-3.056
	[4.26]	[-0.98]	[0.01]	[-1.46]
DCORE	-3.864***	-8.135***	-8.755***	-7.994***
	[-90.52]	[-5.62]	[-5.27]	[-7.26]
OIS	-3.139***		-3.149***	-2.984***
	[-3.42]		[-3.60]	[-3.99]
STOCK RETURN	-16.355		-19.102*	-13.150
	[-1.64]		[-1.70]	[-1.09]
Country Dummy	Y	Y	Y	Y
Cluster(Country)	Y	Y	Y	Y
Bond Characteristics	N	N	N	Y
Bond-Week Obs	362135	362135	362135	339605
Adj R-squared	0.0502	0.0361	0.0523	0.0897

	Panel B: Dependent Variable - *ONLOAN* (%)			
EURIBOR-OIS×DCORE		-0.630	-0.924*	-0.802***
		[-1.24]	[-1.87]	[-4.12]
EURIBOR-OIS	-0.427	0.855***	0.288**	-0.402***
	[-1.13]	[4.60]	[2.16]	[-2.65]
DCORE	2.423***	2.582***	2.779***	2.143***
	[298.50]	[12.83]	[14.80]	[26.31]
OIS	0.504***		0.510***	0.525***
	[6.39]		[6.57]	[8.69]
STOCK RETURN	1.434		1.535	3.922***
	[1.28]		[1.39]	[2.58]
Country Dummy	Y	Y	Y	Y
Cluster (Country)	Y	Y	Y	Y
Bond Characteristics	N	N	N	Y
Bond-Week Obs	407622	407622	407622	339605
Adj R-squared	0.0389	0.0283	0.0392	0.0956

Table 4
Supply and Demand Shifts: Core vs Peripheral

This table reports summary statistics for shifts in supply and demand for European government bonds before and during the European crisis. We place bonds into four categories: demand outward (*DOUT*), supply inward (*SIN*), supply outward (*SOUT*), and demand inward (*DIN*), based on the change of price-quantity pairs during the peak of the European crisis as compared to before the European crisis. Bonds in *DOUT* have seen both their loan fee and their loan amount rise over the designated horizon; bonds in *SIN* have seen their loan fee rise but loan amount fall; bonds in *SOUT* have seen their loan fee fall but their loan amount rise; bonds in *DIN* have seen both their loan fee and loan amount fall. According to Cohen, Diether, and Malloy (2007), if we observe an increase in both loan amount and loan fee, irrespective of all other shifts, we know that at least a demand shift out (increase) has occurred. Panel A calculates the change based on the subsample mean, and Panel B is based on the subsample median. For each shift category, we report the number of bonds in this category and the proportion of this particular type of shift.

Panel A: The difference of the mean value

	DOUT		***SIN***		***SOUT***		***DIN***	
	N	%	N	%	N	%	N	%
CORE	220	42.4%	172	33.1%	77	14.8%	50	9.6%
PERI	25	13.0%	128	66.7%	9	4.7%	30	15.6%

Panel B: The difference of the median value

	DOUT		***SIN***		***SOUT***		***DIN***	
	N	%	N	%	N	%	N	%
CORE	210	40.9%	172	33.5%	87	17.0%	44	8.6%
PERI	29	15.2%	129	67.5%	10	5.2%	23	12.0%

Table 5
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*, defined as the ratio of noncash collateral to the sum of cash and noncash collateral in government bond lending transactions expressed as a percentage. Market stress is measured by the spread of three-month Euribor and OIS, *EURIBOR-OIS*. Control variables include the three-month OIS rate, and European stock market return *STOCK RETURN* based on the Euro Stoxx 50 index, and bond characteristics such as bond issue size, bond time-to-maturity, floating rate dummy, loan tenure, and loan bid-ask spread. The sample period in columns (1) and (2) is July 2006 to June 2012, before the implementation of European central counterparty regulation. The sample period in columns (3) and (4) includes the period in the run-up to the European sovereign debt crisis, July 2009 to April 2010, and the peak of the European sovereign debt crisis. All variables take the weekly value averaged from daily observations.

Dependent Variable*: NONCASH* (%)				
	Sample period: July 2006 to June 2012		Sample period: July 2009 to June 2012	
	(1)	(2)	(3)	(4)
EURIBOR-OIS×DCORE	0.219	0.971	8.083***	8.049***
	[0.13]	[0.59]	[2.56]	[2.54]
EURIBOR-OIS	3.138*	3.153*	1.849	4.803
	[1.94]	[1.91]	[0.88]	[1.66]
CORE	9.956***	9.400***	2.889*	2.907*
	[11.43]	[10.11]	[1.82]	[1.83]
OIS		-1.483***		-8.473
		[-2.92]		[-1.66]
STOCK RETURN		-28.79***		-74.12***
		[-4.25]		[-4.29]
Country Dummy	Y	Y	Y	Y
Cluster(Country)	Y	Y	Y	Y
Bond Characteristics	Y	Y	Y	Y
Bond-Week Obs	241189	241189	81514	81514
Adj R-squared	0.1264	0.1303	0.0887	0.0901

Table 6
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 Dummy	Y	Y	Y	Y
Cluster (Bond)	Y	Y	Y	Y
Bond-Week Obs	26748	26748	26748	26748
Adj R-squared	0.3730	0.1347	0.1338	0.3142

Table 7
Borrowing in Lending Market and Financing in Repo Market during the Crisis

Results show the relation between borrowing government bonds 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 two subsamples: the U.S. crisis (August 2008-June 2009) in column (2), and the peak of the European sovereign debt crisis (August 2011-June 2012) in column (3). The full sample period is July 2006 to December 2014.

Dependent Variable: *FINANCING REPO RATIO*			
	Full sample	*DCRISIS* = U.S. crisis	*DCRISIS* = European crisis
	(1)	(2)	(3)
ONLOAN	-0.009***	-0.012***	-0.009**
	[-3.57]	[-5.10]	[-3.62]
ONLOAN×DCRISIS		0.017***	0.021*
		[4.35]	[1.95]
DCRISIS		0.086***	-0.207***
		[3.51]	[-6.91]
Week Dummy	Y	Y	Y
Cluster (Bond)	Y	Y	Y
Bond-Week Obs	26748	26748	26748
Adj R-squared	0.2280	0.2300	0.2283

Table 8
Government Bond Lending and ECB Intervention

This table examines the influence of ECB security purchases on government bond lending market. The dependent variable is *FEE*, the transaction-weighted average lending fee expressed in basis points (bps), in Panel A; and *ONLOAN* (%), the percentage of value on loan to bond outstanding, in Panel B. 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 program (SMP), and with a value of 0 if a bond is issued by core countries. SMP has two phases: Phase I (May 2010 - March 2011) targets the purchase of government bonds in Greece, Ireland, and Portugal; Phase II (August 2011 - March 2012) 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: Dependent Variable - *FEE*						
	SMP Phase I (May 2010 - March 2011)			SMP Phase II (August 2011 - March 2012)		
SMP×TARGET	-1.203***	-1.142***	-1.152***	-0.376**	-0.280*	-0.280*
	[-4.05]	[-3.87]	[-3.90]	[-2.16]	[-1.90]	[-1.90]
SMP	-0.091	-0.075	0.094	-0.127**	-0.161***	-0.139***
	[-0.90]	[-0.81]	[0.86]	[-2.45]	[-3.23]	[-2.67]
EURIBOR-OIS×TARGET		-37.595***	-37.362***		-15.547***	-15.544***
		[-4.98]	[-4.94]		[-2.84]	[-2.85]
EURIBOR-OIS		-7.314	-0.171		5.488***	5.416***
		[-1.62]	[-0.03]		[6.84]	[7.01]
TARGET	15.871***	26.758***	26.756***	5.188***	16.290***	16.289***
	[49.44]	[11.95]	[12.04]	[7.58]	[3.55]	[3.55]
OIS			3.519			-0.544
			[1.19]			[-0.26]
STOCK RETURN			-41.473***			12.249
			[-2.78]			[1.61]
Cluster (Country)	Y	Y	Y	Y	Y	Y
Country Dummy	Y	Y	Y	Y	Y	Y
Week Dummy	Y	Y	Y	Y	Y	Y
Bond-Week Obs	45922	45922	45922	32023	32023	32023
Adj R-squared	0.1187	0.1198	0.1208	0.0170	0.0199	0.0198

Panel B: Dependent Variable – *ONLOAN* (%)						
	SMP Phase I (May 2010 - March 2011)			SMP Phase II (August 2011 - March 2012)		
SMP×TARGET	0.047***	0.048***	0.048***	-0.011	-0.011	-0.011
	[3.03]	[2.91]	[2.91]	[-0.70]	[-0.87]	[-0.87]
SMP	-0.013	-0.013***	-0.016**	0.024***	-0.006	-0.001
	[-0.84]	[-2.89]	[-2.37]	[3.83]	[-1.39]	[-0.22]
EURIBOR-OIS×TARGET		-0.492	-0.493		-0.54	-0.539
		[-1.31]	[-1.31]		[-1.08]	[-1.08]
EURIBOR-OIS		-0.241	-0.020		0.042	0.265
		[-0.75]	[-0.04]		[0.24]	[1.14]
TARGET	-2.809***	-2.764***	-2.764***	-2.658***	-2.621***	-2.621***
	[-8.55]	[-27.26]	[-27.30]	[-5.94]	[-6.45]	[-6.45]
OIS			0.190			0.625
			[0.70]			[1.16]
STOCK RETURN			2.474			2.720***
			[1.54]			[5.88]
Cluster (Country)	Y	Y	Y	Y	Y	Y
Country Dummy	Y	Y	Y	Y	Y	Y
Week Dummy	Y	Y	Y	Y	Y	Y
Bond-Week Obs	57274	57274	57274	37006	37006	37006
Adj R-squared	0.0146	0.0274	0.0274	0.0193	0.0330	0.0330

Appendix

Table A.1
Government Debt Outstanding By Country and Year

Year	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	Total
2006	178.7	297.4	65.9	1194.4	1587.5	225.6	43.7	1588.1	257.6	115.0	392.2	5946.0
2007	183.0	300.0	63.4	1253.1	1597.0	239.9	47.1	1605.9	259.9	120.1	383.8	6053.2
2008	200.0	327.6	63.3	1358.4	1663.2	264.8	79.6	1671.1	348.1	128.2	439.8	6544.1
2009	228.2	347.3	75.5	1531.8	1782.0	301.1	104.7	1770.0	348.9	146.7	568.7	7204.6
2010	242.7	364.0	88.2	1632.7	2089.9	330.6	144.2	1851.5	372.6	173.1	649.3	7938.9
2011	253.7	388.0	95.5	1754.7	2116.8	356.3	189.7	1907.8	396.4	196.2	743.5	8398.6
2012	258.8	403.4	105.8	1869.7	2193.3	305.1	210.0	1989.8	428.6	212.5	890.7	8867.6
2013	260.9	413.0	112.8	1954.5	2177.8	320.5	215.3	2069.8	442.2	219.6	966.0	9152.6
2014	277.4	426.7	121.8	2040.5	2177.7	319.7	203.3	2136.2	452.1	225.8	1033.7	9414.9

Note: Central government consolidated gross debt (in billions of euro). Source: AMECO, European Commission

Table A.2
Summary Statistics of the Securities Lending Markets in European Government Bonds by Year

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 of euro)									
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Outstanding Value of Lendable Bonds	465	497	506	485	580	564	518	514	485
Outstanding Value of OnLoan Bonds	214	262	224	142	181	182	162	152	167
Percent of OnLoan Bonds to Lendable Bonds	0.46	0.53	0.44	0.29	0.31	0.32	0.31	0.30	0.35

Table A.3
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 *FEE*, the transaction-weighted annualized fee in bps. Market stress is measured by the spread of three-month Euribor and OIS rates, *EURIBOR-OIS*. *LOW (CDS)* is a dummy variable that equals 1 if the bond issue country has the CDS spread lower than the median in week t, and equals 0, otherwise. *LOW (TTM)* is a dummy variable that equals 1 if a bond's time-to-maturity is shorter 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 *STOCK RETURN* based on the Euro Stoxx 50 index, and bond characteristics including bond issue size, bond time-to-maturity, floating rate dummy, loan tenure, and loan bid-ask spread. The sample period is from July 2006 to December 2014. The estimations are based on weekly values averaged from daily observations.

	LOW (CDS)			***LOW (TTM)***		
	(1)	(2)	(3)	(4)	(5)	(6)
*EURIBOR-OIS*LOW (CDS)*	8.430***	8.205***	6.705***			
	[5.38]	[4.11]	[3.61]			
LOW (CDS)	-2.285	-0.756	0.637			
	[-1.28]	[-1.14]	[0.87]			
*EURIBOR-OIS*LOW (TTM)*				8.391***	8.563***	9.212***
				[4.72]	[4.63]	[5.51]
LOW (TTM)				-1.584	-1.741	-2.542***
				[-1.34]	[-1.40]	[-3.04]
EURIBOR-OIS	1.753	5.989***	2.549	1.520	5.634***	1.240
	[1.09]	[3.27]	[1.07]	[0.85]	[3.38]	[0.44]
OIS		-3.044***	-2.896***		-2.999***	-2.842***
		[-4.03]	[-4.15]		[-4.05]	[-4.17]
STOCK RETURN		-25.021*	-18.302		-22.074*	-13.502
		[-1.93]	[-1.59]		[-1.70]	[-1.12]
Country Dummy	Y	Y	Y	Y	Y	Y
Cluster(Country)	Y	Y	Y	Y	Y	Y
Bond Characteristics	N	N	Y	N	N	Y
Observation	339749	339749	339465	339749	339749	339465
Adj R-squared	0.0297	0.0458	0.0899	0.0320	0.0802	0.0903

Table A.4
Robustness Results for Alternative Measure of *ONLOAN*

This table presents robustness test results of using *Log(ONLOAN)* as the dependent variable in Table 3 and 8. In the original tables, we use *ONLOAN* (%) which is the percentage of value on loan to bond outstanding. In this table, we use *Log(ONLOAN*) as the dependent variable, which is the logarithm of value on loan.

Panel A: Government Bond Lending in Market Stress: Core vs Peripheral (Table 3)				
EURIBOR-OIS×DCORE		-0.292*	-0.496**	-0.359***
		[-1.78]	[-2.39]	[-5.02]
EURIBOR-OIS	-0.305***	0.475***	0.078	-0.006
	[-3.01]	[3.95]	[0.42]	[-0.10]
DCORE	0.106***	0.161**	0.297***	1.128***
	[17.15]	[2.52]	[3.90]	[24.62]
OIS	0.351***		0.354***	0.233***
	[6.97]		[7.09]	[4.38]
STOCK RETURN	-1.125***		-1.069***	-2.138***
	[-2.90]		[-2.85]	[-5.74]
Country Dummy	Y	Y	Y	Y
Cluster (Country)	Y	Y	Y	Y
Bond Characteristics	N	N	N	Y
Bond-Week Obs	407622	407622	407622	339605
Adj R-squared	0.0389	0.0321	0.0692	0.0544

Panel B: Government Bond Lending and ECB Intervention (Table 9)

	SMP Phase I (May 2010 - March 2011)			SMP Phase II (August 2011 - March 2012)		
SMP×TARGET	0.049***	0.050***	0.050***	0.002	0.012***	0.012***
	[6.33]	[7.17]	[7.18]	[0.78]	[4.88]	[4.88]
SMP	0.012**	-0.005	-0.005	0.013***	0.000	0.000
	[2.35]	[-1.18]	[-1.19]	[8.36]	[-0.10]	[0.95]
EURIBOR-OIS×TARGET		0.934**	0.934**		-1.337***	-1.337***
		[2.37]	[2.38]		[-3.76]	[-3.76]
EURIBOR-OIS	-0.440*	-0.586***	-0.586***	-0.427	0.366	0.366
	[-1.73]	[-5.14]	[-5.15]	[-1.43]	[1.43]	[1.43]
TARGET		0.147	-0.852***		-0.043	0.121
		[0.88]	[-5.25]		[-0.45]	[1.19]
OIS			-0.861***			0.454***
			[-8.08]			[3.36]
STOCK RETURN			-1.769*			0.271
			[-1.81]			[0.76]
Cluster (Country)	Y	Y	Y	Y	Y	Y
Country Dummy	Y	Y	Y	Y	Y	Y
Week Dummy	Y	Y	Y	Y	Y	Y
Bond-Week Obs	57274	57274	57274	37006	37006	37006
Adj R-squared	0.0020	0.0291	0.0291	0.0048	0.0196	0.0196