The Pricing Implications of Oligopolistic Securities Lending Market:

A Beneficial Owner Perspective

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Abstract

In the last decade, central bank interventions, flights to safety, and the shift in derivatives clearing resulted in exceptionally high demand for high quality liquid assets (HQLA), such as German treasuries, not only in the open market but also in the securities lending market. Despite the high demand and the extremely high utilization rates for these assets, the realizable securities lending income remains economically negligible. In empirically testing Duffie, Gârleanu and Pedersen (2005)'s theory, we find evidence of pricing inefficiencies in the non-transparent, oligopolistic securities lending market for German treasuries from 2006 to 2015. We show that the less connected market participants' interests are potentially underrepresented, which is evident in the longer maturity segment of the market, where lenders are more likely to be conservative passive investors, such as pension funds and insurance firms. The low price elasticity in this segment hinders these beneficial owners to fully capitalize on the additional income from securities lending, giving rise to important negative welfare implications.

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1. Introduction

After the global financial crisis, institutions have gradually moved from the unsecured interbank lending market to the securities lending and repo markets to cover their funding needs. Consequently, by 2016, the fixed income segment of the lending market has become a five-trillion dollar business (ISLA, 2016). The fixed income segment, similarly to the equity segment, operates as a non-transparent oligopolistic market, with about a dozen key agents connecting the supply and demand sides.[1] This setting likely gives rise to market inefficiencies where less connected borrowers are known to receive inferior borrowing terms, as suggested by Duffie et al. (2002; 2005) and recently documented by Chague et al. (2016). The extant studies tend to focus on the borrower side in the equity segment because the borrowers, typically short sellers, play an economically important role in the price discovery process in the stock market (Boehmer and Wu, 2013).

The same market inefficiencies are expected to be also present on the lender side. Prime brokers or agents exploiting their information advantage and market power on the lender's side is not only in line with Duffie et al. (2002; 2005), but it is also confirmed by recent U.S. lawsuits filed by three smaller U.S. pension funds (Reuters, 2017). The welfare implications of the market inefficiencies from the lenders' perspective are potentially more acute in the fixed income segment, where lenders are primarily pension funds and insurance firms, financial institutions responsible for the wealth preservation of citizens worldwide. These institutions are the likely

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[1] For example, Duffie, Gârleanu, and Pedersen (2002; 2005) and Kolasinski, Reed, and Ringgenberg (2013) examine how search costs and the oligopolistic OTC market structure generate inefficiencies in the securities lending market. Saffi and Sigurdsson (2011) show internationally that a developed stock lending market is necessary to support short selling, while Bris, Goetzman, and Zhu (2007) and Boehmer and Wu (2013) show that these short-sale trades are important for pricing efficiency.

beneficial owners because they are mandated to hold a large sovereign debt portfolio, while their risk taking is limited by regulation. Hence, in the low interest environment, the search for yield makes these institutions increasingly reliant on additional income from securities lending.

In reaction to the 2008 global financial crisis and the European debt crisis, central banks and various government agencies have become active in financial markets, especially as they realized that conventional monetary policy tools cannot work at the zero lower bound. Among others, the Bank of Japan (BoJ), the Bank of England (BoE), the U.S. Federal Reserve (Fed), and the European Central Bank (ECB) started actively purchasing a wide range of assets as part of their quantitative easing (QE) efforts. These asset purchases, aiming at decreasing funding costs, drove up the price of sovereign debt assets, especially at the lower end of the sovereign risk spectrum, where demand was exacerbated by flights to safety and quality. The artificially depressed funding costs and the market exuberance emanating from the 4^{th} industrial revolution, the emergence of the Internet of Things (IoT) and the sharing economy, resulted in unprecedented stock market run-ups globally, benefiting corporations and shareholders alike.

On the other hand, conservative investors, such as pension funds and insurers did miss out on the gains from the favourable market conditions because the regulatory restrictions on their asset holdings limited their equity investments (e.g., MiFID II; Directive 2003/41/EC, Directive (EU) 2016/2341; IORP directive). The situation of pension funds was further aggravated by the extremely low, near zero yields on the regulatory mandated asset holdings, such as on safe sovereign bonds, especially after 2010. Thus, the low interest rates likely resulted in an adverse wealth redistribution, in which the average citizen with low stock market participation primarily relying on his/her pension income bears the costs of the economic stimulus. This situation should call for regulatory concerns globally, because unlike the impact of the Troubled Asset Relief

Program (TARP), the economic consequence of "bailing out" the European economy has likely had put a long term burden on pensioners.

In this paper, to our knowledge, we are the first to explicitly examine the welfare implications of the European zero lower bound interest rate policy in conjunction with the functioning of the securities lending market form July 2006 to June 2015. Government interventions and regulatory changes resulted in high demand for high quality liquid assets (HQLA), which unintentionally forced long term conservative investors, such as pension funds and insurance firms to purchase safe government bonds in the secondary market at inflated prices. Theoretically, in a well-functioning, transparent and efficient lending market, the demand pressure for securities lending income could generate significant alternative income for beneficial owners to achieve capital preservation and recoup the loss in yields. However, in practice, the well-documented market inefficiencies, such as the inelasticity of lending fees (Kolasinski et al. 2013) and the low bargaining power of most pension funds, are likely to impede the realization of significant revenues from securities lending.

While Aggarwal et al. (2016) already examine the link between ECB policies and securities lending activities in general, their focus is on the supply and demand effects, and the connection between the securities lending and repo markets. They argue that securities lending has important additional liquidity provisional role, thereby increasing the efficiency of monetary policy transmission. We are more concerned about the welfare implications that appear at the level of the average citizen. For motivation, we first document the differential income generating potential of the stock market and treasury investments, by comparing the average nominal yield on German sovereign bonds with returns on major stock indices, suggesting an adverse welfare effect of QE for pensioners. We also show that the yield on German sovereign bonds declined and that this effect was magnified by the surge in the demand for HQLA due to the increase in need for high quality collateral with the move of derivative trading to central counterparty (CCP) and the increase in reserves requirements for banks.

In our main empirical analysis, we focus on examining the inefficiencies in the securities lending market from the beneficial owners' perspective in the context of German Treasury bonds and notes. Specifically, we focus on the long maturity segment, where the welfare implications are evident because the beneficial owners are likely to be financial institutions responsible for the wealth preservations of the average citizen. We find evidence of market inefficiency by documenting sluggish reaction of lending fees to demand pressure, despite exceptionally high utilization rates in this segment. Furthermore, we also show high relative price spread on the lending contracts, especially when fees are on average high, suggesting that some lenders, potentially those without active lending desk such as the pension funds and insurance firms, are unable to extract the "real" rents because prime brokers capitalize on their information advantage and market power.

We also provide insights from the primary market and show that as the excess demand for the increasingly scarce HQLA drives up prices of Germany bonds at the primary auctions, pension funds, who are unable to participate directly, end up "overpaying" for assets. We document that on average, the realizable lending income is negligible for the average lender, with limited market insight and bargaining power. We conjecture that the primary dealers, acting as lending agents, have "special interest" for a specific large issue with expected high demand in the securities lending market, and provide empirical evidence that this interest is priced in in excess of the expected lending income at the primary auctions. This additional price pressure at the primary auction is likely to have material adverse effect for pension funds and insurance firms, if they are not fully compensated in securities lending because the prime brokers lend out assets to preferred clients at low rates or because the brokers withheld a large fraction of the income, as implied by smaller U.S. pension funds (Reuters, 2017). We suggest that our findings shed some light on the funding problems in the pension sector and imply a nontrivial wealth reallocation after 2010 in the near zero interest rate environment, when securities lending income could have become a necessary means to complement the depressed yields on HQLAs.

In summary, we provide new insights into the inefficiencies of the securities lending market for fixed income assets. We suggest that passive lenders, such as pension funds and insurance firms, need to become more active by either managing their own lending desk or by lobbying for more regulatory oversight and greater transparency to improve their bargaining power. Alternatively, regulators may consider extending the pool of HQLAs thereby reducing the price pressure on these assets, or establish channels through which the funds get access to sovereign bonds directly from the issuer. From a welfare perspective, we suggest that it is inefficient to restrict pension funds to purchase treasuries in the secondary market through dealers because this exposes them to significant direct and indirect costs, which in the end, are borne by the pensioners.

2. Literature Review: The Role of Treasuries for Wealth Preservation

2.1. The Impact of Expansionary Monetary Policy: A Pension Fund's Perspective

In the aftermath of the global financial and perhaps more importantly after the European debt crises, the national central banks (NCBs) and the ECB have become increasingly concerned with economic growth. As a reaction, they have implemented a full arsenal of well-known expansionary policy tools, all of them at no avail at the short term. Despite the intention of central banks to inject the money supply through banks to the end users, banks were reluctant to lend and were piling up cash and liquidity reserves to meet stricter capital reserve and the new liquidity requirements (in response to central banks' stress testing and Basel III). The collapse of Lehman Brothers also increased counterparty risk, and thus central clearing was pushed forth for most previously OTC transactions, which required now posting initial margin on previously bilateral swaps and CDS contracts (2010 Dodd Frank Act and the 2010 European Market Infrastructure Regulation, EMIR). These market forces resulted in a growth in demand for high quality collateral, HQLAs, reaching $4 trillion by 2020 (Oliver Wyman, BCBS / IOSCO QIS, 2013).[2]

Eventually, the high quality collateral shortage in Europe has become more acute with the large scale asset purchase programs of the ECB and NCBs, which included the purchase of €1.3 trillion worth of government bonds by the end of 2016, with over €300 billion in German government bonds (Aggarwal, et al. 2016; ECB, 2017a; ECB 2017b; FT, 2017). The shortage of HQLA gave rise to unprecedented negative interest rates on the safest Eurozone sovereign bonds, the German Bunds. This may have caused (rightfully so) an alarm for long term investors, whose portfolios largely consist of safe assets in compliance with regulatory requirements. Effectively, after 2010, even yields of the longest term nominal German bonds, were barely able to keep up with the average inflation.

Financial institutions, such as insurance firms, pension funds and trusts, are the primary investors in treasuries. Pension funds and insurers play a key role in Europe, as the majority of retirees to a large extent rely on public or occupational pension income. Because the European

2 This potential shortfall of high quality collateral has been noted not only by industry participants and regulators (Singh, 2013) but also by academics (Aggarwal, Bai, and Laeven, 2016).

pension and insurance sectors are so economically essential, they are heavily regulated, and funds are required to hold a significant fraction of their portfolios in low-risk, fixed-income assets. Although the requirement is based on good intentions to evade significant value deterioration due to market downturns, the historically low interest rates likely attribute to the serious concerns due to the European pension industry's aggregate net worth becoming negative for the first time in 2016 (ECB, 2016).[3]

In Germany, besides government pension, various types of corporate pension schemes and defined benefit schemes operate to facilitate long term savings and retirement.[4] Nevertheless, most pension funds and pension schemes generally comply with the Insurance Supervision Act (VAG) and the new Solvency II Directive of the European Commission.[5] The VAG requires funds not to invest more than 35% of their portfolios in risky assets; while the remaining part must be invested in a mix of fixed income assets and real estate. In addition, the European Solvency II Directive promotes better risk management practices, which calls for greater exposure to long term treasuries (IPE, 2016), a practice strictly followed in the industry, as the 2015 Mercer survey finds that non-corporate German pension funds allocate 66% of their bond portfolio in domestic government bonds.[6] Although pension funds have voiced concerns about

3 In extreme cases, for example, ERAFP (Retraite additionelle de la Fonction publique), which manages the French public service additional pension scheme, had to invest 75% of assets into bonds until 2015, when the limit was lowered. In 2016, more than 50% of the fund's assets were still in sovereign bonds (Global Pension Assets Study, 2016). The CEO of ERAFP, France's second largest pension fund, expressed concerns about the suboptimal portfolio allocation of the €26 billion portfolio of the fund (Bloomberg, 2016).

4 For example, most German pension funds place a 30% limit on stocks, a 25% limit on property, and a 5% limit on non-EU bonds, among others. (For clarification, there are five major pension fund types in Germany and the so-called pension funds, the newest corporate structure type, is currently the least regulated).

5 Versicherungsaufsichtsgesetz (VAG).

6 Corporate pension funds had 46% of their total assets in bonds while other pension funds not using CTAs (non-CTA funds) had 52% of their assets in bonds.

the low yields on these conservative assets, no major asset re-allocations have occurred or are expected in the near future.

2.2. Securities Lending Market Dynamics and the Role of Lenders

Due to the increased liquidity provisional and liquidity transformational role, the repo and securities lending markets warrant academic and regulatory attention (Agarwal et al. 2016; Arnesen, 2017). Globally, securities lending markets are primarily OTC, where lenders and borrowers are connected through agents and/or prime brokers, which results in a high degree of opaqueness. Although there have been efforts to establish a centralized and more transparent securities lending market, such as SecFinex, we have yet to see this becoming the norm.

In the current oligopolistic market setting, about a dozen prime brokers/agent lenders control their own significant market share. In fact, this gives rise to high search costs, moreover, the less connected borrowers or borrowers with limited bargaining power are often unable to arrange transactions to execute their trades (Duffie et al. 2002; 2005; Kolasinski et al. 2013). These inefficiencies are well document in the equity segment of the securities lending market because they cause binding short-sale constraints, which negatively affect market quality and market efficiency (e.g., Boehmer and Wu, 2013; Chague et al. 2017; Saffi and Sigurdsson, 2011). Thus far, these inefficiencies have not attracted much attention in the fixed income segment.

Nonetheless, in recent years the fixed income segment of the securities lending market became increasingly important for collateral swaps and the facilitation of CDS trades. Natural lenders on the market are pension funds, trusts, and insurance firms, who hold a large portfolio of assets passively, both in the equity and fixed income segments. The IHS Markit data show that these institutions combined account for about 75% of the lending investors. As such, securities lending as a nonconventional source of income, where the received collateral is passed through to invest in potentially more profitable structured financing vehicles, is likely to become critical in the persistently low interest rate environment (State Street, 2016).[7] This income source is especially valuable in the Eurozone, where most pension funds hold a large portfolio of sovereign debt, while nominal yields have been hovering around zero, and real yields below zero since 2011.

3. Data, Summary Statistics and Hypothesis Development

3.1 Data and Variable Constructions

Our dataset contains daily bond yields of Germany treasuries from July 3, 2006 to June 1, 2015. Daily closing mid-prices of German government bonds, obtained from Bloomberg, are used to calculate yield-to-maturity, following market conventions. The Germany Federal bonds (Bunds), five-year Federal notes (Bobls), and Federal treasury notes (Schätze) are listed on the German stock exchanges, which provide transparency about daily prices and yields (Deutsche Bundesbank, Eurosystem 2016).[8] We complement the daily yield data with bond characteristics, such as issue and maturity dates and information on coupon and issuance amounts from Bloomberg. We also collect data from the German Finance Agency (Finanzagentur GmbH) on all primary auctions during our sample period, including information on issuance amounts, initial

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[7] This pass-through investment alternative using off balance sheet investment through securities lending should be a concern for regulators, especially if the primary motive with the large bond holdings was to reduce the risk taking of pension funds. For example, one of the largest public pension funds in the world, the California Public Employee's Retirement system (CalPERS) was a pioneer with its active securities lending program, allowing the fund to realize almost $1.2 billion from securities lending over the eight years until June 2008, "enhanc[ing] returns by more than 30 basis points per annum" (Amery, 2008). However, the fund incurred about $634 million loss from securities lending after the Lehman bankruptcy because of ill advised collateral reinvestment program (CalPERS, 2009).

[8] Despite excluding government bills due to differences in market conventions and microstructure, our bond sample covers 70% flow and 90% stock of the German sovereign debt.

average and lowest prices, average yields and bid-to-cover ratios. To adjust for market liquidity and demand for a security, we also create an on-the-run dummy, capturing the liquidity premium in secondary market yields, as in Krishnamurthy (2002) and Jordan and Jordan (1997).

Using International Securities Identification Numbers (ISIN), we match bond yield information from Bloomberg, with bond characteristics from Bloomberg and Finanzagentur (for primary market) data, and with securities lending market data from IHS Markit. In the merged dataset, we have information about the total supply value and total borrowing value in USD. While the equity focused securities lending studies use relative measures, scaling with the total shares outstanding, we are forced to rely on aggregate nominal values because the total outstanding bond value or volume is unavailable. At any point in time, in the sovereign bond market it is difficult to measure the exact available total quantity in the secondary market because of ongoing central bank interventions. In the empirical analysis, we use the natural logarithm of the total supply value and demand value in millions of EUR (*LogSupply* and *LogDemand*), converted from the USD values provided by IHS Markit using the daily official exchange rates from the Statistical Warehouse of the ECB.

In addition to demand and supply variables, we also use the utilization rate (*Utilization*), which is the percentage of the total supply that is currently lent out. The other key measures are related to the lending income. We use the average lending fee, the annualized value-weighted average lending fee (*Allfees*) that is based on all outstanding contracts measures in basis points. Since the variable is highly skewed (which is well document in the literature, e.g. Duong et al., 2018), in the empirical analysis we use the natural logarithm of the value-fees (*LogFees*). Last, we also use the feespread (*Feespread*) measure, which is the difference between the highest and lowest fee in basis points on all outstanding contracts on a given day.

3.2 Summary Statistics

Table 1 presents the summary statistics of the key variables based on our sample of German nominal bonds for the period of July 2006 to June 2015. Table 1 shows that in our sample the average bond has an issue size of EUR 17.5 billion, it is issued about 5.5 years ago (*Age*) and has 7.8 years remaining until maturity (*TTM*). The average coupon rate is 3.57%, while yield-to-maturity is 1.99%. On average, 5.1% of the outstanding bonds are on-the-run. Considering the securities lending market activity measures, during our sample period the average total supply is about €3.7 billion (*Suppleurval*) per issue with average total demand of 2.3 billion (*Demandeurval*). The average lending fee (*Allfees*) is 10.8 bps with average spread (*Feespread*) of 3.83 bps. The average utilization rate (*Utilization*) is 51.6%. The latter high utilization rate, striking in comparison with the equity market, signals the importance of the securities lending activity for fixed income securities, at least in the HQLA segment

[Table 1 about here]

In the lower section of Table 1, we provide summary statistics for bonds with 10 years or longer maturity. These longer term assets are more likely to be held by pension funds because these are suitable for minimizing the maturity gap of assets and liabilities (risk management), and their compensation for duration risk makes their coupon and (often even) price higher, which is also important for income generation.[9] About 1/4 of our sample is in the longer maturity segment, with an average coupon rate of 5% and TTM about 21.5 years. Interestingly, the securities lending market variables are comparable: the average fee is about 11.6 bps, while the supply value is somewhat larger, about €4.4 billion in comparison with the €3.7 billion in the full

[9] While we do not report all summary statistics for all maturity buckets in the main text, additional subsample statistics are available upon request.

sample, the demand value is slightly lower, about €1.6 billion in comparison with €2.3 billion in the full sample.

In addition to Table 1, we also provide more dynamic, time series insights about sample in Figure 1. Figure 1 depicts the moving monthly averages of the key securities lending variables. The upper panel depicts the average of value-weighted fees and the utilization rates over time. The average fee pattern shows significant variation over time, with a notable increase after the Lehman bankruptcy in 2008, and a peak at around 40 bps at the height of the European debt crisis. Specifically, the average fee rose substantially in the fall of 2011, spiking at 25 bps in November, just before the ECB implemented the largest ever infusion of credit into the European banking system, providing €489 billion in loans to 523 banks (Reuters, 2011).

[Figure 1 about here]

3.3 Hypothesis Development

While regulators and lobbyist are optimistic about the effect of the QE and the near zero interest environment, the welfare implications are far from clear. On the one hand, investors, who invested directly in the European or U.S. stock markets could have almost doubled their investment by trading on major US index (e.g., S&P500 trackers) or trading on the German Stock Exchange index (e.g., DAXtrackers) between January 2010 to July 2015 (see Figure 2 for reference).

[Figure 2 about here]

On the other hand, investors of fixed income securities by and large missed out on this market run-up. During the same 2010-2015 period, the annualized return on the safe long term sovereign bond, such as long-term German Treasuries, was only about 2% on average. The majority of investors of these long-term safe assets are regulated government and public pension funds and insurance firms, who are responsible for supporting the average old age citizen in most European countries. Consequently, the welfare effects of the low interest environment and HQLA-dominated pension and insurance portfolios cannot be overlooked.

In this study, we are concerned with the welfare implication of the prolonged expansionary monetary policy in conjunction with securities lending market activity. First, we depict the average yields on the safest Eurozone treasuries, on German nominal sovereign bonds, in comparison with stock market returns and inflation to motivate our work. Then we examine two empirical hypotheses related to securities lending market inefficiencies, which inhibit the complementary income generating role of securities lending for pension funds.[10]

In our first hypothesis, we suggest that the information dissemination to the securities lending market may be inefficient. Specifically, we conjecture that in a transparent securities lending market, the prices (lending fees) dynamically capture demand and supply. With the rising demand for HQLA, the demand for the European benchmark treasury (German sovereign bonds) exploded, which should be reflected in the securities lending fees if the market is efficient. However, given the anecdotal and empirical evidence of market inefficiencies from the equity lending literature (Kolasinski et al., 2013), we expect that the oligopolistic and non-transparent features of the lending market may also distort the pricing dynamics in the Treasury segment.

Potentially, the price elasticity is even more subdued in the fixed income segment for two reasons. First, following the Euro crisis, the ECB and the national central banks actively intervened in the securities lending market and have become a new type of lender of last resort. Second, the beneficial owners (lenders) are more likely to be passive long term investors, such as

[10] For simplicity of calculations and to facilitate ease of interpretation of our yield analysis, we exclude inflation indexed assets from our analysis.

pension funds and insurance firms, institutions that generally do not manage active lending desks and might be unaware of the demand and supply forces in the securities lending market. This makes them vulnerable to be "exploited" by prime brokers, who underrepresent their interest by giving them a smaller cut from the lending fee. Thus, we formulate two hypotheses to test the pricing efficiency of the securities lending market for HQLA, using the German government bond lending market as a laboratory in a period that includes both the onset and the recovery from the global financial and European debt crises.

$H1_0$ (null): In a well-functioning securities lending market with rational expectations, lending fees should instantaneously incorporate expected and realized demand pressures.[11]

$H1_A$ (alternative): In an inefficient securities lending market, fees react to changes in demand with delay; and not all lenders are equally compensated.

We examine the market reaction to both realized and expected demand and supply changes. Unlike the extant empirical studies examining the efficiency of the equity securities lending market, which focus only on the fee elasticity in conjunction with endogenous demand and supply changes, we are also able to consider exogenous demand and supply effects in addition to the endogenous changes. In efficient markets, securities lending should not only capture the ex post demand pressure but also incorporate the expected demand/supply pressures.

More importantly, unlike equity securities lending market studies, we also attempt to address lender heterogeneity. We examine the primary hypothesis not only in the full sample, but in the subsample of long maturity assets, where pension funds and insurance firms are expected to be

[11] The hypothesis is motivated by Diamond and Verrecchia (1987)'s rational expectation model, where in the presence of lack of transparency because of short sale constraints, rational traders should price in also the unobservable demand. Additionally, we rely on Duffie et al (2005)'s work that shows that in a nontransparent securities lending market, pricing is discriminatory.

the beneficial owners; and thus, the ultimate lenders. If prime brokers and dealers withhold information or exercise their market power, these less connected lenders may be less effective to capitalize on demand pressures, as suggested by Duffie et al. (2002; 2005) and Chague et al. (2017). In addition, in this subsample, the welfare implications are more pronounced and should attract regulatory attention.

In our second hypothesis, we are concerned with the monetary implication of securities lending in conjunction with frictions in the primary market. According to Duffie et al. (2002), secondary market prices should incorporate the expected lending income, which investors should treat as an alternative dividend stream. However, in our setting the pricing of future lending income is less trivial because of specific microstructure characteristics of the treasury market. First, government bonds are auctioned to a small group of primary dealers, many of whom are prime brokers and also active agents in securities lending. These banks can inherently be “interested” in bidding for HQLAs to fulfil capital reserve requirements or because they know these assets are in shortage in the secondary market and they can be important i) in maintaining banking relationships with key asset management firms to facilitate collateral swaps, or ii) providing these HQLA assets for borrowing to other key clients.

The conflict of interest arises in selling HQLAs to pension funds because the primary dealer banks know that if they sell the HQLA assets to pension funds or insurance firms, they can act as their lending agents and keep the assets available. Subsequently, as a lending agent they can make the HQLA assets available potentially at low costs to themselves or to their preferred customers given the lack of transparency in the market. These forces may inflate bond prices for pension funds and insurers in the secondary market, who in compliance with regulatory requirements must buy these assets despite their disadvantaged position in the securities lending market. Thus, we formulate the following null and alternative hypotheses:

H2 (null): The interest of primary dealers that emanates from the future securities lending demand is fully priced in at the initial bond auction in the form of expected future lending income.

H2 (alternative): The additional interest of primary dealers that emanates from the future securities lending demand is priced in in access of the expected future lending income.

If the beneficial owners are not fully compensated, the loss can be exacerbated in the low interest environment resulting in irreversible negative welfare consequences.

4. Empirical Analysis

First in Section 4.1., we provide insights into the overall time trend in the German treasury yields during our sample period from 2006 to 2015, and study the influence of securities lending market demand on secondary market prices, in line with Duffie et al. (2005). In Section 4.2, we examine Hypothesis 1, documenting the price dynamics and price dispersion in the German nominal Treasury segment of the global securities lending market. Last, in Section 4.3., we test our Hypothesis 2, whether the primary auction demand effectively captures the expected realizable lending income.

4.1 Panel Regression Analysis of Daily German Treasury Yields in the Secondary Market

In the this section, we document the downward trend in German sovereign bond yields after 2010, an artefact of extensive large scale purchase programs and the QE, using secondary market yield information from Bloomberg. In addition, we are interested in the pricing implications of the securities lending market. If the income from securities lending is material, the expected lending fees should be captured in secondary market prices (or yields), as suggested by Duffie et al. (2002). However if market demand is very low, or lenders have limited bargaining power or representation by the agent lenders, the expected lending income may be trivial and would not influence prices (yields).

[Table 2 about here]

The results in Table 2 Panel A show that on average, higher utilization rates in the securities lending market are associated with lower yields, suggesting that investors are willing to pay higher secondary market prices for securities with higher expected lending income implied by the higher utilization rate.[12] We find similar results in Models 4 and 5, where we focus on securities lending demand and supply measures. We find that the higher the lending demand for a given security, the lower yields (higher prices) are.

In Table 2 Panel B, we repeat the analysis from Panel A, including an additional dummy variable (*Longmat*) that takes on the value of one for bonds with more than 10 years to maturity. We also include this dummy variable in interaction with the main securities lending variables. In Model 5, we find that utilization rates have pronounced effect for long maturity bonds in addition to fees. The significant negative coefficient on the *Uti*Longmat* variable implies that the secondary market yields are significantly lower for higher expected lending income, as suggested by higher utilization rate, in access of the expected lending income implied by the average lending fees. These results suggest that perhaps market participants are over enthusiastic about

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[12] In Appendix D, the complete Tables are shown with year fixed effects. The significant negative coefficients on the later year dummies indicate that the secondary market yields substantially declined over time. Specifically, all else equal, the market yield is 1% lower after 2010.

the potential income from lending, especially given the high utilization rates, in access of 50% in the HQLA segment.

4.2. Examining Pricing Dynamics in the Treasury segment of the Securities Lending Market

To test our first hypothesis, in Table 3 we examine lending fee dynamics in the panel setting. Lending fees effectively proxy for the lending market liquidity of a specific bond, where the fees are established as the intersection of demand and supply. Higher fees imply that the owner of the security can earn significant additional income, which is why beneficial owners (prospective lenders) are more likely to accept holding assets with lower yields (Duffie, 1996). In Table 3, we find significant positive coefficients on the demand change variables $DemIncrease_t$, where the increase in demand is defined as a dummy variable that takes the value of one, when $LogDemand_t$—$LogDemand_{t-1}$>2%, or the increase is from the top 25% of the demand increase distribution. More importantly, we find that the fees react to the increase in demand but with some delay, thereby providing support for our alternative hypothesis ($H1_A$) that the securities lending market for HQLAs is inefficient. Last, in Models 4-6, we include the long maturity dummy (*Longmat*) and its interactions with the alternative $DemIncrease_t$ measures. We find that the pricing in of demand changes in the longer end of the yield curve is muted.[13]

[Table 3 about here]

Next, in Table 4, we focus on exogenous demand shocks that can be known to market participants in advance.[14] The most prominent expected shocks are the cyclical demand pressures

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[13] In unreported regressions (available upon request), we also study the fee effect of securities lending supply changes, but we do not find significant fee reactions, most likely due to the persistent nature of supply.

[14] In unreported regressions (available upon request), we also analyse the supply shocks that correspond to Treasury auctions in various maturity segments and find that fees exhibit a slight decline following the auctions, most likely

for HQLAs at year-end reporting dates and new issuances and reopening of comparable Treasuries, where dates are known for month in advance from the issuance calendar. In an efficient market, all public information should be fully captured in in prices. Table 4 presents the relevant empirical results with the lending fee dynamics at year-end reporting dates.

[Table 4 about here]

Banks with large trading desks have traditionally been active participants of repo and securities lending markets. However, recently due to the increasingly stringent regulation and reporting requirements, banks are incentivized to lock in good credit quality and liquid assets in their portfolios for year-end reporting dates to minimize their required capital buffers. Consequently, around these dates, nonbank lenders may be able to capitalize on their "unique" lender position (ICMA 2017). In Table 4 we find that fees are significantly higher around year-end using five calendar days to proxy for year-end (*Repwind*).[15] This result is robust to the inclusion of controls for contemporaneous and lagged supply and demand.

[Table 4 about here]

In Table 4 Models 2 to 4 also incorporate *Longmat*, the dummy for long maturity bonds. We find that at the long end of the yield curve, fees are less sensitive to the changes in expected demand shocks around year-end reporting dates. Models 3 and 4 also incorporate a dummy, *Aft2010* that takes the value of 1 in year 2010 and thereafter. This variables shows that fees have increased following 2010 (and the inception of the European debt crisis), but its interactions with *Repwind* and *Longmat* show a mixed picture. The fees seem to increase at the year-end after

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due to the increased availability of similar securities that decreases beneficial owners' bargaining power against agents who are also primary dealers and market-makers of Treasuries.

15 In auxiliary analysis, we use 3 and 4 calendar days, as well as 3, 4, and 5 trading days. The results are economically and statistically similar to the reported ones.

2010, captured by the positive coefficient on the *Aft2010*Repwind* interaction variable in Model 3. However, once we include the triple interaction term *Aft2010*Repwind*Longmat* in Model 4, the coefficient on *Aft2010*Repwind* becomes less significant. This loss of statistical significance suggests that in the long term maturity segment, where bonds are predominantly held by long term investors, i.e. pension funds and insurers, fees are not significantly higher at year end after 2010. From a welfare perspective it is important to know whether these beneficial owners can temporarily substitute for banks in providing funding liquidity, and in exchange, capitalize on the increased fees. Nevertheless, the absence of significant reaction in fees in the natural habitat of these long term investors at year-end or following 2010 suggests that while pension funds may have become more important as lenders, they are not fully compensated for it.

In Table 5, we further test the market inefficiencies with the *Feespread* measure, which is the difference in the highest and lowest fees on all outstanding contracts. Given the high utilization rates, beneficial owners should all benefit from high income. However, if the insurance firms and pension funds' interests are not well represented as often they have both limited insights into the market and limited bargaining power, then we expect to find that while some lenders are able to capitalize on the high demand, others cannot. Indeed, the results from Table 5 show that with higher utilization rate the feespread narrows on average.

On the other hand, we see that *Feespread* increases with supply and around year-end reporting dates, confirming that not all lenders are able to capitalize on temporarily increased lending fees around reporting dates. Results from Models 6 and 7, by showing that with higher fees and higher demand spread increases, provide support for the second part of our Hypothesis 1 that there is significant price discrimination in the market. To further explore this issue, we focus on the role of conservative long term investors, such as pension funds by including the

Longmat dummy variable and its interaction terms with utilization, fees and demand. We find that most coefficients are positive (albeit statistically insignificant in a small sample), suggesting that in the long maturity segment some beneficial owners, likely the less connected ones, receive persistently low fee income, while some special clients, those with greater bargaining power, receive higher fees. This further confirms Hypothesis 1 that fees are not only slow to incorporate lending market information but they are also dependent on the market power and connectedness of lenders.

Taken together the results from Tables 3-5, we highlight evident securities lending market inefficiencies, which could arise from three key issues: i) the non-transparent nature of the market, ii) the beneficial owners' lack of involvement or ability for income maximization, or iii) the misrepresentation of clients' interest along with the exploitation of oligopolistic market power of the lender-agents.

4.3 Securities Lending Market Implications in the Primary Auction Market

In this section, we shift our focus to the pricing implication of the securities lending market on primary auctions. For the auction process, we collect data from the German Finance Agency. The dataset contains coupon rate, tenor, issue size, average price and yield, expected issue size, and bid-to-cover ratios. The relevant summary statistics based on the 296 unique new issuances and reopenings in our sample are presented in Table 6.

[Table 6 about here]

The upper section of Table 6 presents statistics of the overall auction sample for the period of July 2006 to June 2015. We include both new issues and reopenings (70% of the sample), where multiple reissuances allow a specific ISIN target volume to be reached.[16] The value-weighted average prices are slightly above the face value, however, investors are sometimes willing to pay almost 40% more. This also translates into yields, which can even become negative in periods of demand pressure on HQLA and flights to safety. The average auction has a bid-to-cover (BTC) ratio of 1.66, while oversubscription (BTC>2) for issues is quite common, suggesting the string supply for the Eurozone benchmark asset. Coupons range from 1.96% to 4.75%, in the full sample and somewhat higher, ranging from 2.68 to 4.75% in the subsample including issues with longer than 10-year remaining tenure.

In addition to the standard bond information, we construct securities lending benchmarks for all issuances, specifically for fees (*BenchFee*), utilization (*BenchUti*) and yields (*BenchYield*). These variables are defined as the 10-day moving average of a specific securities lending measure respective maturities. The average benchmark fee is 9.5 bps while the average benchmark utilization rate is around 53%. In the lower section of Table 6, we present the summary statistics of new issues with maturity of 10 years or longer. In this subsample, most features are qualitatively similar, with yields and coupons being higher to compensate for duration risk and the term premium. We also create two new measures, the *RelImp* and the *Interest* measures. *RelImp* captures the relative importance of the specific bond issue in the securities lending market, measured as the new issue size relative to the total outstanding supply in the specific maturity bucket. *Interest* measures the primary dealers' interest for the specific issue as the ratio of competitive and non-competitive bids submitted.

[16] This Finance Agency's practice is to maintain market liquidity, which allows auction participants to purchase bonds at prices reflecting current market conditions.

In Table 7, we test the pricing implications of the HQLA excess demand and the expected securities lending income. Specifically, in Table 7, we show that the market does price in the expected lending income, as the benchmark fee measure has a significant negative coefficient in Models 4 and 6. More importantly, we find that the primary dealers' interest is an additional important predictor, as higher dealers' interest is associated with significantly lower yield. The significant negative coefficient on the benchmark utilization measure also indicates that higher expected lending income is priced in and investors are willing to accept lower yields, while the positive significant coefficient term on the interaction variable of *BenchUti*Interest* indicates some endogeneity between the two measures, which we address in Table 8.

[Table 7 and 8 about here]

In Table 8, we address the endogeneity of the *Interest* variable by running a two-stage instrumental variable regression, in which we use bond characteristics and securities lending market information to proxy for the competitive bidding interest. We show that the primary dealers interest captures various aspects of a bond issue, including the issue size, the maturity segment and whether the auction is a reopening or a new issuance. Larger issue size and longer maturity bonds on average attract higher interest but the negative coefficient on the interaction term (*LogSize*Longmat*) suggests a more complex relation. More importantly, the relative important (*RelImp*) of the issue is the key determinant of the competitive bidding interest. The large significant positive coefficient on *RelImp* imply that brokers specifically target issues, which is likely to be important in the securities lending market of for the bank themselves or their clients. These inferences are robust to the inclusion of various securities lending income proxies from Models 2 through 4.

In the second stage, we see that our instrumented interest variable is significant and with a negative sign, indicating demand pressure from primary dealers that is priced in on top of benchmark utilization and fee measures. These results suggest (albeit indirectly) that as primary dealers' interest are not aligned with that of the ultimate beneficial owners, long term investors may have to buy safe assets at an inflated price, thereby reducing the wealth preservation and return generating potential of pension funds and insurance firms.

5. Conclusion

We suggest that the artificially depressed yields for safe European sovereign bonds in combination with the inherent inefficiencies in the securities lending market have important negative welfare implications. Specifically, the increasing demand pressure of HQLA resulted in extremely low yields, which in turn hurts many conservative long-term investors facing stringent regulation, such as pension funds and insurance firms. They struggle to generate returns or "seek for yields", while on the other hand, being responsible for preserving wealth and managing retirement savings for the majority of European citizens.

We suggest that long term sovereign bond investors should become more active in the securities lending market, because their interest may not be well represented by the major prime broker agents. Thus, we recommend that pension funds and insurance firms need to become more active in the lending market, potentially by lobbying for regulatory oversight and more transparency to reduce inefficiencies. Alternatively, sovereign debt management offices (DMOs or treasuries) may want to consider granting direct access to long-term investors to the primary market, which is a common practice for instance in Singapore, thereby allowing pension funds to access safe assets without involving prime brokers, eliminating potential rent extraction between primary and secondary market transactions.

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Table 1. Summary Statistics from July 3, 2006 to June 1, 2015

The table reports summary statistics of the main variables used in the empirical analysis, where the sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015.. *Age* is the fraction of years since the first issue date, *TTM* is the time-to-maturity of a specific Germany treasury bond, both measured in years with 2-decimal accuracy. *Coupon* is the annual coupon rate in percentage format. *Ontherun* dummy takes on the value of one for a specific security for a given trading day, when the security is on-the-run for its tenor. *Sizeineuro* is the issue size in million euros. *Yield* is the daily yield-to-maturity and is calculated based on the daily closing mid prices from Bloomberg, following market conventions. *AllFees* is the annualized value-weighted average fee in percentage (in calculations we use the originally reported values in basis points). *Feespread* is the difference between the highest and lowest fees in basis points on all outstanding borrowing contracts for a specific security and trading day. *Suppleurval* is the total supply of a specific issue in millions of euro, while the *RelSupply* is the percentage of the total issuance volume available for borrowing. *Utilization* is the percentage of the total supply of the issue utilized, currently out on loan. For these measures, the numerator is the total available value and lent out value reported from Markit in USD, which is converted into EUR using the daily exchange rate from the Statistical Data Warehouse of the European Central Bank.

Label	**N**	**Mean**	**Std. Dev**	**Minimum**	**Maximum**
Full Sample					
Age	115611	5.475	5.628	0.000	28.970
TTM	115611	7.779	8.025	0.500	32.480
Coupon	115611	3.566	1.620	0.000	6.500
Ontherun	115611	0.051	0.219	0.000	1.000
Sizeineuro	115611	17472.900	5107.939	750.000	27000.000
Yield	115574	1.986	1.547	-0.300	4.900
AllFees	115611	0.108	0.122	-0.663	4.172
Feespread	104505	3.834	1.047	-6.908	8.161
Suppleurval	115611	3697.902	2695.570	0.000	35164.830
Demandeurval	115611	2334.356	2116. 582	0.000	15640.650
Utilization	115611	0.516	0.243	0.000	1.000
Bonds with TTM >10 years					
Age	24572	9.003	5.068	0.000	20.020
TTM	24572	21.507	5.965	10.010	32.480
Coupon	24572	5.005	1.114	0.500	6.500
Ontherun	24572	0.092	0.289	0.000	1.000
Sizeineuro	24572	14730.760	4251.487	750.000	24000.000
Yield	24554	3.029	1.121	0.100	4.900
AllFees	24572	0.116	0.135	-0.613	2.650
Feespread	22012	3.957	1.039	-2.3026	8.160
Suppleurval	24572	4414.363	3063.018	0.000	21506.620
Demandeurval	24572	1677.4579	664.67491	0	21506.620
Utilization	24572	0.380	0.217	0.000	1.000

Table 2. Daily Panel Regressions of German Treasury Yields based on Secondary Market Trade Prices
The dependent variable, *Yield,* is the daily yield-to-maturity in percentage, calculated based on the daily closing mid prices from Bloomberg, following market conventions. *LogSupply* is the natural logarithm of the total supply while *LogDemand* is the natural logarithm of the total demand in the securities lending market in millions of EUR, based on the total supply and demand reported in IHS Markit data in USD and converted to EUR using daily exchange rates from the Statistical Warehouse of the European Central Bank. *LogFees* is the natural logarithm of the annualized value-weighted average fee in percentage. *LogTTM* is the natural logarithm of time-to-maturity of specific Germany treasury measured in years with 2-decimal accuracy. *OnTheRun* dummy takes the value of one for a specific security for the trading days when the specific security is on-the-run for its tenor. *Utilization* is the percentage of the total supply of the issue utilized, currently out on loan. *Longmat* dummy takes the value of one for issues with more than 10 years of remaining maturity, and *LogDemand*Longmat, Uti*Longmat* and *LogFees*Longmat* are interaction terms with *LogDemand*, *Utilization* and *LogFees*, respectively. The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from panel regression with year and bond fixed effects and clustered standard errors at the bond level, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

Panel A. Panel Regression Results of Bond Yields with Securities Lending Variables

	(1)	(2)	(3)	(4)	(5)
	Yield	**Yield**	**Yield**	**Yield**	**Yield**
Utilization		-0.306***	-0.311***		
		(-4.93)	(-5.18)		
LogSupply			0.003	0.022**	0.024*
			(0.63)	(2.01)	(1.69)
LogDemand				-0.031**	-0.037**
				(-2.40)	(-2.18)
LogFees					-0.077***
					(-5.69)
LogTTM	1.204***	1.143***	1.142***	1.185***	1.190***
	(12.10)	(12.11)	(12.16)	(11.83)	(11.64)
OnTheRun	0.126*	0.096	0.097	0.108	0.117*
	(1.87)	(1.46)	(1.48)	(1.59)	(1.72)
Constant	0.835***	1.147***	1.130***	0.927***	1.079***
	(3.29)	(4.71)	(4.50)	(3.48)	(3.92)
Time and bond FE	Yes	Yes	Yes	Yes	Yes
Observations	115,574	115,574	115,574	115,574	112,851
R-squared	0.929	0.930	0.930	0.929	0.929

Table 2. Continued

Panel B. Panel Regression Results of Bond Yields with Securities Lending Variables in Conjunction with Long Maturities

	(1) Yield	(2) Yield	(3) Yield	(4) Yield	(5) Yield
Utilization			-0.209***	-0.318***	-0.209***
			(-2.78)	(-5.38)	(-2.87)
LogSupply	0.024*	0.024*	-0.000	-0.000	-0.000
	(1.70)	(1.67)	(-0.02)	(-0.00)	(-0.02)
LogDemand	-0.037**	-0.037**			
	(-2.18)	(-2.22)			
LogFees	-0.078***	-0.078***	-0.089***	-0.128***	-0.124***
	(-5.78)	(-5.74)	(-6.71)	(-7.94)	(-7.83)
Longmat	0.310***	0.313**	0.517***	-0.199	0.029
	(3.38)	(2.57)	(5.49)	(-1.51)	(0.26)
LogDemand*Longmat		-0.000			
		(-0.03)			
Uti*Longmat			-0.594***		-0.491***
			(-3.71)		(-3.13)
LogFees*Longmat				0.197***	0.174***
				(5.75)	(5.44)
LogTTM	1.199***	1.199***	1.079***	1.064***	1.014***
	(11.85)	(11.72)	(10.96)	(11.16)	(10.37)
OnTheRun	0.098	0.098	0.090	0.075	0.080
	(1.44)	(1.44)	(1.45)	(1.17)	(1.30)
Constant	0.984***	0.984***	1.382***	1.565***	1.653***
	(3.55)	(3.57)	(4.89)	(5.99)	(6.03)
Time and bond FE	Yes	Yes	Yes	Yes	Yes
Observations	112,851	112,851	112,851	112,851	112,851
R-squared	0.930	0.930	0.932	0.932	0.932

Table 3.
Lending Fee Dynamics in Response to Endogenous Demand/Supply Shocks in the Securities Lending Market
The dependent variable *LogFees* is the natural logarithm of the annualized value-weighted average fee in percentage. *LogDemand* and *LogSupply* are lagged by 3 days. $DemIncrease_{-1}$ and its two- and three-day lagged values are defined as the 2% increase in demand in the securities lending market from one day to the next. *Longmat**DemIncrease* is the interaction term between the different lagged values o *DemIncrease* and *Longmat,* where the *Longmat* dummy takes the value of one for issues with more than 10 years of remaining maturity. *LogTTM* and *OnTheRun* are defined in Tables 1 and 2 or are lagged values of those variables defined in the tables, where the lags are indicated in the subscripts. The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from panel regression with year and bond fixed effects and clustered standard errors at the bond level, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

	(1) LogFees	(2) LogFees	(3) LogFees	(4) LogFees	(5) LogFees	(6) LogFees
$LogDemand_{-3}$	0.019	0.019*	0.018	0.019*	0.020*	0.019
	(1.63)	(1.69)	(1.52)	(1.68)	(1.75)	(1.60)
$LogSupply_{-3}$	-0.028***	-0.028***	-0.029***	-0.028***	-0.028***	-0.030***
	(-2.89)	(-2.91)	(-3.11)	(-2.94)	(-2.96)	(-3.21)
$DemIncrease_{-1}$	0.036**	0.038**	0.038**	0.036**	0.039**	0.038**
	(2.20)	(2.23)	(2.22)	(2.50)	(2.58)	(2.54)
$DemIncrease_{-2}$		0.024*	0.020		0.028**	0.025
		(1.78)	(1.34)		(2.02)	(1.59)
$DemIncrease_{-3}$			-0.026			-0.018
			(-1.53)			(-0.95)
Longmat				0.158	0.159	0.167
				(1.47)	(1.47)	(1.53)
$DemIncrease_{-1}$*Longmat				-0.004	-0.005	-0.002
				(-0.07)	(-0.10)	(-0.04)
$DemIncrease_{-2}$*Longmat					-0.019	-0.022
					(-0.49)	(-0.54)
$DemIncrease_{-3}$*Longmat						-0.038
						(-1.15)
LogTTM	0.043	0.041	0.043	0.047	0.045	0.044
	(0.46)	(0.44)	(0.46)	(0.50)	(0.48)	(0.47)
OnTheRun	0.089*	0.089	0.088	0.080	0.080	0.077
	(1.66)	(1.65)	(1.63)	(1.55)	(1.54)	(1.49)
Constant	1.715***	1.710***	1.735***	1.666***	1.664***	1.693***
	(7.23)	(7.22)	(7.33)	(6.78)	(6.78)	(6.93)
Time and Bond FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,667	112,667	112,667	112,667	112,667	112,667
R-squared	0.344	0.344	0.344	0.344	0.344	0.344

Table 4. Pricing Dynamics in Relation with Expected Supply and Demand Changes

The dependent variable *LogFees* is the daily natural logarithm of the value-weighted average fees, as defined in Tables 1 and 2. *LogSupply* is the natural logarithm of the total supply while *LogDemand* is the natural logarithm of the total demand in the securities lending market in millions of EUR, based on the total supply and demand reported in IHS Markit data in USD and converted to EUR using daily exchange rates from the Statistical Warehouse of the European Central Bank. *Longmat* takes the value of one for issues with more than 10 years of remaining maturity. *Repwind* is a dummy variable that takes on the value of 1 for the last 5 days of the calendar year. *Aft2010* is a dummy that takes on the value of one for year 2011 and thereafter. *Repwind*Longmat, Repwind*Aft2010* and *Aft2010*Repwind*Longmat* are interaction variables of *Repwind, Longmat* and *Aft2010*, respectively. *LogTTM* and *OnTheRun* are defined in Tables 1 and 2 or are lagged values of those variables defined in the tables, where the lags are indicated in the subscripts. The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from panel regressions with bond and year fixed effects and clustered standard errors at the bond level, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

	(1)	(2)	(3)	(4)
	LogFees	**LogFees**	**LogFees**	**LogFees**
LogSupply	-0.028***	-0.028***	-0.028***	-0.028***
	(-4.05)	(-4.03)	(-4.03)	(-4.03)
Repwind	0.098***	0.080***	0.024	0.052
	(4.63)	(3.26)	(0.61)	(1.08)
$LogSupply_{-5}$	-0.022**	-0.023**	-0.023**	-0.023**
	(-2.51)	(-2.57)	(-2.57)	(-2.58)
$LogDemand_{-5}$	0.021*	0.022**	0.022**	0.022**
	(1.95)	(2.03)	(2.03)	(2.04)
Longmat		0.165	0.165	0.165
		(1.63)	(1.63)	(1.63)
Repwind*Longmat		0.080*	0.079*	-0.050
		(1.69)	(1.67)	(-0.45)
Aft2010			0.820***	0.818***
			(5.55)	(5.57)
Aft2010*Repwind			0.090*	0.045
			(1.83)	(0.78)
Aft2010*Repwind*Longmat				0.204
				(1.39)
LogTTM	0.051	0.055	0.055	0.054
	(0.54)	(0.59)	(0.59)	(0.58)
OnTheRun	0.084	0.075	0.075	0.075
	(1.54)	(1.42)	(1.42)	(1.42)
Constant	1.852***	1.799***	1.800***	1.804***
	(7.81)	(7.30)	(7.31)	(7.35)
Bond and Time FE	Yes	Yes	Yes	Yes
Observations	112,479	112,479	112,479	112,479
R-squared	0.347	0.347	0.347	0.347

Table 5. Dispersion in Fees as a Function of Utilization, Supply and Maturity
The dependent variable is the *Feespread*, the difference between the highest and lowest securities lending fees on a given calendar day. *Repwind* is a dummy variable that takes on the value of 1 for the last 5 days of the calendar year, while *Longmat* is a dummy that takes the value of 1 for bonds with 10 years or longer maturity bonds. *LogFees*Longmat* is the interaction between the *Longmat* dummy and the natural logarithm of the value-weighted average lending fees (*AllFees*). *Utilization* is the percentage of the total supply of the issue utilized, currently out on loan. *Uti*Longmat* is the interaction terms of *Utilization* and *Longmat*. The *LogDem*Longmat* is the interaction between the *Longmat* dummy and the *LogDemand*. LogTTM and OnTheRun are defined in Tables 1 and 2. The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from panel regressions with bond and year fixed effects and clustered standard errors at the bond level, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	Feespread	**Feespread**	**Feespread**	**Feespread**	**Feespread**	**Feespread**	**Feespread**
LogSupply	0.716***	0.716***	0.716***	0.717***	0.717***	0.619***	0.621***
	(12.32)	(12.32)	(12.47)	(12.35)	(12.50)	(7.76)	(7.82)
Repwind	0.136***	0.135***	0.135***	0.131***	0.131***	0.149***	0.153***
	(4.75)	(4.77)	(4.79)	(4.67)	(4.70)	(5.20)	(5.50)
LogFees	0.141***	0.141***	0.141***	0.124***	0.124***	0.146***	0.146***
	(5.86)	(5.84)	(5.85)	(4.14)	(4.16)	(6.16)	(6.14)
Utilization	-0.607***	-0.607***	-0.598***	-0.595***	-0.593***		
	(-3.52)	(-3.52)	(-3.20)	(-3.47)	(-3.19)		
Longmat		0.071	0.086	-0.154	-0.151	0.070	-0.354
		(0.68)	(0.49)	(-0.71)	(-0.59)	(0.63)	(-0.51)
Uti*Longmat			-0.042		-0.008		
			(-0.11)		(-0.02)		
LogFees*Longmat				0.085	0.085		
				(1.19)	(1.20)		
LogDemand						0.091*	0.075
						(1.77)	(1.39)
LogDem*Longmat							0.066
							(0.64)
LogTTM	-0.518***	-0.516***	-0.522***	-0.554***	-0.555***	-0.353***	-0.319**
	(-4.81)	(-4.78)	(-4.36)	(-4.77)	(-4.40)	(-3.27)	(-2.52)
OnTheRun	0.003	-0.001	-0.001	-0.005	-0.005	0.059	0.058
	(0.04)	(-0.02)	(-0.01)	(-0.06)	(-0.06)	(0.70)	(0.69)
Constant	-0.544	-0.566	-0.554	-0.427	-0.425	-1.229**	-1.232**
	(-1.14)	(-1.17)	(-1.04)	(-0.83)	(-0.77)	(-2.28)	(-2.37)
Bond and Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	104,505	104,505	104,505	104,505	104,505	104,505	104,505
R-squared	0.461	0.461	0.461	0.461	0.461	0.454	0.454

Table 6. Summary Statistics for the German Primary Market Auctions

The table reports summary statistics for the German Treasury auctions from July 2006 to June 2015. *AvgPrice* is the value weighted-average accepted bid price at the initial auction, as reported by the German Finanzagentur based on €100 notional amount. *Bid-to-cover ratio* is the ratio of total bid value to the overall issued amount. *AvgYield* is derived from *Avgprice,* as reported by the German Finanzagentur. Coupon rate is (*Coupon*) is the percentage annual coupon, while age is measured as the natural logarithm of the number until the maturity date (*LogAge*). *Longmat* and *Reopening* are dummy variables, which take the value of one, when the bond has more than 10 years remaining maturity, or when the issue is a reopening, respectively. *BenchFee* is the average fee based on the last 10 trading-day data of similar securities, which are bonds within the same maturity bucket as the new issuance and with the same coupon rate. Following the same logic, we define *BenchUti* and *BenchYield* as the average utilization rate and yield based on the last 10 trading-day data of similar securities, respectively. *RelImp* is the ratio of the bond issue size relative to the total supply in the same maturity bucket in the securities lending market. *Interest* is the fraction of the competitive bid and non-competitive bids in the auction process, while *LogSize* is the natural logarithm of the issue size recorded in millions of Euro. Benchmarks are based on the following maturity buckets: 0-1 year, 1-2 years, 2-5years, 5-10 years, and above 10 years.

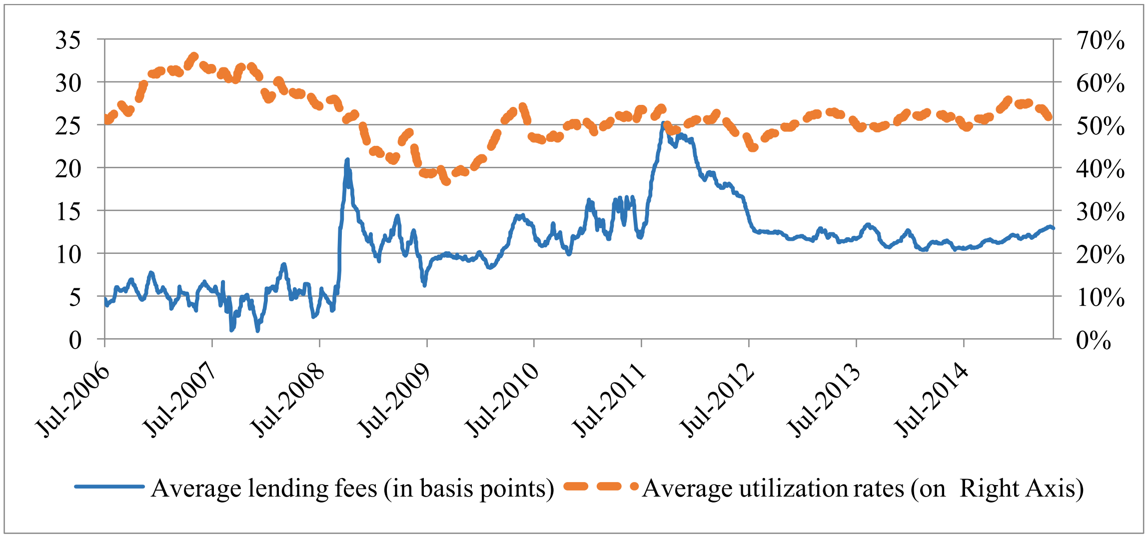
	N	Mean	Std. Dev	Minimum	Maximum
Full Sample					
AvgPrice	296	100.761	4.053	87.920	138.250
Bid-to-cover	296	1.663	0.387	1.000	4.000
AvgYield	296	1.906	1.453	-0.280	4.910
Coupon	296	1.965	1.437	0.000	4.750
LogAge	296	1.682	0.850	0.693	3.401
Longmat	296	0.392	0.489	0.000	1.000
Reopening	296	0.699	0.459	0.000	1.000
BenchFee	296	0.095	0.042	0.007	0.249
BenchUti	296	53.408	11.290	20.279	75.605
BenchYield	296	1.694	1.460	-0.235	4.779
RelImp	296	0.159	0.111	0.033	0.791
Interest	296	1.467	0.897	0.248	6.279
LogSize	296	8.503	0.306	7.601	9.105
Bonds with TTM >10 years					
Avg. price	116	101.781	6.233	87.920	138.250
Bid-to-cover	116	1.504	0.322	1.100	2.700
AvgYield	116	2.578	1.176	0.130	4.910
Coupon	116	2.681	1.120	0.500	4.750
LogAge	116	2.568	0.472	2.303	3.401
Reopening	116	0.759	0.430	0.000	1.000
BenchFee	116	0.099	0.042	0.025	0.212
BenchUti	116	49.510	13.498	20.279	69.255
BenchYield	116	2.283	1.269	0.007	4.779
RelImp	116	0.104	0.056	0.033	0.306
Interest	116	1.252	0.863	0.248	6.279
LogSize	116	8.396	0.370	7.601	8.987

Table 7. The Pricing Implications of Expected Income from Securities Lending in the Primary Market
The dependent variables are the primary auction day average yield outcome (*AvgYield*) in percentage. The explanatory variables are standard bond characteristics such as the natural logarithm of the bond issue age defined as the number of years remaining until maturity (*LogAge*), and the coupon rate in percentage (*Coupon*). *LogSize* is the natural logarithm of the issue size recorded in millions of Euro. *Reopening* dummy variable takes on the value of one when the issue is a reopening. *Interest* is the fraction of the competitive bid and non-competitive bids in the auction process. *BenchFee* (*BenchUti)* is the average value weighted fee in basis points (utilization rate) based on the last 10 trading-day data of similar securities, which are bonds within the same maturity bucket as the new issuance. *BenchUti*Interest* is an interaction variable of the benchmark utilization rate and the *Interest* variables. The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from cross sectional regression, including year fixed effect and robust clustered standard errors at the year level, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

	(1) AvgYield	(2) AvgYield	(3) AvgYield	(4) AvgYield	(5) AvgYield	(6) AvgYield
Interest	-0.015	-0.015	-0.154**	-0.164***	-0.150**	-0.158***
	(-0.67)	(-0.69)	(-3.02)	(-4.09)	(-2.55)	(-3.26)
BenchUti		0.043	-0.340*	-0.389**	-0.264	-0.286*
		(0.19)	(-2.16)	(-2.60)	(-1.61)	(-1.91)
BenchUti*Interest			0.255**	0.289***	0.245*	0.278**
			(2.59)	(3.63)	(2.17)	(2.93)
BenchFee				-0.273**		-0.290**
				(-2.53)		(-2.82)
Longmat					0.106*	0.148***
					(1.96)	(3.76)
LogAge	0.165**	0.165**	0.160**	0.189**	0.105	0.114
	(2.72)	(2.68)	(2.77)	(2.67)	(1.46)	(1.60)
Coupon	0.750***	0.751***	0.758***	0.728***	0.749***	0.714***
	(16.34)	(15.88)	(17.05)	(12.26)	(18.21)	(13.09)
LogSize	0.096	0.089	0.096	0.073	0.014	-0.044
	(0.65)	(0.53)	(0.58)	(0.49)	(0.08)	(-0.28)
Reopening	-0.044	-0.045	-0.048	-0.062	-0.061*	-0.081**
	(-1.55)	(-1.63)	(-1.69)	(-1.81)	(-2.14)	(-2.38)
Constant	-0.611	-0.569	-0.424	0.427	0.312	1.509
	(-0.49)	(-0.42)	(-0.31)	(0.33)	(0.22)	(1.15)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	296	296	296	296	296	296
R-squared	0.972	0.972	0.973	0.975	0.973	0.976

Table 8. The Pricing Implications Excessive Bidding in the Primary Market
The dependent variables are the primary auction day average yield outcome (*AvgYield*) in percentage from two stage regressions, where the endogenous variable, the brokers interest (*Interest*) is instrumented by the securities lending market variables, size (*LogSize*), age (*Longmat*) and the importance of the issue (*Relimp*). The explanatory variables are the same as in Table 7, in addition to relative importance and the dummy *Aft2010*, which takes on the value of one for year 2011 and thereafter. *RelImp* is the ratio of the bond issue size relative to the total supply in the same maturity bucket in the securities lending market. *Interest* is the fraction of the competitive bid and non-competitive bids in the auction process. *LogSize*Longmat* is an interaction variable of the size of an issue, LogSize and indicator variable for ling maturities (*Longmat*). The sample contains Germany nominal Treasuries securities lending market information based on IHS Markit data from July 2006 to June 2015. Coefficient estimates, reported from cross sectional instrumental variable regressions with robust clustered standard errors at the year, are reported with t-stats (in parenthesis). ***, **, and * denote the 1%, 5% and 10% significance levels.

	(1)		**(2)**		**(3)**		**(4)**	
	1st Stage Interest	**2nd Stage AvgYield**	**1st Stage Interest**	**2nd Stage AvgYield**	**1st Stage Interest**	**2nd Stage AvgYield**	**1st Stage Interest**	**2nd Stage AvgYield**
Interest		-0.163**		-0.136*		-0.147**		-0.127*
		(-2.38)		(-1.96)		(-2.11)		(-1.81)
LogAge	0.161	0.001	0.189	0.010	0.147	0.016	0.175	0.021
	(0.81)	(0.03)	(0.84)	(0.22)	(0.73)	(0.34)	(0.78)	(0.46)
Coupon	0.071	0.941***	0.084	0.942***	0.085	0.927***	0.101*	0.929***
	(1.20)	(36.54)	(1.51)	(37.89)	(1.38)	(33.40)	(1.72)	(34.61)
Aft2010	-0.315	-0.276***	-0.292	-0.269***	-0.351*	-0.231***	-0.331*	-0.229***
	(-1.63)	(-3.58)	(-1.54)	(-3.67)	(-1.72)	(-2.88)	(-1.65)	(-2.98)
BenchUti			0.470	0.225			0.508	0.186
			(0.59)	(1.37)			(0.63)	(1.15)
BenchFee					0.102	-0.100*	0.116	-0.098*
					(0.70)	(-1.92)	(0.76)	(-1.93)
LogSize	0.763*	0.270***	0.644	0.233**	0.744*	0.280***	0.613	0.245**
	(1.82)	(2.63)	(1.57)	(2.22)	(1.77)	(2.77)	(1.47)	(2.35)
Longmat	9.529***		9.207***		9.203***		8.812***	
	(3.19)		(3.09)		(3.09)		(2.95)	
LogSize*Longmat	-1.172***		-1.135***		-1.134***		-1.089***	
	(-3.36)		(-3.28)		(-3.26)		(-3.14)	
Reopening	0.212*		0.207*		0.211*		0.206*	
	(1.80)		(1.79)		(1.79)		(1.79)	
Relimp	2.581***		2.991***		2.526***		2.961**	
	(3.32)		(2.57)		(3.23)		(2.54)	
Constant		-1.809**		-1.674*		-1.721**		-1.566*
		(-1.97)		(-1.88)		(-1.96)		(-1.82)
Observations	296	296	296	296	296	296	296	296
R-squared	0.251	0.957	0.249	0.960	0.249	0.959	0.249	0.961



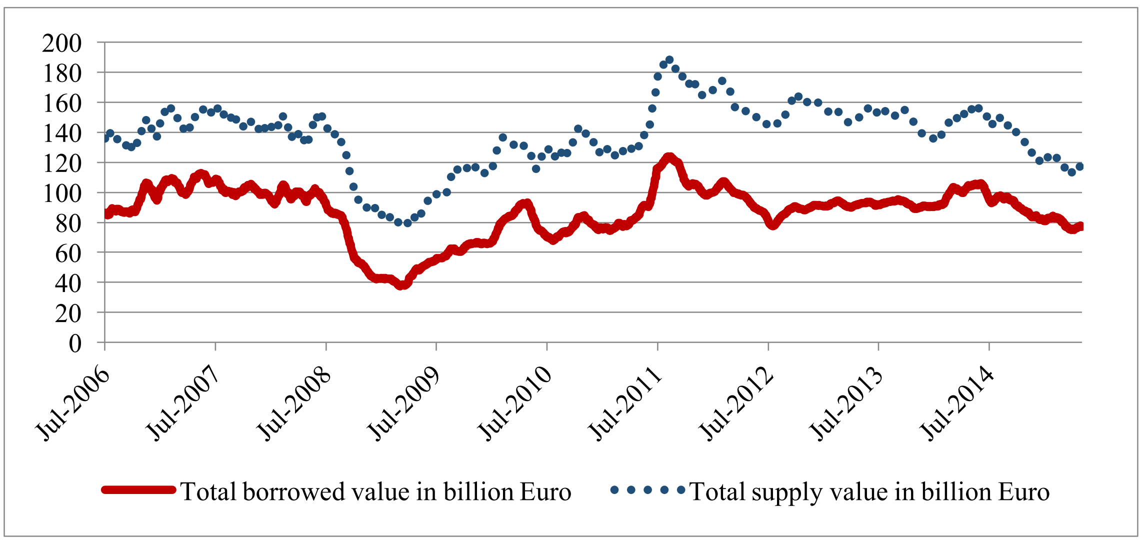
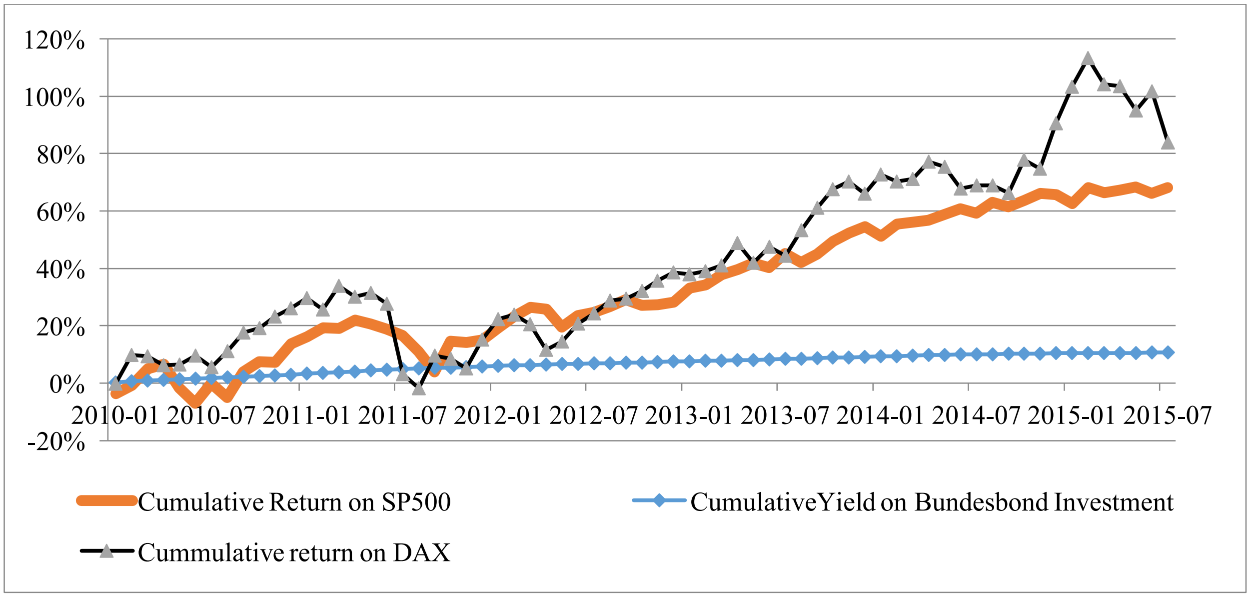


Figure 1. Time-series of Average Lending Market Variables for German Sovereign Bonds
The figures depicts the time-series of average lending market variables for German sovereign bonds from July 2006 to June 2015. The top panel shows the time-series of the monthly moving average lending fee and utilization rates across all available German nominal sovereign bonds in our sample, while the bottom panel depicts the aggregate shorted value and supply value in the market in billions of euros.



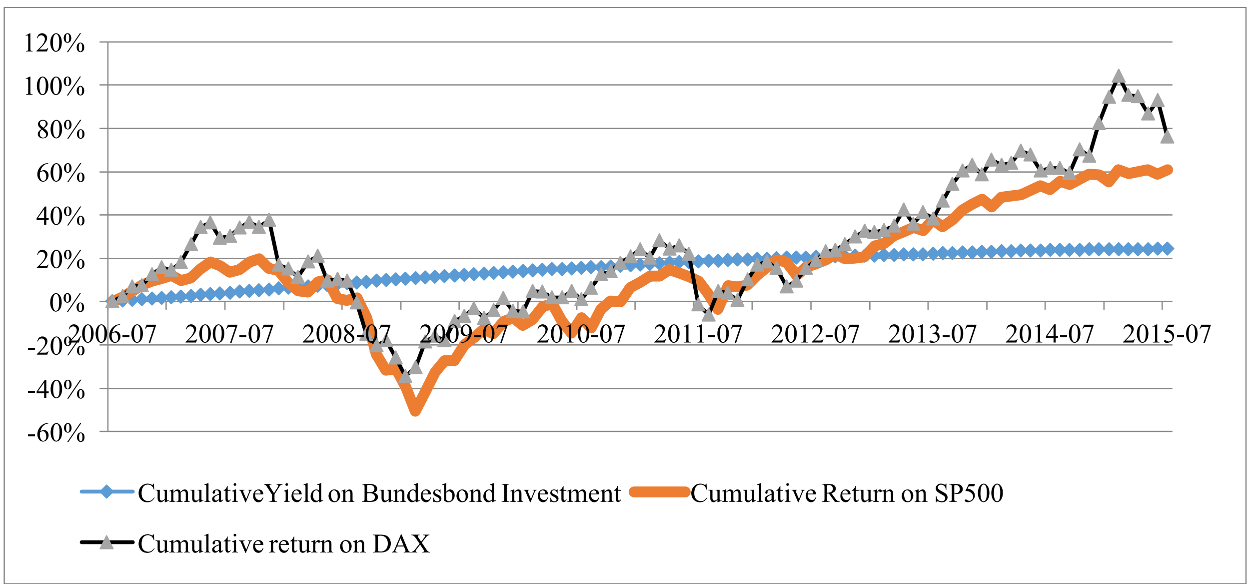
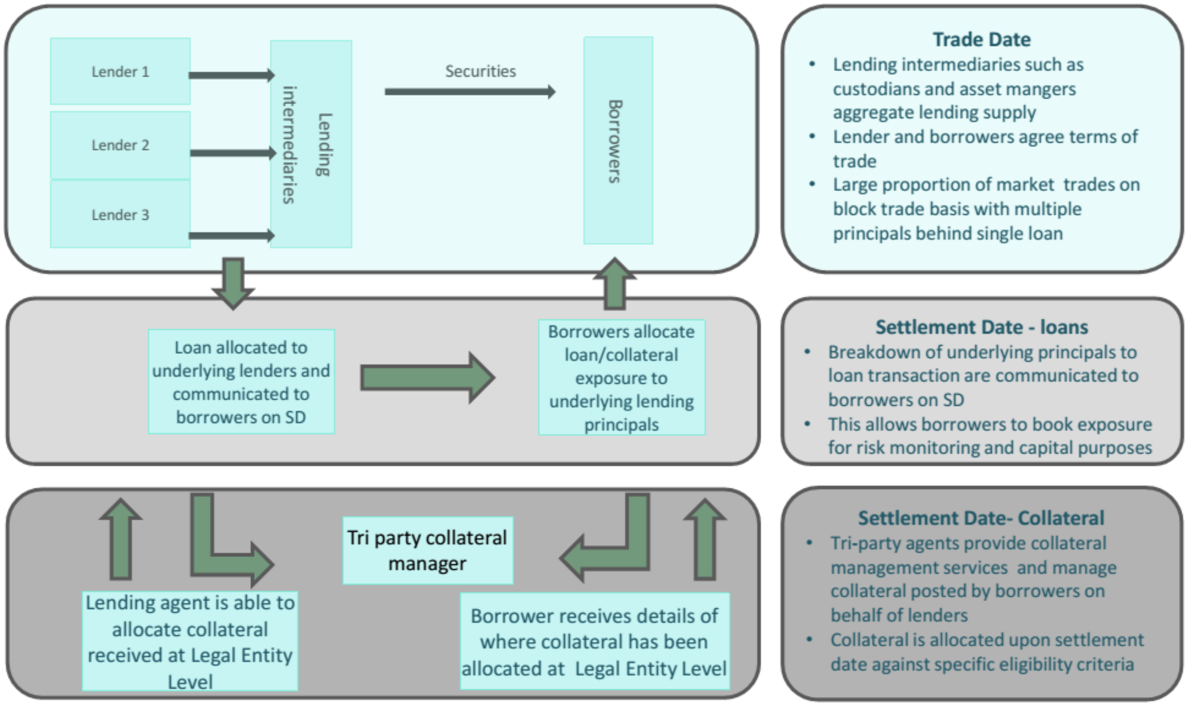


Figure 2. Cumulative Returns on Major Stock Indices and Long-term German Nominal Sovereign Bond
The figure shows the cumulative returns on S&P500 Index, DAX index, and the cumulative yield on portfolio of long German sovereign bonds.

Appendix A. Overview of Fixed Income Securities Lending Transactions

Securities Lending Loan and Collateral Flows from Trade to Settlement



Source: International Securities Lending Association (ISLA, 2016).

Appendix B. Description of Variables

Panel A. Key Variables for the Panel Data Analysis

Variables	Definition and explanation
Issue size (LogSize)	The Issue size is the total issue size in million euros as reported by the German Bundesbank at the time of issuance.
Coupon	The Coupon rate is the annual percentage amount, as reported by the Bundesbank.
Ontherun	Ontherun is an indicator variable. It takes the value of one for the days when the specific security is on-the-run for its tenor, and is zero for all seasoned securities.
Yield or market yield	The yield-to-maturity is at the daily frequency and is calculated based on the daily closing secondary market mid prices from Bloomberg, following market conventions.
Time-to-maturity (TTM) and (Age)	TTM is the time-to-maturity of specific Germany treasury, measured in years and with 2-decimal accuracy. Age is the number of years since issuance, at the 2-digit accuracy.
Allfees	Allfees is the value-weighted average annualized lending fee, based on all outstanding contracts, as provided by the Markit database. The variable is reported in basis points.
RelSupply	RelSupply is the percentage of the total issuance volume available for borrowing. It is calculated as the total available supply reported by Markit Securities relative to the total issuance value. Since Markit reports the daily lent out value in USD, we convert the daily value into EUR, using the daily relevant exchange rates from the Statistical Warehouse of the ECB.
Utilization	Utilization is the percentage value of assets on loan from lenders, divided by the total lendable value.
Feespread	Feespread is the difference between the highest and the lowest fees on all outstanding borrowing contracts for a specific security.

Panel B. Key Variables for the Event Study Analysis

Variables	Definition and explanation
VWaveprice	VWaveprice is the value weighted-average price at the initial auction, as reported by the German Finanzagentur. The price, following international conventions, is based on a €100 notional amount, or the percentage of the bond face value.
Lowestprice	Lowestprice is the lowest bid price placed at the initial auction, as reported by the German Finanzagentur. The price, following international conventions, is based on a €100 notional amount, or the percentage of the bond face value.
BenchmFee10d	BenchmFee10d is the average fee, based on the last 10 trading-day data of similar securities, which are bonds within the same maturity bucket as the new issuance, and with the same coupon rate. Our maturity buckets are 0-1 year, 1-2 years, 2-5years, 5-10 years and above 10 years.
BenchmSupply10d	BenchmSupply10d is the average relative supply based on the last 10 trading-day data of similar securities, where the relative supply is the percentage of issuance value available for borrowing in the securities lending market. Similar securities are bonds within the same maturity bucket as the new issuance, and with the same coupon rate. Our maturity buckets are 0-1 year, 1-2 years, 2-5years, 5-10 years and above 10 years.
BenchmUti10d	BenchmUti10d is the average utilization rate across bonds with the same maturity bucket as the new issuance, based on the last 10 trading-day data, where the maturity buckets are 0-1 year, 1-2 years, 2-5years, 5-10 years and above 10 years.

Appendix C. Overview of the German Treasury Market

Primary Market of German Sovereign Bonds

The German Finance Agency has been responsible for issuing German Federal securities on behalf of the German government, since June 2001. German sovereign bonds are not only highly liquid; they also carry small issuer risk and managed to preserve their AAA rating throughout the Euro crisis. The German Government issues various maturity instrument, such as 6 and 12-month maturity treasury discount papers, 2-year maturity Federal treasury notes (Schaetze); five-year maturity Federal notes (Bobls) and 10 and 30-year maturity Federal bonds (Bunds). The two-year notes account (Schaetze) for 9% of the outstanding German public debt and about 11% of the total trading volume while the five-year notes (Bobls), account for one fifth of the outstanding tradable German sovereign debt value and constitute to about 17% of the overall trading volume. The 2-year, 5-year, 10-year, and 30-year treasuries account for about 90% of all German tradable government debt and 70% of the total issuance (German Finance Agency, 2015). Thus, any study that includes these assets provides a representative picture of the German government debt market and the benchmark interest rate in Europe.

The German Finance Agency (Treasury) reports that 90% of the funding needs of the Federal Government are covered by placing issues to primary dealers in the form of single issues via auctions. Primary dealers are financial institutions approved by the Finance Agency and admitted to the Bund Issues Auction Group. In principle, any credit or securities trading institution or investment firm domiciled in the EU can become a member of the Auction Group. The membership comes with rights and obligations. Specifically, members must bid a specific amount of each issue. The auctions take place according to the issuance calendar announced at the end of each year for the following calendar year. These annual previews include detailed information on the forthcoming issuances: including the type of the security to be issued, the day of the issuance, maturity date, and targeted nominal issuance amount. Such high level of transparency and detailed schedule makes the German Government a globally recognized and reliable issuer.

All regularly issued capital market securities are issued in a tender process, where members of the Bund Issues Auction Group participate in a multi-price auction process. As such, the bids are allotted at the price specified in the bid, not at a single price. Bids that are above the lowest accepted bid are allotted in full. At the end of the auction, the allotted amounts are published in the Bund Bidding System, and shortly after the information becomes publicly available. For each auction, the government retains a certain amount of the nominal volume issued, which is gradually introduced into the secondary market following the tender. Moreover, for some issues, auctions are also followed by multiple reopenings, which aim to facilitate liquidity in the market and the delivery of futures contracts on these bonds.

Secondary Market of German Sovereign Bonds

All German capital market securities are traded on stock exchanges, international electronic trading platforms, and OTC. They are quoted by market makers throughout the trading day, and at the tightest bid-ask spreads of all euro-denominated sovereign debt securities. Quotes are at a voluntary basis; thus, no artificial liquidity or market depth are created. According to the statistics of the Finance Agency, the average yearly trading volume of capital market securities was EUR 5.7 trillion between 2006 and 2015. This, for 2015, an average nominal volume of EUR 1.1 trillion was in circulation, which implies that this amount has turned over 4-6 times every year for the same period. The corresponding daily trading volumes were in the magnitude of EUR 19 billion. The liquidity of German bonds is supported by futures contracts traded on the Eurex. While future contracts are available on most Bundesbonds, with 2-, 5-, 10- and 30-year maturities, the most liquid products are those linked to 10-year Federal Bunds with a turnover of 177 million contracts traded yearly, in the volume of EUR 27 trillion in 2015.

The securities that are retained at the auctions are mostly sold in the secondary market, to collateralize repos or interest swaps or to be used in securities lending. Next to providing additional liquidity and facilitating delivery of specific securities, the Finance Agency and the Deutsche Bundesbank (German National Bank) also act as market makers on the different platforms, where German public debt is traded. Nevertheless, the Agency and the Bundesbank aim to minimize the price impact of their secondary market transactions.

According to the information supplied by a representative sample of primary dealers, most trading activity of German debt securities takes place between European and Euro area counterparties. Looking at the institutional shares of trades, the Finance Agency reports that the most important parties are brokers, asset managers, and banks, with a slight increase in hedge fund and decrease in central bank transactions.

Appendix D. Full Tables Displaying the Coefficients on Time Fixed Effect

Table 2 Panel A, Displaying Year Fixed Effects

	(1) Yield	(2) Yield	(3) Yield	(4) Yield	(5) Yield
Utilization		-0.306***	-0.311***		
		(-4.93)	(-5.18)		
LogSupply			0.003	0.022**	0.024*
			(0.63)	(2.01)	(1.69)
LogDemand				-0.031**	-0.037**
				(-2.40)	(-2.18)
LogFees					-0.077***
					(-5.69)
LogTTM	1.204***	1.143***	1.142***	1.185***	1.190***
	(12.10)	(12.11)	(12.16)	(11.83)	(11.64)
OnTheRun	0.126*	0.096	0.097	0.108	0.117*
	(1.87)	(1.46)	(1.48)	(1.59)	(1.72)
Year 2007	0.648***	0.664***	0.664***	0.649***	0.643***
	(23.01)	(23.82)	(23.87)	(23.11)	(22.81)
Year 2008	0.572***	0.561***	0.561***	0.567***	0.581***
	(11.43)	(11.61)	(11.63)	(11.28)	(11.09)
Year 2009	-0.613***	-0.677***	-0.677***	-0.623***	-0.592***
	(-4.98)	(-5.80)	(-5.80)	(-5.10)	(-4.71)
Year 2010	-1.089***	-1.138***	-1.139***	-1.099***	-1.046***
	(-8.85)	(-10.06)	(-10.07)	(-9.02)	(-8.43)
Year 2011	-0.992***	-1.040***	-1.042***	-1.004***	-0.917***
	(-8.48)	(-9.71)	(-9.74)	(-8.65)	(-7.72)
Year 2012	-2.004***	-2.065***	-2.068***	-2.021***	-1.931***
	(-15.77)	(-17.84)	(-17.92)	(-15.94)	(-14.75)
Year 2013	-1.900***	-1.963***	-1.966***	-1.921***	-1.847***
	(-14.48)	(-16.69)	(-16.78)	(-14.62)	(-13.69)
Year 2014	-2.061***	-2.128***	-2.130***	-2.084***	-2.021***
	(-16.91)	(-19.80)	(-19.91)	(-17.04)	(-16.22)
Year 2015	-2.567***	-2.631***	-2.631***	-2.590***	-2.533***
	(-23.28)	(-26.82)	(-26.92)	(-23.32)	(-22.59)
Constant	0.835***	1.147***	1.130***	0.927***	1.079***
	(3.29)	(4.71)	(4.50)	(3.48)	(3.92)
Time and Bond FE	Yes	Yes	Yes	Yes	Yes
Observations	115,574	115,574	115,574	115,574	112,851
R-squared	0.929	0.930	0.930	0.929	0.929

Table 2 Panel B, Displaying Year Fixed Effects

	(1) **Yield**	(2) **Yield**	(3) **Yield**	(4) **Yield**	(5) **Yield**
Utilization			-0.209***	-0.318***	-0.209***
			(-2.78)	(-5.38)	(-2.87)
LogSupply	0.024*	0.024*	-0.000	-0.000	-0.000
	(1.70)	(1.67)	(-0.02)	(-0.00)	(-0.02)
LogDemand	-0.037**	-0.037**			
	(-2.18)	(-2.22)			
LogFees	-0.078***	-0.078***	-0.089***	-0.128***	-0.124***
	(-5.78)	(-5.74)	(-6.71)	(-7.94)	(-7.83)
Longmat	0.310***	0.313**	0.517***	-0.199	0.029
	(3.38)	(2.57)	(5.49)	(-1.51)	(0.26)
LogDemand*Longmat		-0.000			
		(-0.03)			
Uti*Longmat			-0.594***		-0.491***
			(-3.71)		(-3.13)
LogFees*Longmat				0.197***	0.174***
				(5.75)	(5.44)
LogTTM	1.199***	1.199***	1.079***	1.064***	1.014***
	(11.85)	(11.72)	(10.96)	(11.16)	(10.37)
OnTheRun	0.098	0.098	0.090	0.075	0.080
	(1.44)	(1.44)	(1.45)	(1.17)	(1.30)
Year 2007	0.647***	0.647***	0.654***	0.640***	0.635***
	(23.50)	(23.50)	(25.20)	(23.49)	(24.14)
Year 2008	0.588***	0.588***	0.559***	0.542***	0.527***
	(11.35)	(11.29)	(10.55)	(10.59)	(9.93)
Year 2009	-0.585***	-0.585***	-0.694***	-0.697***	-0.733***
	(-4.66)	(-4.61)	(-5.52)	(-5.74)	(-5.86)
Year 2010	-1.037***	-1.037***	-1.155***	-1.157***	-1.214***
	(-8.40)	(-8.28)	(-9.44)	(-9.95)	(-10.02)
Year 2011	-0.905***	-0.905***	-1.028***	-1.041***	-1.104***
	(-7.70)	(-7.52)	(-8.75)	(-9.48)	(-9.57)
Year 2012	-1.916***	-1.916***	-2.072***	-2.079***	-2.160***
	(-14.82)	(-14.47)	(-16.39)	(-17.43)	(-17.32)
Year 2013	-1.829***	-1.830***	-2.014***	-2.003***	-2.106***
	(-13.77)	(-13.37)	(-15.69)	(-16.50)	(-16.40)
Year 2014	-1.996***	-1.996***	-2.191***	-2.186***	-2.295***
	(-16.13)	(-15.53)	(-18.08)	(-19.43)	(-18.85)
Year 2015	-2.507***	-2.507***	-2.698***	-2.701***	-2.811***
	(-22.44)	(-21.65)	(-24.70)	(-26.23)	(-25.31)
Constant	0.984***	0.984***	1.382***	1.565***	1.653***
	(3.55)	(3.57)	(4.89)	(5.99)	(6.03)
Time and Bond FE	Yes	Yes	Yes	Yes	Yes
Observations	112,851	112,851	112,851	112,851	112,851
R-squared	0.930	0.930	0.932	0.932	0.932

Table 3, Displaying Year Fixed Effects

	(1) LogFees	(2) LogFees	(3) LogFees	(4) LogFees	(5) LogFees	(6) LogFees
$LogDemand_{-3}$	0.019	0.019*	0.018	0.019*	0.020*	0.019
	(1.63)	(1.69)	(1.52)	(1.68)	(1.75)	(1.60)
$LogSupply_{-3}$	-0.028***	-0.028***	-0.029***	-0.028***	-0.028***	-0.030***
	(-2.89)	(-2.91)	(-3.11)	(-2.94)	(-2.96)	(-3.21)
$DemIncrease_{-1}$	0.036**	0.038**	0.038**	0.036**	0.039**	0.038**
	(2.20)	(2.23)	(2.22)	(2.50)	(2.58)	(2.54)
$DemIncrease_{-2}$		0.024*	0.020		0.028**	0.025
		(1.78)	(1.34)		(2.02)	(1.59)
$DemIncrease_{-3}$			-0.026			-0.018
			(-1.53)			(-0.95)
Longmat				0.158	0.159	0.167
				(1.47)	(1.47)	(1.53)
$DemIncrease_{-1}$*Longmat				-0.004	-0.005	-0.002
				(-0.07)	(-0.10)	(-0.04)
$DemIncrease_{-2}$*Longmat					-0.019	-0.022
					(-0.49)	(-0.54)
$DemIncrease_{-3}$*Longmat						-0.038
						(-1.15)
LogTTM	0.043	0.041	0.043	0.047	0.045	0.044
	(0.46)	(0.44)	(0.46)	(0.50)	(0.48)	(0.47)
OnTheRun	0.089*	0.089	0.088	0.080	0.080	0.077
	(1.66)	(1.65)	(1.63)	(1.55)	(1.54)	(1.49)
Year 2007	-0.142***	-0.142***	-0.142***	-0.140***	-0.140***	-0.140***
	(-4.82)	(-4.81)	(-4.80)	(-4.71)	(-4.70)	(-4.70)
Year 2008	0.134*	0.134*	0.134*	0.137*	0.137*	0.136*
	(1.90)	(1.90)	(1.90)	(1.93)	(1.92)	(1.92)
Year 2009	0.425***	0.425***	0.424***	0.428***	0.428***	0.426***
	(6.16)	(6.18)	(6.18)	(6.17)	(6.18)	(6.18)
Year 2010	0.637***	0.638***	0.636***	0.641***	0.642***	0.639***
	(8.22)	(8.22)	(8.21)	(8.27)	(8.27)	(8.26)
Year 2011	0.962***	0.963***	0.962***	0.967***	0.968***	0.966***
	(10.34)	(10.36)	(10.36)	(10.35)	(10.35)	(10.34)
Year 2012	0.980***	0.983***	0.981***	0.987***	0.988***	0.985***
	(9.38)	(9.40)	(9.40)	(9.41)	(9.41)	(9.39)
Year 2013	0.767***	0.769***	0.767***	0.775***	0.776***	0.772***
	(6.23)	(6.26)	(6.25)	(6.27)	(6.28)	(6.25)
Year 2014	0.716***	0.718***	0.716***	0.728***	0.729***	0.725***
	(5.19)	(5.21)	(5.20)	(5.22)	(5.22)	(5.19)
Year 2015	0.802***	0.804***	0.802***	0.815***	0.815***	0.810***
	(5.53)	(5.55)	(5.54)	(5.54)	(5.54)	(5.51)
Constant	1.715***	1.710***	1.735***	1.666***	1.664***	1.693***
	(7.23)	(7.22)	(7.33)	(6.78)	(6.78)	(6.93)
Time and Bond FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,667	112,667	112,667	112,667	112,667	112,667
R-squared	0.344	0.344	0.344	0.344	0.344	0.344

Table 4, Displaying Year Fixed Effects

	(1) LogFees	(2) LogFees	(3) LogFees	(4) LogFees
LogSupply	-0.028***	-0.028***	-0.028***	-0.028***
	(-4.05)	(-4.03)	(-4.03)	(-4.03)
Repwind	0.021*	0.022**	0.022**	0.022**
	(1.95)	(2.03)	(2.03)	(2.04)
$LogSupply_{-5}$	-0.022**	-0.023**	-0.023**	-0.023**
	(-2.51)	(-2.57)	(-2.57)	(-2.58)
$LogDemand_{-5}$	0.098***	0.080***	0.024	0.052
	(4.63)	(3.26)	(0.61)	(1.08)
Longmat		0.165	0.165	0.165
		(1.63)	(1.63)	(1.63)
Repwind*Longmat		0.080*	0.079*	-0.050
		(1.69)	(1.67)	(-0.45)
Aft2010			0.090*	0.045
			(1.83)	(0.78)
Aft2010*Repwind			0.820***	0.818***
			(5.55)	(5.57)
Aft2010*Repwind*Longmat				0.204
				(1.39)
LogTTM	0.051	0.055	0.055	0.054
	(0.54)	(0.59)	(0.59)	(0.58)
OnTheRun	0.084	0.075	0.075	0.075
	(1.54)	(1.42)	(1.42)	(1.42)
Year 2007	-0.138***	-0.136***	-0.137***	-0.137***
	(-4.68)	(-4.58)	(-4.61)	(-4.62)
Year 2008	0.141*	0.143**	0.143**	0.142**
	(1.97)	(2.01)	(2.00)	(1.99)
Year 2009	0.424***	0.427***	0.427***	0.426***
	(6.18)	(6.17)	(6.17)	(6.16)
Year 2010	0.638***	0.642***	-0.180*	-0.179*
	(8.13)	(8.14)	(-1.84)	(-1.84)
Year 2011	0.972***	0.978***	0.155**	0.156**
	(10.42)	(10.40)	(2.04)	(2.05)
Year 2012	0.994***	1.001***	0.179***	0.180***
	(9.47)	(9.47)	(2.81)	(2.82)
Year 2013	0.781***	0.789***	-0.033	-0.032
	(6.34)	(6.38)	(-0.57)	(-0.57)
Year 2014	0.727***	0.740***	-0.082**	-0.082**
	(5.27)	(5.30)	(-2.19)	(-2.18)
Year 2015	0.808***	0.822***	-	-
	(5.56)	(5.55)		
Constant	1.852***	1.799***	1.800***	1.804***
	(7.81)	(7.30)	(7.31)	(7.35)
Time and Bond FE	Yes	Yes	Yes	Yes
Observations	112,479	112,479	112,479	112,479
R-squared	0.347	0.347	0.347	0.347

Table 5, Displaying Year Fixed Effects

	(1) Feespread	(2) Feespread	(3) Feespread	(4) Feespread	(5) Feespread	(6) Feespread	(7) Feespread
LogSupply	0.716***	0.716***	0.716***	0.717***	0.717***	0.619***	0.621***
	(12.32)	(12.32)	(12.47)	(12.35)	(12.50)	(7.76)	(7.82)
Repwind	0.136***	0.135***	0.135***	0.131***	0.131***	0.149***	0.153***
	(4.75)	(4.77)	(4.79)	(4.67)	(4.70)	(5.20)	(5.50)
LogFees	0.141***	0.141***	0.141***	0.124***	0.124***	0.146***	0.146***
	(5.86)	(5.84)	(5.85)	(4.14)	(4.16)	(6.16)	(6.14)
Utilization	-0.607***	-0.607***	-0.598***	-0.595***	-0.593***		
	(-3.52)	(-3.52)	(-3.20)	(-3.47)	(-3.19)		
Longmat		0.071	0.086	-0.154	-0.151	0.070	-0.354
		(0.68)	(0.49)	(-0.71)	(-0.59)	(0.63)	(-0.51)
Uti*Longmat			-0.042		-0.008		
			(-0.11)		(-0.02)		
LogFees*Longmat				0.085	0.085		
				(1.19)	(1.20)		
LogDemand						0.091*	0.075
						(1.77)	(1.39)
LogDem*Longmat							0.066
							(0.64)
LogTTM	-0.518***	-0.516***	-0.522***	-0.554***	-0.555***	-0.353***	-0.319**
	(-4.81)	(-4.78)	(-4.36)	(-4.77)	(-4.40)	(-3.27)	(-2.52)
OnTheRun	0.003	-0.001	-0.001	-0.005	-0.005	0.059	0.058
	(0.04)	(-0.02)	(-0.01)	(-0.06)	(-0.06)	(0.70)	(0.69)
Year 2007	0.026	0.027	0.026	0.017	0.017	0.001	0.008
	(0.37)	(0.38)	(0.38)	(0.25)	(0.25)	(0.01)	(0.11)
Year 2008	0.235**	0.236**	0.234**	0.219**	0.218**	0.280***	0.294***
	(2.46)	(2.47)	(2.50)	(2.22)	(2.26)	(2.81)	(2.85)
Year 2009	0.010	0.012	0.007	-0.011	-0.012	0.179	0.205
	(0.08)	(0.09)	(0.05)	(-0.09)	(-0.09)	(1.47)	(1.51)
Year 2010	-0.576***	-0.574***	-0.581***	-0.610***	-0.611***	-0.445***	-0.408***
	(-4.88)	(-4.85)	(-4.26)	(-4.75)	(-4.26)	(-3.43)	(-2.70)
Year 2011	-0.363**	-0.361**	-0.369**	-0.406**	-0.408**	-0.221	-0.180
	(-2.54)	(-2.52)	(-2.21)	(-2.51)	(-2.26)	(-1.43)	(-1.01)
Year 2012	-0.615***	-0.612***	-0.621***	-0.665***	-0.667***	-0.423**	-0.371*
	(-4.24)	(-4.21)	(-3.53)	(-4.01)	(-3.50)	(-2.58)	(-1.89)
Year 2013	-0.940***	-0.936***	-0.947***	-0.994***	-0.996***	-0.735***	-0.673***
	(-5.71)	(-5.66)	(-4.78)	(-5.36)	(-4.69)	(-4.01)	(-3.09)
Year 2014	-0.974***	-0.969***	-0.981***	-1.034***	-1.036***	-0.761***	-0.691***
	(-5.66)	(-5.56)	(-4.70)	(-5.33)	(-4.65)	(-3.90)	(-2.93)
Year 2015	-0.732***	-0.726***	-0.738***	-0.795***	-0.797***	-0.537***	-0.469**
	(-4.14)	(-4.07)	(-3.36)	(-3.97)	(-3.40)	(-2.75)	(-2.05)
Constant	-0.544	-0.566	-0.554	-0.427	-0.425	-1.229**	-1.232**
	(-1.14)	(-1.17)	(-1.04)	(-0.83)	(-0.77)	(-2.28)	(-2.37)
Time and Bond FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	104,505	104,505	104,505	104,505	104,505	104,505	104,505
R-squared	0.461	0.461	0.461	0.461	0.461	0.454	0.454