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This paper describes the market for borrowing corporate bonds using a comprehensive dataset from a major lender. The cost of borrowing corporate bonds is comparable to the cost of borrowing stock, between 10 and 20 basis points, and both have fallen over time. Factors that influence borrowing costs are loan size, percentage of inventory lent, rating, and borrower identity. There is no evidence that bond short sellers have private information. Bonds with CDS contracts are more actively lent than those without. Finally, the 2007 Credit Crunch does not affect average borrowing costs or loan volume, but does increase borrowing cost variance.

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This paper describes the market for borrowing corporate bonds using a comprehensive dataset from a major lender. The cost of borrowing corporate bonds is comparable to the cost of borrowing stock, between 10 and 20 basis points, and both have fallen over time. Factors that influence borrowing costs are loan size, percentage of inventory lent, rating, and borrower identity. There is no evidence that bond short sellers have private information. Bonds with CDS contracts are more actively lent than those without. Finally, the 2007 Credit Crunch does not affect average borrowing costs or loan volume, but does increase borrowing cost variance.

1. Introduction

This paper analyzes the market for borrowing and shorting corporate bonds. The corporate bond market is one of the largest over-the-counter (OTC) financial markets in the world. Between 2004 and 2007, the time period of our study, the value of outstanding corporate debt averaged \$6.6 trillion and, according to the Securities Industry and Financial Market Association (SIFMA), trading activity averaged \$17.3 billion per day. We estimate that shorting represents 19.1% of all corporate bond trades.

There is a large theoretical literature on short sales constraints and their impact on asset prices. Constraints on short selling may lead to mis-valuation because they limit the ability of some market participants to influence prices. The empirical literature on short sales, while also large, has focused almost exclusively on stocks. Our analysis of shorting corporate bonds allows us to determine if the empirical findings on shorting stocks are present in other markets. In addition, unlike stocks, where borrowing takes place in an OTC market and short selling takes place on an exchange, both borrowing and shorting activities take place OTC in the corporate bond market. Thus, any effects of short sale constraints may be amplified in the bond market.

A major issue in the study of any OTC market is the availability of data. Unlike stock short positions, which are reported bimonthly by the stock exchanges, bond shorting is not regularly reported. In addition, while a number of studies have access to proprietary databases of stock lending for short periods (e.g., D'avolio 2002; Geczy, Musto, Reed 2005), comparable analyses of bond lending do not exist, with the exception of Nashikkar and Pedersen (2007).

This paper uses a large proprietary database of corporate bond loan transactions from a major depository institution for the four year period, January 1, 2004 through December 31, 2007. Although our data is only from one lender, the size and coverage of our database allows us to study the functioning of a relatively opaque, yet large market. Our lender's par value of loanable bond inventory averages \$193.3 billion daily and accounts for 2.9% of the overall par value of outstanding corporate bonds listed by the Fixed Income Securities Database (FISD). From this inventory, our lender loans an average daily par value of \$14.3 billion and 66.4% of bonds which appear in inventory are lent out at some point during our time period 2004-2007.

We begin the paper by describing the market for borrowing corporate bonds and the reasons why corporate bonds are shorted. Next, we examine cross-sectional and time-series determinants of borrowing activity and costs. Third, we investigate the relationship between bond and stock shorting. Finally, we check if bond short sellers have private information.

We find that the market for borrowing bonds is large and most lent bonds have small borrowing costs. In our database, the mean and median annual borrowing cost, equally-weighted by loan, are 33 and 18 basis points (bps), respectively, for the entire sample period. In mid-2006, there is a dramatic narrowing in the distribution of bond borrowing costs. This compression causes a reduction in mean and median borrowing costs during the latter part of our sample period. By 2007, these rates fall to 19 and 13 bps, respectively.

Borrowing costs are related to several factors. Four significant factors are loan size, the bond's credit rating, on-loan percentage, which is the fraction of the lender's inventory already lent, and the identity of the borrowing broker. Smaller loans (less than 100 bonds) and lower rated bonds have higher borrowing costs. In addition, borrowing costs increase after ratings downgrades and bankruptcy filings. Borrowing costs remain flat until on-loan percentage reaches approximately 70% and then rise sharply for high yield bonds. Finally, while our lender lends to 65 brokers, a select few borrow at significantly lower rates.

Borrowing costs for corporate bonds and stocks are linked. Since our lender has a significant market share of stock shorting, we construct a matched sample of corporate bond and stock loans for the same firms. The costs of borrowing the two securities are usually quite close and 63.7% of matched loan borrowing costs are within 10 bps of each other. When the borrowing costs of matched loans are not close, the stock is usually more expensive to borrow than the bond.

Bond shorting does not appear to be motivated by investors possessing private information since bond short sellers do not earn excess returns on average. Portfolios of bonds with a high on loan percentage or with high borrowing costs do not underperform the market portfolio of corporate bonds. In addition, mimicking the actual positions of bond short sellers (using the beginning and ending dates of bond loans) does not generate excess returns.

We examine two other aspects of the market for borrowing corporate bonds. The first is whether credit default swap (CDS) contracts impact bond borrowing activity. Almost half of our borrowed bonds also have CDS contracts available. These bonds are more actively borrowed and have higher average higher borrowing costs (1 bp) than those where CDS contracts are not available.

The second aspect is the Credit Crunch of 2007. We examine the second half of 2007, the beginning of the Credit Crunch, separately to see if borrowing activity changes. In this period, borrowing costs became more volatile. However, the volume of bond shorting remained stable, as did the average level of borrowing costs. In addition, the average returns to shorting bonds did not change.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the reasons for shorting bonds, the mechanics of shorting a bond, and estimates the market's size. Section 4 describes our data sample, Section 5 describes the costs of borrowing, and Section 6 examines the relationship between bond and stock shorting. Section 7 examines the performance of bond short sellers. The next two sections consider how corporate bond shorting relates to the CDS market and whether it was impacted by the Credit Crunch of 2007. Finally, Section 10 outlines some implications of our results and concludes.

2. Related Literature

The theoretical literature on the effects of short sale constraints on asset prices is extensive. One modeling approach examines the implications of heterogeneous investor beliefs in the presence of short sale constraints and whether this causes mis-valuation. Miller (1977) argues that short sale constraints keep more pessimistic investors from participating in the market, so market prices reflect only optimists' valuations (see also Lintner 1971). Harrison and Kreps (1978) consider a dynamic environment and provide conditions where short sale constraints can drive the price above the valuation of even the most optimistic investor. More recent contributions include Chen, Hong, and Stein (2002) who relate differences of opinion between optimists and pessimists to measures of stock ownership, and Fostel and Geanokoplos (2008), who consider the additional effects of collateral constraints.

Another approach to studying the effects of short sale constraints focuses on search and bargaining frictions, which arise because investors must first locate securities to short (Duffie 1996, Duffie, Garleanu, and Pedersen 2002). Finally, there is theoretical literature in the rational expectations tradition, which examines how short sale constraints can impede the informativeness of prices (see Diamond and Verrechia 1987, and Bai, Chang, and Wang 2006).

The empirical literature on short sale constraints focuses almost entirely on stocks. An early strand of this literature examines the information content of short interest (see Asquith and Meulbroek 1995) where short interest is the number of shares shorted divided by the number of shares outstanding. This literature advanced in two directions as richer data sets became available. The first direction examines daily quantities of short sales by observing transactions either from proprietary order data (Boehmer, Jones and Zhang 2008) or from Regulation SHO data (Diether, Lee, Werner, and Zhang 2009). Both papers find that short sellers possess private information and that trading strategies based on observing their trades generate abnormal returns.

The second direction in this literature examines the direct cost (or price) of borrowing stocks. These papers either use data from a unique time period when the market for borrowing stocks was public (Jones and Lamont 2002) or proprietary data from stock lenders (D'avolio 2001, Geczy, Musto, Reed 2002, and Ofek et. al 2004). Jones and Lamont (2002) and Ofek et. al. (2004) find that stocks with abnormally high rebate rates have lower subsequent returns, while Geczy et. al. (2002) find that higher borrowing costs do not eliminate abnormal returns from various short selling strategies. D'avolio (2001) and the other three papers find that only a small number of stocks are expensive to borrow. Using data from 12 lenders, Kolasinski, Reed, and Riggenberg (2010) find that the equity loan market is opaque, and this, in combination with search costs, results in borrowing costs varying across lenders.

A challenge identified in this literature is that short interest is a quantity and borrowing costs are a price, both of which are simultaneously determined by shorting demand and the supply of shares available to short. A high borrowing cost may indicate either a high shorting demand or a limited supply of shares available to short. As a result, some researchers have constructed proxies for demand and supply and have tried to isolate shifts in either demand or supply. Asquith, Pathak, and Ritter (2005) use institutional ownership as a proxy for the supply of shares available for shorting and find that stocks that have high short interest and low levels of institutional ownership significantly underperform the market on an equally-weighted basis, but not on a value-weighted basis. Using richer, proprietary loan-level data, Cohen, Diether and Malloy (2007) examine shifts in the demand for shorting, and find that an increase in shorting demand indicates negative abnormal returns for the stocks being shorted. Both papers highlight that their results only apply to a small fraction of outstanding stocks.

The only paper on corporate bond market shorting is Nashikkar and Pedersen (2007), who describe a proprietary dataset from a corporate bond lender between September 2005 and June 2006. Their examination of the cross-sectional determinants of borrowing costs complements ours, but they do not examine as extensively the differences between investment grade and high yield bonds, the relationship between bond and stock shorting, and the profitability of short selling corporate bonds. Furthermore, our longer time period allows us to document several time-series patterns, such as the reduction in borrowing costs and the increase in volatility of borrowing costs during the 2007 Credit Crunch.

3. Shorting a Corporate Bond: Rationales, Mechanics, and Market Size

Rationales for Shorting Corporate Bonds

The primary purpose of borrowing a corporate bond is to facilitate a short sale of that bond. Aside from market making activities, investors short bonds for the same reason they short stocks: to bet that the security will decline in price. If short sellers focus on overvalued firms and can either short the stock or the bond, it would seem that they would target the stock due to the priority of claims. That is, since bond holders have a higher priority in bankruptcy, stock prices should decline before bond prices when there is a threat of financial distress. Thus, on first pass, short sellers short bonds only if they cannot find the stock to short or it is too expensive to short.

One potential reason why a firm's stock cannot be borrowed is that the firm is private, yet has publicly traded debt. That is, there is public debt but no public stock. In this case, taking a position that the firm is overvalued requires an investor to short bonds. We show below that we are unable to match our corporate bonds to publicly traded stock for 18.4% of our sample.[1]

If a stock is publicly traded and the stock and bond markets are linked, bond shorting is attractive if the net return for shorting bonds is greater than the net return for shorting stocks, adjusting for risk. We expect this to occur more frequently for lower credit quality bonds. This is because bonds without default risk trade at par (absent interest rate movements) while lower rated bonds will experience greater price fluctuations. Thus, investment grade bonds should not decrease in price as often as high yield bonds, and therefore, the market for shorting high yield bonds should be different than the market for shorting investment grade bonds.

If the stock and bond markets are not linked, bonds may be shorted due to segmentation. One possibility is that bond short sellers are separate from stock short sellers and evaluate the firm's prospects independently. For instance, within an investment firm, the bond and stock trading desks may not trade in each other's instruments. Hence, the bond desk may short the bonds, while the stock desk shorts the stocks.

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[1] This does not mean that 18.4% of our bonds were issued by private firms, however. We discuss this further below.

There are also reasons for shorting bonds that are not related to the value of the firm's stock. If there is a capital structure arbitrage, investors may go long one tier of the firm's capital structure and short another. Arbitrage is also possible between a firm's bonds and their CDS (or other securities reflecting the firm's credit).

Arbitrage trades involving bond shorting are not necessarily specific to an individual bond issue. Two examples are credit spread arbitrage (between different yield curves) and market-wide interest rate arbitrage. In the first case, if investors believe that yield curves are mispriced in relation to one another, they will short one credit category of bonds, and go long another. In this instance, it is not important which firm issued the bond, only the bond's credit rating. In the second case, we expect that investors who believe interest rates will rise prefer to short government bonds rather than corporate bonds because of their low credit risk. However, bond traders have told us that AAA-rated debt is occasionally used for this purpose because it is sometimes cheaper to borrow than treasuries. Here, it is not important which firm issued the AAA-rated debt.

Finally, corporate bonds may be borrowed short term to facilitate clearing of long trades in the presence of temporary frictions in the delivery process.

Mechanics of Shorting Bonds

The mechanics of shorting corporate bonds parallel those of shorting stocks. Shorted bonds must first be located and then borrowed. The investor has three days to locate the bonds after placing a short order. Investors usually borrow bonds through an intermediary such as a depository bank. Such banks serve as custodians for financial securities and pay depositors a fee in exchange for the right to lend out securities. The borrower must post collateral of 102% of the market value of the borrowed bond, which is re-valued each day. Loans are typically collateralized with cash although US Treasuries may also be used. In our sample, 99.6% of bond loans are collateralized by cash. Investors subject to Federal Reserve Regulation T must post an additional 50% in margin, a requirement that can be satisfied with any security. The loan is "on-demand" meaning that the lender of the security may recall it at any time. Hence, most loans are effectively rolled over each night, and there is very little term lending.

The rebate rate determines the fee that the borrower pays for the bond loan. The rebate rate is the interest rate that is returned by the lender of the security for the use of the collateral. For example, if the parties agree to a bond loan fee of 20 bps, and the current market rate for collateral is 100 bps, then the lender of the corporate bond returns, or "rebates", 80 bps back to the borrower undertaking the short position. There can be variability in the rebate rate for the same bond even on the same day. It is even possible that the rebate rate is negative, which means the borrower receives no rebate on their collateral and has to pay the lender. Finally, if a bond makes coupon payments or has other distributions, the borrower is responsible for making these payments back to the owner of the security.

Size of the Bond Loan Market

There is limited information about the size of the markets for shorting any security. For stocks, all three major stock exchanges release short interest statistics bimonthly.[2] Short interest is the number of shares shorted at a particular point in time divided by the total shares outstanding and is often represented as a percentage. In addition, daily stock shorting information is available from January 2005 through July 2007 when Regulation SHO was in effect. Regulation SHO required all exchanges to mark stock trades as long or short. This is no longer the case.

To estimate the size of the market for shorting stocks, most researchers first examine stock short interest statistics released by the exchanges. Asquith, Pathak, and Ritter (2005) report that in 2002 the equally-weighted average short interest for stocks is approximately 2.4% for the NYSE and AMEX combined, and 2.5% for the NASDAQ-NMS. That is, 2.4% or 2.5% of the total number of shares are lent out on average. To examine short sales as a percentage of trading volume, Diether, Lee, and Werner (2007) use Regulation SHO data and find that short sales represent 31% of share volume for NASDAQ-listed stocks and 24% of share volume for NYSE-listed stocks in 2005. Asquith, Au, and Pathak (2006) report that short sales represent 29.8% of all stock trades on the NYSE, AMEX, and NASDAQ-NMS exchanges during the entire SHO period.[3] Since bonds primarily trade OTC, comparable information on short interest does not exist and Regulation SHO did not apply.

To estimate the size of the market for shorting corporate bonds, we assume that our proprietary lender's share of the bond shorting market is identical to their share of the stock shorting market. Asquith, Au, and Pathak (2006) report that our proprietary lender made stock loans totaling 16.7% of all stock shorting volume on the NYSE, AMEX, and NASDAQ-NMS

[2] Prior to September 2007, all three exchanges reported short interest once a month.
[3] Asquith, Oman and Safaya (2010) find for a sample of NYSE and NASDAQ stocks, that short trades are 27.9% of trading volume in 2005.

markets during the SHO period. From Table 1, discussed below, the average daily par value of the bonds on loan by our proprietary lender is $14.3 billion. This measure is comparable to short interest, i.e. it is the daily average par value of bonds shorted over our sample period. If we assume that our lender represents 16.7% of the bonds lent, then total bonds lent for the entire market on an average day is $85.6 billion. This is 1.3% of the average par value of corporate bonds outstanding as reported from the FISD database discussed below. Thus, by this measure, bond shorting is approximately half as large as stock shorting.

The average daily new corporate bond loan volume of our proprietary lender is $550.3 million. If we again assume our proprietary lender is responsible for the same proportion of loans to bond short sellers as they are to stock short sellers, this implies that the average daily par value of corporate bonds shorted is $3.3 billion. SIFMA reports that the average daily corporate bond trading volume for the years 2004-2007 is $17.3 billion. By this measure, bond short selling would represent 19.1% of all corporate bond trades.

Using these estimates implies that shorting corporate bonds is an important market activity. The percentage of corporate bonds shorted, 1.3%, is slightly greater than half the percentage of stocks shorted, 2.5%. Furthermore, the percentage of all daily corporate bond trades that represents short selling, 19.1%, is almost two-thirds the percentage of stock trades that entails short selling, 29.8%. Thus, at any point in time the amount of corporate bonds shorted is large, and trading in the corporate bond market includes significant short sale activity.

4. Description of Sample

We use four separate databases, two that are commercially available and two that are proprietary, to construct the sample of corporate bonds used in this paper. All four databases cover the period from January 1, 2004 through December 31, 2007. The commercially available databases are the Trade Reporting and Compliance Engine database (TRACE) and the Fixed Income Securities Database (FISD). The two proprietary databases are a bond inventory database and a bond loan database. These databases were provided to us by one of the world's largest custodians of corporate bonds. The bond inventory database contains all corporate bonds available for lending, and the companion bond loan database describes the loans made from that inventory. The bond CUSIP is used as the common variable to link these four databases.

TRACE is a database of all OTC corporate bond transactions and was first implemented on a limited basis on July 1, 2002. TRACE reports the time, price, and quantity of bond trades, where the quantity is top-coded if the par value of the trade is $5 million or more for investment grade bonds and $1 million or more for high yield bonds. Over time, bond coverage expanded in phases, and the compliance time for reporting and dissemination of bond prices shortened. Our sample begins between Phase II and III of TRACE. Phase II was implemented on March 3, 2003, while Phase III was implemented in two stages, on October 1, 2004 and on February 7, 2005. Phase III required reporting on almost all public corporate bond transactions.[4] Since the vast majority of corporate bonds are traded over-the-counter, TRACE provides the first reliable daily pricing data for corporate bonds.

The FISD database contains detailed information on all corporate bond issues including the offering amount, issue date, maturity date, coupon rate, bond rating, whether the bond is fixed or floating rate, and whether it is issued under SEC Rule 144a. We exclude any corporate bond in the inventory file that we cannot match to FISD. In addition we also exclude all convertibles, exchangeables, equity-linked bonds, and unit deals.

The proprietary bond inventory database contains the number of bonds in inventory and number of bonds available to lend. From January 1, 2004 through March 30, 2005 we have end-of-the month inventory information for all bonds. The database reports daily inventory information from April 1, 2005 to December 31, 2007. In contrast to the inventory database, the loan database is updated daily for the entire period January 1, 2004 through December 31, 2007.[5] For each day, the loan database includes which bonds are lent, the size of the loan, the rebate rate paid to the borrower, and an indicator of who borrows the bond. The proprietary loan database identifies 65 unique borrowers for corporate bonds. These borrowers are primarily brokerage firms and hedge funds.

Table 1 describes the match between the proprietary bond inventory and loan databases to the overall universe of FISD corporate bonds averaged by day. Panel A shows that from 2004 to 2007, the average number of bonds in the inventory database is 7,752. This represents 20.7%

[4] Phase I of TRACE covered transaction information on approximately 500 bonds. It required users to report transaction information on covered bonds to the NASD (since renamed FINRA) within 75 minutes. Phase II of TRACE expanded coverage of bonds to approximately 4,650 bonds. Coverage of additional 120 bonds was added on April 14, 2003. On October 1, 2003 the time to report was shortened to 45 minutes. A year later, on October 1, 2004, reporting time was shortened again to 30 minutes. Finally, on July 1, 2005 the reporting time was shortened to 15 minutes. Most reported trades are immediately disseminated by FINRA.

[5] There are several missing days in the loan database. On these days the file we obtained from the proprietary lender was either unreadable or a duplicate of an earlier daily file. These days are December 16-31, 2004, all of February 2005, June 7, 2006, and November 27, 2007.

of all corporate bonds in FISD for an average day. The relationship between the number of bonds in FISD and the inventory is stable over each of the four years. Although not aggregated in Table 1, there are a total of 15,493 unique bonds in the bond inventory sample that match to FISD at some point. In addition, 2,901 or 37.4% of bonds in the lender inventory are on loan on an average day. There is a slight upward trend in the fraction of bonds lent from inventory during 2004 to 2007. There are 10,293 unique bonds in the merged database that are lent at some point during the four-year period.

Table 1 Panel B reports similar comparisons using the par value of the bonds. The average daily par value of corporate bonds outstanding in the FISD database during the period 2004 to 2007 is $6.6 trillion, while the average daily par value of corporate bond inventory in the database is $193.3 billion. This represents 2.9% of the total par value of corporate bonds issued and listed in FISD. Of this inventory, an average $14.3 billion, or 7.4% of the total par value of the inventory, is on loan each day.

In Figure 1, we plot our proprietary lender's number of loans outstanding, on the left hand axis, and the total par value of these loans, on the right hand axis, over time. On an average day, there are between 7,000 and 11,000 outstanding loans. The total par value of outstanding loans also fluctuates around the overall mean of $14.3 billion, with a maximum of more than $16.8 billion in October 2004, and a minimum of about $10.5 billion in January 2004.

Table 1 and Figure 1 clearly demonstrate that the number and value of corporate bonds and corporate bond loans in the two proprietary databases are large. The bond inventory database covers 20.7% of the bonds in FISD. The par value of the inventory is $193.3 billion on average, representing 2.9% of the $6.6 trillion market. In total, the proprietary database consists of 367,751 loans, covering 10,293 bonds, and representing an average par value of $14.3 billion per day. We believe this is of sufficient size to draw inferences about the overall market.

Sample Characteristics

Table 2 compares various bond characteristics from FISD to the proprietary inventory and loan databases by year and for the entire period. It allows us to determine how representative the proprietary databases are of the entire corporate bond market. We focus on characteristics that are likely to affect the demand and supply for corporate bond loans. The characteristics we examine are the size at issue, maturity, time since issuance, percent defaulted, percent floating rate, and percent subject to SEC Rule 144a. Rule 144a is a provision that allows for certain private resale of restricted securities to qualified institutional buyers.

Table 2 Panel A shows that the average bond in the inventory is much larger at issue ($418.6 million) than the average FISD bond at issue ($175.3 million). The average bond lent is even larger at issue with a size of $487.4 million. The average maturity at issue of the bonds in the inventory database (11.3 years) is close to the average maturity at issue of the universe of all FISD corporate bonds (10.7 years). The average maturity at issue for lent bonds is 11.9 years. A comparison of time since issuance indicates that lent bonds are not outstanding as long as the average bond in the inventory or in FISD. There are no year-to-year trends in the values of these bond characteristics.[6]

Bonds in the FISD database are less likely to default (0.6%) than bonds in inventory (1.1%) and the default percentage for lent bonds is between the two (0.7%). Bonds on loan are much less likely to be floating rate bonds (10.6%) than bonds in either the FISD dataset (22.4%) or the inventory dataset (17.0%). The fraction of bonds that are subject to SEC Rule 144a is much lower for bonds on loan than for the FISD and inventory samples.

Panel B of Table 2 reports Standard and Poor's (S&P) rating characteristics of corporate bonds. The coverage of the S&P ratings information in FISD is not as extensive as those characteristics reported in Panel A, however. For instance, there are 57,896 bonds in FISD where we observe the size at issue, while we observe S&P ratings for only 39,197 of these bonds. Fortunately, the limited coverage of ratings in FISD has a smaller impact on the inventory and loan samples. While we have issue size information for 10,293 lent bonds, we have an S&P rating for 9,822, or 95.4% of lent bonds.

The bond inventory has a lower median rating at time of issue and over our time period than the universe of FISD corporate bonds. The sample of lent bonds has the same median rating at time of issue as inventory, but a lower rating over the entire period. The other rows of Panel B, which show percentage investment grade at issue and percentage investment grade as of the

[6] The values for some of the variables, e.g. maturity and time since issuance, over the entire period are outside the range of the per-year means. This is because each bond is only counted once for the entire period, but may be counted multiple times when counting the observations in the per-year columns. For example, the number of FISD, inventory, and lent bonds for the entire sample period is not the respective sums of the four separate years.

date of the loan, show a pattern consistent with the lower ratings for lent bonds than for FISD bonds.[7]

In summary, Table 2 shows that shorted bonds are much larger at issue, have a slightly longer maturity at issue, and have a lower median rating at issue than the average FISD bond. 68.9% of the lent bonds are investment grade, while 79.2% of all FISD bonds are. Lent bonds are also more likely to be fixed rate and less likely to be defaulted.

Properties of Short Positions

Each loan in the loan database has a unique loan number, which allows us to describe the time series properties of lent positions. Using the loan number, we are able to determine when the loan is initiated, the duration of the loan, and the number of bonds lent over the duration of the loan. Table 3 provides descriptive statistics for the new bond loans in the database in total and split by whether the bonds are investment grade or high yield and unrated[8]. There are 10,293 unique bonds lent in the database, and 367,751 unique loans for an average of 35.7 loans per bond. Some bonds change ratings between investment grade and high yield over the sample period. There are 293,649 loans on investment grade bonds and 128,102 loans on high yield bonds.

The data in Table 3 indicates that the size and duration of loans are skewed and this skewness differs between investment grade and high yield loans. The mean loan size for investment grade bonds is 1,267.3 bonds or approximately $1.3 million at a par value of $1,000. The median loan size is only 200 bonds or $200,000. The mode loan size is $100,000. High yield bonds have a higher mean, $1.8 million, a higher median, $980,000, and a mode of $1.0 million. The mean new investment grade loan is outstanding for 28 calendar days, with a median time outstanding of 10 days and a mode of one day. For high yield bonds the mean is 40 days, the median is 13 days, and the mode is also one day. Thus, loans for high yield bonds are larger and longer than those for investment grade bonds.

The last three rows of Table 3 show how often loan size changes during the life of the loan. Changes to loan size may occur if borrowers partially repay the loan or if portions of their

[7] The data on treasury spreads has a different pattern. The lent bonds have a smaller spread to treasuries than do our inventory or the FISD database. It is important to note, however, that the available information on treasury spreads is much smaller than that of bond ratings, and therefore these two descriptives are not directly comparable since the samples are different. The notes in Table 2 give more information on this issue.

[8] There are only 13,884 loans to unrated bonds in our database and we have grouped them with high yield bonds. Holding the unrated bonds out as a separate sample does not change the analysis. We will refer to high yield and unrated bonds as high yield in the text going forward.

loan are recalled by the lender. In the sample, loan size decreases for 29.3% of investment grade loans and 34.8% of high yield loans before the loan is closed. Of the loans which change size, the average decreases of the initial loan size are 55.7% and 58.6% respectively, and the average number of decreases are 1.9 and 1.8. We do not observe increases in loan size, presumably because a borrower who wishes to borrow more bonds initiates a new loan.

Tables 1, 2, 3 and Figure 1 show that the proprietary inventory and loan databases are extensive. The inventory database covers over 20% of all corporate bonds issued and the loan database contains over 367,000 loans on over 10,000 bonds. The average amount in inventory per day is $193.3 billion, and the average amount on loan per day is $14.3 billion. The lent bonds are larger, have a longer duration, and have a lower rating than the average bond in the FISD database. Loan activity is extensive throughout the entire period. New bond loans average over $1.4 million and have an average duration of 32 days. Loans on high yield bonds are larger and longer than those on investment grade bonds. Finally, approximately one-third of loans are partially repaid before being closed out.

5. Costs of Borrowing Corporate Bonds

The borrowing cost for corporate bonds has two major components: the rebate rate paid by the lender and the market interest rate. The rebate rate is the interest rate the lender pays on the collateral posted by the borrower and is typically lower than the market rate that the borrower could receive on the same funds invested at similar risk and duration elsewhere. Thus, we calculate the cost of borrowing as the difference between the market rate and the rebate rate. The loan database gives the rebate rate paid by the lender, but not the market rate. We use the one-month commercial paper rate as a proxy for the market rate.[9]

Even though most corporate bond loans are short term, as shown in Table 3, borrowing costs vary frequently over the life of the loan. Although not shown in a table, overall, 49.3% of the bond loans in the sample experience a change of at least 5 bps in their borrowing cost before repayment. These changes are due both to changes in the rebate rate and changes in the

[9] An alternative to the commercial paper rate is the Fed Funds rate. We use the commercial paper rate because we think it more accurately represents the rate the borrowers could get on their collateral. For most of the period, January 1, 2004 through December 31, 2007, the commercial paper and Fed Funds rates correlate highly (the average difference across days is 4.9 bps and the coefficient of correlation is 0.998).

commercial paper rate. 42.3% of bond loans experience a rebate rate change of at least 5 bps, while 21.2% experience a change in the commercial paper rate of at least 5 bps.[10]

It is possible for the lender to change the rebate rate frequently because all of the loans are demand loans. In addition, if supply and demand conditions for the bond improve, and if the lender does not raise the rebate rate, the borrower has the option of closing out the loan and borrowing from a different lender. For the loan sample, there is an average of 3.5 rebate rate changes of at least 5 bps per loan, or approximately 8 rebate rate changes for those loans with changes. Furthermore, rebate rate changes of at least 5 bps go in both directions. 38.4% of all loans have a rebate rate increase, 29.7% of all loans have a rebate rate decrease, and 25.8% of all loans have both. Hence, a considerable factor driving changes in the cost of borrowing is changes in the rebate rate on existing loans by the lender.

The frequent changes in borrowing costs suggest that existing loans should track current market conditions, although perhaps with a lag. Comparing new and existing loans, the average absolute difference in the borrowing costs for the same bonds on the same day is 4.3 bps, with a standard deviation of 27.6 bps. Moreover, for those bonds that have new and existing loans on the same day, 46.5% of new loans have an average borrowing cost that is more expensive than existing loans and 35.4% of new loans are cheaper than existing loans. Given these differences, the analyses below only use the borrowing cost for new loans unless otherwise stated. All loans start as new loans, and new loans must reflect current market conditions.

Time Series and Cross-Section of Borrowing Costs

Figure 2 plots the distribution of equally-weighted borrowing costs by quintile for each month of our sample period. The plot shows that the distribution of borrowing costs changes abruptly between March and July 2006. Before March 2006, the 60th and 80th percentiles of borrowing costs are usually at or above 50 bps for each month. After March 2006, the 60th percentile is at or below 20 bps for each month. The 80th percentile drops below 20 bps in August 2006 and is near or below 20 bps until the start of the Credit Crunch in August 2007. The plot of value-weighted loan borrowing costs, although not shown, shows a similar but less dramatic pattern during the same time period.

[10] High yield loans are more likely than investment grade loans to experience a rebate rate change of at least 5 bps (45.9% versus 40.4%), though this may be due to their longer average duration.

The reasons why borrowing costs are reduced in 2006 are not immediately clear. Table 1, Table 2, and Figure 1 show that the lender's inventory of bonds and the amount lent do not change significantly after 2005. Furthermore, although not reported, the duration of bond loans also does not change significantly over time. To further investigate the decline in borrowing costs, Table 4 presents borrowing costs over time partitioned by loan size and credit quality. Over the sample period 2004-2007, shown in the first column, the equally-weighted mean and median borrowing costs are 33 bps and 18 bps, respectively.[11] The composition of loans by size and credit quality does not change dramatically in 2006. Table 4 shows that the percentage of large loans remains fairly constant (it decreases slightly by 2007) and the percentage of investment grade loans remains flat.

Panel A divides loans into those of 100 bonds or less (i.e., $100,000 par value, the overall mode loan size) and those of more than 100 bonds. It shows that large loans have lower borrowing costs than small loans, but this difference diminishes over time. For example, in 2004 the mean borrowing cost for loans of 100 bonds or less is 51 bps. For loans of more than 100 bonds, the mean borrowing cost is 31 bps. By 2007, it appears that size is no longer priced as the mean borrowing cost for small loans is 19 bps, which is identical to that of large loans. The median borrowing costs behave similarly.

Panel B presents borrowing costs over time by credit rating. For the entire period high yield bonds have a higher average borrowing cost than investment grade bonds, 37.4 bps versus 30.0 bps, but identical medians of 18.0 bps. Borrowing costs for both investment grade and high yield bonds decline by 2007. The decline in both mean and median borrowing costs is greater for investment grade bonds than for high yield bonds.

Thus, Table 4 shows that average borrowing costs are usually lower for large loans and for investment grade loans. Borrowing costs generally decline over our sample period regardless of loan size and credit quality. In addition, the decline in borrowing costs is not explained by changes in the composition of large vs. small or investment grade vs. high yield loans.

Another factor why borrowing costs change over time may be greater transparency in bond market pricing related to the growth of TRACE during our sample period. The sample

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[11] The borrowing costs in Table 4 are equally-weighted by loan. When value-weighting borrowing costs by loan size, the value-weighted mean borrowing cost is 22 bps and the median is 14 bps.

begins between Phases II and III of TRACE. As stated above, Phase II was implemented on April 14, 2003, while implementation of Phase III was completed by February 7, 2005. Phase III required reporting on almost all public corporate bond transactions. It seems unreasonable, however, that it would take more than a year, until April 2006, for the effects of this increased coverage to have an impact. Finally, the growth of the CDS market may have driven improvements in the liquidity of corporate bonds, and the narrowing of borrowing cost spreads may reflect this trend. We investigate the impact of the CDS market for the market for borrowing corporate bonds in Section 8.

Determinants of Borrowing Costs

We next investigate how the cost of borrowing is related to the available supply of bonds in the lender's inventory. As previously mentioned, we do not have daily inventory data from January 2004 to March 2005, and thus cannot compute the daily available supply of bond inventory during this period. Figure 3 plots the relationship between the average borrowing cost and the amount of inventory on loan divided by investment grade and high yield loans for the periods April 2005 to March 2006 and April 2006 to December 2007. It also plots the Credit Crunch 2007 period from July 2007 to December 2007 which we will discuss later in section 9. The vertical axis displays average borrowing cost and the horizontal axis displays amount of inventory lent.

For both periods, April 2005 to March 2006 and April 2006 to December 2007, high yield bonds are more expensive to borrow than investment grade bonds at higher on loan percentages. When the loan percentage is below 40-45%, there is no noticeable difference in borrowing costs between high yield and investment grade bonds. However, when the on-loan percentage is greater than 45% high yield bonds become more expensive while the cost of borrowing investment grade bonds remain flat. Finally, at approximately 70% on loan there is a steep increase in the average borrowing cost for high yield bonds: each 10% increase in the amount on loan is associated with a greater than 10 bps increase in the average borrowing cost.[12] In contrast, the borrowing costs for investment grade bonds continue to be insensitive to on loan percentage.

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[12] The pattern for high yield bonds is consistent with the results of D'avlio (2001) and Kolasinski, Reed, and Riggenberg (2010) for the equity loan market. Neither paper divides the equity loan market by credit quality.

Figure 3 also shows that borrowing costs are significantly lower in the latter period, April 2006 through December 2007, compared to the earlier period, April 2005 to March 2006. This is true for both high yield and investment grade bonds. This result is consistent with Figure 2 and Table 4,which show a decrease in borrowing costs after April 2006. Note, the kink at 70% of available inventory still exists, and although borrowing costs are lower in the latter period, the slope of that segment is similar. This suggests that the reduction in borrowing costs in the latter half of our sample period is not due to changes in how inventory impacts borrowing costs. Finally, the pattern for high yield and investment grade bonds during the 2007 Credit Crunch is similar.

Table 5 presents the 35 corporate bonds with the highest borrowing costs in the sample. Each bond is listed once, together with its maximum loan borrowing cost and the date and borrowing cost corresponding to that maximum. Since there is a great deal of clustering by firm of the most expensive bonds to borrow, the last column of Table 5 indicates the number of bonds from that issuer where the borrowing cost is greater than the 250th most expensive to borrow bond in the sample. For example, the borrowing cost of the most expensive loan on the Calpine Corp bond with CUSIP 131347AW6 is 14.50%, but there are 10 other Calpine Corp bonds which have borrowing costs above the 250th most expensive to borrow bond in the sample.

There are three features of the bonds in Table 5 that are worth noting. First, these bonds are highly lent out. The average percentage on loan is 79.7%, well above the 70% 'kink' observed in Figure 3. Second, most of the firms in Table 5 experience credit problems around the date they appeared on our list and as seen in the next to the last column, all of the bonds are high yield. Of the 35 firms on the list, 9 are bankrupt as of the date of the loan, while another 6, while not filing for bankruptcy, were downgraded in the prior year. In addition, 7 of the firms, while not bankrupt or downgraded, were frequently mentioned in the press in the previous year as "financially struggling." Interestingly, 8 of the remaining firms undertook an LBO during this period. Although we did not check explicitly, we infer the increased leverage from the LBO impacted the bond's borrowing cost.

A third feature of Table 5 is that a large fraction of the most expensive bond loans take place during the latter half of 2007. Thirteen out of 35 bond loans in our list are after July 1, 2007, and 8 of these are on one day, October 31, 2007. Importantly, all 8 have negative rebate rates on that date. This means their inclusion cannot be explained solely by that day's reported commercial paper rate.

Calculated borrowing costs are not always positive. A negative borrowing cost is the result of the lender paying a rebate rate above the commercial paper rate, and it implies that the lender loses money on the loan. In total, we have 11,971 loans (or 3.3% of the total) with negative borrowing costs in the sample. Most of the loans with negative borrowing costs coincide with the 2007 Credit Crunch from August 2007 until December 2007. This can be seen in Figure 2, which shows that the borrowing cost of the bottom quintile becomes negative after July 2007. Of the 11,971 loans with negative borrowing costs, 8,832 of them occur between August and December 2007, of which 7,960 are on only 26 different days.

There is more than one possible reason why the cost of borrowing is negative for some bond loans. It is possible that the reported one-month commercial paper rate, which we take from the Federal Reserve Board's website, is not representative of the true market conditions for all days. This is particularly true for those days with very large intra-day interest rate movements. During the 2007 Credit Crunch, the Fed eased credit and dropped the Fed Funds rate several times, causing the commercial paper rate to fall as well. It is also possible that the proprietary lender is slow to respond to changes in credit conditions.

Finally, it should be noted that during the Credit Crunch in the last half of 2007, the Fed's intervention caused short-term rates to fall substantially below medium-term rates. If the reinvestment rate on collateral received by the lending institution is above short-term rates, the lender can still make a profit on their bond loans even with negative borrowing costs.[13] Alternatively, the Credit Crunch of 2007 may have caused borrowers of the bond to want to close out their short position and have their collateral returned. If the lender has invested the collateral in illiquid securities which have lost value, they may have difficulty in returning collateral on demand. In this instance, they may subsidize borrowers to avoid reducing their collateral pool. This scenario was reported in the financial press and a number of lenders

[13] Our loan database provides a reinvestment rate which the lender estimates they will receive on the collateral. This rate is not constant across all loans or even across all loans on one particular bond at a point in time. The reason for this is that the lender invests the collateral in a number of different funds at the direction of the bond's owner. These funds can have a different duration and risk than that represented by investing short term at the commercial paper rate. We ignore these reinvestment rates when calculating borrowing costs since they do not represent the opportunity cost of the borrower's collateral.

reported losses on their collateral during this period.[14] To determine if the market for lending bonds in the period July to December 2007 is different, we examine this time period separately in Section 9.

Regression Analysis of Borrowing Costs

Although we know that borrowing costs are lower in 2006 and 2007 than they are in 2004 and 2005 and that borrowing costs are dependent on the size of the loan, the credit rating of the bond, and the available inventory to borrow, it is hard to determine the relative importance of these factors from the univariate comparisons we have made so far. We next conduct a multivariate analysis, which allows us to simultaneously control for the factors we have examined.

Even though bond loans are fully collateralized, bond characteristics may affect borrowing costs because they reflect supply and demand conditions. A bond's time since issuance may be important if it affects how widely the bond is held, and thus how difficult it is to locate, or if investor beliefs become more heterogeneous the longer the bond is outstanding. The availability to borrow may also be proxied by whether the debt is public or private (Rule 144a), as private debt may be harder to sell short. Smaller issue size may also make the bonds harder to find, increasing borrowing costs. Another factor is whether the bond is fixed or floating rate. Floating rate bonds re-price with interest rate movements and are thus less likely to deviate from par.

In addition, a bond's rating may be an important determinant of borrowing costs. As stated earlier, high yield bonds might attract more shorting activity because they are more likely to deviate from par than investment grade bonds. In our sample, 5.0% of the inventory for investment grade bonds is lent out, while for high yield it is 13.7% of inventory. Moreover, ratings will impact borrowing costs if lower rated bonds are in short supply. For our lender, investment grade bonds represent 70.8% of inventory, while high yield bonds are 29.2%. This 29.2% is under-represented (relative to FISD), where high yield bonds constitute 43.5% of the FISD universe.

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[14] See Weiss, "AIG to Absorb $5 Billion Loss on Securities Lending," *Bloomberg News*, June 27, 2008 and Karmin and Scism, "Securities-Lending Sector Feels Credit Squeeze," *Wall Street Journal*, October 30, 2008. Also, see State Street Press Release on July 7, 2010, "State Street Records Second-Quarter After-Tax Charge of $251 Million, or $0.50 Per Share."

Borrowing costs may also differ for a given bond because of loan characteristics. A larger percentage of bonds already on loan may lead to higher borrowing costs. In addition, holding inventory constant, larger loans may have lower borrowing costs if there is a size discount. Further, borrowing costs may differ by borrower if the lender either gives a discount to large volume borrowers or if some borrowers are more knowledgeable about the lending market than others.

Our regression model incorporates the data on bond characteristics from Table 2 as well as on loan percentage, loan size, and loan initiation day dummies. In some specifications, we also include dummy variables for each bond's CUSIP and the identity of the borrowing broker. The CUSIP controls allow us to examine how pricing varies across loan market variables, while fixing bond characteristics. Since daily inventory data is only available after March 2005, the regression analysis covers the period April 2005 through December 2007. The models we estimate are variations of the following model for the borrowing cost of loan *i* on bond *b* on day *t*:

$$\text{Borrowing Cost}_{ibt} = \text{CPrate}_t\text{-RR}_{ibt} = \beta_1\text{*on loan \%}_{bt} + \beta_2\text{*loan size}_i + \beta_3\text{*rating}_{bt} + \beta_4\text{*issue size}_b + \beta_5\text{*time since issue}_{bt} + \beta_6\text{*floating rate}_b + \beta_7\text{*rule144a}_b + \delta_t + \kappa_b + \lambda_{broker} + \varepsilon_{ibt},$$

where CPrate is the one month financial commercial paper rate (in our model 100 basis points = 1.00) and RR is the rebate rate (with the same scale as the CPrate). The on loan % is the percentage of daily inventory already lent, and loan size is the total number of bonds lent in thousands of bonds (that is, the loan value in $ millions). Rating is the bond's S&P rating at the time of the loan (where AAA is given a value of 1, D is given a value of 22, and all intermediate ratings are given consecutive values between 1 and 22). Issue size is the size of the initial bond offering (in $100 millions). The time since issue variable is the time since the bond was issued (in years). The floating rate variable is a dummy variable equal to 1 if the bond pays a floating rate coupon and 0 if the bond has a fixed rate coupon. The Rule 144a variable is a dummy variable equal to 1 if the bond was issued under SEC Rule 144a and 0 otherwise. δ_t represents a set of dummies for each trading day in the sample. κ_b represents a set of dummies for each bond CUSIP in the sample, and λ_{broker} are a set of dummies for each unique borrower in the sample who borrows 100 or more times during our sample period.[15] We report heteroscedasticity-robust standard errors.

Table 6 reports estimates from four specifications of the regression: one without broker or bond CUSIP dummies, one with broker dummies, one with bond CUSIP dummies, and one with both broker and bond CUSIP dummies. The specifications with bond CUSIP dummies do not include issue size, floating rate, and Rule 144a since these characteristics are completely captured by the bond-specific controls. We also exclude time since issuance when we have bond and date controls since these controls together capture nearly all of the variation in this variable.

In all four specifications the on loan % coefficient is positive and significant. In the two specifications without CUSIP dummies, the coefficient is 26.30 without broker dummies and 26.23 with broker dummies. When we add the bond-specific controls, the estimates fall to 3.19 and 4.38.The coefficients are reduced because the bond-specific controls pick up much of the variation in bond inventory. Still, consistent with the pattern we observed in Figure 3, the larger the percentage of the inventory lent, the higher the borrowing cost. Increasing the percentage lent by 10% is associated with an increase in borrowing costs by 2.6 bps across the sample of all bonds. For a specific bond, a 10% increase in on loan percentage is associated with an increase of 0.3 to 0.4 bps on average.

Loan size is negative and significant in each specification. Our regression results on loan size show that the larger the loan, the lower the borrowing cost. The magnitude of the coefficient is economically large and similar across all four regression models, ranging from -1.36 to -2.16. This means that adding 1,000 bonds to loan size decreases borrowing costs by 1.36 to 2.16 bps.

The coefficients on bond ratings are positive and significant in all four specifications. The lower rated the bond, the higher the borrowing costs. The magnitude of the estimate is larger when we include bond-specific controls. For the specification in column (4), with broker and CUSIP dummies, the estimates imply that a full letter downgrade raises borrowing costs by 9.69 bps (three times the regression coefficient estimate of 3.23).

[15] Our lender identifies 65 borrowers. 40 make 100 or more loans and 25 make less than 100 loans during our sample period. The average number of loans made by the largest 40 is 9,178 and the average made by the smallest 25 is 25. Restricting our sample to the period covered by the regression, there are a total of 62 borrowers, 38 of whom make 100 or more loans.

The estimated coefficient for issue size is small, but positive and significant for the first two specifications. Issue size must increase by $300 million for borrowing costs to increase by 1 bp. The coefficient on time since issuance is positive and significant in the two specifications, implying that the longer a bond is outstanding, the higher the borrowing cost. For every year a bond is outstanding, the borrowing cost increases by 0.7 bps.

The last two bond characteristics from Table 2 are indicators for floating rate bonds and for whether a bond is Rule 144a. The estimates imply that fixed rate bonds are almost 6 bps more expensive to borrow than floating rate bonds and that the borrowing costs for Rule 144a bonds are about 3 bps more expensive.

The identity of the borrower who initiates a loan is also important in determining borrowing costs. The proprietary database only allows us to observe the borrowing broker (or hedge fund); it does not allow us to determine the final party undertaking the short sale transaction. In the database each bond is lent to one of 65 unique brokers who then either delivers the bonds to their own institutional and retail clients for short selling or keeps them for its own account.

The specifications in Table 6 columns (2) and (4) include 38 broker dummies, each of which borrowed 100 or more bonds from April 2005 to December 2007. For both specifications, we can reject the hypothesis that all broker coefficients are zero. The difference between maximum and minimum broker coefficients and the 75th and 25th percentile broker coefficients are also reported. In column (4), the "best" broker receives borrowing costs 59 bps less than the "worst" broker. This means that on the same day for the same CUSIP and loan size, the lowest cost broker is able to borrow at a rate 59 bps lower than the rate for the highest cost broker. This difference is considerably larger than the average borrowing cost of 33 bps as reported in Table 4. The difference between the 75th and 25th percentiles is 20 bps. Both are statistically significant.[16]

Table 7 further explores whether some brokers obtain lower borrowing costs. We examine all days where two or more brokers borrow the same bond. Requiring that a broker "compete" with another broker on the same day at least 100 times restricts us to consider 26 brokers. For this group, we rank each broker's "performance" on that day for that bond by

[16] While we find differences in costs across borrowers, Kolasinki, Reed, and Riggenberg (2010) find significant differences in costs across lenders for the equity lending market.

evaluating whether they received a lower, higher, or the same borrowing cost as another competing broker.[17] Those results are summarized in Table 7 and show that some brokers receive consistently lower borrowing costs. We ran two sets of "competitive" races per borrower. One set was between two brokers only; the second set was between three or more brokers. The top-rated broker received the lowest borrowing cost for any given day and bond 92.5% of the time when there were two brokers and 78.9% of the time when there were three or more brokers for the same bond on the same day.

The two winning percentages of the top-rated broker are both significant using the sign test. In fact, the top eight brokers all have winning percentages which are significantly greater than 50% at the 1% level when "competing" with one other broker and significantly greater than 33% when competing with two or more brokers. This success in the competitive races is not dependent on the number of loans or the amount borrowed by the borrower. Rank order correlations between placement in the competitive races and either the number of loans or the dollar amount of the bonds borrowed are not significant. Furthermore, the differences are not due to differences in the credit quality of brokers. Using broker bond ratings from S&P and 5-year CDS spreads from Markit, there is no significant relationship between either and broker rank in the competitive race.[18] Thus it appears that differences in borrowing costs between borrowers reflect differences in market knowledge and abilities to negotiate borrowing costs.[19]

To summarize, the borrowing cost regression results in Table 6 show that a smaller loan size, a higher percentage of inventory lent, and a lower bond rating lead to higher borrowing costs. These results hold for all four specifications of the model, although the coefficients for on loan percentage are weaker when CUSIP dummies are included. Finally, the identity of the borrowing broker significantly influences borrowing costs, both in aggregate and when comparing loans for the same bond, regardless of the broker's volume.

Borrowing Costs Around Credit Events

We next look at borrowing costs in the 30 days before and after significant credit events. The events we examine are bankruptcy filings and large credit rating changes. We define a large

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[17] The last line of Table 7 with Broker ID "Remainder" is a summary line that consolidates the other 39 brokers as one competitor. The competitive race results in columns 5-8 represent contests between the combined 39 brokers and any of the 26 brokers above. It does not include contests that the 39 remaining brokers have with each other.

[18] We only found ratings and CDS spreads for 15 and 17 of the 31 brokers, respectively.

[19] Each unique broker's identity is available to us from the proprietary database, although we are not allowed, for confidentiality reasons, to disclose it. The differences in borrowing costs are consistent with our perceptions of reputation.

credit rating change as a movement of three or more S&P ratings, or one full letter or more, e.g. going from an A+ to a B+ or from a BB- to an AA-. There are 241 bonds in the inventory database of corporate bonds involved in a bankruptcy, representing 93 unique bankruptcies. However, only 88 bonds have lending activity during the period from 30 trading days before until 30 trading days after the bankruptcy, which corresponds to 42 unique bankruptcies.

The average borrowing cost of these bonds for each of the 61 days is plotted in Figure 4. Since there are new loans for only 2.9 bankrupt bonds per day in the period -30 to +30 days around bankruptcy, we expand the sample by including old loans (which, as we discussed above, are re-priced). This expands the number of bonds per day in Figure 4 to an average of 60. However, not all bonds have a loan outstanding for all 61 days. We have also done the analysis only on new loans and only on bonds that have loans for all 61 days. Although there are far fewer observations, the results are qualitatively similar.

Figure 4 shows that bond borrowing costs are high for the entire period from -30 days to +30 days, where Day 0 is the bankruptcy filing date. The average equally-weighted bond borrowing cost for firms that file bankruptcy is 173 bps during the 30 days before filing. This is substantially greater than the average 33 bps reported for all new loans in Table 4 and indicates that these bonds are difficult to borrow before bankruptcy. After bankruptcy, bond borrowing costs increase further to an average of 245 bps for the 30 days after the filing. Thus, the borrowing costs indicate that short sellers identify firms in financial distress prior to bankruptcy, but the bankruptcy filing is not completely anticipated since borrowing costs rise after that date.

In Figure 5, we report a similar analysis for large bond downgrades and upgrades. There are 292 full-letter upgrade events on bonds in the inventory, covering 281 unique bonds as some bonds have multiple upgrades. Our loan data covers 125 of these events, which correspond to 122 unique bonds. The plot for these upgrade events shows that the average upgraded bond borrowing cost is close to the average for all bonds before the upgrade and does not vary much after the rating change. The average borrowing cost for the 30 days before the upgrade is 29.9 bps, and the average borrowing cost for the 30 days after the upgrade is 32.1 bps.

The bond borrowing costs for downgrades are much lower than those for bankruptcies, but are above the average of all bonds and increase after the downgrade. There are 381 full-letter downgrade events during our time period on 356 unique bonds. The data covers 206 of these events on 193 bonds. The average borrowing cost for the bonds involved in a full-letter downgrade is 38.4 bps in the 30 days before the downgrade and 52.3 bps in the 30 days after the downgrade. It is important to remember that all downgrades are included, including those between investment grades, i.e. from an A+ to a BBB+, and thus all downgrades do not signal financial distress.

Thus, Figures 4 and 5 show that bankruptcies and large credit downgrades increase a bond's borrowing cost, while large credit upgrades do not decrease a bond's borrowing cost. The reasons for these changes in borrowing costs around bankruptcies and downgrades are difficult to discern. Although not shown, for bankruptcies, the supply of bankrupt bonds in inventory falls by 12.5% in the 30 days after bankruptcy is announced compared to the 30 days before. That is, our lender has 12.5% less bonds to lend. The amount lent also falls after bankruptcy by 23.9% comparing 30 days after to 30 days before. Hence, while the cost of borrowing bankrupt bonds increases, we cannot definitively rule out that the reason is a decrease in supply versus changes in demand. For downgrades, however, the amount of inventory actually increases by 4%, and the quantity of bonds borrowed increases by 6%. Since the cost of borrowing also goes up after downgrades, we can infer that there is increased demand for borrowing these bonds.

6. Relationship between Bond and Stock Shorting

Matching Bonds and Stocks

We next investigate how the market for shorting corporate bonds is related to the market for shorting stocks. If the purpose of borrowing securities is to short the firm, we expect the two markets to be integrated. As mentioned above, given the priority of claims, the stock of a firm should lose its value before the debt, suggesting that investors who wish to express a negative view about the firm may prefer to short stocks. This is consistent with loan activity by our proprietary lender who made 367,751 bond loans and made 7,241,173 stock loans during our sample time period.[20]

To understand how the market for shorting corporate bonds is related to the market for shorting stocks, we matched each firm's bonds to its corresponding common stock. We match

[20] The stock loan database has some borrowing costs that are suggestive of data errors. In particular, there are stock loans that occur at large negative borrowing costs, implying that borrowers were being paid a significant amount to borrow the stock. We eliminate the 53,481 stock loans with borrowing costs below -5%. Also, there are some stock loans at high borrowing costs which would require that a significant amount of the borrower's collateral would be consumed by lending fees. We eliminate 4,883 stock loans where the borrowing cost is greater than or equal to 6% if that is the most expensive loan for a stock on a given day and the borrowing cost for the next most expensive loan for that stock on that day is no more than 3 times the general collateral rate.

the first 6 digits of the bond CUSIP to the first 6 digits of the common stock CUSIP. This match was not complete since many of the bonds in the dataset are subsidiaries or private firms and thus have 6 digit CUSIPs which do not directly correspond to a common stock CUSIP. To add the subsidiary bonds (which may have a different 6 digit CUSIP), we hand matched the remaining bonds using SEC filings and CUSIP.com. To avoid potential biases that hand matching may introduce, we analyze our results for both methods separately, i.e. those that were matched with 6 digit CUSIPs versus those which were hand matched. There are 15,493 bond CUSIPs in the inventory file. We were able to match 11,591 bond CUSIPs, 5,997 using the 6-digit CUSIP match, and an additional 5,594 were matched by hand. We found no significant differences in results between the two subsamples.

Another matching problem is that there are many firms with multiple bond issues. For instance, there are 124 different GM bonds in inventory, and we want to relate the borrowing costs of all of those bonds to the cost of borrowing GM's common stock. We group all issues of bonds together for this analysis. The reason we group in this way is that for any given day, within the same firm, bond rebate rates are close. When different bonds from the same firm have a new loan on the same day, the median absolute value of the difference in bond borrowing costs is zero bps. This means that for more than half the firm-day observations, the borrowing costs are the same for all bonds of a given firm. Furthermore, the 75th percentile of this distribution is only 4 bps.

As a result, for our bond and stock analysis, if a firm has more than one new bond loan on a given day, we aggregate the borrowing costs across all bonds and all new loans by computing a value-weighted median borrowing cost. Likewise, for stocks we take the median stock borrowing cost for new loans weighted by shares lent. Hence the unit of observation in this section is a matched firm-day, corresponding to a firm's median value-weighted borrowing cost across bonds and the firm's median value weighted stock borrowing cost.

There are 336,449 bond loans which are matched to a stock in our sample. This represents 91.5% of all bond loans. There are 2,304,127 stock loans which are matched to a bond in our sample, which is 31.8% of all stock loans. Thus, it is much more likely that a bond loan occurs in conjunction with a stock loan, than vice versa.

Comparison of Bond and Stock Borrowing Costs

Figure 6 plots the equally-weighted distribution of stock loan borrowing costs over time by quintile for matched stock loans. It is comparable to Figure 2, which plots a similar time series for bond borrowing costs. Comparing Figure 6 to Figure 2 shows that the 20th and 40th percentiles of bond and stock borrowing costs are similar. However, the 60th and 80th percentiles of stock borrowing cost are less expensive than bonds until mid 2006. At that point, there is a compression in the distribution of stock borrowing costs generated by the large drop at the top quintiles. This compression occurs at the same time as the compression in bond borrowing costs discussed extensively above and seen in Figure 2. After mid 2006, stock and bond borrowing costs are similar at all quintiles.[21]

To compare borrowing costs for stocks and bonds within a firm, it is necessary to impose the restriction that stock and bond loans occur on the same day. This restriction reduces our sample to 238,940 bond loans and 316,216 stock loans, corresponding to 113,548 matched firm-days.

For most firms, there is a fixed link between bond and stock borrowing costs. In particular, the difference between stock and bond borrowing costs is one of six distinct values: -10 bps, -5 bps, -1 bp, 0 bps, +35 bps, and +40 bps for 75.5% of the firm-days in the matched sample. This is seen in Figure 7, which plots the percentage of loans in the matched sample in each of these six categories over time.

The largest category in Figure 7 is new bond loans with borrowing costs 1 bp below new stock loans. For the matched loans, this category accounts for an average of 39.4% of observations. This 1 bp difference is impossible to explain if bond and stock borrowing costs are not related. There are two other major fixed borrowing cost differences where bonds are cheaper to borrow than stocks. They are -5 bps and -10 bps, which average 14.0% together.

The second largest category of fixed borrowing cost differences is bond loans with borrowing costs 35 bps more expensive than stock loans. This relationship changes, however, during our sample period. For the period from December 2004 until March 2006, the mean number of observations in this category is 22.8%. For the period from April 2006 until December 2007, the mean number in this category is 6.7%. This drop is clearly shown in Figure 7 and April 2006 appears to be a fundamental shift in the pricing relationship between bond and

[21] The extreme values of stock borrowing costs are significantly greater than those of bond borrowing costs throughout the period. For example, the borrowing cost for the 35th most expensive stock loan is still three times the most expensive bond loan shown in Table 5.

stock loans. Moreover, the +40 bps category, where bond loans are 40 bps more expensive than stocks, disappears by June 2006. These changes coincide with the reduction in the premium charged for small bond loans in April 2006, as described in Section 4.

There is a category that expands dramatically after March 2006: bond and stock loans that have the same borrowing cost. Before March 2006, the average percentage of matched loans in this category is 0.2%, while after March 2006, it is 7.1%. The percentage of loans in this category expands exactly when the percentage of loans in the +35 bps category decreases, although not by equal amounts. The -1 bp category also increases after March 2006.

While Figure 7 graphs the differences in bond and stock borrowing costs, Table 8 considers these differences by credit quality and compares expensive bond and stock loans. The first part of Table 8 confirms Figure 7 and shows that 63.7% of loans in the matched sample have borrowing costs within 10 bps of each other. There is no significant difference between investment grade firms and high yield firms which have 63.6% and 64.0% of matched loans within 10 bps of each other respectively for the sample period.

For expensive matched loans the borrowing costs are not close to one another; the stock loan is more likely to be expensive. In particular, only 1.3% of all matched bond loans are over 100 bps, while 6.2% of matched stock loans are over 100 bps. Furthermore, if a bond borrowing cost is more than 100 bps, 15.6% of matched stock borrowing costs also costs more than 100 bps. For the converse, if a stock borrowing cost is more than 100 bps, only 3.2% of the matched bond borrowing costs are over 100 bps. This means that it is more common for stocks to be hard to borrow (as measured by borrowing costs) than it is for bonds. Furthermore, when a bond is harder to borrow, the stock is more likely to be as well. While not definitive, this pattern is consistent with stock borrowing activity leading bond borrowing activity.

These aggregate differences in stock and bond loan percentages are largely driven by high yield bonds. Only 0.3% of all matched investment grade bond loans are over 100 bps, while 3.0% of all matched high yield bond loans are over 100 bps. For matching stock loans there is little difference between investment grade and high yield (6.0% vs. 6.4%, respectively). In addition, for investment grade bonds if a stock borrowing cost is more than 100 bps, only 0.4% of bonds are greater than 100bps, whereas for high yield bonds, the corresponding number is 7.6%. This indicates that loan costs are more likely to be linked for high yield securities, which is consistent with high yield bonds serving as substitutes for stocks when stocks are expensive to borrow. These patterns also hold for borrowing costs greater than 75 bps. Finally, since borrowing costs for stocks are insensitive to investment grade status, while borrowing costs for bonds are, supports credit quality as an important determinant of borrowing activity for bonds.

To summarize, there are three main results on the relationship between bond and stock market shorting. First, most bond and stock loans for the same firm differ by one of six fixed amounts, which do not depend on the day of the loan. For example, the most common differences in borrowing costs between bonds and stocks, which are -1 bps and +35 bps, constitute 55.1% of the matched sample. Second, bond borrowing costs are very close to stock borrowing costs for most matched loans. For matched bond and stock loans from the same firm on the same day, 63.7% of the borrowing costs are within +/- 10 bps of each other. Finally, if neither the bond nor the stock is hard to borrow, they are priced very similarly. However, on a day when a stock is expensive to borrow, bonds from the same firm are usually not, and vice versa. This suggests that for low levels of borrowing costs bond and stock lending markets are similar, but when borrowing costs are high the bond and stock lending markets are fragmented.

7. Returns to Shorting Bonds

In the last two sections, we calculated bond borrowing costs, described their cross-sectional and time-series distribution, and examined some of their important determining factors. In this section, we perform similar analysis on the returns to shorting bonds. As mentioned above, we do not know if all borrowed bonds are necessarily shorted, but for the purposes of this section we assume they are. The literature on stock shorting that uses proprietary lending databases makes a similar, although usually unstated, assumption. The literature on shorting stocks infers that excess returns from highly shorted stocks imply the existence of private information among short sellers and/or borrowing constraints. We make the same inference for the market for shorting bonds.

To calculate bond returns over any holding period, it is necessary to have bond prices at the beginning and end of the period. Following the approach of Bao and Pan (2010) we match the proprietary databases of bond inventory and loans to the FISD TRACE database, which provides transaction bond prices. The number of bonds covered in TRACE increased during our sample period. This increase ostensibly extended TRACE's coverage to all US corporate bonds by February 7, 2005. Even with universal TRACE coverage, there are difficulties in computing bond returns. (See Bessembinder, Maxwell, Kahle and Yu (2010) for the difficulty of working with bond returns in general and TRACE in particular.)

We calculate bond returns with the following formula:

return = (sale price – buy price + sale accrued interest – buy accrued interest + coupons paid) / (buy price + buy accrued interest).[22]

In this formula, the return is computed from the point of view of a long holder of the bond. That is, the returns are positive if the bond prices increase. A short seller of the bond, therefore, benefits if the return is negative. In the formula, sale and buy prices are "clean", meaning net of accrued interest, which is the way prices are reported in TRACE. In some databases bond prices are "dirty", meaning they include accrued interest, and the above formula has to be modified appropriately.

Of the 10,293 bonds that are ever loaned in the bond loan database, 8,212 bonds have at least one TRACE price observation, and 8,033 have at least ten TRACE price observations. Since a bond must only be delivered to a buyer within three trading days after a short sale, a bond loan does not always occur on the same day as the linked trade. They can either be located first and then sold short, or sold short and then located within 3 days after the sale. Of the 367,751 bond loans during the sample period, 301,167 have TRACE prices both within three days before or after the initiation of the loan and three days before or after the loan's termination.[23]

The fact that bonds do not trade every day and that short sales may occur on different days than the bond loans complicates calculating holding-period returns. As a result, our approach to calculating monthly returns for a bond is not precisely over thirty days because the bond may not trade exactly one month apart. We compute a monthly bond return when a bond has a trade in two consecutive calendar months. If there is more than one bond trade in a calendar month, we use the price of the last trade in that month. If there are multiple bond trades on this day, we use the trade-size-weighted median price for the day. Following Bessembinder, Maxwell, Kahle, and Yu (2010) we exclude bond trades that are cancelled, modified, or include commissions. An equally-weighted monthly portfolio return is then calculated by equally

[22] This is Bessembinder, Maxwell, Kahle, and Yu's (2010) formula with a correction for a typographical error in that paper.

[23] After February 7, 2005 when TRACE's universal coverage became effective, 245,508 out of 277,220 bond loans have TRACE prices both three days before or after the initiation of the loan and three days before or after the loan's termination.

weighting the monthly returns of the individual bonds in the portfolio. We also calculate an issue-size value-weighted monthly portfolio return by weighting monthly returns by the bond's issue amount. Weekly returns are calculated in a similar manner.

Returns to Portfolios of Shorted Bonds

In Table 9, we form monthly portfolios of bonds sorted by either percent of inventory on loan or borrowing cost. Panel A reports the returns from taking long positions in portfolios of bonds based on the percentage of inventory lent as of the last day of the month. The first two rows of Panel A report the monthly returns for portfolios of bonds that are not lent as well as those that are. In addition for each month, we calculate on loan percentage quintiles and assign the lent bonds to one of five portfolios. We also construct portfolios of bonds in the 95th and 99th percentiles of the on loan percentage distribution. These portfolios are formed conditional on the bonds being lent; that is, e.g, the 95th percentile portfolio is only selected from the universe of lent bonds. We report four different one-month returns for these portfolios.

In column 1, we report the number of bonds in each portfolio. Quintile sizes are not exactly equal because some values of on loan percentage are identical. Column 3 reports the equally-weighted raw portfolio return, while column 7 reports equally-weighted excess portfolio returns. Columns 5 and 9 report issue-size value-weighted raw and excess portfolio returns.[24] We calculate excess returns by subtracting equally-weighted and issue-size value-weighted TRACE index returns from the corresponding portfolio's raw returns.[25]

The results in Table 9 Panel A show that there is no significant difference in the raw or excess returns between portfolios of bonds that are not lent and those that are lent. In fact, the mean issue-size value-weighted excess return in column 9 for the portfolio of lent bonds is -0.02%. Moreover, Panel A does not support the hypothesis that bonds which have higher on loan percentage are more likely to have lower returns in the future. In fact, both the equally-weighted and issue-size value-weighted returns for the 5th quintile, which has the highest amount

[24] We calculated value-weighted returns several ways including using the bond price times issue size as the weight. This results in no significant differences relative to the discussion below.

[25] It is customary to use the Lehman Brothers (now Barclays) Corporate Bond Index when calculating bond excess returns (see, e.g., Bessembinder, Maxwell, Kahle, and Yu (2010) and Bao and Pan (2010)). While we also used this benchmark, we calculated a separate TRACE bond index using corporate bond prices from TRACE that were also in our FISD sample. We do this for two reasons. First, the Lehman Index uses matrix pricing while our TRACE index uses transaction prices. Second, the Lehman Index is a single aggregate number and does not match as closely our sample, e.g., the Lehman Corporate Bond Index does not include high yield bonds, but we include them in our TRACE index, since they are in our sample.

lent, are larger than those for all of the other quintiles in columns 3, 5, 7, and 9. Across quintile portfolios, the equally-weighted portfolio excess returns in column 7, though mostly negative, are small, and the issue-size value-weighted portfolio excess returns in column 9 are all within 8 bps of zero. Finally, the standard deviations of all portfolios returns, both equally- and issue-size value-weighted, are much larger than the means. As a result, none of the excess returns are significantly different from zero or from each other.

In Panel B, we form monthly portfolios based on the borrowing cost of the bonds. The first row of the Panel reports returns for all new loans. Each bond is then assigned a borrowing cost equal to the borrowing cost of the last new loans in the month, median-weighted by loan size. Then, for each month we calculate borrowing cost quintiles and assign bonds to one of the five portfolios. As in Panel A, we report one-month returns for these portfolios as well as for portfolios that include only bonds in the 95th and 99th percentiles of borrowing costs. Panel B has fewer observations than Panel A because it includes only bonds with new loans, whereas Panel A includes bonds with existing loans.

The results in Panel B do not support the hypothesis that bonds which are more expensive to borrow are more likely to have lower returns in the future. The 95th and 99th percentile portfolios have the highest borrowing costs, but they also have the highest average returns across all measures. Furthermore, the returns for the quintiles are not monotonic. Overall, the results in Panel B parallel those in Panel A: there are no significant results for any of the portfolios or any of the differences between the portfolios.

Table 9 shows that none of the portfolio returns or differences in Panels A or B are statistically significant. That is, neither the bond's on loan percentage nor the borrowing cost predicts future returns. Although not shown, we also calculated one week, two week, and three-month returns for all of the portfolios in Table 9. In no instances were any of the excess returns significantly different from zero. In addition, we also did the analysis in Table 9 split into investment-grade or high-yield bonds. Neither of those results are significantly different from zero, nor are they statistically different from each other.

Profitability to Short Sellers of Corporate Bonds

Table 9 indicates that shorting portfolios of bonds with high on loan percentage or high borrowing costs are not strategies that yield abnormal returns to short sellers. These results are based on shorting portfolios of bonds that are already highly shorted. They may indicate, but do not accurately measure, whether short sellers made money on their short positions. To evaluate the profitability of actual short trades, we must know the period the short position was held, and we must net out the borrowing costs and the overall movements in the bond market. The bond loan database, which has the start and end date of bond loans and their borrowing costs, allows us to undertake this analysis.

To calculate short sellers' profitability, we compute a return on capital net of coupons paid, accrued interest, and borrowing costs. We assume that the beginning and ending dates of a short position are the same as the beginning and ending dates of a bond loan. Since corporate bonds do not necessarily trade every day, we take as the starting price the TRACE price closest to the loan's actual start date in the period three trading days before until three trading days after the loan's initiation. The ending price is computed analogously. If there are multiple trades in one day, we take the trade-size-weighted median price of all trades that day.

Loans where the nearest trades are more than three days removed from either the loan start or end date are eliminated. We also eliminate loans where the starting and ending dates are matched to the same TRACE trade. This can occur if the loan is short term and there is only one reported TRACE trade during the time period from three days before the initiation until three days after loan termination. The profit from each loan, net of borrowing costs, accrued interest, and coupon payments, is then summed to obtain aggregate short sellers' profits over some period. This amount is then divided by the average capital invested during that period. Average capital invested is the summed daily par value of new and old outstanding loans divided by the number of days in the time period. Thus, the net return on capital is calculated as total net profit divided by average capital invested over a time period.

As an example, for the entire four-year period, the total profit assuming all borrowed bonds were shorted is -$2.4 billion, which is a loss for short sellers. The borrowing cost for all loans over the same period totaled $112 million. The average amount of bond loans outstanding per day is $12.4 billion.[26] Thus, the average monthly return over the four-year sample period is -48 bps. This is consistent with positive monthly returns to long portfolios of shorted bonds in Table 9. For example, in Panel A, the raw portfolio returns for equally-weighted and issue-size value-weighted for all lent bonds are both 40 bps, and in Panel B, the comparable returns for all

[26] This number differs from the average daily par value of bonds on loan in the lender inventory in Table 1 because we only compute profits when we have both beginning and ending TRACE prices, and the loan must begin and end during our four-year period.

new loans are 43 bps. These values do not account for the average 2.8 bps monthly borrowing cost.

We next evaluate short seller profits by several loan characteristics, including loan size, duration, and borrowing cost. Loan size and duration do not substantively change the result reported above, but borrowing costs appear to be responsible for some variation in short seller profits. The return on capital for loans where the borrowing cost is greater than 100 bps is substantially lower than the return on loans where the borrowing cost is less than 100 bps. The return on capital is -123 bps per month for the more expensive loans and -46 bps per month for the less expensive loans. Even though borrowing costs are higher for the more expensive loans, they only account for 31 bps of the difference. This finding of larger losses for high borrowing cost loans parallels the finding of high positive returns for the 95th and 99th borrowing cost portfolios in Table 9.

Table 9 shows that portfolios formed on the basis of bond shorting activity do not earn significant excess returns. Examining realized profits from the actual short trades indicates that short sellers do not have private information. In fact, the average monthly return for short sellers is negative and almost the opposite of the returns from holding the bond market. This result is consistent with short selling being used as a hedging activity with short sellers paying for the hedge.

8. Relationship between the Market for Shorting Bonds and the CDS Market

Rather than shorting a bond, another way for an investor to profit from a bond price decline is to purchase a credit default swap. This is similar to a stock investor purchasing a put. Unlike the options market for equities, which is smaller in notional amount than the stock market, the notional amount of the CDS market has become larger than the market value of corporate bonds. In mid 2009, the par value of corporate bonds was $6.8 trillion, while the notional principal amount of CDS on corporate debt was $12.1 trillion.[27]

There is a documented link between shorting stocks and the equity options market. Many dealers who write equity puts hedge their positions by shorting stocks. There is also a link

[27] Corporate bond value is from Securities Industry and Financial Markets Association (SIFMA), and CDS market value is from Depository Trust and Clearing Corporation (DTCC). This data is from 2009 because we are unable to find the breakout of corporate debt CDS during our sample period. The par value of outstanding corporate bonds in 2007 is $7.2 trillion.

between option put-call parity and shorting constraints in the stock market (see, for example, Figlewski and Webb (1993) and Ofek, Richardson, and Whitelaw (2004)).

We use Markit as the source for the CDS data. Markit collects data from various financial institutions, inter-dealer brokers, and electronic trading platforms. The data consist of daily CDS spreads for reference securities. Each CDS contract is assigned a REDCODE number by Markit, which we then map to individual bond CUSIPs. Because of cross-default provisions, CDS contracts can correspond to more than one bond for any given firm. As a result, we ultimately match individual CDS to multiple bonds based on the first six digits of the bond CUSIPs.

Of the 15,493 bonds in the lender's inventory, we are able to match 7,033 (45.4%) to a CDS. The percentage of bonds lent with a CDS is higher: of the 10,293 bonds ever lent, 5,540 (53.8%) had a corresponding CDS at some point during our sample period. Furthermore, of the 367,751 new loans in the sample, 77.8% are of bonds with CDS. Thus, inventory bonds matched with CDS are more likely to be lent and constitute a much larger fraction of new loans. This suggests that there are common factors that determine which bonds have CDS contracts and which bonds are lent.

We next use the bond characteristics in Table 2 to examine the differences between bonds with CDS and those without. Lent bonds with CDS tend to be larger and have much higher credit quality than lent bonds without CDS. For example, 70.7% of the lent bonds with CDS are investment grade at the time of the loan, while only 50.4% of the lent bonds without CDS are. Examining loan size and duration in a manner similar to Table 3, we find that loans on bonds with CDS have similar sizes and median duration to those without. Importantly, the distribution of borrowing costs is almost identical between bonds with CDS and those without. For example, the mean and median equally-weighted borrowing costs for bonds with CDS are 33 and 19 bps, while they are 32 and 18 bps for bonds without CDS.

When we include an indicator for CDS in the borrowing cost regression presented in Table 6, we find that the presence of a CDS results in a significant increase in borrowing costs of 1.5-2.0 bps and has no discernible impact on the relative importance of the other factors we previously examined. This cross-sectional comparison does not imply that the presence of CDS causes higher borrowing costs; rather it may reflect the fact that bonds that are most likely to be shorted are more expensive to short and, are also most likely to have a CDS contract.

To look at the impact of CDS on borrowing costs, we next examine the introduction of a CDS contract. We plot the borrowing cost on individual bonds for the 30 days before and after Markit first lists a CDS on those bonds. This time series comparison holds fixed all other bond attributes unlike the previous cross-sectional comparisons. There are 332 new CDS introductions during our sample period, representing 1,589 lent bonds. 820 of these bonds have borrowing cost data in the 61-day window. There is no noticeable change in borrowing costs over this period. The average borrowing cost for the 30 days prior to the introduction of a CDS contract is 27.2 bps, while the average for the 30 days after is 25.3 bps. There is also no noticeable increase or decrease in the amount lent. Since Markit does not collect information from all dealers, there is the possibility that CDS contracts exist for some bonds before they first appear in Markit.

In summary, bonds with CDS tend to have higher loan activity than bonds without. In addition, borrowing costs for loans with CDS are slightly higher than those without. Finally, the introduction of a CDS contract does not materially affect borrowing costs in the short term. All of these facts suggest that CDS are correlated with bond shorting, but do not substantially replace it.

9. The 2007 Credit Crunch

The Credit Crunch of 2007-2008 started in late July or early August 2007. The 3-month LIBOR-OIS rate, the difference between LIBOR and the overnight indexed swap rate, increased from 12.3 bps on August 1st to 40.0 bps on August 8th. By September 10th, the rate was 94.9 bps. The LIBOR-OIS rate is considered by many to be a "barometer of fears of bank insolvency."[28] This increase occurred shortly after Bear Stearns announced they were liquidating two hedge funds investing in mortgage-backed securities on July 31, 2007. The Federal Reserve Bank took immediate action, reducing interest rates starting in mid-August 2007.

We examine the impact of this credit market turmoil on the market for borrowing corporate bonds. Although we do not have data from the entire Credit Crunch of 2007-2008 in our sample period, we are able to investigate the first six months, from July – December 2007. In particular, we investigate the impact of the 2007 Credit Crunch on lending activity, borrowing costs, and their determinants.

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[28] Alan Greenspan quoted in Thornton (2009).

Figure 1 indicates that there was no distinguishable change in the number or par value of outstanding loans during the period July 2007 to December 2007 compared to the first half of 2007. Moreover, in Table 1, the average daily par value of bonds on loans in 2007 is $14.4 billion and the percentage of inventory lent is 7.3%. Although not shown, the average daily par value of bonds on loan for the first and second half of 2007 are both $14.4 billion, and the percentage of inventory lent changes from 7.1% to 7.5%. Both measures of loan activity are greater than those in 2006, but below the activity in 2005. The average characteristics of bonds lent reported in Table 2 also do not change between the first and the second half of 2007. The size and duration of lent bonds reported in Table 3 also do not change in any meaningful way even when dividing the sample by investment grade and high yield.

While the number of bonds lent, their characteristics, and loan size do not change in the second half of 2007, borrowing costs do. Figure 2 shows that following the March 2006 period, the distribution of borrowing costs is compressed. During the first half of 2007, the spread between the 20^{th} and the 80^{th} percentile borrowing cost averages 6 bps per month. In the second half, the spread expands and the average difference between the 20^{th} and the 80^{th} percentile is 28 bps per month. This increase in spread is due to both an increase and decrease in borrowing costs. As seen in Figure 2, the borrowing costs for the 80^{th} percentile climbs from an average of 14 bps to 28 bps. At the same time, the borrowing cost for the 20^{th} percentile falls from an average of 8 bps to 0 bps with three months showing negative borrowing costs.

This increase in volatility of borrowing costs does not affect the mean or median borrowing costs substantially. The mean equally-weighted and value-weighted borrowing costs for the first half of 2007 are 19 and 13 bps, respectively. The comparable mean borrowing costs for the second half of 2007 are 20 and 13 bps. The median equally-weighted and value-weighted borrowing costs behave similarly: they are 13 and 8 bps in the first half of 2007 and 13 and 7 bps in the second.

Borrowing costs becomes more volatile in the second half of 2007 because both components of borrowing costs, the commercial paper rate and the rebate rate, are more volatile. Although not shown, in the first half of 2007, only 6.7% of loans experienced commercial paper rate changes of at least 5 bps, while in the second half, 59.0% of loans experienced commercial paper rate changes of at least 5 bps. There is also a large increase in the percentage of loans that have a change in their loan rebate rate during the second half of 2007. For the first half of 2007 the percentage with rebate rate changes is 29.4%, while for the second half it is 63.4%. Thus, during the Credit Crunch of 2007 borrowing costs are reset more frequently than previously.

There are also a large number of loans with negative borrowing costs during the 2007 Credit Crunch period. This differs from the earlier sample period. During the second half of 2007, 17.6% of the loans have negative borrowing costs as compared to 3.4% during the first half of 2007. Interestingly, 90% of the loans with negative borrowing costs in the second half of 2007 occur on only 26 days. As discussed in Section 5, these negative borrowing costs may occur for two reasons. First, during this period short-term rates fell substantially below medium-term rates and, as a result, reported commercial paper rates may not reflect market conditions.[29] Second, these negative borrowing costs may arise if the lender is subsidizing borrowers to maintain collateral pools.

This large number of loans with negative borrowing costs is the reason why in Figure 3, where we plot borrowing costs against inventory lent, the lines for the July 2007 to December 2007 period are below the other plotted lines for most of the range. This is true for both investment grade and high yield bonds. The slope of the high yield line from this period continues to have a kink at 70%, and is similar to that of high yield lines from earlier periods.

Since the distribution of borrowing costs widens during the second half of 2007, we re-estimate the borrowing cost regression presented in Table 6 using only data from the second half of 2007. For all four specifications of the model, the coefficients for the second half of 2007 have similar magnitudes as the entire period presented in Table 6. All coefficients also remain significant.

In summary, the Credit Crunch of 2007 affected the market for borrowing corporate bonds primarily by widening the distribution of borrowing costs. The number of loans, the types of bonds lent, the size of loans, and the average borrowing costs all remained relatively stable in the second half of 2007 compared to the prior period. Thus, the change we document in March 2006 appears to be more of a structural change than that occurring during the Credit Crunch of 2007.

10. Conclusion and Implications

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[29] Our use of commercial paper rates as the market rate is not responsible for these negative borrowing costs. If we use the Fed Funds rate, loans with negative borrowing costs are still prevalent.

This paper presents the first complete examination of short selling for securities traded in an OTC market. It does this by utilizing a detailed proprietary database of corporate bond loans from 2004 to 2007. Short selling activity in corporate bonds is large and substantial. We estimate that short selling constitutes 19.1% of trading activity in the corporate bond market. This is about two-thirds of the percentage of short selling in equity markets.

Borrowing costs for corporate bonds are comparable to stocks and have become cheaper over time. The average borrowing cost of loans in the sample is 33 bps per year on an equally-weighted basis. There is a structural change in the pricing of corporate bond loans starting in April 2006 when the entire distribution of borrowing costs is compressed. As a result, the average equally weighted weighted borrowing costs by 2007 is 19 bps.

Our analysis shows that bond borrowing costs are related to loan size, the bond's credit rating, and the lender's inventory. The importance of loan size on borrowing costs diminishes over our sample period. At the beginning, the median borrowing cost of a small loan is three times that of a large loan, while by the end, loan size is no longer priced. Credit rating and inventory remain important throughout our sample period. High yield bonds are more expensive to borrow than investment grade. Furthermore, borrowing costs increase substantially following bankruptcy and bonds with credit downgrades, not involving bankruptcy, also experience increases in borrowing costs.

A bond's credit quality also impacts the relationship between inventory and borrowing costs. When the lender has greater than 70% of its available bonds lent out, borrowing costs for high yield bonds rise sharply. In contrast, borrowing costs for investment grade bonds do not depend on percent of inventory lent. This holds before and after the mid 2006 structural shift.

Another factor impacting borrowing costs is the identity of the borrower. Broker effects are significant both in our regression analysis and in our competitive broker races. Moreover, our results do not indicate that this pricing differential is due to loan volume or the credit quality of the borrowing broker.

The market for borrowing corporate bonds is linked closely to the market for borrowing stock. 63.7% of the matched borrowing costs are within +/- 10 bps of each other, and 42.6% are within 1 bp. In fact, borrowing costs for 75.5% of the matched bond and stock loans for the same firm on the same day differ by one of only six distinct amounts. The distribution of stock borrowing costs also becomes compressed starting in April 2006, like the bond borrowing costs.

After examining returns to short selling, there is no evidence that, on average, bond short sellers have private information. Portfolios formed on the basis of corporate bond borrowing costs or levels of borrowing activity do not generate excess returns. Moreover, in aggregate, bond short-sellers do not realize a profit from their trades. In addition, borrowing costs have a very small influence on overall trade performance. Finally, there is strong evidence that short sellers, on average, pay a small cost for shorting corporate bonds.

We also investigate the impact of the CDS market on the market for borrowing corporate bonds tangentially. We find that bonds that have higher lending activity are more likely to have CDS contracts. Furthermore, we find that these bonds have small, but significantly higher borrowing costs (one or two bps) than bonds without CDS contracts. These differences are after controlling for other factors such as percent on loan, loan size, and bond rating. We conclude that the CDS market is correlated with bond shorting and is not a perfect substitute.

Finally, we examine six months of the 2007 Credit Crunch and compare it to the remainder of our period. We find that the volume and average pricing of corporate bond loans do not change. We do find, however, that the distribution of borrowing costs widen substantially during this period. There may be effects of the 2007 Credit Crunch on this market that do not appear until 2008, which our analysis does not capture.

An important caveat to our work is that we only examine data from one proprietary lender. We do not know with certainty if the patterns we document are particular to our lender or are market-wide. However, given the number of bonds and the size of lending activity by our lender, our analysis applies to a large portion of the market for shorting corporate bonds.

Our results speak to the larger literature on short sale constraints and their effects on asset prices. That literature has argued that short sale constraints may generate mis-valuation. We find, at least for the sample of bonds covered by our lender, that while short selling is a large and important market activity, constraints, as measured by borrowing costs, do not have a measurable impact on corporate bond pricing. In addition, we find that shorting securities that are traded in an over-the-counter market is very similar to shorting exchange-listed securities, in particular stocks. Moreover, the fact that portfolios of heavily shorted bonds do not generate excess returns suggests that private information is not driving shorting activity. Finally, our results indicate that short selling is not responsible for the growth of the CDS market, nor is it being replaced by it.

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Table 1. Number and Par Value of Bonds in Corporate Bond Databases

Table 1 reports the number and par value of bonds in the FISD Corporate Bond, Proprietary Bond Inventory, and Proprietary Bond Loan databases for the overall period and by year. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. All data is daily except for data from the proprietary inventory database which is only available monthly from January 1, 2004 to March 31, 2005.

Panel A: Daily Average Number of Bonds

	2004 - 2007	2004	2005	2006	2007
Number of Corporate Bond CUSIPs in FISD	37,535	32,919	35,796	37,471	39,163
Number of Corporate Bond CUSIPs in Both Lender Database and FISD	7,752	7,592	7,669	7,750	7,827
Percent of FISD Represented in Lender Database	20.7%	23.1%	21.4%	20.7%	20.0%
Number of Corporate Bond CUSIPs in Lender Database and FISD That Go on Loan	2,901	2,612	2,797	2,841	3,054
Percent of Corporate Bond CUSIPs in Lender Database and FISD That Go on Loan	37.4%	34.4%	36.5%	36.7%	39.0%

Panel B: Par Value of Bonds

	2004 - 2007	2004	2005	2006	2007
Average Daily Par Value of Existing FISD Bonds (Billions of $)	6,619	5,649	6,105	6,530	7,159
Average Daily Par Value of Existing FISD Bonds in Lender Inventory (Billions of $)	193.3	183.4	186.7	195.5	196.8
Lender Inventory as a % of FISD Par Value	2.9%	3.2%	3.1%	3.0%	2.7%
Average Daily Par Value of Bonds On Loan in Lender Inventory (Billions of $)	14.3	14.2	14.7	13.9	14.4
Lent as a % of Lender Inventory	7.4%	7.7%	7.9%	7.1%	7.3%

Figure 1. Number and Par Value of Outstanding Loans

Figure 1 plots the evolution of the corporate bond loans from the Proprietary Bond Inventory and Loan databases the over time. The left-hand axis reports the number of loans outstanding, while the right-hand axis shows the total par value of these loans. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007.

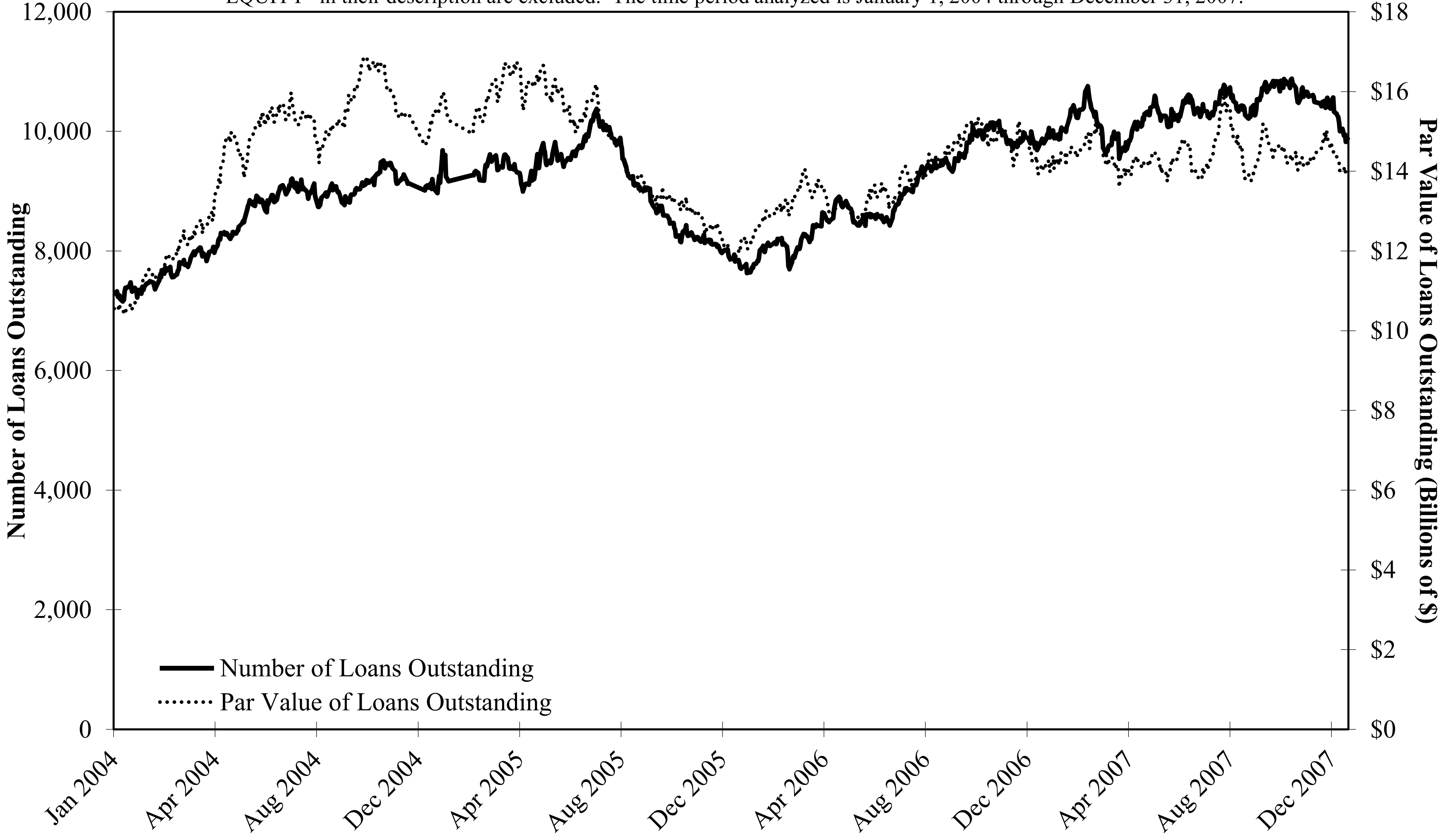

Table 2. Characteristics of Bonds in the Corporate Bond Databases

Table 2 reports bond characteristics from the FISD Corporate Bond, Proprietary Bond Inventory, and Proprietary Bond Loan databases. All ratings are S&P Ratings. Ratings data is missing for some FISD bonds. Therefore, the FISD dataset in Panel B is a subset of the overall FISD dataset in Panel A. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. Time series variables are daily averages. "Rating at Issue" is defined as the first S&P rating. For rating and rating at issue, we report the median. The treasury spread variable is available over the entire sample period for 15,785, 8,601, and 6,236 bonds in FISD, Lender Inventory, and Lent, respectively. In 2004, it is available for 13,235, 5,960, and 3,527 bonds. In 2005, it is available for 12,917, 5,605, and 3,821 bonds. In 2006, it is available for 12,686, 5,523, and 3,821 bonds. In 2007, it is available for 12,576, 5,584, and 3,830 bonds.

Panel A: Non-rating Characteristics of Corporate Bonds

	2004 - 2007		2004		2005		2006		2007	
Number of Observations:	**FISD (57,896), Inventory (15,493), Lent (10,293)**		**FISD (38,075), Inventory (9,730), Lent (5,449)**		**FISD (40,835), Inventory (9,534), Lent (5,771)**		**FISD (43,189), Inventory (9,909), Lent (6,321)**		**FISD (44,807), Inventory (9,884), Lent (6,256)**	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Size At Issue (Millions of $)										
FISD	$175.3	$324.8	$168.1	$288.7	$168.5	$296.1	$175.4	$314.0	$183.8	$339.1
Lender Inventory	$418.6	$461.1	$374.3	$408.0	$402.7	$431.7	$435.7	$460.7	$474.9	$496.5
Lent	$487.4	$481.7	$466.2	$461.2	$484.1	$471.4	$505.3	$478.1	$555.9	$518.6
Maturity at Issuance (years)										
FISD	10.7	10.1	12.5	10.5	12.2	10.4	12.0	10.5	12.1	10.7
Lender Inventory	11.3	10.1	12.0	10.1	12.1	10.3	12.0	10.7	12.4	11.1
Lent	11.9	10.2	12.1	9.6	12.1	9.7	12.2	10.3	12.8	10.9
Time Since Issuance (years)										
FISD	5.4	5.7	5.5	5.8	5.3	5.7	5.4	5.6	5.4	5.6
Lender Inventory	4.4	4.0	4.3	3.8	4.3	3.9	4.4	4.0	4.4	4.1
Lent	3.6	3.1	3.3	2.8	3.4	2.9	3.7	3.2	3.8	3.4
% Defaulted										
FISD	0.6%		0.8%		0.7%		0.6%		0.5%	
Lender Inventory	1.1%		1.4%		1.1%		1.0%		1.0%	
Lent	0.7%		0.8%		0.6%		0.7%		0.5%	
% Floating Rate										
FISD	22.4%		15.9%		17.3%		19.5%		19.5%	
Lender Inventory	17.0%		10.3%		11.5%		15.2%		16.0%	
Lent	10.6%		5.5%		6.5%		9.1%		10.0%	
% Rule 144a										
FISD	20.6%		17.0%		17.8%		19.8%		19.6%	
Lender Inventory	23.0%		16.0%		16.1%		18.1%		18.8%	
Lent	14.2%		6.5%		8.6%		10.1%		10.4%	

Table 2. Characteristics of Bonds in the Corporate Bond Databases

Table 2 reports bond characteristics from the FISD Corporate Bond, Proprietary Bond Inventory, and Proprietary Bond Loan databases. All ratings are S&P Ratings. Ratings data is missing for some FISD bonds. Therefore, the FISD dataset in Panel B is a subset of the overall FISD dataset in Panel A. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. Time series variables are daily averages. "Rating at Issue" is defined as the first S&P rating. For rating and rating at issue, we report the median. The treasury spread variable is available over the entire sample period for 15,785, 8,601, and 6,236 bonds in FISD, Lender Inventory, and Lent, respectively. In 2004, it is available for 13,235, 5,960, and 3,527 bonds. In 2005, it is available for 12,917, 5,605, and 3,821 bonds. In 2006, it is available for 12,686, 5,523, and 3,821 bonds. In 2007, it is available for 12,576, 5,584, and 3,830 bonds.

Panel B: Rating Characteristics of Corporate Bonds

	2004 - 2007		**2004**		**2005**		**2006**		**2007**	
Number of Observations:	**FISD (39,197), Inventory (13,836), Lent (9,822)**		**FISD (27,513), Inventory (8,972), Lent (5,272)**		**FISD (30,338), Inventory (8,850), Lent (5,601)**		**FISD (31,841), Inventory (9,005), Lent (6,105)**		**FISD (32,729), Inventory (8,995), Lent (6,013)**	
	Median / Average	Standard Deviation	Median / Average	Standard Deviation	Median / Average	Standard Deviation	Median / Average	Standard Deviation	Median / Average	Standard Deviation
Median Rating at Issue										
FISD	A		A-		A-		A		A	
Lender Inventory	BBB		BBB+		BBB+		BBB+		BBB+	
Lent	BBB		BBB+		BBB+		BBB+		BBB+	
Median Rating over Period										
FISD	A-		BBB+		A-		A-		A-	
Lender Inventory	BBB+		BBB		BBB+		BBB+		BBB+	
Lent	BBB		BBB		BBB		BBB		BBB	
% Investment Grade at Issue										
FISD	79.2%		78.1%		78.7%		79.0%		79.1%	
Lender Inventory	69.0%		72.4%		73.8%		74.5%		74.3%	
Lent	68.9%		72.6%		71.3%		71.6%		72.0%	
% Investment Grade when Lent										
FISD	70.7%		70.9%		69.5%		70.2%		72.0%	
Lender Inventory	70.7%		69.8%		69.6%		71.1%		71.3%	
Lent	64.3%		64.0%		61.3%		64.8%		66.4%	
Treasury Spread (bps)*										
FISD	177.7	181.5	170.0	181.4	179.1	184.1	185.5	185.4	191.8	185.7
Lender Inventory	178.4	155.2	163.4	145.0	156.3	133.3	155.6	130.2	161.3	130.0
Lent	164.7	137.8	146.8	118.9	147.7	117.1	152.3	123.2	157.6	123.9

Table 3. Loan Size, Loan Duration, and Changes in Loan Size

Table 3 provides descriptive statistics for the new bond loans in the Proprietary Bond Inventory and Loan databases for all bonds and by credit rating. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. Size of New Loans is reported as the number of bonds lent. Duration of New Loans is reported as the number of days that bonds are lent. New loans are only defined when we have loan data for the previous day. That is, for the first day of data or the first day after missing data, no loans classified as new. Similarly, duration and changes in loan size are only defined when the last day of a loan is not the day before a missing day. Thus, in the duration and loan size calculations, there are only 359,754 loans in total, comprised of 234,450 in investment grade bonds and 125,306 in high yield and unrated bonds.

Year	All Bonds	Investment Grade Bonds	High Yield and Unrated Bonds
Number of New Loans	**367,751**	**239,649**	**128,102**
Size of New Loans (Bonds)			
Mean	1,444.1	1,267.3	1,774.8
Median	350	200	980
Mode	100	100	1000
10th percentile	73	58	100
25th percentile	100	100	210
75th percentile	1,435	1,000	2,000
90th percentile	4,000	3,500	4,350
Duration of New Loans (Days)			
Mean	32.4	28.3	40.1
Median	11	10	13
Mode	1	1	1
10th percentile	1	1	1
25th percentile	3	3	3
75th percentile	34	30	43
90th percentile	83	71	107
Changes in Loan Size			
Percentage of loans that decrease in size	31.2%	29.3%	34.8%
Average total decrease in loan size (for loans that decrease)	56.9%	55.7%	58.6%
Average number of decreases (for loans that decrease)	1.9	1.9	1.8

Figure 2. Equally-Weighted Monthly Distribution of Loan Borrowing Costs

Figure 2 plots the equally-weighted borrowing cost quintiles monthly from the Proprietary Bond Inventory and Loan databases over time. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007.

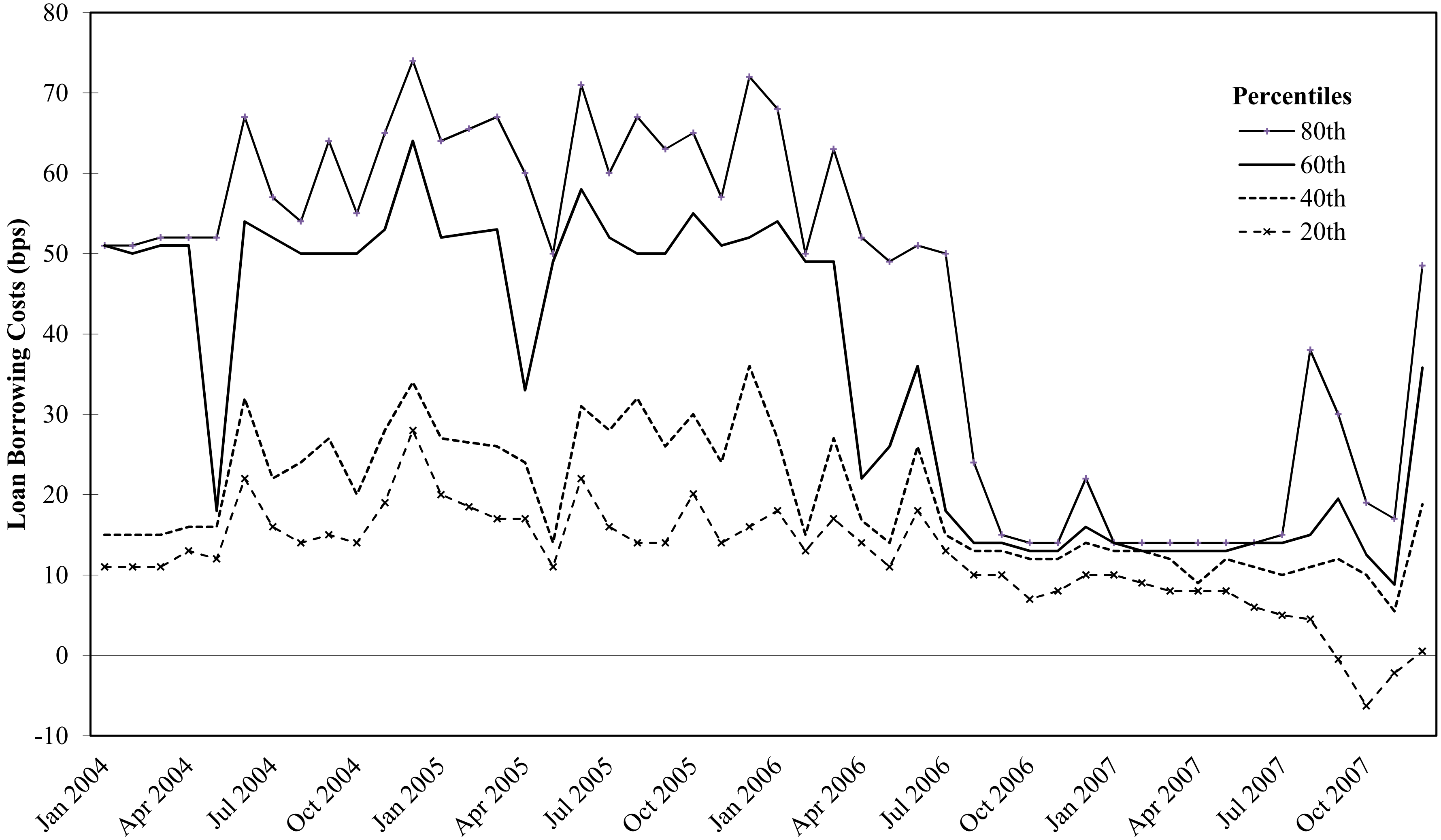

Table 4. Distribution of New Loan Borrowing Costs

Table 4 Panel A presents borrowing costs over time partitioned by loan size. Panel B presents borrowing costs over time partitioned by credit rating - investment grade (IG) vs. high yield (HY). Unrated bonds are included with high yield bonds. All borrowing costs are calculated on an equally weighted basis. Data is from the Proprietary Bond Loan database for the overall period and by year. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. Loan Borrowing Costs are defined as the One-month Commercial Paper Rate minus the Rebate Rate. Loans are allocated to the year in which they are initiated, even if they extend into subsequent years. New loans are only defined when we have loan data for the previous day. That is, for the first day of data or the first day after missing data, no loans classified as new.

Panel A: Borrowing Costs (bps) by Loan Size

Year		**2004-2007**		**2004**		**2005**		**2006**		**2007**	
Number of New Loans	**367,751**	**109,124**	**258,627**	**23,127**	**58,994**	**24,067**	**64,854**	**27,126**	**67,194**	**34,804**	**67,585**
	All Loans	**≤100**	**>100**	**≤100**	**>100**	**≤100**	**>100**	**≤100**	**>100**	**≤100**	**>100**
Mean	32.6	39.0	29.9	50.9	31.1	62.6	38.5	33.0	31.1	19.4	19.2
Median	18.0	48.0	16.0	52.0	22.0	56.0	27.0	20.0	15.0	13.0	13.0
Mode	13.0	13.0	13.0	51.0	51.0	49.0	14.0	13.0	13.0	13.0	13.0
10th percentile	7.0	9.0	6.0	12.0	11.0	24.5	11.0	9.0	8.0	3.0	-1.0
25th percentile	12.0	13.0	12.0	50.0	15.0	50.0	16.0	13.0	12.0	9.0	5.5
75th percentile	51.0	54.0	49.0	65.0	51.0	67.0	54.0	50.0	35.0	21.8	15.0
90th percentile	64.0	69.0	59.0	76.0	58.0	74.0	69.0	61.0	56.0	50.0	49.0

Panel B: Borrowing Costs (bps) by Credit Rating

Year		**2004-2007**		**2004**		**2005**		**2006**		**2007**	
Number of Loans	**367,751**	**239,649**	**128,102**	**54,457**	**27,664**	**56,119**	**32,802**	**60,752**	**33,568**	**68,321**	**34,068**
	All Loans	**Investment Grade**	**High Yield**	**Investment Grade**	**High Yield**	**Investment Grade**	**High Yield**	**Investment Grade**	**High Yield**	**Investment Grade**	**High Yield**
Mean	32.6	30.0	37.4	38.4	33.4	44.7	45.6	26.0	41.8	14.8	28.2
Median	18.0	18.0	18.0	50.0	23.9	50.0	27.0	15.0	17.0	13.0	13.0
Mode	13.0	13.0	13.0	51.0	51.0	49.0	14.0	13.0	13.0	13.0	13.0
10th percentile	7.0	7.0	7.0	11.0	11.0	13.0	11.8	8.0	9.0	-0.5	-0.5
25th percentile	12.0	12.0	13.0	16.0	15.0	20.0	16.0	12.0	12.0	8.0	7.0
75th percentile	51.0	51.0	50.0	53.0	51.0	60.0	55.0	48.0	49.0	15.0	28.0
90th percentile	64.0	63.0	66.0	68.0	66.0	71.0	73.0	55.0	68.0	48.0	50.0

Figure 3. Relationship Between Borrowing Cost and Percent of Inventory On Loan

Figure 3 plots the relationship between the average borrowing cost and the amount of inventory on loan for the period April 2005 to December 2007 and for several sub-periods, by credit status. Data is from the Proprietary Bond Inventory and Loan databases. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded.

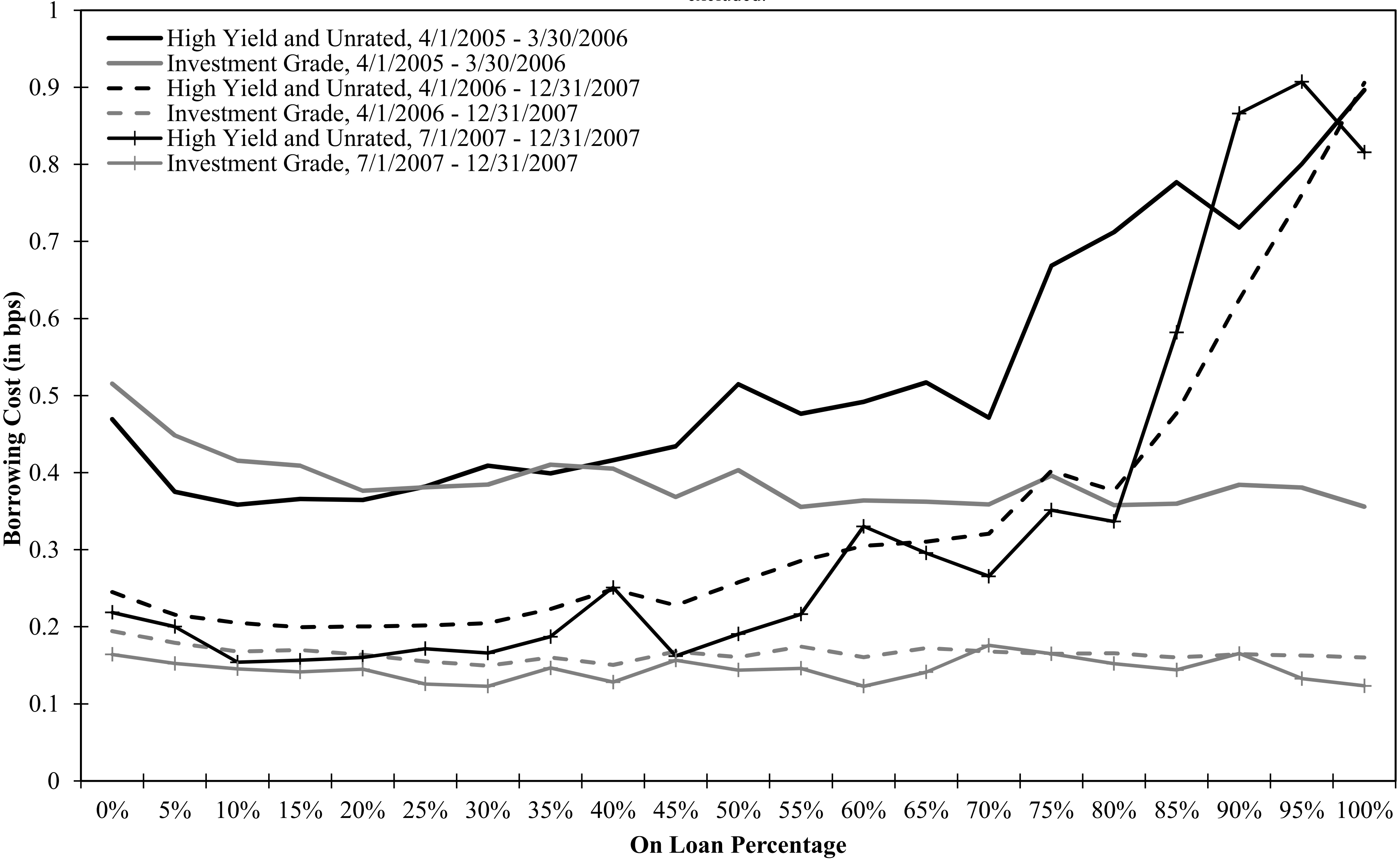

Table 5. Corporate Bonds with the Highest Borrowing Costs

Table 5 presents the 35 corporate bonds with the highest borrowing costs in our sample. Data is from the Proprietary Bond Loan database for the overall period and by year. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. Each bond is listed once with corresponding S&P credit rating, date, rebate rate, maximum loan borrowing cost, and on loan percentage. Number of Bonds is the number of bonds issued by a given firm that ever had borrowing costs greater than the 250th most expensive to borrow bond in our sample.

CUSIP	Issuing Company Name	Date	Rebate Rate (in bps)	Borrowing Cost (in bps)	On Loan %	Credit Rating	Number of Bonds
13134VAA1	CALPINE CDA ENERGY FIN ULC	5/10/06	-1,000	1,501	100.00%	D	1
131347AW6	CALPINE CORP	2/15/06	-1,000	1,450	75.87%	D	10
26632QAK9	DURA OPER CORP	2/28/07	-700	1,223	21.62%	D	2
247126AC9	DELPHI AUTOMOTIVE SYS CORP	2/2/06	-700	1,150	51.59%	D	3
07556QAN5	BEAZER HOMES USA INC	10/31/07	-479	932	100.00%	B+	2
45661YAA8	INEOS GROUP HLDGS PLC	10/31/07	-479	932	65.26%	B-	1
729136AF8	PLIANT CORP	10/31/07	-479	932	100.00%	CCC	3
909279AW1	UNITED AIR LINES INC	12/13/05	-500	927	90.18%	D	1
256605AD8	DOLE FOOD INC	10/31/07	-413	866	38.82%	B-	1
15101QAC2	CELESTICA INC	10/31/07	-400	853	100.00%	B-	1
800907AK3	SANMINA - SCI CORP	10/31/07	-400	853	76.75%	B-	1
194832AD3	COLLINS & AIKMAN PRODS CO	6/23/06	-300	824	99.46%	D	2
001765AU0	AMR CORP DEL	3/14/07	-250	775	76.26%	CCC+	1
370442BT1	GENERAL MTRS CORP	10/31/07	-288	741	88.29%	B-	6
35687MAP2	FREESCALE SEMICONDUCTOR INC	9/6/07	-200	728	84.32%	B	2
984756AD8	YANKEE ACQUISITION CORP	8/7/07	-200	728	100.00%	CCC+	2
85375CAK7	STANDARD PAC CORP NEW	10/31/07	-200	653	100.00%	B+	3
978093AE2	WOLVERINE TUBE INC	2/1/06	-200	648	64.29%	CCC	1
624581AB0	MOVIE GALLERY INC	10/24/06	-100	625	34.69%	CCC-	1
256669AD4	DOLLAR GEN CORP	10/16/07	-100	583	99.89%	CCC+	1
179584AG2	CLAIRES STORES INC	12/26/07	-75	539	99.00%	CCC+	2
767754AD6	RITE AID CORP	8/2/06	0	532	10.73%	B-	2
156503AH7	CENTURY COMMUNICATIONS CORP	7/31/06	0	531	73.22%	D	3
373200AT1	GEORGIA GULF CORP	9/11/07	0	531	100.00%	B-	2
667281AM1	NORTHWEST AIRLS INC	8/1/06	0	531	80.00%	D	4
640204AH6	NEIMAN MARCUS GROUP INC	7/18/06	0	530	97.22%	B-	1
651715AD6	NEWPAGE CORP	7/27/06	0	530	84.70%	CCC+	1
75040KAC3	RADIOLOGIX INC	7/18/06	0	530	98.81%	CCC+	1
872962AD7	TECHNICAL OLYMPIC USA INC	6/26/07	0	530	100.00%	CCC+	1
247361XY9	DELTA AIR LINES INC DEL	7/17/06	0	529	99.66%	D	4
420029AD2	HAWAIIAN TELCOM COMMUNICATIONS INC	7/26/06	0	529	82.81%	CCC+	5
721467AF5	PILGRIMS PRIDE CORP	8/7/07	0	528	99.76%	B	2
79546VAF3	SALLY HLDGS LLC / SALLY CAP INC	9/6/07	0	528	85.02%	CCC+	2
87971KAA5	TEMBEC INDS INC	12/12/06	0	528	14.27%	CCC-	3
682391AC1	155 EAST TROPICANA LLC / 155 EAST TROPICANA FIN CORP	6/29/06	0	527	99.45%	B-	1

Table 6. Regression Analysis of Determinants of Borrowing Costs

Table 6 reports estimates of the following equation:

$$\text{Borrowing Cost}_{ibt} = \beta_1\text{*on loan\%}_{bt} + \beta_2\text{*loan size}_i + \beta_3\text{*rating}_{bt} + \beta_4\text{*issue size}_b + \beta_5\text{*time since issue}_{bt} + \beta_6\text{*floating rate}_b + \beta_7\text{*rule144a}_b + \delta_t + \lambda_{broker} + \kappa_b + \varepsilon_{ibt}$$

where the on loan % is the percentage of daily inventory already lent, and loan size is the total number of bonds lent in thousands of bonds (that is, the loan value in $ millions). Rating is the bond's S&P rating at the time of the loan (where AAA is given a value of 1, D is given a value of 22, and all intermediate ratings are given consecutive values between 1 and 22). Issue size is the size of the initial bond offering (in $100 millions). The time since issue variable is the time since the bond was issued (in years). The floating rate variable is a dummy variable equal to 1 if the bond pays a floating rate coupon and 0 if the bond has a fixed rate coupon. The Rule 144a variable is a dummy variable equal to 1 if the bond was issued under SEC Rule 144a and 0 otherwise. δ represents a set of dummies for each trading day in the sample. κ represents a set of dummies for each bond CUSIP in the sample, and λ are a set of dummies for each unique borrower in the sample who borrows 100 or more times during our sample period. Subscripts i, b, and t correspond to loan i, bond b, and day t. There are 62 brokers that borrow from the lender during the period covered by the regression, 38 make 100 or more loans and 24 make less than 100 loans. Standard errors are heteroscedasticity-robust and t-statistics are reported in parenthesis. The data is from the FISD Corporate Bond, Proprietary Bond Inventory, and Proprietary Bond Loan databases. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is April 1, 2005 through December 31, 2007. * significant at 0.10; ** significant at 0.05; *** significant at 0.01.

	[1]	[2]	[3]	[4]
On Loan %	26.30 ***	26.23 ***	3.19 ***	4.38 ***
	(47.42)	(48.33)	(6.10)	(8.58)
Loan Size (thousands)	-2.16 ***	-1.74 ***	-1.67 ***	-1.36 ***
	(-49.10)	(-39.30)	(-48.91)	(-40.20)
Bond Rating	1.12 ***	1.41 ***	3.33 ***	3.23 ***
(where AAA=1, …, D=22)	(35.12)	(40.64)	(16.30)	(16.05)
Bond Issue Size ($100M)	0.31 ***	0.31 ***		
	(22.15)	(22.46)		
Bond Time Since Issuance	0.74 ***	0.72 ***		
(years)	(17.90)	(17.87)		
Bond Floating	-5.86 ***	-5.72 ***		
	(-13.32)	(-13.10)		
Bond Rule 144a	3.34 ***	3.05 ***		
	(4.31)	(3.94)		
Broker Dummies	N	Y	N	Y
CUSIP Dummies	N	N	Y	Y
Broker Effects				
F-test	n/a	F = 969.21 ***	n/a	F = 1172.05 ***
p-value	n/a	$p < 0.0001$	n/a	$p < 0.0001$
max - min	n/a	59.28 ***	n/a	59.14 ***
p-value		$p < 0.0010$		$p < 0.0010$
p_75-p_25	n/a	23.72 ***	n/a	19.76 ***
p-value		$p < 0.0010$		$p < 0.0010$
R^2	0.3924	0.4328	0.5486	0.5888
N	258,060	258,060	258,060	258,060

Table 7. Competitive Races between Brokers

Table 7 uses data from the Proprietary Bond Loan database and compares broker borrowing costs by examining all days where two or more brokers borrow the same bond. 26 identified brokers have at least 100 competitive races. Success in 2 Broker and 3+ Broker Competitive Races is defined as having the lowest borrowing cos for a new loan in the same bond on the same day. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007. *** indicates Percentage of Wins that are significantly different than 50% and 33.33% at 0.01 one tailed probability for 2 and 3+ brokers, respectively.

				2 Broker Races		3+ Broker Races	
Broker ID	# of Loans	# of Bonds Borrowed	Total Lending Fees Paid	# Competitive Races / Wins	Percentage of Wins	# Competitive Races / Wins	Percentage of Wins
A	40,994	41,714,394	$13,090,277	6,478 / 5,993	92.5% ***	1,561 / 1,231	78.9% ***
B	2,595	2,075,390	$63,271	546 / 479	87.7% ***	164 / 127	77.4% ***
C	12,773	42,175,029	$6,994,331	1,780 / 1,423	79.9% ***	719 / 476	66.2% ***
D	5,816	24,283,893	$7,006,490	790 / 622	78.7% ***	361 / 239	66.2% ***
E	11,132	28,620,944	$4,632,767	1,668 / 1,261	75.6% ***	574 / 328	57.1% ***
F	1,755	7,944,398	$2,764,846	257 / 189	73.5% ***	118 / 59	50.0% ***
G	4,190	12,189,596	$3,043,453	556 / 406	73.0% ***	252 / 151	59.9% ***
H	35,259	90,905,675	$22,738,738	3,444 / 2,128	61.8% ***	1,244 / 532	42.8% ***
I	972	2,639,919	$189,152	125 / 76	60.8%	55 / 25	45.5%
J	2,209	5,404,871	$1,420,770	345 / 194	56.2%	129 / 46	35.7%
K	3,767	11,597,273	$9,623,957	366 / 195	53.3%	183 / 68	37.2%
L	3,011	8,902,543	$2,063,986	399 / 206	51.6%	184 / 77	41.8%
M	11,762	26,925,386	$3,697,178	1,444 / 695	48.1%	584 / 226	38.7%
N	21,355	38,973,071	$10,798,318	2,323 / 976	42.0%	861 / 332	38.6%
O	5,428	6,060,740	$1,565,975	503 / 177	35.2%	195 / 50	25.6%
P	87,613	84,175,234	$40,545,670	6,992 / 2,399	34.3%	2,056 / 518	25.2%
Q	6,633	18,783,575	$7,711,792	645 / 217	33.6%	318 / 83	26.1%
R	14,339	23,432,851	$15,138,170	1,404 / 403	28.7%	607 / 144	23.7%
S	43,344	22,503,842	$4,825,499	2,951 / 839	28.4%	1,109 / 241	21.7%
T	2,662	1,787,228	$260,718	287 / 41	14.3%	136 / 19	14.0%
U	2,244	535,303	$88,309	237 / 29	12.2%	139 / 4	2.9%
V	10,638	3,875,297	$858,456	996 / 113	11.3%	395 / 25	6.3%
W	14,407	5,641,386	$1,195,550	1,464 / 94	6.4%	442 / 26	5.9%
X	2,646	1,213,004	$253,763	309 / 19	6.1%	136 / 4	2.9%
Y	3,460	1,323,795	$272,237	518 / 24	4.6%	175 / 11	6.3%
Z	11,813	5,726,357	$1,701,179	1,577 / 54	3.4%	458 / 29	6.3%
Remainder	4,934	11,640,326	4,764,471	682 / 291	42.7%	256 / 90	35.2%

Figure 4. Borrowing Costs Around Bankruptcies

Figure 4 plots borrowing costs around bankruptcy filings. Data is from the Proprietary Bond Inventory and Loan databases. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. There are 241 bonds in the inventory database involved in a bankruptcy, representing 93 unique bankruptcies. However, only 88 bonds have any lending activity (either new or existing loans) during the period from 30 trading days before until 30 trading days after the bankruptcy. These bonds correspond to 42 unique bankruptcies.

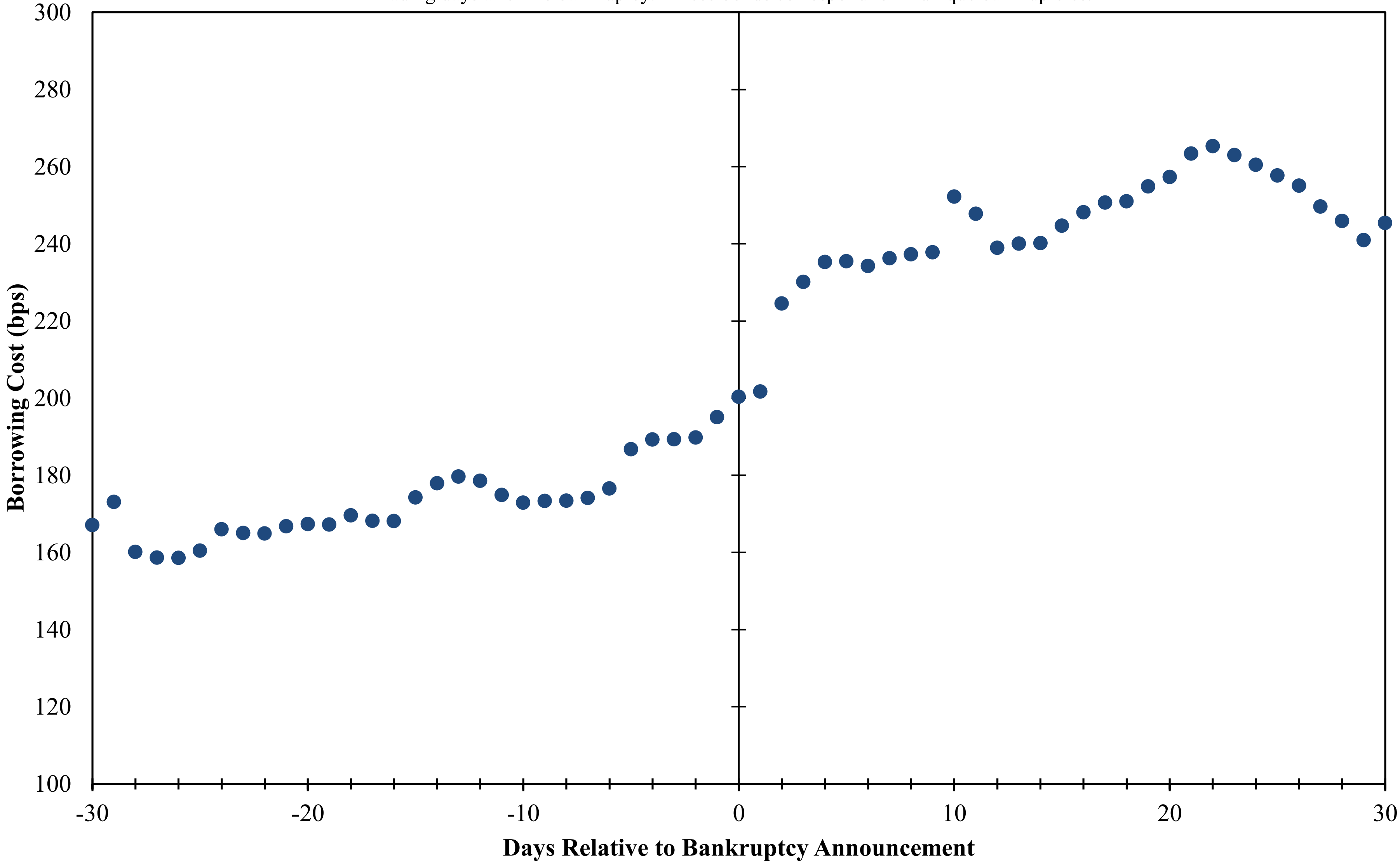

Figure 5. Borrowing Costs Around Credit Events

Figure 5 plots borrowing costs around credit rating changes. Data is from the Proprietary Bond Inventory and Loan databases. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. We define a large credit rating change as a movement of three or more S&P ratings, or one full letter or more, e.g. going from an A+ to a B+ or from a BB- to an AA-. There are 292 full-letter upgrades on bonds in the inventory database, which correspond to 281 unique bonds. Our data covers 125 of these upgrades, corresponding to 122 unique bonds. There are 381 full-letter downgrades during our time period on 356 unique bonds. Our data covers 206 of these downgrades, corresponding to 193 bonds.

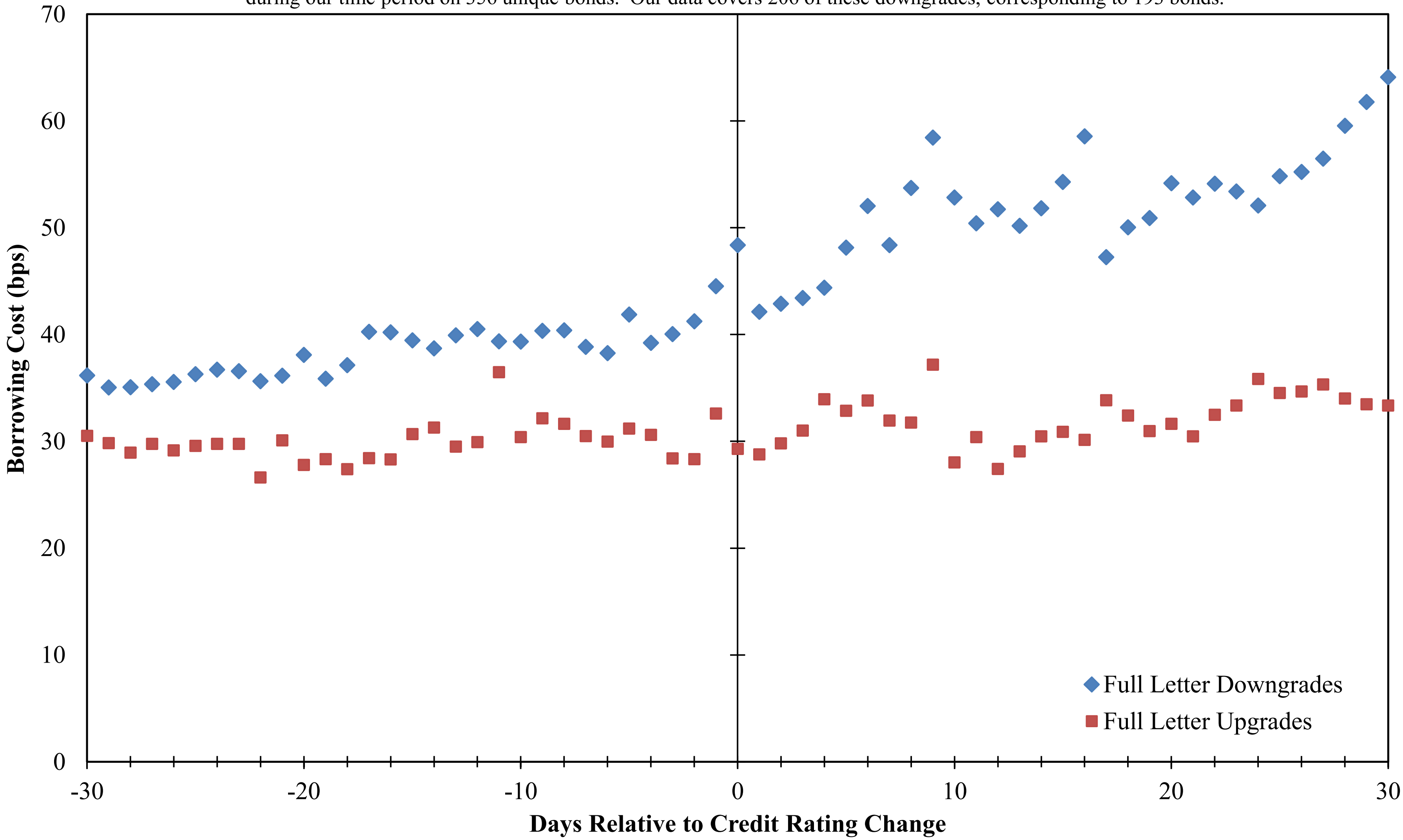

Figure 6. Equally-Weighted Monthly Distribution of Stock Loan Borrowing Costs

Figure 6 plots the equally-weighted borrowing cost quintiles monthly from the Proprietary Stock Inventory and Loan databases over time. The time period analyzed is January 1, 2004 through December 31, 2007. Only stocks that are matched to bonds are used.

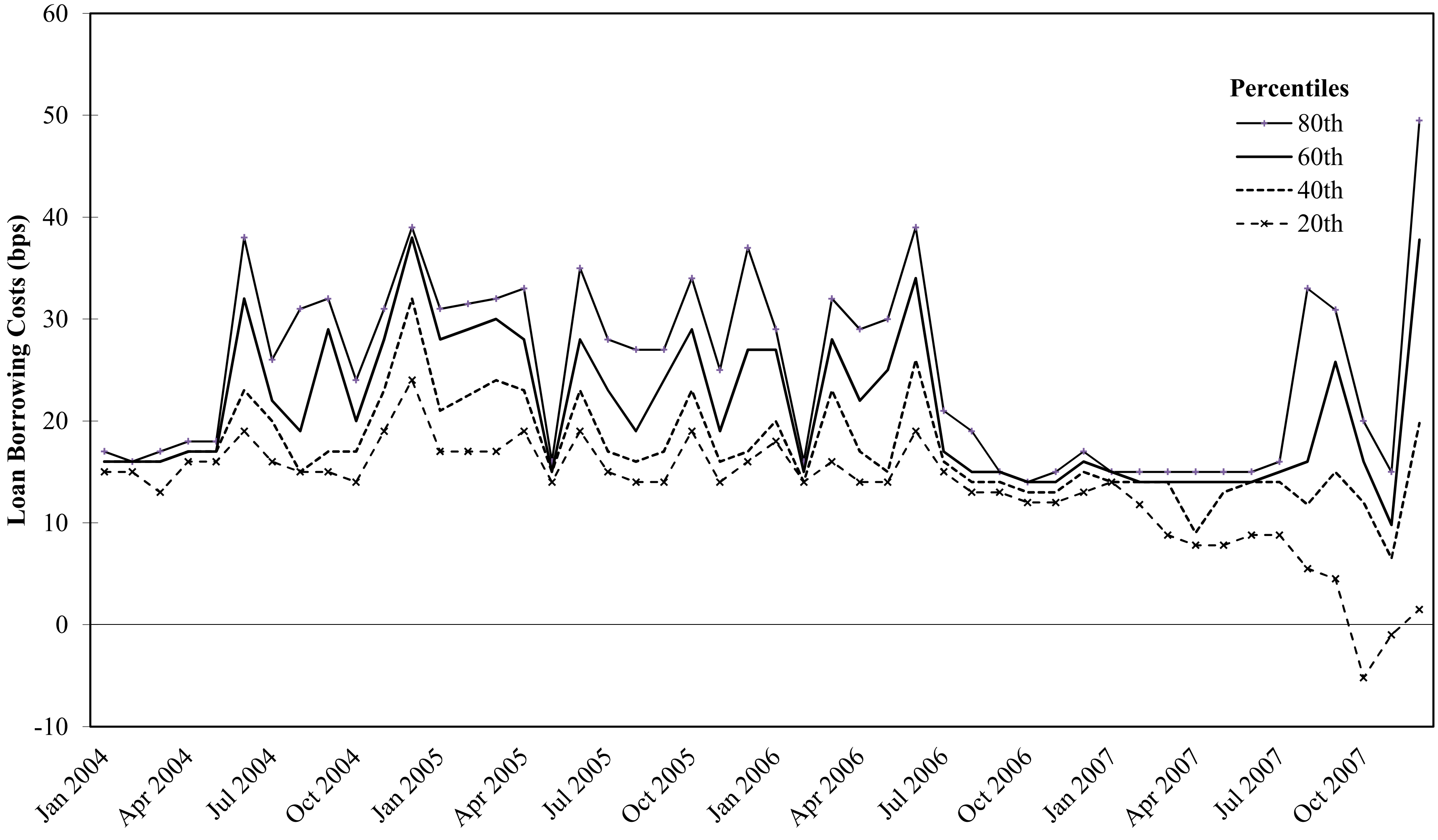

Figure 7. Bond and Stock Borrowing Cost Differences

Figure 7 examines differences in borrowing costs between matched corporate bonds and stocks. Data is from the Proprietary Loan databases for the overall period and by year. Only bonds that can be matched to a unique stock for a given loan and date are included. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007.

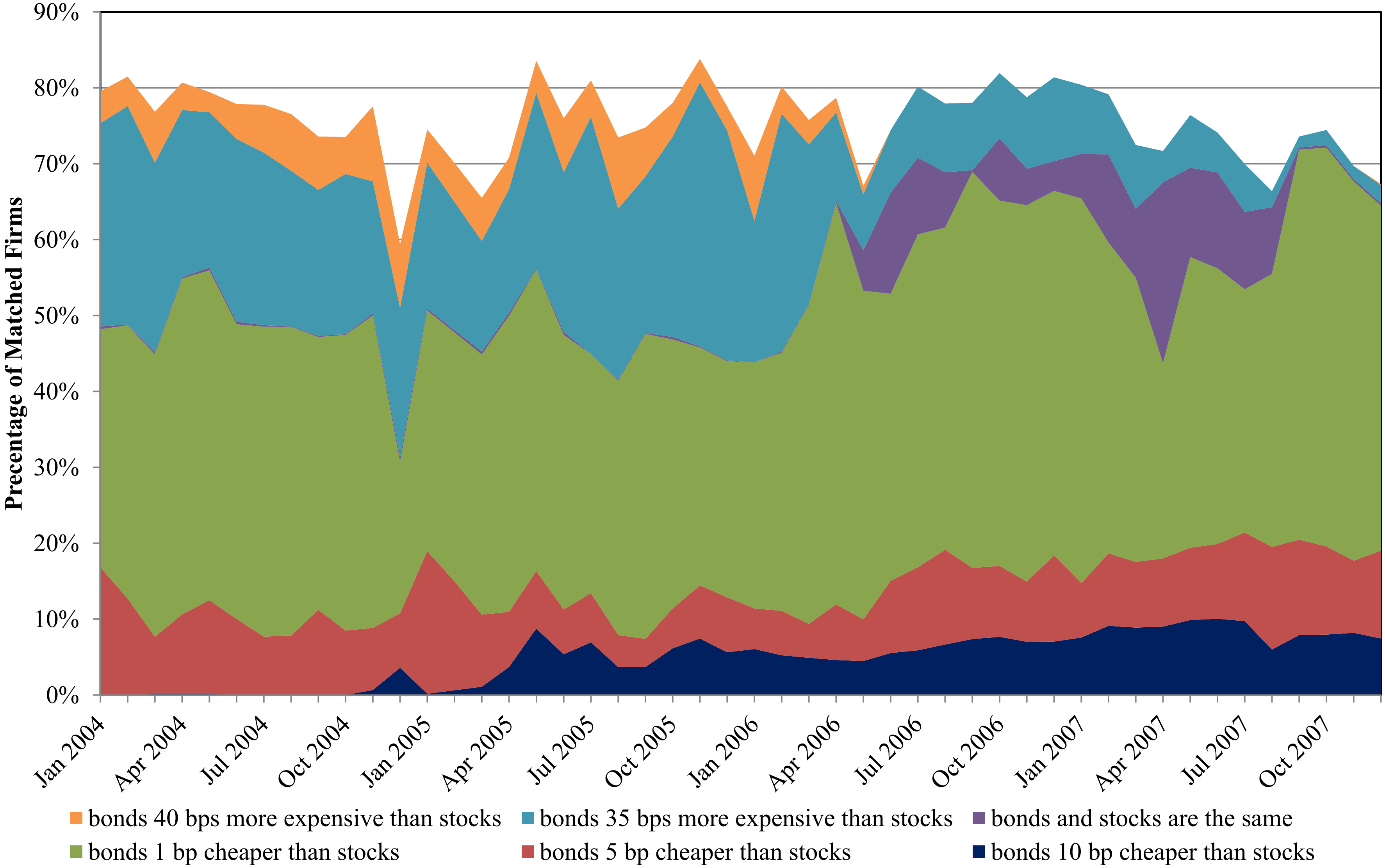

Table 8. Bond and Stock Borrowing Relationship

Table 8 examines differences in borrowing costs between matched corporate bonds and stocks. The unit of observation are CUSIP-days aggregated by loans by firms within a day. Data is from the Proprietary Loan databases for all firms and by credit status. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007.

	All Firms	**Investment Grade**	**High Yield and Unrated**
N	**113,548**	**72,051**	**41,497**
% bond > stock	28.8%	28.9%	28.5%
% bond = stock	3.3%	3.4%	3.1%
% bond < stock	68.0%	67.7%	68.4%
% bond and stocks within +/- 10 bps	63.7%	63.6%	64.0%
% bond > stock by more than 10 bps	25.6%	25.8%	25.3%
# bond > 75 bps	3,131	1,114	2,017
% of all matched loans	2.8%	1.5%	4.9%
# stock > 75 bps	7,626	4,720	2,906
% of all matched loans	6.7%	6.6%	7.0%
if bond > 75 bps, % stock > 75 bps	11.6%	5.7%	14.9%
if stock > 75 bps, % bond > 75 bps	4.8%	1.3%	10.4%
# bond > 100 bps	1,425	184	1,241
% of all matched loans	1.3%	0.3%	3.0%
# stocks > 100 bps	7,015	4,348	2,667
% of all matched loans	6.2%	6.0%	6.4%
if bond > 100 bps, % stock > 100 bps	15.6%	9.8%	16.4%
if stock > 100 bps, % bond > 100 bps	3.2%	0.4%	7.6%

Table 9. Monthly Returns to Long Bond Portfolio Positions

Table 9 uses the TRACE database and computes returns for portfolios of bonds that are borrowed. Equally-weighted and issue-size value weighted returns are computed for each month, both raw and excess (net of TRACE). Portfolio quintiles are calculated at the beginning of each period based on the set of bonds that go on loan in that period. Equally-weighted raw returns are the unweighted average of (end of period sell - start of period buy + coupons paid + change in accrued interest) / (start of period buy + initial accrued interest). Equally-weighted excess returns are the unweighted average of raw returns minus the TRACE portfolio return. The TRACE portfolio return is the return from holding a portfolio of all bonds in TRACE. The issue-size value-weighted raw returns are the average of raw returns, weighted by the bond's issue size. Issue-size value-weighted excess returns subtract the issue-size valu weighted TRACE portfolio return. Convertibles, exchangeables, unit deals, perpetual bonds, bonds with missing or nonsensical offering amount data, and all bonds with "KNOCK", "REVERSE", or "EQUITY" in their description are excluded. The time period analyzed is January 1, 2004 through December 31, 2007.

Panel A: Bond Portfolios Which Are Formed According To Percent of Inventory On Loan

	# of Bonds in Portfolio	# of Bonds with TRACE Coverage in All Months	Equally-weighted Raw Returns		Issue-size Value-weighted Raw Returns		Equally-weighted Excess Returns (Net of TRACE)		Issue-size Value-weighted Excess Returns (Net of TRACE)	
Portfolio	Mean	Mean	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Not Lent	5,013.5	2,574.1	0.40%	0.70%	0.37%	0.69%	-0.04%	0.32%	-0.05%	0.17%
Lent	2,821.5	2,246.9	0.40%	0.98%	0.40%	0.96%	-0.04%	0.39%	-0.02%	0.17%
1st Quintile	564.8	478.4	0.37%	0.92%	0.37%	0.91%	-0.08%	0.48%	-0.05%	0.28%
2nd Quintile	564.3	466.8	0.39%	0.93%	0.38%	0.93%	-0.06%	0.43%	-0.03%	0.24%
3rd Quintile	564.3	454.1	0.40%	0.99%	0.39%	1.02%	-0.05%	0.43%	-0.02%	0.27%
4th Quintile	564.3	442.0	0.41%	1.03%	0.40%	1.02%	-0.03%	0.46%	-0.01%	0.26%
5th Quintile	563.9	405.6	0.47%	1.32%	0.48%	1.28%	0.03%	0.82%	0.07%	0.79%
95th Percentile	141.5	93.9	0.44%	1.97%	0.47%	1.98%	0.00%	1.68%	0.06%	1.72%
99th Percentile	57.7	35.4	0.37%	2.38%	0.43%	2.64%	-0.07%	2.21%	0.02%	2.51%

Panel B: Bond Portfolios Which Are Formed According To Borrowing Cost

	# of Bonds in Portfolio	# of Bonds with TRACE Coverage in All Months	Equally-weighted Raw Returns		Issue-size Value-weighted Raw Returns		Equally-weighted Excess Returns (Net of TRACE)		Issue-size Value-weighted Excess Returns (Net of TRACE)	
Portfolio	Mean	Mean	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
All New Loans	2,360.9	1,937.3	0.43%	0.89%	0.43%	0.90%	-0.06%	0.40%	-0.03%	0.17%
1st Quintile	536.0	432.2	0.45%	0.93%	0.44%	0.92%	-0.05%	0.46%	-0.02%	0.23%
2nd Quintile	469.6	373.3	0.45%	0.90%	0.45%	0.91%	-0.04%	0.42%	-0.01%	0.22%
3rd Quintile	509.7	417.3	0.40%	0.92%	0.40%	0.92%	-0.09%	0.41%	-0.06%	0.20%
4th Quintile	451.7	380.5	0.38%	0.85%	0.38%	0.86%	-0.10%	0.44%	-0.06%	0.22%
5th Quintile	403.5	342.1	0.46%	0.96%	0.46%	0.94%	-0.03%	0.50%	0.00%	0.30%
95th Percentile	163.3	134.0	0.56%	1.36%	0.56%	1.38%	0.07%	0.96%	0.10%	0.91%
99th Percentile	26.4	19.5	0.81%	3.60%	1.12%	4.67%	0.33%	3.39%	0.67%	4.48%