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ABSTRACT

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 per year. Factors that increase borrowing costs are loan size, percentage of inventory lent, rating, and borrower identity. Trading strategies based on cost or amount of borrowing do not yield excess returns. Bonds with corresponding CDS contracts are more actively lent than those without. Finally, the 2007 Credit Crunch did not affect average borrowing cost or loan volume, but increased borrowing cost variance.

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1. Introduction

Short selling, where feasible, is an important activity in many asset markets. Constraints on short selling may lead to mis-valuation because they limit the ability of some market participants to influence prices. These constraints include various institutional or legal prohibitions on taking short positions as well as the additional costs and risks associated with short selling. There is a large theoretical literature on short sale constraints and their impact on asset prices. The empirical literature on short sales, while also large, has focused almost exclusively on stocks.

In this paper, we analyze 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 slightly over $6 trillion and, according to the Securities Industry and Financial Market Association (SIFMA), trading activity averaged $17.3 billion per day.

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 monthly by the stock exchanges (the NYSE reports bi-monthly beginning September 2007), 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 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 64.4% of bonds which appear in inventory are lent out at some point during our time period 2004-2007.

Our paper uses this database to examine three primary hypotheses about the market for borrowing corporate bonds. The first is whether the market for borrowing corporate bonds has higher costs and lower liquidity than the market for borrowing stock. It does not. The borrowing costs for corporate bonds are usually low and linked to the costs of borrowing stock. In addition, we estimate that shorting represents 19.1% of corporate bond trades. The second hypothesis is whether bond shorting is motivated by investors possessing private information. The evidence is that it is not and bond short sellers do not earn excess returns on average. The third primary hypothesis we examine is whether bond borrowing activity is affected by the credit default swap (CDS) market. While it appears that bond shorting and CDS issuance are correlated, bond short selling has not been replaced by the growth of CDS.

In our database, the mean and median annual borrowing cost, equally-weighted by loan, are 33 and 18 basis points (bps) for the entire sample period. By 2007, these rates fall to 19 and 13 bps, respectively. This drop is largely because bond loans under 100 bonds have much higher borrowing costs in the early part of our sample, but are almost identical to bond loans over 100 bonds by the end of our sample. This change occurs in April 2006.

Borrowing costs are related to several factors other than loan size. Three significant factors are on-loan percentage, which is the fraction of the lender's inventory already lent, the bond's credit rating, and the identity of the borrowing broker. Borrowing costs remain flat until on-loan percentage reaches approximately 70% and then rise sharply. Lower rated bonds have higher borrowing costs, and borrowing costs jump at ratings downgrades and bankruptcy filings. Finally, while our lender lends to 65 brokers, a select few borrow at significantly lower rates.

We also investigate the linkage between borrowing corporate bonds and stocks. Since our lender has a significant market share of stock shorting, we construct a matched sample of corporate bonds and stock loans for the same firms. The costs of borrowing the two securities are usually quite close and 60.1% of matched loans 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.

We next study whether bond short sellers have private information. Trading strategies that short portfolios of bonds with a high on loan percentage or with high borrowing costs do not outperform the market portfolio of corporate bonds. In addition, using the beginning and ending dates of bond loans in our database to mimic the actual positions of bond short sellers, does not generate positive excess returns.

Credit default swap (CDS) contracts provide an alternative means for investors to profit from price declines in corporate bonds. This motivates our third hypothesis of whether CDS activity impacts bond borrowing. Almost half of our shorted bonds also have CDS contracts available, but these bonds are more actively shorted than those that do not and they represent over three quarters of our loans. Moreover, borrowing costs of bonds with CDS contracts are higher than those without; one basis point higher on average and slightly more than two bps higher adjusting for cross-sectional characteristics in our regression analysis.

The Credit Crunch of 2007 began in the second half of that year. In this period, borrowing costs became more volatile, primarily because of variability in the credit market. 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 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 costs. 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 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). 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 the 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.

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, although we examine additional determinants of bond borrowing costs such as borrower identity. Furthermore, our longer time period allows us to examine several time-series patterns, such as the existence and disappearance of bimodality in the distribution of borrowing costs and the 2007 Credit Crunch. Finally, we examine the profitability of short selling corporate bonds and the relationship between bond and stock shorting.

Our paper is also related to the literature which describes the transactions costs and price impact of trading corporate bonds. Bessembinder, Maxwell, and Venkataraman (2008) develop a model to test the effect of public transaction reporting on trade execution costs and Edwards, Harris, and Piwowar (2007) describe transaction costs in the corporate bond market using the TRACE dataset. That literature finds that transaction costs are higher for bonds than for stocks, but decrease significantly with trade size. It also finds bonds that are highly rated and recently issued have lower transactions costs. Using borrowing costs, not transaction costs, we find that bonds and stocks have similar borrowing costs, but that size and rating do have an effect.

3. Shorting a Corporate Bond: Mechanics and Market Size

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. Usually, these bets involve views about the particular credit quality of a corporate bond, rather than views about overall future interest rate movements. Government bonds allow an investor to take a position solely on the market movement of interest rates, so we expect that investors who believe interest rates will rise prefer to short government bonds rather than corporate bonds. Corporate bond shorting may also be part of an arbitrage strategy involving relative mis-valuations, such as trades related to the capital structure of a particular firm or trades related to CDS-corporate bond mis-valuations. In addition, corporate bonds may be borrowed short term to facilitate clearing of long trades in the presence of temporary frictions in the delivery process.

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 lent bonds 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 fee that the borrower pays for the bond loan is expressed in terms of a rebate rate. This 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 great 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.

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 once monthly.[1] Short interest is the number of shares shorted at a particular point in time. After dividing by total number of shares outstanding, short interest 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%

[1] As mentioned above, the NYSE reports bi-monthly beginning September 2007.

for the NYSE and AMEX combined, and 2.5% for the NASDAQ-NMS. Using Regulation SHO data, Diether, Lee, and Werner (2007) 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.[2] 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 lent 16.7% of all stocks shorted on the NYSE, AMEX, and NASDAQ-NMS 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 on an average day is \$85.6 billion. This is 1.3% of the par value of the average amount 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 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

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[2] 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.

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 the bond trade, 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 April 14, 2003, while Phase III was implemented by February 7, 2005. Phase III required reporting on almost all public corporate bond transactions.[3] 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.

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[3] Phase I of TRACE covered transaction information on approximately 500 bonds. It required users to report transaction information on covered bonds to the NASD (later changed to FINRA) within 75 minutes. Phase II of TRACE expanded coverage of bonds to approximately 4,650 bonds. 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.

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.[4] 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% 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 9,971 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 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

[4] 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.

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 billion on average, representing 2.9% of the $6.6 trillion market. In total, the proprietary database consists of 367,749 loans, covering 9,971 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. 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 allows us to determine how representative the proprietary databases are of the entire corporate bond market.

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 ($175.4 million). The average bond lent is even larger at issue with a size of $493.8 million. The average maturity at issue of the bonds in the inventory database (10.7 years) is close to the average maturity at issue of the universe of all FISD corporate bonds (11.3 years). The average maturity at issue for lent bonds is 12.0 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.[5]

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 (0.8%). Bonds on loan are much less likely to be floating rate bonds (10.4%) than bonds in either the FISD dataset (22.3%) or the inventory dataset (17.0%). The fraction of bonds that are subject to SEC Rule 144a is

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[5] 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.

much higher in the FISD and inventory samples than the bonds on loan. These patterns (except for Rule 144a data) hold for the yearly comparisons as well.

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 57,622 bonds in FISD where we observe the size at issue, while we observe S&P ratings for only 31,145 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 9,971 lent bonds, we have an S&P rating for 9,025, or 90.5% 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 date of the loan, show a pattern consistent with the lower ratings for lent bonds than for FISD bonds.[6]

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. 69.0% 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 for the overall period and by year. While there are 9,971 unique bonds lent in the database, there are 367,749 unique loans or an average of 36.9 loans per bond.

The data in Table 3 indicates that the size and duration of loans are skewed. The mean loan size (at par value of $1,000) is $1.44 million, but the median loan size is only $350,000.

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[6] 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 descriptive are not directly comparable since the samples are different. The notes in Table 2 give more information on this issue.

The mode loan size is $100,000. The mean new loan is outstanding for 32 calendar days while the median new loan is outstanding for 11 days. The mode duration of new loans is one day. There is a decrease in mean and median loan size from 2004 to 2007 (the median drops from $490,000 to $250,000). The distribution of duration of new loans is relatively stable over the four years.

The last three rows of Table 3 show how 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 loan are recalled by the lender. In the sample, 31.2% of loans are reduced in size before the loan is closed. Of the loans which change size, the average decrease is 56.9% of the initial loan size, and there are on average 1.9 loan decreases. 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 almost 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 large throughout the entire period. New bond loans average over $1.4 million and have an average duration of 32 days. 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 which the borrower forgoes on the collateral. 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.[7]

[7] An alternative to the commercial paper rate is the Fed Funds rate. We use the commercial paper rate because we think it more properly 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 basis points and the coefficient of correlation is 0.998).

Even though most corporate bond loans are short term, as shown in Table 3, borrowing costs vary frequently over the life of the loan. 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 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.

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 lower 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.

Characteristics of Borrowing Costs

Table 4 Panel A presents the borrowing costs on new loans over time, equally-weighted by loan and value-weighted by loan size. The average borrowing cost, equally-weighted by loan (EW), is 33 bps and the median borrowing cost is 18 bps over the period 2004 to 2007. When we weight borrowing costs by the size (or par value) of the loan (VW), the mean drops to 22 bps and the median to 14 bps. This indicates that smaller loans have higher borrowing costs than larger loans. Panel A also shows that new loan borrowing costs fall substantially in 2006 and 2007. For example, the equally-weighted median borrowing costs for 2004 to 2007 are 31, 49, 16, and 13 bps, respectively. This pattern is also reflected in the mean as well as all the percentiles shown. This temporal decrease is present for both equally-weighted and value-weighted borrowing costs.

Table 4 Panel B presents borrowing costs over time partitioned by loan size. We divide loans into those of 100 bonds or less (i.e., $100,000 par value, the mode loan size) and those of more than 100 bonds. The results show 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, "small" loans, is 51 bps. For loans of more than 100 bonds, "large" loans, the mean borrowing cost is 31 bps. By 2007, the mean borrowing cost for small loans is 19 bps, which is identical to that of large loans.

Thus, Table 4 shows that on average borrowing costs fall over time, and that the difference between equally-weighted and value-weighted borrowing costs decreases in 2006 and 2007. In addition, this decrease in borrowing cost is steeper for small loans than for large loans. Small loans are substantially more costly than large loans at the beginning of our sample period, but the costs are almost equivalent by the end of our period.

Figure 2 plots equally-weighted borrowing cost quintiles for each month of our sample period. It shows that the distribution of borrowing costs changes abruptly after March 2006. Before that date, 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 if less dramatic pattern during the same time period. This indicates that there was a substantial change in the pricing of bond loans in early to mid 2006 for both large and small loans.

Figure 3 presents histograms of equally-weighted borrowing costs pre- and post-April 1, 2006. The lighter 'before' histogram shows that the most frequent borrowing cost pre-April 1, 2006 is between 51 and 55 bps, with the second most frequent borrowing cost between 11 and 15 bps. This bimodal distribution pattern is significantly changed in the darker 'after' histogram. The most frequent borrowing cost post-April 1, 2006 is between 11 and 15 bps, and the percentage of observations in that range is more than twice that of the highest range in the 'before' histogram. The range between 51 and 55 bps is now the 7th most frequent. Although not shown, the corresponding value-weighted histograms are similar.

The reasons why borrowing costs are reduced in early 2006 and why small loans began to be priced closer to large loans after that date 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. Further, as shown in Table 3, the average size and duration of bond loans also do not change significantly over time. Therefore, we cannot explain the change in borrowing costs with simple supply or demand proxies.

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 begins between Phase II and III of TRACE. As stated above, Phase II was implemented on April 14, 2003, while Phase III was implemented by February 7, 2005. The last phase 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 below.

Determinants of Borrowing Costs

We first 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 4 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. The vertical axis displays average borrowing cost and the horizontal axis displays amount of inventory lent. For the entire period, the average borrowing cost is relatively flat at 30 bps for bonds with less than 70% on loan. After that level, however, there is a steep increase in the average borrowing cost: each 10% increase in the amount on loan is associated with a greater than 10 basis point increase in the average borrowing cost.

Also included in Figure 4 are separate plots of average borrowing costs versus available inventory for the period April 2005 to March 2006 and for the period April 2006 until December

2007. Those two plots show that borrowing costs are significantly lower in the latter period, consistent with the results in Table 4 and Figures 2 and 3. However, a 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 inventory. Finally, the line for the 2007 Credit Crunch is also plotted in Figure 4. We will discuss that result below in Section 9.

Second, 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 also 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 4. Second, most of the firms in Table 5 experienced credit problems around the date they appeared on our list. Of the 35 firms on the list, 10 are bankrupt as of the date of the loan, while another 6, while not filing for bankruptcy, were downgraded in the year prior. 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 didn't 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.[8] 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 reported losses on their collateral during this period.[9] To determine if the market for lending bonds in the period July to December 2007 is different, we examine this time period separately. We will note in Section 9 differences in any of the results for this time period.

Regression Analysis of Borrowing Costs

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[8] 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. 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.

[9] 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."

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 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 that determine a bond's borrowing cost.

Bond characteristics may affect borrowing costs in several ways. 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. Other bond factors that may affect borrowing costs include the bond's rating and whether the bond is fixed or floating rate. Bonds with lower ratings might attract more loans because of their higher probability of default and thus have higher borrowing costs. Finally, the values of floating rate bonds re-price with interest rate movements and are thus less likely to deviate from par.

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*:

$\text{Borrowing Cost}_{ibt} = \text{CPrate}_t - \text{RR}_{ibt} = \beta_1 * \text{on loan \%}_{bt} + \beta_2 * \text{loan size}_i + \beta_3 * \text{rating}_{bt} +$

β_4*issue size$_b$ + β_5*time since issue$_{bt}$ + β_6*floating rate$_b$ + β_7*rule144a$_b$ + $\delta_t + \lambda_{broker} + \kappa_b + \varepsilon_{ibt}$,

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.[10] 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. The specifications with bond CUSIP dummies do not include issue size, time since issuance, floating rate, and Rule 144a since these characteristics are completely captured by the bond-specific and date controls.

In all four specifications the on loan % coefficient is positive and significant. In the two specifications without CUSIP dummies, the coefficient is 0.2630 without broker dummies and 0.2623 with broker dummies. When we add the bond-specific controls, the estimates fall to 0.0319 and 0.0438. 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 4, the larger the percentage of the inventory lent, the higher the borrowing cost. Increasing the

[10] 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.

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 -0.0136 to -0.0216. 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. This implies that 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 0.0323).

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 basis point. The coefficient on time since issuance is positive and significant in the two specifications without CUSIP dummies, 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 initial broker (or hedge fund); it does not allow us to determine the final party undertaking the loan 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.

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 evaluating whether they received a lower, higher, or the same borrowing cost as another competing broker.[11] 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. Furthermore, 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. Thus it appears that differences in borrowing costs between borrowers reflect differences in market knowledge and abilities to negotiate borrowing costs.[12]

[11] 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.
[12] 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.

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 around credit events. The events we examine are bankruptcy filings and large credit rating changes. 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 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 5. 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 5 to an average of 60. However, each bond does not 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 5 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 6, 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 5 and 6 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.

6. Relationship between Bond and Stock Shorting

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. 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. Although investors may short debt if it is easier to access and cheaper to borrow than stock, the total market for shorting stocks is much larger than that for shorting bonds. While the proprietary lender made 367,749 bond loans over our sample period, they made 7,241,173 stock loans during the same time period.

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 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. To avoid potential biases that hand matching may introduce, we analyze our results for both methods separately, i.e. those that were matched with a 6 digit CUSIP versus those which were hand matched. There are 15,493 bond CUSIPs in the inventory file. We were able to match 5,997 using the 6-digit CUSIP match, and an additional 4,409 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 value-weighted median borrowing cost. Likewise, for stocks we take the median stock borrowing cost for new loans weighted by shares lent. In our matched sample, 29.7% of new bond loans have a corresponding new stock loan on the same day.

Borrowing Costs for Matched Sample

For most firms, there is a fixed difference in borrowing cost between bond and stock loans. In particular, 76% of the firms in the matched sample have loans whose bond and stock borrowing costs differ by one of six distinct values: -10 bps, -5 bps, -1 bp, 0 bps, +35 bps, and +40 bps. 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 39.6% 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 22.9%. For the period from April 2006 until December 2007, the mean number in this category is 6.8%. This drop is clearly shown in Figure 7 and April 2006 appears to be a fundamental shift in the pricing relationship between bond and 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, it does not show their levels. This is explored in Table 8 and row 4 shows that 63.8% of loans in the matched sample have borrowing costs within 10 bps of each other. This percentage rises to 74.6% by 2007. For those matched loans whose borrowing costs are not close to one another, it is more common for the stock loan to be more expensive. In particular, only 1.2% of all matched bond loans are over 100 bps, while 6.1% of matched stock loans are over 100 bps. Furthermore, if a bond loan borrowing cost is more than 100 bps, 14.7% of matched stock loan borrowing costs also costs more than 100 bps. For the inverse, if a stock loan borrowing cost is more than 100 bps, only 3.0% of the matched bond loan borrowing costs are over 100 bps. This mean that it is more common for stocks to be hard to borrow (as measured by borrowing costs) than it is for bonds, and when a bond is harder to borrow, the stock is more likely to be as well.

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 55.5% 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, 63.8% of the borrowing costs are within +/- 10 bps of each other, a percentage which increased to 74.6% by 2007. 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 these two securities lending markets are similar, but when borrowing costs are high they are fragmented.

7. Returns to Shorting Bonds

In the last two sections, we calculated borrowing costs, described their cross-sectional and time-series distribution, and examined some of their important determining factors. In this section, we do a 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 implies the existence of private information among short sellers and/or borrowing constraints. We make the same inference for the market for shorting bonds.

In order 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 (2009) 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 once during our sample period on February 7, 2005. This increase ostensibly extended TRACE's coverage to all US corporate bonds. 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).[13]

In this formula, the return is 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

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

"dirty", meaning they include accrued interest, and the above formula has to be modified appropriately.

Of the 9,971 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 367,749 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.[14]

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 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

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[14] 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.

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.[15] We calculate excess returns by subtracting equally-weighted and issue-size value-weighted TRACE index returns from the corresponding portfolio's raw returns.[16]

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 -0.05%. 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 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

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[15] 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.

[16] 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 (2009)). 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.

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 new loans, whereas Panel A includes all 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 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 portfolio returns significantly different from zero.

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 lent bond 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 a bond price in the period three trading days before until three trading days after the loan's initiation. The ending price is from a bond trade in the period three days before until three days after the loan's termination. If there are multiple trades within an allotted period, we take the one closest to the loan date. 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 -$2.421 billion. The borrowing cost for all loans over the same period totaled $112 million. The average amount of bond loans outstanding per day is $12.380 billion.[17] 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 40 and 39 bps, respectively, and in Panel B, the comparable returns for all new loans are 43 and 42 bps. These values would be even closer if Table 9 accounted for the average 2.8 basis point 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

[17] 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.

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 indicate that short sellers do not have private information. In fact, the average monthly return for short sellers is negative and almost the inverse of the returns from holding the bond market. Thus, short selling corporate bonds appears to take place in an efficient market, with a small cost. 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 (CDS). 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.[18]

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 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.

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[18] 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.

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 9,971 bonds ever lent, 5,540 (55.6%) had a corresponding CDS at some point during our sample period. Furthermore, of the 367,749 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 and are thus more expensive to short, 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 12.25 bps on August 1st to 39.95 bps on August 8th. By September 10th, the rate was 94.90 bps. The LIBOR-OIS rate is considered by many to be a "barometer of fears of bank insolvency."[19] 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 turmoil in the credit markets 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.

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.

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

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 20th and the 80th percentile borrowing cost averages 6 bps per month. In the second half, the spread expands and the average difference between the 20th and the 80th 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 80th percentile climbs from an average of 14 bps to 28 bps. At the same time, the borrowing cost for the 20th 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 is also a large number of loans with negative borrowing costs during the 2007 Credit Crunch period. This is different 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.[20] 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 4, where we plot borrowing costs against inventory lent, the line for the July 2007 to December 2007 period is below the other plotted lines for most of the range. However, the slope of the line from this period continues to have a kink at 70%, and the slope is similar to that of 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

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. It estimates that short selling constitutes 19.1% of the trading activity in the corporate bond market. This is about two-thirds of the percentage of short selling in equity markets.

The average borrowing cost of loans in the sample is 33 bps per year on an equally-weighted basis and 22 bps per year on a value-weighted basis for the entire period. These costs decline over time and by 2007 are 19 and 13 bps, respectively. Small loans, fewer than 100 bonds, are more expensive than large loans early in our sample period, but by the end the mean

[20] 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.

and median borrowing costs are identical. There was a structural change in the pricing of corporate bond loans in April 2006 that we cannot explain by either market or institutional factors. At that date not only do small loans become cheaper, but the entire distribution of borrowing costs, irrespective of loan size, is compressed.

Two other important factors, in addition to loan size, that determine borrowing costs are the lender's inventory and the bond's credit rating. When the lender has greater than 70% of its available bonds lent out, borrowing costs rise sharply. Furthermore, lower rated bonds are more expensive to borrow, and borrowing costs increase substantially immediately following bankruptcy. Bonds with credit downgrades not involving bankruptcy also experience borrowing cost increases, albeit less dramatic.

Another factor impacting borrowing costs is the identity of the borrower. Broker effects are significant both in our regression analysis and in multiple-broker contests. Moreover, our results do not indicate that this pricing differential is due to volume.

The market for borrowing corporate bonds appears to be linked closely to the market for borrowing stock. The borrowing costs for 78% of the matched bond and stock loans for the same firm on the same day differ by one of six fixed amounts. Furthermore, the differences between borrowing costs for corporate bonds and stocks are reduced after April 2006. By 2007, 69.0% of the matched borrowing costs are within +/- 10 bps of each other, and 39.4% are within 1 basis point.

The changes in bond borrowing costs in April 2006 involve three structural components. First, borrowing costs for all loans are reduced. Second, the relatively higher borrowing costs for small loans are reduced, and third, there is a reduction in the difference in borrowing costs between stock and bond loans. Since we are only dealing with data from one lender, we do not know if these changes are idiosyncratic or market-wide. Given the size and importance of our proprietary lender in this market, however, we assume any changes our lender made in borrowing costs would have a market-wide impact.

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. This is consistent with shorting corporate bonds as a hedging activity for which users pay a price.

These results are in contrast to some of the literature on stock short selling. That literature demonstrates that some short portfolios, based on selection criteria such as a high level of shorting activity and/or high borrowing costs, significantly underperform the market. In the sample of bond short selling, short portfolios based on these criteria do not underperform. This may be due to the fact that we are only examining bonds available in inventory from the lender. As such, there may not be many bonds in the sample that are analogous to "hard to borrow" stocks, which underperform in the stock literature.

Another important caveat to our work is that we only examine data from one lender. Still, given the number of bonds and the size of lending activity, the conclusions that borrowing costs for corporate bonds are small and that bond short sellers do not earn positive excess returns applies to a large portion of this market.

We 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 the first 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 will not capture.

Our results speak to the larger literature on short sale constraints and their effects on asset prices. This literature has argued that short sale constraints may generate mis-valuation, and short selling takes place primarily for speculative reasons. At least for the sample of bonds covered by our lender, we find 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. Moreover, the fact that portfolios of heavily shorted bonds do not generate excess returns suggests that speculation 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.

References

Asquith, Paul, Andrea Au, and Parag A. Pathak (2006): "Short Sales Constraints." Unpublished mimeo, MIT Sloan.

Asquith, Paul and Lisa Meulbroek (1995): "An Empirical Investigation of Short Interest." Unpublished MIT Working paper.

Asquith, Paul, Rebecca Oman, and Chris Safaya (2010): "Short Sales and Trade Classification Algorithms." *Journal of Financial Markets*, forthcoming.

Asquith, Paul, Parag A. Pathak, and Jay Ritter (2005): "Short Interest, Institutional Ownership and Stock Returns." *Journal of Financial Economics*, 78(2), 243-276.

Bai, Yang, Eric C. Chang, and Jiang Wang (2006): "Asset Prices Under Short-Sales Constraints." Working paper, MIT Sloan School of Management.

Bao, Jack and Jun Pan (2009): "Excess Volatility of Corporate Bonds." Working paper, MIT Sloan School of Management.

Bessembinder, Hendrik, William Maxwell, Kathleen Kahle, and Danielle Xu (2009): "Measuring Abnormal Bond Performance." *Review of Financial Studies*, 22, 4219-4258.

Bessembinder, Hendrik and William Maxwell (2008): "Transparency and the Corporate Bond Market." *Journal of Economic Perspectives*, Spring.

Bessembinder, Hendrik, William Maxwell, and Kumar Venkataraman (2006): "Market Transparency, Liquidity Externalities, and Institutional Trading Costs in Corporate Bonds." *Journal of Financial Economics*, 82(2), 251-288.

Boehmer, Ekkehart, Charles Jones, and Xiaoyan Zhang (2008): "Which Shorts Are Informed?" *Journal of Finance*, 63(2): 491-527.

Chen, Joseph, Harrison Hong, and Jeremy C. Stein (2002): "Breadth of Ownership and Stock Returns." *Journal of Financial Economics,* 66, 171-205.

Cohen, Lauren, Karl Diether, and Christopher Malloy (2007): "Supply and Demand Shifts in the Shorting Market." *Journal of Finance*, 62: 2061-2096.

D'avolio, Gene (2002): "The Market for Borrowing Stock." *Journal of Financial Economics*, 66, 271-306.

Diamond, Douglas and Robert Verrechia (1987): "Constraints on short-selling and asset price adjustment to private information." *Journal of Financial Economics*, 18, 27-311.

Diether, Karl, K.-H Lee, and Ingrid M. Werner (2009): "Short-Sale Strategies and Return Predictability." *Review of Financial Studies*, 22, 575-607.

Duffie, Darrell (1996): "Special Repo Rates." *Journal of Finance*, 51(2), 493-526.

Duffie, Darrell, Nicolae Garleanu, and Lasse Pedersen (2002): "Securities Lending, Shorting, and Pricing." *Journal of Financial Economics*, 66, 307-339.

Edwards, Amy, Larry Harris, and M. Piwowar (2006): "Corporate Bond Market Transparency and Transaction Costs." *Journal of Finance*, 62, 1421-1451.

Figlewski, Stephen and Gwendolyn P. Webb (1993): "Options, Short Sales, and Market Completeness." *Journal of Finance*, 48, 761-777.

Fostel, Ana and John Geanakoplos (2008): "Leverage Cycles and the Anxious Economy." *American Economic Review,* 98(4), 1211-1244.

Harrison, J. Michael and David M. Kreps (1978): "Speculative Investor Behavior in a Stock Market with Heterogeneous Expectations." *Quarterly Journal of Economics*, 92(2), 323-336.

Geczy, Chris, David K. Musto, and Adam Reed (2002): "Stocks are Special Too: An Analysis of the Equity Lending Market." *Journal of Financial Economics*, 66, 241-269.

Jones, Charles M. and Owen Lamont (2002): "Short Sale Constraints and Stock Returns." *Journal of Financial Economics*, 66, 207-239.

Lintner, John (1971): "The Effects of Short Selling and Margin Requirements in Perfect Capital Markets." *Journal of Financial and Quantitative Analysis*, 6(5), 1173-1195.

Miller, Edward M. (1977): "Risk, uncertainty, and divergence of opinion." *Journal of Finance*, 32, 1151-1168.

Nashikkar, Amrut and Lasse Pedersen (2007): "Corporate Bond Specialness." *Working paper, New York University*.

Ofek, Eli and Matthew Richardson (2003): "DotCom Mania: The Rise and Fall of Internet Stock Prices." *Journal of Finance*, 58, 1113-1138.

Ofek, Eli, Matthew Richardson, and Robert Whitelaw (2004): "Limited Arbitrage and Short Sale Restrictions: Evidence from the Options Market." *Journal of Financial Economics*, 74, 305-342.

Securities Industry and Financial Markets Association (2009): Report on Outstanding U.S. Bond Market Debt

Thornton, Daniel L. (2009): “What the LIBOR-OIS Spread Says” Economic Synopsis, Federal Reserve Bank of St. Louis.

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.

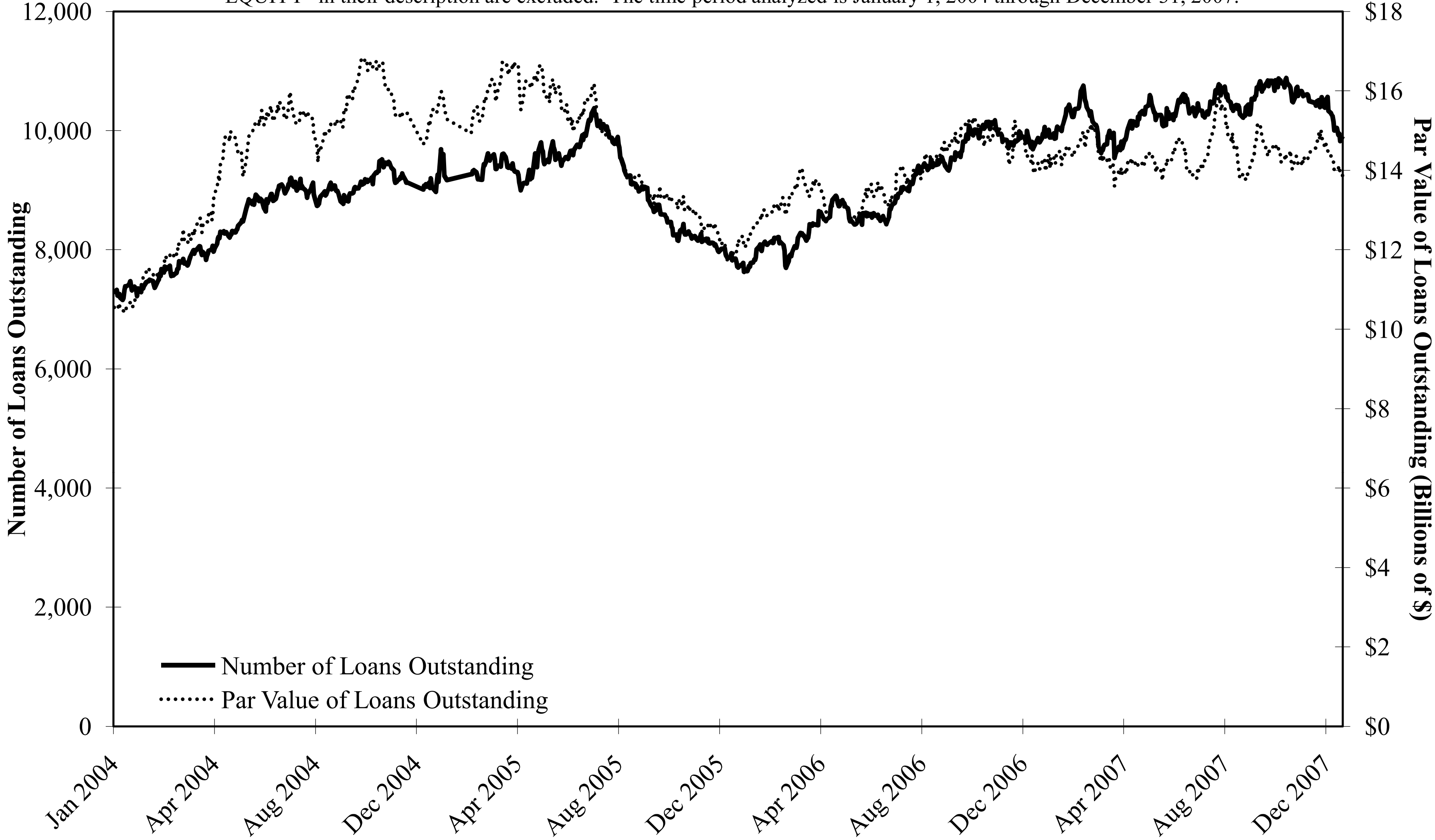

Table 2. Characteristics of Bonds in the Corporate Bond Databases

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 15,724, 8,601, and 6,034 bonds in FISD, Lender Inventory, and Lent, respectively. In 2004, it is available for 13,187, 5,960, and 3,157 bonds. In 2005, it is available for 12,879, 5,605, and 3,509 bonds. In 2006, it is available for 12,686, 5,523, and 3,835 bonds. In 2007, it is available for 12,576, 5,584, and 3,834 bonds.

Panel A: Non-rating Characteristics of Corporate Bonds

	2004 - 2007		**2004**		**2005**		**2006**		**2007**	
Number of Observations:	**FISD (57,622), Inventory (15,493), Lent (9,971)**		**FISD (37,978), Inventory (9,730), Lent (4,852)**		**FISD (40,611), Inventory (9,534), Lent (5,609)**		**FISD (43,189), Inventory (9,909), Lent (6,344)**		**FISD (44,807), Inventory (9,884), Lent (6,262)**	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Size At Issue (Millions of $)										
FISD	$175.4	$325.1	$168.0	$288.6	$168.5	$296.2	$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	$493.8	$484.7	$488.5	$476.8	$489.9	$475.4	$504.8	$477.5	$555.6	$518.5
Maturity at Issuance (years)										
FISD	10.7	10.1	12.5	10.5	12.3	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	12.0	10.2	12.0	9.3	12.1	9.6	12.2	10.4	12.8	10.9
Time Since Issuance (years)										
FISD	5.3	5.6	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	3.7	3.2	3.4	2.9	3.5	3.0	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	0.8%		0.9%		0.7%		0.7%		0.6%	
% Floating Rate										
FISD	22.3%		15.8%		17.1%		19.5%		19.5%	
Lender Inventory	17.0%		10.3%		11.5%		15.2%		16.0%	
Lent	10.4%		4.6%		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	14.3%		6.2%		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 15,724, 8,601, and 6,034 bonds in FISD, Lender Inventory, and Lent, respectively. In 2004, it is available for 13,187, 5,960, and 3,157 bonds. In 2005, it is available for 12,879, 5,605, and 3,509 bonds. In 2006, it is available for 12,686, 5,523, and 3,835 bonds. In 2007, it is available for 12,576, 5,584, and 3,834 bonds.

Panel B: Rating Characteristics of Corporate Bonds

	2004 - 2007		**2004**		**2005**		**2006**		**2007**	
Number of Observations:	**FISD (31,145), Inventory (11,897), Lent (9,025)**		**FISD (24,637), Inventory (8,487), Lent (4,559)**		**FISD (26,587), Inventory (8,156), Lent (5,284)**		**FISD (29,805), Inventory (8,319), Lent (5,954)**		**FISD (30,532), Inventory (8,396), Lent (5,841)**	
	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	68.4%		71.5%		70.9%		71.6%		72.1%	
% Investment Grade when Lent										
FISD	70.6%		71.0%		69.0%		70.2%		72.0%	
Lender Inventory	70.7%		69.8%		69.6%		71.1%		71.3%	
Lent	64.5%		64.1%		61.5%		64.8%		66.4%	
Treasury Spread (bps)*										
FISD	178.2	181.7	170.7	181.8	179.4	184.2	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	165.5	138.0	148.9	119.3	147.6	116.7	152.4	123.0	157.7	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 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. 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 over the entire sample period, and 78,448, 86,440, 93,667 and 101,199 loans in 2004, 2005, 2006 and 2007, respectively.

Year	**2004-2007**	**2004**	**2005**	**2006**	**2007**
Number of New Loans	**367,749**	**82,119**	**88,921**	**94,320**	**102,389**
Size of New Loans (Bonds)					
Mean	1444.1	1558.5	1498.9	1411.9	1334.3
Median	350	490	453	325	250
Mode	100	100	100	100	100
10th percentile	73	85	100	60	55
25th percentile	100	100	100	100	100
75th percentile	1,435	1,600	1,554	1,436	1,066
90th percentile	4,000	4,100	4,000	3,975	3,515
Duration of New Loans (Days)					
Mean	32.4	34.8	32.1	35.4	28.4
Median	11	11	10	12	11
Mode	1	1	1	1	1
10th percentile	1	1	1	1	1
25th percentile	3	3	2	3	3
75th percentile	34	34	33	37	33
90th percentile	83	84	82	92	76
Changes in Loan Size					
Percentage of loans that decrease in size	31.2%	33.1%	30.5%	32.6%	29.0%
Average total decrease in loan size (for loans that decrease)	56.9%	58.1%	58.5%	56.6%	54.7%
Average number of decreases (for loans that decrease)	1.9	1.8	1.8	2.0	1.8

Table 4. Distribution of New Loan Borrowing Costs

Table 4 Panel A reports borrowing costs on new loans over time, equal-weighted by loan (EW) and value-weighted by loan size (VW). Panel B presents borrowing costs over time partitioned by loan size. 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) Equally Weighted by Loan (EW) and Weighted by Par Value of Loan (VW)

Year	**2004-2007**		**2004**		**2005**		**2006**		**2007**	
Number of New Loans	**367,749**		**82,119**		**88,921**		**94,320**		**102,389**	
	EW	**VW**	**EW**	**VW**	**EW**	**VW**	**EW**	**VW**	**EW**	**VW**
Mean	32.6	22.2	36.7	21.5	45.0	28.0	31.6	26.3	19.3	13.1
Median	18.0	14.0	31.0	16.0	49.0	18.1	16.0	14.0	13.0	8.0
Mode	13.0	13.0	51.0	51.0	49.0	49.0	13.0	13.0	13.0	13.0
10th percentile	7.0	3.5	11.0	8.0	12.0	7.1	8.0	4.0	-5.0	-3.0
25th percentile	12.0	8.8	15.0	14.0	18.0	13.0	12.0	9.0	7.8	3.0
75th percentile	51.0	23.0	53.0	25.0	59.0	28.0	48.0	22.0	17.0	14.0
90th percentile	64.0	40.0	67.0	39.0	72.0	53.0	58.0	48.0	49.0	26.1

Panel B: Borrowing Costs (bps) by Loan Size

Year	**2004-2007**		**2004**		**2005**		**2006**		**2007**	
Number of Loans	**109,124**	**258,625**	**23,127**	**58,992**	**24,067**	**64,854**	**27,126**	**67,194**	**34,804**	**67,585**
	≤100	**>100**	**≤100**	**>100**	**≤100**	**>100**	**≤100**	**>100**	**≤100**	**>100**
Mean	39.0	29.9	50.9	31.1	62.6	38.5	33.0	31.1	19.4	19.2
Median	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	51.0	51.0	49.0	14.0	13.0	13.0	13.0	13.0
10th percentile	9.0	6.0	12.0	11.0	24.5	11.0	9.0	8.0	3.0	-1.0
25th percentile	13.0	12.0	50.0	15.0	50.0	16.0	13.0	12.0	9.0	5.5
75th percentile	54.0	49.0	65.0	51.0	67.0	54.0	50.0	35.0	21.8	15.0
90th percentile	69.0	59.0	76.0	58.0	74.0	69.0	61.0	56.0	50.0	49.0

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.

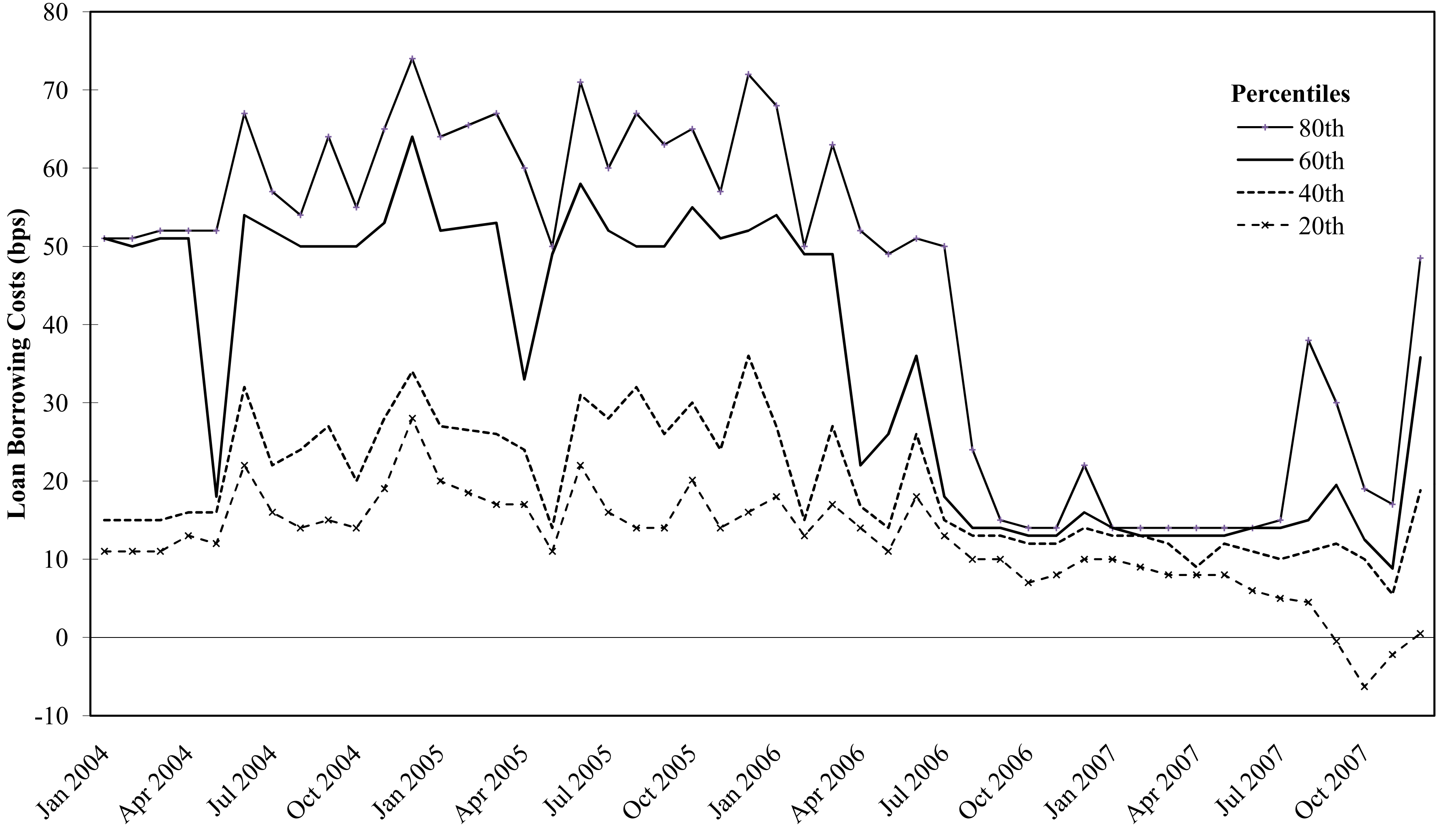

Figure 3. Histogram of Equally-weighted Loan Borrowing Costs by Time Period

Figure 3 plots histograms of equally-weighted borrowing costs pre- and post- April 2006. Data is 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. Loans with negative borrowing costs are not included and loans with borrowing costs greater than 100 basis points are aggregated at 101+ category.

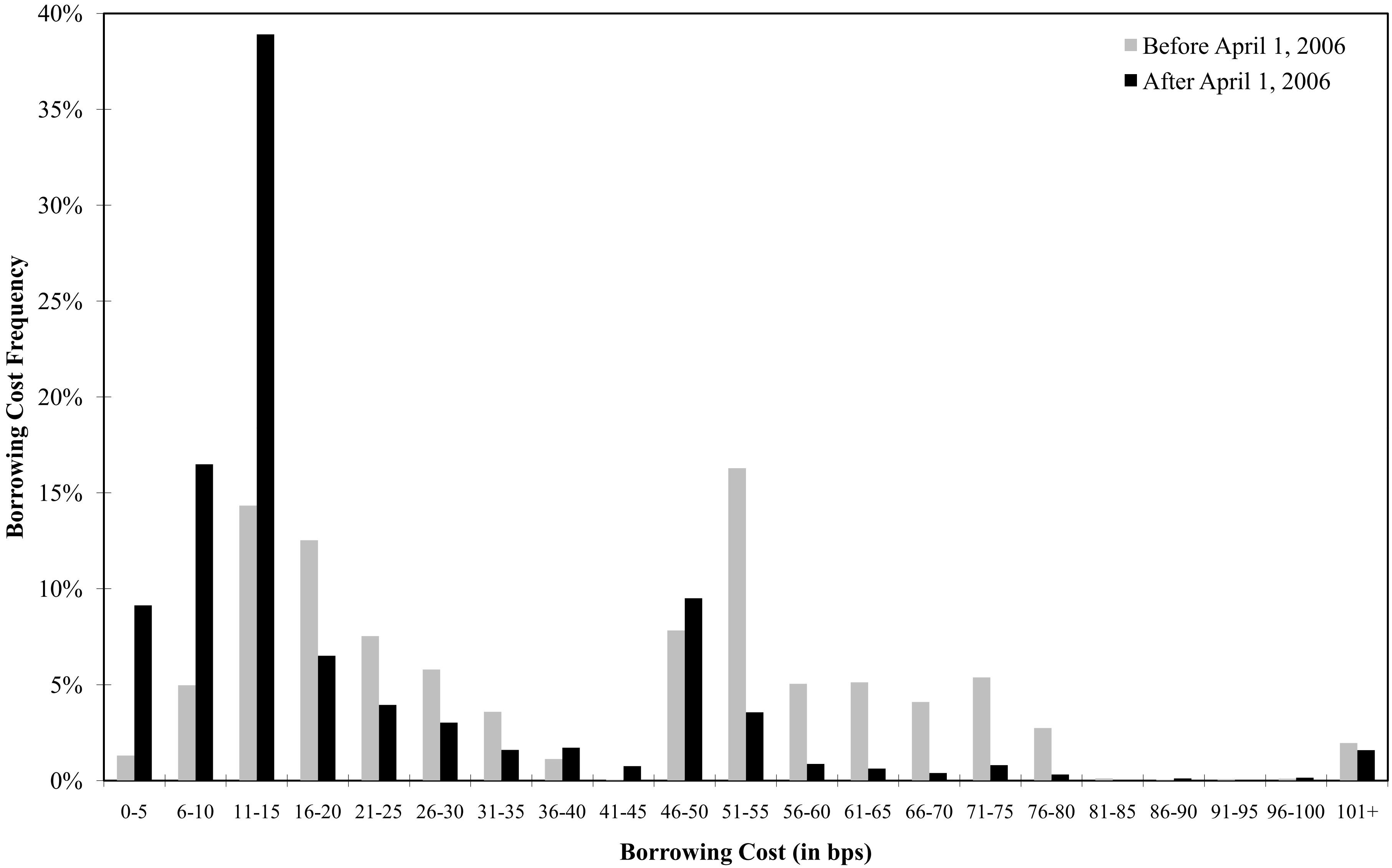

Figure 4. Relationship Between Borrowing Cost and Percent of Inventory On Loan

Figure 4 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. 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.

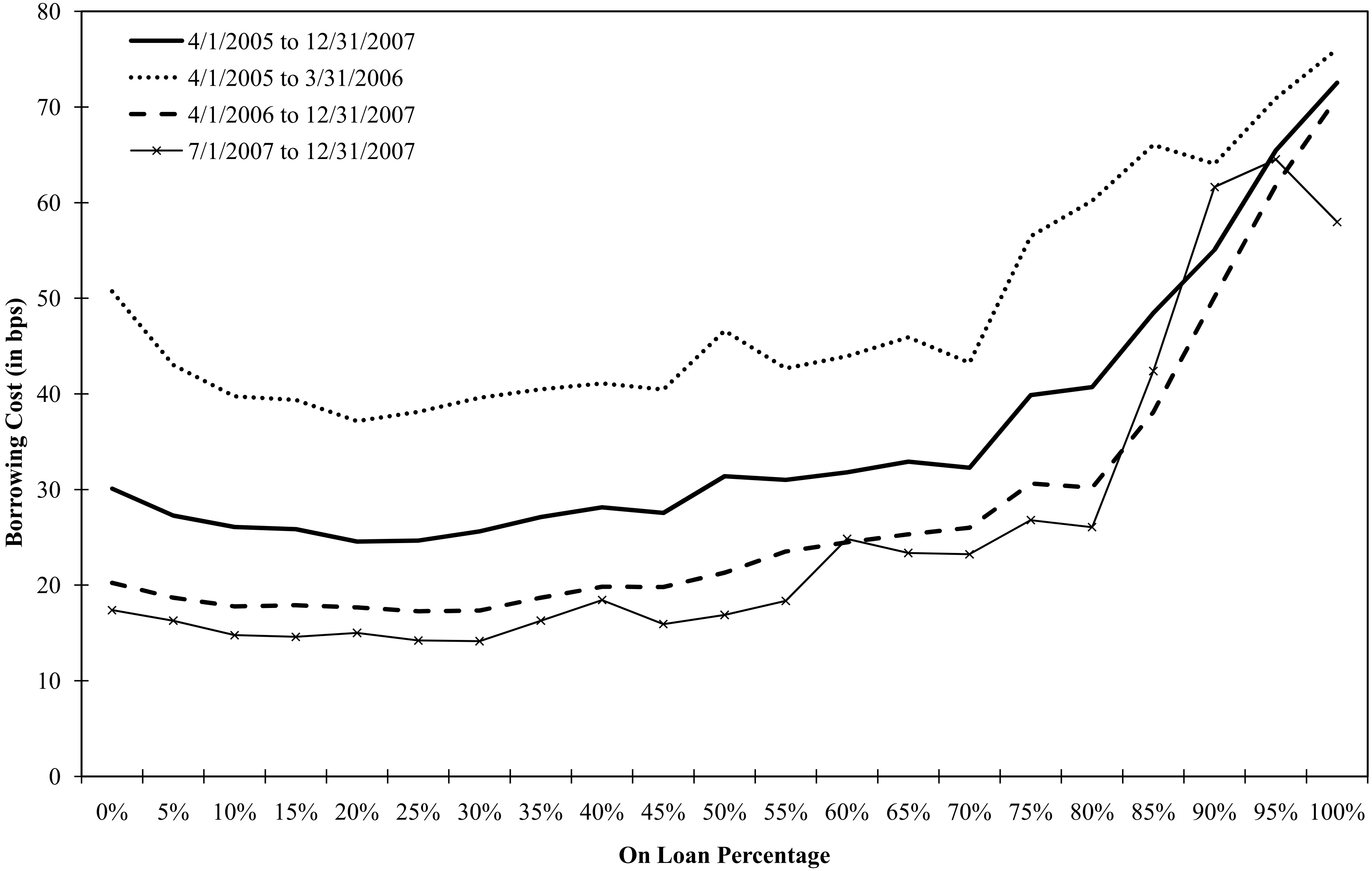

Table 5. Corporate Bonds with the Highest Borrowing Costs

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

Table 6. Regression Analysis of Determinants of Borrowing Costs

Table 6 reports estimates of the following equation:

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

where CPrate is the one month financial commercial paper rate (in bps) and RR is the rebate rate (in bps). 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 cost 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	35,258	90,905,175	$22,738,674	3,444 / 2,128	61.8% ***	1,246 / 534	42.9% ***
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	87,612	84,174,639	$40,545,662	6,992 / 2,399	34.3%	2,057 / 519	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 5. Borrowing Costs Around Bankruptcies

Figure 5 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.

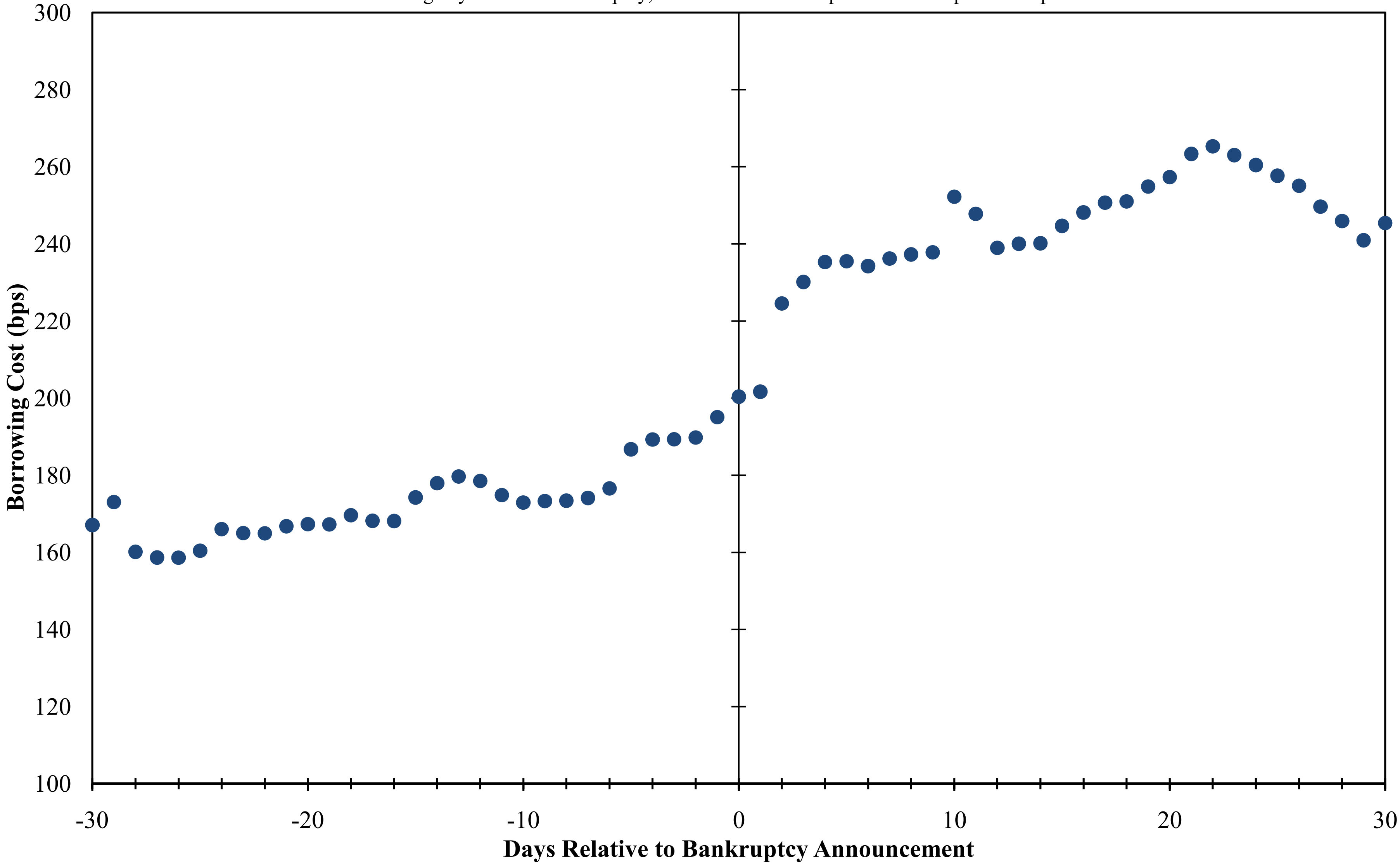

Figure 6. Borrowing Costs Around Credit Events

Figure 6 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.

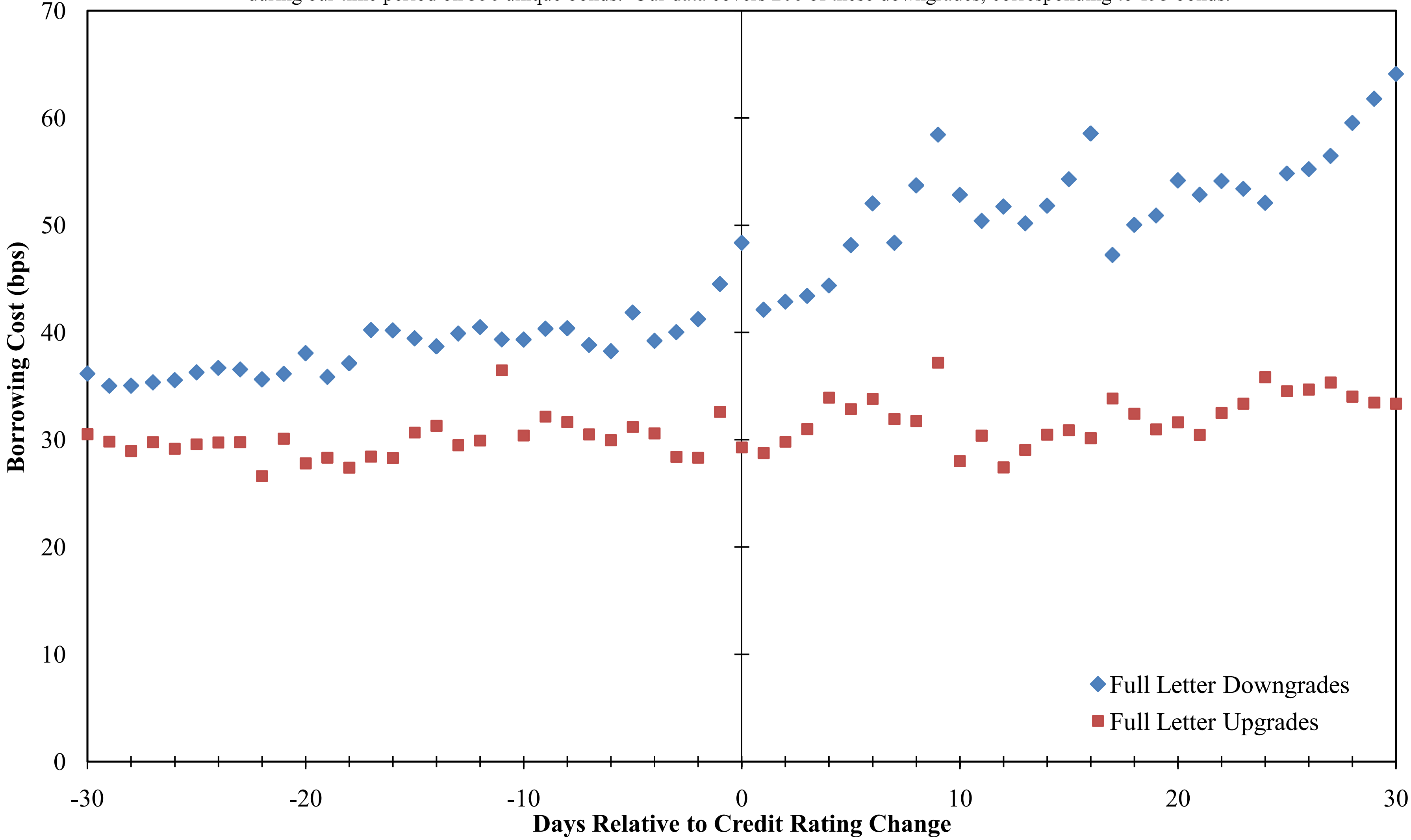

Figure 7. Bond and Stock Borrowing Cost Differences

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.

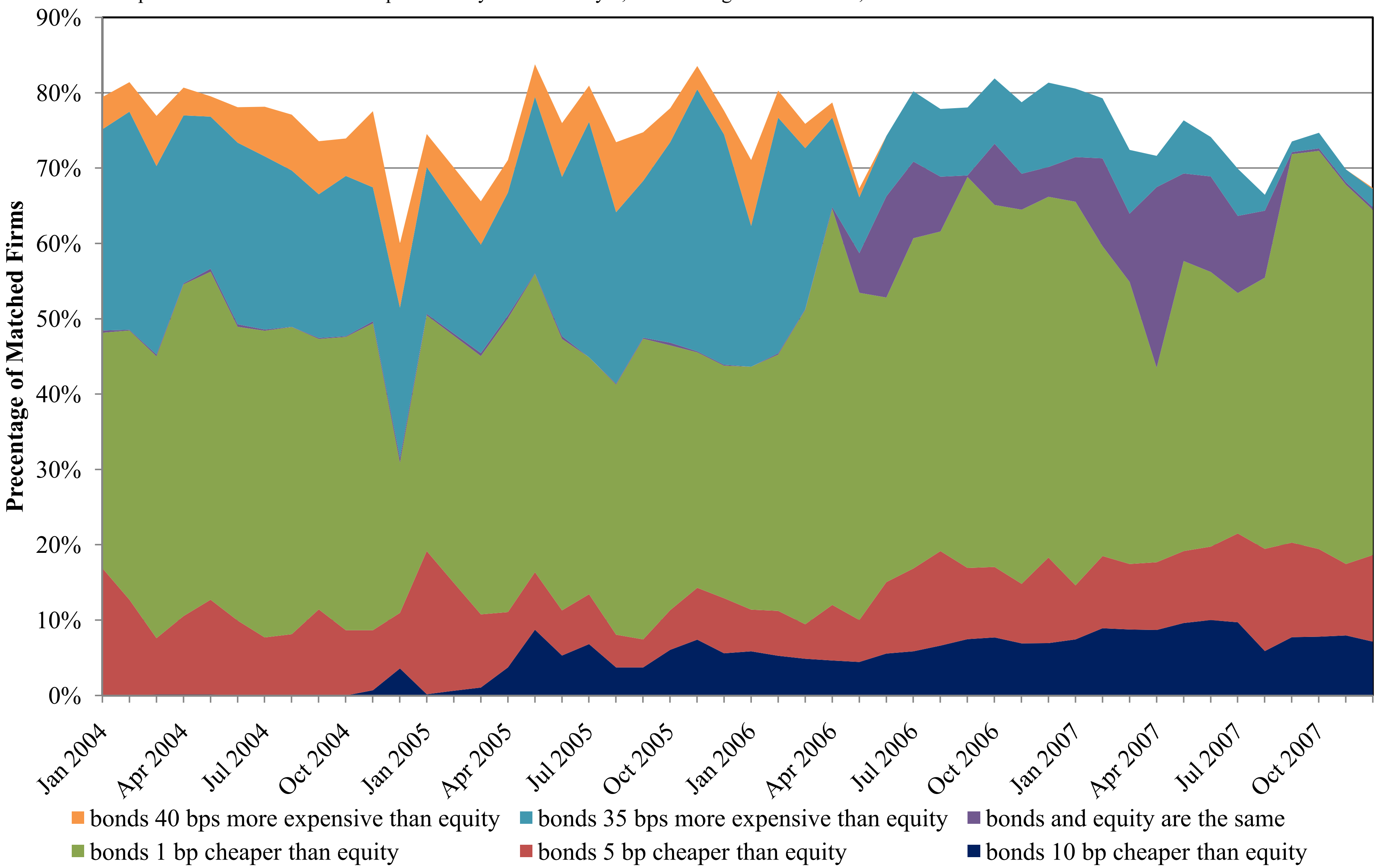

Table 8. Bond and Stock Borrowing Relationship

Table 8 examines differences in borrowing costs between matched corporate bonds and stocks. 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.

	2004-2007	**2004**	**2005**	**2006**	**2007**
N	**111,903**	**26,345**	**28,056**	**28,433**	**29,069**
% bond > stock	28.8%	37.1%	39.9%	23.5%	15.8%
% bond = stock	3.3%	0.2%	0.2%	4.5%	7.9%
% bond < stock	67.9%	62.6%	59.9%	72.0%	76.3%
% bond and stocks within +/- 10 bps	63.8%	58.2%	53.8%	67.6%	74.6%
% bond > stock by more than 10 bps	25.7%	34.5%	37.9%	20.3%	11.3%
# bond > 100 bps	1,390	170	581	397	242
% of all matched loans	1.2%	0.6%	2.1%	1.4%	0.8%
# stocks > 100 bps	6,860	827	1,448	2,158	2,427
% of all matched loans	6.1%	3.1%	5.2%	7.6%	8.3%
if bond > 100 bps, % stock > 100 bps	14.7%	17.6%	11.0%	18.4%	15.7%
if stock > 100 bps, % bond > 100 bps	3.0%	3.6%	4.4%	3.4%	1.6%
# bond > 75 bps	3,074	947	1,128	637	362
% of all matched loans	2.7%	3.6%	4.0%	2.2%	1.2%
# stock > 75 bps	7,442	1,140	1,530	2,244	2,528
% of all matched loans	6.7%	4.3%	5.5%	7.9%	8.7%
if bond > 75 bps, % stock > 75 bps	11.0%	9.2%	9.0%	14.0%	16.9%
if stock > 75 bps, % bond > 75 bps	4.5%	7.6%	6.6%	4.0%	2.4%

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 value 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

Portfolio	# 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)	
	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	5013.5	2574.1	0.40%	0.70%	0.37%	0.69%	-0.04%	0.32%	-0.05%	0.17%
Lent	2821.5	2246.9	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

Portfolio	# 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)	
	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	2360.9	1937.3	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%