Corporate Swap Use and Its Effect on Swap Spreads

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Abstract

Interest rate swaps are financial derivatives that allow people to speculate on interest rates or hedge certain interest rate exposures. Corporations, in particular, can use the swap market to effectively change fixed rate debt into floating rate debt or vice versa. This paper empirically tests whether debt issuance by financial firms has a measurable effect on the relative pricing of swaps in the market. I hypothesize that upon issuing debt, these corporations enter into pay-floating, receive-fixed swaps which, ceteris paribus, would decrease the swap spread. I find that in some cases debt issuance does have a statistically significant tightening effect.

I. Introduction

The interest rate swap market is one of the largest and most liquid derivative markets today. Estimates place the notional amount outstanding in interest-rate and currency swap contracts at more than $170 trillion in 2006, up from $3 trillion in 1991 (BIS, 2006). The size of the swap market, therefore, dwarfs the amount outstanding of U.S. Treasury bonds, which was only $5.7 trillion in June 2001 (Liu, 2002). The growth of the interest rate swap market has made it an increasingly popular choice for a variety of market participants to trade interest rates.

Interest rate swaps are best conceptualized as a simple exchange of cash flows between two counterparties for a given time period. In the most basic fixed-for-floating swap counterparty A pays a floating interest rate (usually 3 month LIBOR[1]) on a predetermined notional amount and in return receives a fixed interest rate on the same notional amount from counterparty B. This exchange of cash flows occurs periodically, typically every six months or one year, for the duration of the swap. The fixed rate which counterparty A receives is the swap rate quoted in the market. At any given time, the quoted swap rate is the fixed rate which gives the swap a present value of zero when the swap begins.

Swap rates are published every day by financial publications such as the Wall Street Journal and some online services provide constantly updated swap rates throughout the day, even though they are not traded on any central exchange. If interest rates decrease (increase), the value of the swap to the counterparty which receives fixed becomes positive (negative). This behavior makes receiving fixed in swaps analogous to

[1] LIBOR stands for the London Interbank Offered Rate. Published daily by the British Bankers Association, it represents the interest rate at which banks lend money to one another in the London interbank market. It is widely used as a short term benchmark interest rate.

owning traditional interest rate securities. Paying fixed in swaps, therefore, is analogous to selling an interest rate security. [2]

Multiple authors have investigated corporations' motivations for using swaps. One reason corporations may use the swap market is to better match their assets and liabilities. Consider a bank who wishes to issue long term debt. The bank's income is generated by loans and it has liabilities in the form of short term deposits. Therefore both its income and its primary liabilities are tied to floating rates so ideally the bank would want to issue floating rate debt. However, since market demand for long term floating rate debt is extremely limited, the bank must issue fixed rate debt. In order to simplify its liability management, the bank may enter into a swap in which they pay floating and receive fixed. Even though they have issued fixed rate debt, they are essentially able to transform all of their liabilities into floating rate liabilities. There are currently no studies which empirically test this hypothesis. Another reason corporations may use the swap market is to take advantage of information asymmetries (Titman, 1992). A corporation with favorable nonpublic information about its future may choose to borrow short term (at floating rates), because as the information becomes public, the company will presumably face lower borrowing costs. However, this exposes the company to interest rate risk; if interest rates rise, the borrowing costs also rise, even if the prospects of the business are entirely unrelated to the level of interest rates. To solve this problem, the corporation can enter into an interest rate swap to pay fixed and receive floating.

Since swaps have become such actively traded interest rate derivatives, investigating how they behave relative to the other primary interest rate instrument, U.S. Treasury debt securities, seems reasonable. This behavior is quantified in the swap

[2] For further details and diagrams about the mechanics of swaps, refer to Section III of this paper

spread, which is the difference between the quoted fixed rate on a traditional fixed-for-floating or "vanilla" swap and the yield on the Treasury security with an equivalent maturity. The rate on the swap is almost always higher and these spreads typically range between 20 and 100 basis points. Understanding the dynamics of the swap spread should be a priority for anyone who uses swaps because changes in the spread cause swaps to behave differently compared to traditional government debt. To gain intuition for how the swap spread behaves, suppose the government unexpectedly announces a large amount of new debt they will be bringing to the market. Although this does not change the fundamental outlook on the path of interest rates in the United States, yields on Treasury notes will increase in order to digest the new supply, and the swap spread will narrow as a result. If people could have predicted this move in advance they would have preferred to receive fixed in a swap relative to holding the Treasury debt. Alternatively, they could short sell Treasuries and receive fixed in swaps to limit their direct exposure to interest rates and hope to profit from a decrease in the swap spread.

Some of the literature has attempted to identify all of the factors which influence the swap spread including the spread between LIBOR and the general collateral (GC) repo rate on Treasuries, government bond issuance, the slope and level of the yield curve, and risk and liquidity premiums (Cortes, 2003)[3]. But despite the strand of literature which focuses on the motivations of corporations to use swaps in conjunction with debt issuance, no models of swap spreads explicitly include corporate debt issuance as a determining factor.

In this paper I quantitatively examine the effect of corporate debt issuance, in particular that of highly rated financial firms, on the swap spread and how the

[3] Further explanation of these factors can be found in Section III

relationship has changed over time as the swap market has expanded. The financial press has recognized the existence of this relationship: Barrett and Marine (2006) identify five different financial corporations issuing debt with a total value of over $10 billion during a particularly active week in the investment grade credit market and note that this issuance would probably put pressure on swap spreads to tighten, reasoning that the issuers would enter swaps in which they pay floating and receive fixed. This paper aims to take an academic perspective by using a regression framework to analyze whether issuance of debt by financial corporations empirically causes swap spreads to narrow. In addition, I will investigate if any other conclusions can be made regarding the timing of the tightening or the type of firm whose issuance has the greatest effect. Given my data set, I find that swap spreads do generally decrease upon financial debt issuance, though this result is not always statistically significant. As the swap market has grown, this effect has actually become less significant. The spread narrowing exists both on days that the debt is issued and on days when future issuance is announced, and is statistically significant for investment brokerage firms.

The paper will continue as follows: Section II provides a more detailed overview of the relevant literature regarding motivations for corporations to use swaps and the determinants of swap spreads. Section III places the empirical analysis of this paper within a theoretical framework of how swap spreads should behave. Section IV discusses the data used in the tests, which are described and performed in Section V. Section VI concludes the paper with a summary of the results and commentary on the implications of the study.

II. Literature Review

Since swaps are a relatively recent financial innovation, the body of literature covering them is small, yet growing. As mentioned in the introduction, there is a collection of papers which aim to explain corporate decisions regarding financing decisions and the use of swaps, and a handful which address determinants of the swap spread, yet none which explicitly connect the two ideas together as this paper aims to do. The literature also emphasizes the decision for non-financial firms to enter into pay-fixed swaps, spending little time focusing on why firms may wish to receive fixed in swaps. By empirically estimating whether the quantity of debt issued by financial firms has an observable effect on the swap spread, I hope to potentially identify an area for further theoretical research in the swap literature.

There are two prevalent theories regarding why firms may pay fixed in standard fixed-for-floating swaps; Bicksler and Chen (1986) enumerate the first theory that market imperfections may cause certain corporations to have a comparative advantage borrowing fixed and others to have an advantage borrowing floating[4]. If a firm with an advantage borrowing floating wishes to borrow at a fixed rate and the opposite holds true for another firm, both parties receive economic benefits by entering into a swap with each other. In particular, low credit-quality firms must borrow at a higher rate than high credit-quality firms in both the short term floating rate market and the long term fixed rate market. The spread between borrowing costs, however, is wider for longer maturity fixed rate debt than short term floating rate debt. Therefore if the lower credit-quality firm wants to borrow at a fixed rate it benefits by borrowing short term at a floating rate and

[4] Borrowing fixed refers to a debt contract in which the corporation must make the same interest payment on the loan, regardless of what happens to interest rates. Borrowing floating refers to a loan whose interest payments vary, typically as a spread over a short term interest rate such as LIBOR.

paying fixed in a swap. As a result, this theory predicts that low credit-quality firms tend to pay fixed and receive floating, while implying, though never explicitly stating, that firms with better credit benefit when they receive fixed and pay floating.

A disadvantage of this theory is that it neglects the credit risk that the higher credit-quality firm assumes when entering into the swap. Theoretically, the party receiving fixed from the lower credit-quality firm should require additional compensation for the additional risk that the lower credit-quality firm cannot make its payments. In practice, however, this consideration is quite small and pricing of swaps generally does not depend on the credit quality of the counterparty. One reason is that the actual dollar exposure of a given counterparty is quite small relative to the total notional value of the swap, especially once payments are netted. Litzenberger (1992) hypothesizes that swaps are not sensitive to credit rating differences because the treatment of swaps in the event of bankruptcy is asymmetric (it favors the solvent party), swaps sometimes contain "credit triggers" which allow for early cash settlement in the event of a credit downgrade, and firms with weak credit are often required to collateralize the swaps. Along the same lines, Duffie and Huang (1996) estimate that if the credit spread between two counterparties involved in a swap is 100 basis points, then the relevant adjustment to the swap rate should be less than 1 basis point. In other words, the effect of the credit quality differential on the swap rate is extremely small.

The second primary theory for pay-fixed use of interest rate swaps involves information asymmetries. Titman (1992) builds on previous theories that borrowers with favorable non-public information about their prospects prefer to enter into a series of short term floating rate loans with the idea that their interest rates on these loans will

decrease as the information becomes public. These short term loans, however, expose them to interest rate risk. In an environment of interest rate uncertainty, Titman proposes that they can enter into a long term swap contract to pay fixed and receive floating. Unfortunately Titman cannot extend this theory to rationalize why some firms enter into swaps to pay floating. He resolves this issue by reasoning that because there is an excess demand to pay fixed, swaps are priced to favor those who receive fixed. This argument seems tenuous, especially if I can show that corporate debt issuance by large financial firms moves the swap market in a direction that makes paying fixed relatively more attractive.

Both of these theories have been subjected to numerous empirical tests to verify their validity, and the results are encouraging. Simkins and Rogers (2006) find strong evidence supporting Titman's theory, noting that firms which synthetically finance at a fixed rate by borrowing floating and swapping into fixed are more likely than other firms to have their credit quality upgraded. Li and Mao (2003) extend Titman's theory to include firms using long term floating rate bank loans, rather than a sequence of short term floating rate loans. In their thorough empirical analysis, they find results that support both the Bicksler and Chen theory and the Titman theory. They discover that firms who receive fixed generally have superior credit ratings compared to those who pay fixed. They also find evidence for their theory that fixed rate payers have a higher proportion of bank loans than floating rate payers. Another intriguing result with implications for this paper is that in general, fixed payers are smaller than floating payers. As a result, one might expect a significant impact on the swap spread when floating payers (i.e. large financial firms) enter into swap contracts.

Only Gnanakumar Visvanathan (1998) directly addresses the question of who exactly pays floating in swaps. In addition to the simple conjecture that high credit quality firms pay floating in swaps to share benefits with lower quality firms who pay fixed, Visvanathan hypothesizes that a duration mismatch between assets and liabilities could provide an incentive for a firm to enter into a receive fixed swap. Suppose the interest rate sensitivity of the liabilities of a firm is higher than that of the assets so that when interest rates decrease, the value of the firm's liabilities increase by more than its assets. To resolve this problem, the firm can pay floating and receive fixed to increase the duration of its assets. Empirically Visvanathan finds no evidence to support either of these explanations for why firms pay floating. He notes, however, that the variable he uses to test the asset-liability duration mismatch actually tests the relative length of asset and liability maturities. Additionally he performed this study based on data from 1992 and 1993 when the swap market was still relatively young. This paper utilizes more recent data in searching for empirical evidence that financial firms noticeably influence the swap market when paying floating.

The effect, if observed, will occur on the swap spread. Much of the more recent literature regarding swaps has focused on the behavior of the swap spread, though there are still fewer papers than those discussing the corporate financing choice and they are typically more focused on gathering empirical evidence than developing theory. Fehle (2003) develops a model in which swap spreads are driven by expected LIBOR spreads[5] and market structure, in addition to default risk. Expectations of increases in the LIBOR

[5] The LIBOR spread is the difference between the rate on LIBOR and the rate on a given government security of the same maturity. They are typically positive because LIBOR is subject to default in the case of a banking system failure, whereas it is implicitly assumed that government securities are essentially risk-free.

spread would cause a pay floating user of a swap to demand additional compensation in the form of a higher spread to Treasuries. His theory on market structure recognizes the deficiency in the literature in explaining the types of floating payers and hypothesizes that these players enter the market only because of the advantages they can share with the fixed rate payers. He finds that these two additional factors do have an effect on swap spreads. Liu, Longstaff, and Mandel (2002) find that the liquidity differential between U.S. Treasury debt securities has a tangible effect on swap spreads. This is because on-the-run Treasuries are considered extremely liquid instruments and therefore have a liquidity premium built into the price[6]. If overall liquidity decreases, this premium will rise, driving prices of these Treasuries up and resulting in a wider swap spread. Finally, Cortes (2003) empirically identifies and analyzes a number of factors which may affect the swap spread. These include expectations of government bond issuance, the slope of the yield curve, risk and liquidity premiums, and mortgage prepayment hedging.

[6] In other words, investors give the most actively traded Treasury securities added value because they are easily bought and sold in the secondary market.

III. Theoretical Framework

The swap spread is simply determined by the balance of supply and demand in the Treasury market and the interest rate swap market which shift corresponding yield curves up and down respectively (see Figure 1). There is a natural tendency for the swap spread to be positive since swap rates are based on LIBOR whereas short term Treasury securities typically trade at levels below LIBOR. This is the LIBOR spread that Fehle (2003) identified as key determinant of swap spreads. As expectations for this spread increase, swap spreads should see a corresponding widening.

In addition to this fundamental spread, there are a number of other factors which affect supply and demand of the two yield curves. The Treasury market supply can be increased directly through the issuance of new debt by the U.S. government. Additions to supply can also be made in the secondary market when investors sell bonds that they own. Similarly, the demand for Treasuries can be satisfied either through the primary market (auctions) or the secondary market. One critical difference between the swap

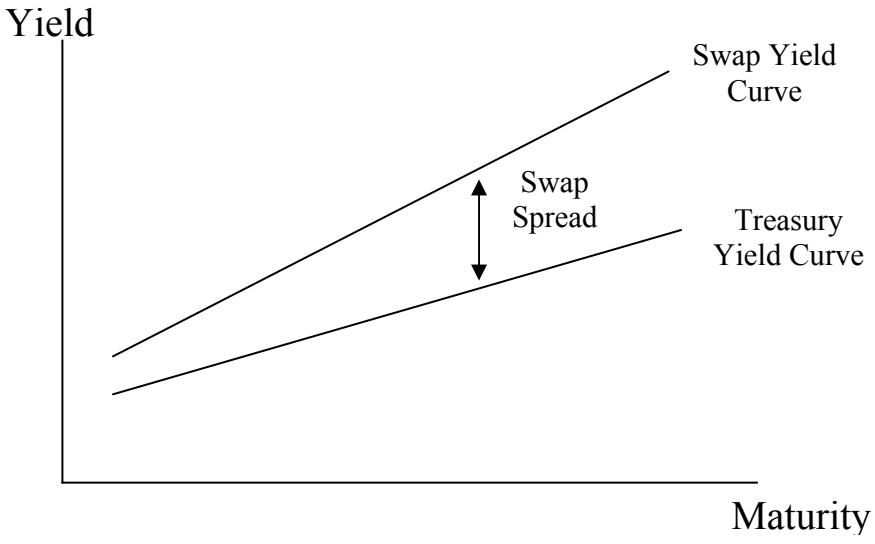

Figure 1: Visual representation of the swap spread.

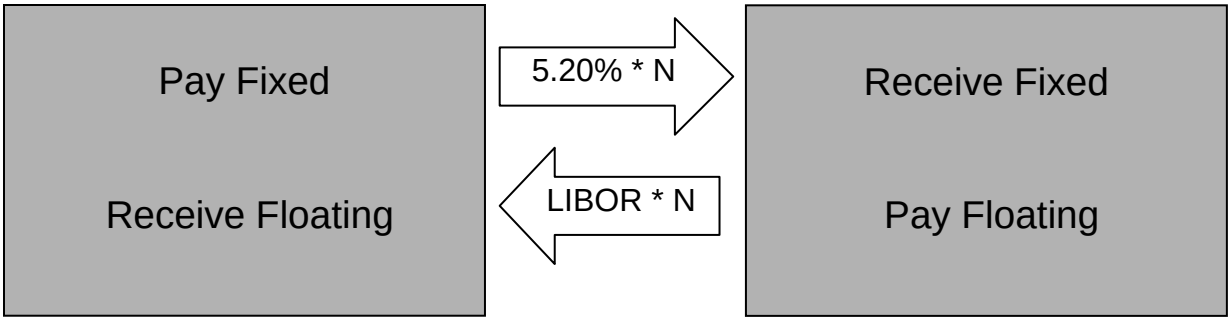

Figure 2: Visual representation of a swap contract which can be created at any time between two counterparties. 5.20% represents the fixed rate from the swap market and N represents the notional amount of the swap

market and the Treasury market is that while there is a fixed supply of outstanding government debt obligations, there is theoretically an infinite supply of "swap assets" on the market. The nature of swaps is that they can be created at any time by two consenting counterparties for any desired notional amount (See Figure 2). Swap users wishing to pay fixed and receive floating, which is analogous to selling a Treasury bond, determine the "supply" of swaps. Similarly, those who wish to receive fixed and pay floating compromise the swap demand. The existence of market makers, typically investment banks, ensures that there is always a liquid market for swaps, despite the lack of a central exchange. They also allow swaps to be traded without the consent of both counterparties. For example, if I own a swap to receive fixed and pay floating, I can sell this to someone else. If interest rates have decreased since I entered the contract, I will receive money when I sell the swap. But if they have gone up, I must pay a lump sum to the person I am selling the swap to. The fixed payments that the original counterparty makes go to the new third party, who is responsible for making the floating payments that I was previously responsible for.

Arbitrage theory predicts that the quoted swap rate will not differ substantially from one dealer to another, otherwise there would be a risk-free, profitable trading strategy. For example, suppose a trader could enter into one swap to receive 5.5% fixed

for 10 years and another to pay 5% fixed for 10 years. This trade is a financial free lunch; traders can earn the guaranteed 0.5% spread between these two rates, regardless of what happens in the market. They would execute this trade with as much money as possible, including using leverage to their advantage. As money pours into this trade, however, the 5.5% rate will gradually decrease and the 5% rate will gradually increase until they equilibrate and the arbitrage opportunity vanishes.

Economics dictates that given a particular demand level, an increase in supply lowers the price. Thus, an increase in the supply, either direct or indirect, of Treasuries decreases the price and increases the yield. In the same manner an increase in the number of fixed-payers would cause the quoted swap rate to increase. The demand portion works in the exact opposite fashion; an increase in demand for receiving fixed in swaps or Treasuries will decrease the quoted swap rate or the yield respectively. Therefore, I predict that debt related swap use by financial firms results in a narrowing of the swap spread, as the swap rate decreases relative to Treasury yields (see Figure 3).

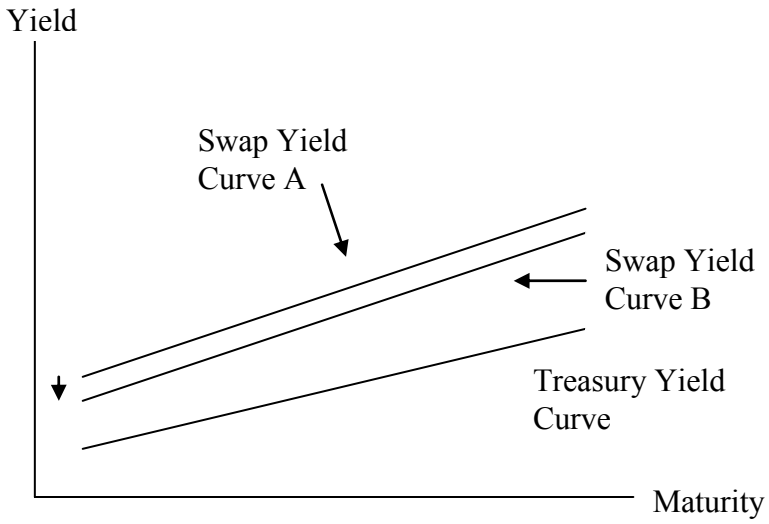

Figure 3: Corporate debt issuance by financial firms may raise the demand for receiving fixed in swaps. This would shift the swap yield curve from A to B, decreasing the swap spread.

Typical market events, such as economic data releases, tend to cause price movements of approximately equal magnitude in the Treasury market and the swap market. Therefore, we must examine some essential differences between the two markets which drive the relative supply and demand and therefore the swap spread. Cortes (2003) identifies a number of different explanatory variables that affect the swap spread. This paper tests whether corporate debt issuance also helps determine the swap spread.

Cortes' regression includes data reflecting budget expectations, the slope of the yield curve, the "on/off spread", implied volatility from the equity market, and the effective duration of mortgage backed securities. There is also a medium run adjustment variable which "accounts for the persistent deviations in swap spreads." A decrease in the budget expectations of the government (i.e. a deficit) would tighten the swap spread, as the supply of Treasuries increases relative to swaps. Empirically, the slope of the yield curve is inversely related to swap spreads. This may stem from the fact that in an inverted yield curve environment, financing a short position in Treasuries through the repurchase, or repo, market becomes relatively more expensive. Thus there is a relative decrease in supply of Treasuries. The on/off spread is the difference in yield between the most liquid, on-the-run government bonds and less frequently traded off-the-run bonds. This spread primarily reflects the liquidity premium other authors have identified as a driver of swap spreads. Despite the growth in the swap market, people may still tend to view the government bond market as the most liquid, so an increase in the on/off spread (decrease in liquidity) should widen the swap spread as demand for bonds increases relative to swaps. Government bonds are also considered extremely secure investments so that demand may be boosted by a "flight-to-quality" in risky or uncertain periods. Thus an

increase in volatility expectations, as measured by the VIX, would increase the swap spread[7]. The effective duration of mortgage backed securities affects swap spreads primarily because holders of mortgage portfolios, like corporations, have become more active in using the swap market to manage their interest rate exposure. For example, in a falling interest rate environment, more and more homeowners will refinance their mortgages, shortening the duration of these portfolios. In order to maintain a constant duration, portfolio managers may choose to receive fixed in swaps, which would narrow the swap spread. Since all of these variables affect the relative pricing of swaps and Treasuries, I should include them in my model of swap spreads.

Cortes finds that the coefficients on slope, implied volatility, effective duration of mortgage backed securities, and the medium run adjustment variable are all significant and obtains an R-squared value of 0.40. The form of my regressions will be similar, but I will add a variable that quantifies the issuance of debt by financial corporations and test to see whether its coefficient is statistically significant. I will also include a variable that measures LIBOR spreads since they are the fundamental driver of swap spreads.

[7] The VIX is an index which tracks the "implied volatility" of the stock market. All other things equal, options are more valuable in a high volatility environment. Therefore if options prices are high, the VIX will also be at an elevated level, reflecting market expectations that large price swings may lie ahead.

IV. Data

I have obtained time series data for market variables which will allow me to measure the factors which influence swap spreads. This data set was collected using Bloomberg, a service that is a primary source of information for many market professionals and is regarded as very reliable. In addition to including variables which have been shown as significant in affecting swap spreads, my data set also contains an index of financial debt issuance that enables me to test for the effect of corporate swap use on swap spreads. The time series range from May 31, 1998 to January 25, 2007 and include 2,284 daily price observations. I use the price of the last trade on each day.

As discussed in the previous section, there are numerous market factors which can affect swap spreads[8]. The interest rate variables collected are 3 month LIBOR, the yield on 3 month Treasury Bills, the 10 year swap rate, the yield of the on-the-run 2 and 10 year U.S. Treasuries[9] and a Merrill Lynch index which tracks the yield of a basket of "off-the-run" Treasuries with maturities ranging from 9.5 to 11 years. From this fundamental group, I define the actual variables to be used in the regression as shown in Table 1.

Regression Variable	Definition
Swap Spread	10 Year Swap Rate - 10 Year On The Run Treasury Yield
On/Off Spread	10 Year Off the Run Yield - 10 Year On the Run Yield
Slope	10 Year Treasury Yield - 2 Year Treasury Yield
LIBOR/T-Bill Spread	3 Month LIBOR - 3 Month T-Bill Yield

Table 1: Definition of interest rate variables used in the regression

[8] See Section III for a complete list of these factors, their definitions, and reasoning for how they affect swap spreads.

[9] These yields are obtained from Merrill Lynch indices which track the on-the-run Treasuries. The use of a separate index is necessary because Bloomberg contains the yield of the current 10 year note only back until the date when it first became on-the-run, which is typically less than 3 years. The indices are superior to Constant Maturity Treasury (CMT) yields because it reflects prices of actual securities whereas CMT is a synthetic measure.

One disadvantage of these definitions is that they are quite restrictive. Not all firms will hedge with 10 year swaps, especially if the debt matures in less than 10 years. As a result, even if a firm hedges its debt issuance using swaps, there may be no effect on the ten year swap spread. But because precisely matching swap spreads with debt issuance would be extremely difficult, I choose to use the 10 year swap spread because it is a widely traded rate. In addition, there is a possibility that when a corporation hedges at a certain point along the swap curve, other points on the curve could also tighten. Imagine a firm receiving fixed in a seven year swap. The counterparty to this swap is likely a dealer who may wish to hedge their newly acquired exposure to paying fixed by receiving fixed. Depending on their market outlook and current positions, however, they may hedge this exposure by receiving fixed at another maturity along the swap curve, including the 10 year bucket, which would narrow the swap spread at that maturity.

Other market variables which I have obtained include the Chicago Board Options Exchange volatility index (VIX), a Citigroup index which measures the effective duration of mortgage backed securities, and a Bloomberg survey of economists' expectations for the monthly budget release by the U.S. Treasury. The last two sets are only computed monthly, so they only have 104 observations. In addition, the budget expectations survey may not be the best measure because it is based on short term expectations. Thus changes in values recorded by this survey may not necessarily correspond with an altered market view of future U.S. Treasury debt issuance, which is what impacts swap spreads.

Basic statistics for these time series can be found in Table 2. Graphs which compare the swap spread to various independent variables are located in the Data Appendix at the end of this paper. Note that the LIBOR/T-Bill spread is typically positive

	Swap Spread (%)	Slope (%)	On/Off Spread (%)	Volatility (%)	Budget Expectations ($B)	MBS Duration (years)	LIBOR / T-Bill Spread (%)
Mean	0.576	0.780	1.055	19.717	-13.105	3.180	0.404
Stdev	0.239	0.867	0.946	6.848	53.649	0.880	0.212
Min	-0.031	-0.516	-0.336	9.890	-117.140	1.189	-0.058
Max	1.355	2.787	3.176	45.740	181.692	4.556	1.604

Table 2: Descriptive statistics for variables included in the regression

as we would expect and since this is the fundamental driver of swap spreads they are also usually positive. The table also reveals that the yield curve tends to be upward sloping[10] and that a liquidity premium does exist between on-the-run and off-the-run Treasuries. The swap spread varies significantly: the standard deviation of 24 basis points is almost half of its mean. Notice that slope, on/off spread, volatility, budget expectations, MBS duration, and the LIBOR/T-Bill spread all share the swap spread's characteristic of relatively large standard deviations compared to their means. This suggests that a relationship between them may exist, as has been found by previous studies.

I have also created an index of corporate debt issuance by financial firms in order to test my hypothesis that issuance has a tangible effect on swap spreads. I have decided to use financial firms for this study because they may be the type of corporation most aware of the hedging opportunities that swaps provide, there is a dearth of literature giving theoretical motivations for companies to pay floating and receive fixed, and they provide a data set of workable size. Currently this index consists of 24 different financial firms[11] and 9,002 separate note issues dating back to 1995. The firms included all have a significant amount of their business related to interest rates so they could have incentives to hedge their debt issuance by entering into a swap to receive fixed, which, all else

[10] This is an expected result. Even in an environment where interest rates are expected to be flat, investors are likely to demand greater compensation (i.e. higher yields) for owning securities that are more sensitive to interest rate fluctuations.

[11] See the Data Appendix for a list

equal, would decrease swap spreads. Like the above data series, the issuance data was obtained from Bloomberg. I have also separated the firms into three separate categories based on classifications by Yahoo! Finance. The categories are Investment Brokerage, Regional and Money Center Banks, and Other Financial Firms. This will allow me to determine whether certain subgroups of financial firms have different effects on swap spreads.

For each security issued I gather the date that the issuance was announced, the actual date of issuance, the maturity date, and the notional amount issued. In order to properly account for the difference between $2B of debt maturing in two years and $2B of debt maturing in 30 years, I have obtained a set of duration weights given certain assumptions about the bonds (see Data Appendix). I multiply the amount issued (in millions) by the duration to obtain the duration-weighted amount issued and sum these amounts on each day to obtain the time series index of financial debt issuance. One weakness of this data is that it is only a proxy for the actual amount these firms use swaps to hedge their issuance. The extent to which they use swaps likely varies over time.

Table 3 contains simple correlations based on the data obtained so far. The signs are as expected[12] and they are fairly large, confirming findings of previous research. Unfortunately, at this point, there does not appear to be a discernible relationship between financial debt issuance and the swap spread. This can also be seen by looking at the

Correlation with Swap Spread	
Slope*	-0.547
On/Off Spread*	0.654
Volatility*	0.419
Budget Expectations	0.339
MBS Duration*	0.339
Financial Debt Issuance	-0.049
LIBOR/T-Bill Spread	0.385

Table 3: Swap spread correlations. Those which were found as significant in previous studies have been noted by a *

[12] See Section III

chart of the swap spread as a function of financial debt issuance (Figure 4), in which no obvious pattern emerges. A possible explanation for this phenomenon is that firms may not have hedged their debt issuance with swaps as far back as 1998 or perhaps the effect of issuance may be masked by other variables. Moving to a regression model will provide a clearer analysis.

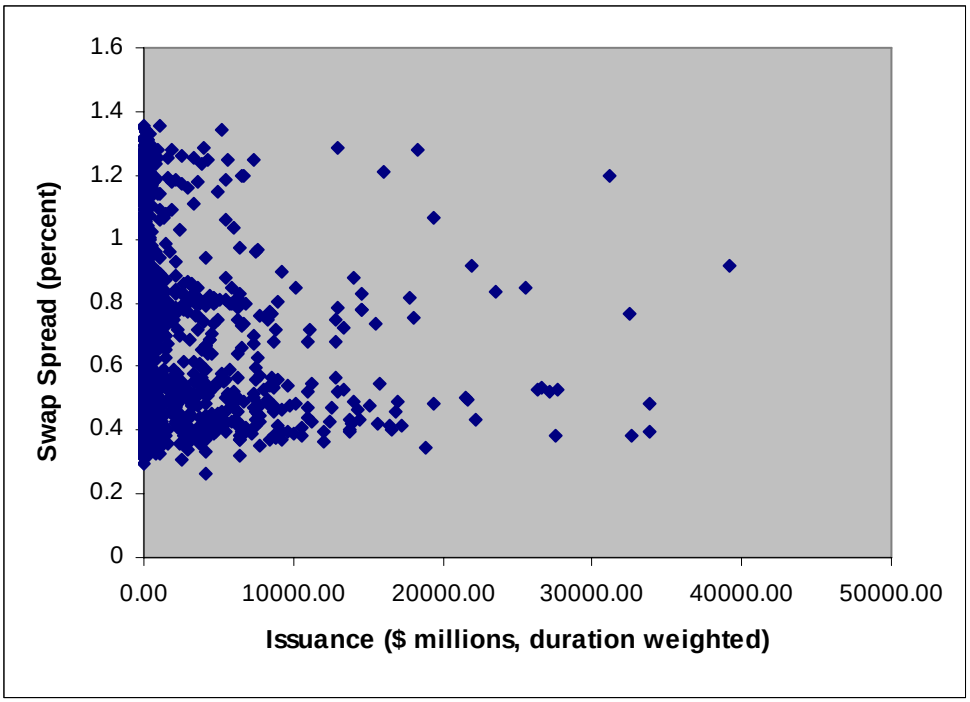

Figure 4: Swap spreads plotted against duration weighted issuance since May 31, 1998

V. Empirical Specifications and Findings

As discussed in previous sections, I will attempt to determine the significance and size of various market factors on the swap spread. My regression is similar to ones performed in the past except that it is the first to explicitly include financial debt issuance as a potential explanatory variable. The general form of my regressions is as follows[13]:

$$\textbf{Swap Spread}_t = \beta_0 + \beta_1 * \textbf{Financial Debt Issuance}_t + \beta_2 * \textbf{Budget Expectations}_t$$
$$+ \beta_3 * \textbf{Slope}_t + \beta_4 * \textbf{On/Off Spread}_t + \beta_5 * \textbf{Volatility}_t$$
$$+ \beta_6 * \textbf{Duration of MBS}_t + \beta_7 * \textbf{LIBOR/T-Bill Spread}_t$$

Instead of using first differences as has been done in previous studies, the regressions use cross sectional data over time. This is done because unlike the other market variables, issuance data varies widely over time. There can easily be $400 million of duration-weighted issuance on one day, followed by none on the following day. While we expect a tightening of swap spreads on the day of issuance, using first differences would lead to accounting for the effect of "negative" $400 million of issuance on the second day on swap spreads. Since it seems irrational for corporations to issue debt and hedge it on one day, only to exit the hedge on the next day, I want to avoid capturing this effect. The drawback of this approach is inputting the current levels of the various determinants could result in a predicted swap spread that is quite different from the actual swap spread.

Despite this shortcoming, the model will still give predictions of the change in the swap spread given a change in one of the independent variables, assuming that all the other variables stay the same. For example, the coefficient β_1 will allow market participants to determine, on average, how much swap spreads move given a certain level of issuance. In general, the results of the regression will allow market participants to

[13] Definitions of these variables and rationale for their place in the regression can be found in Section III

Coefficient	Variable	Expected Sign
$ß_1$	Financial Debt Issuance	-
$ß_2$	Budget Expectations	+
$ß_3$	Slope	-
$ß_4$	On/Off Spread	+
$ß_5$	Volatility	+
$ß_6$	Duration of MBS	+
$ß_7$	LIBOR/T-Bill Spread	+

Table 4: Expected signs on independent variables. Explanation of the variables and reasoning for the expected signs can be found in Section III

analyze how the swap spread moves in response to a variety of factors and adjust their investment decisions based on their views. Consider a simple example in which they observe a change in the slope of the yield curve in the market but all the other factors remain the same. Knowledge of the coefficient β_3 will tell them how much, and in what direction, the swap spread has historically moved in response to variations in slope. Then, if there is a deviation between the actual and expected behavior of the swap spread, they could decide to put on a trade. If financial debt issuance is indeed a determinant of swaps, its inclusion should make the regression a better model for the behavior of swap spreads. Table 4 above summarizes the expected signs on the various coefficients.

One weakness of the model is the use of the current LIBOR/T-Bill spread as an explanatory variable for the current swap spread. In reality, it is expectations of future LIBOR/T-Bill spreads that drive the swap spread. Therefore in its current specification, the model assumes that the current level of LIBOR/T-Bill spreads is the best predictor of future LIBOR/T-Bill spreads.

Another concern is the potential existence of reverse causality between corporate debt issuance and swap spreads which could result in biased coefficients. The idea is that corporate debt issuance not only has an effect on swap spreads, but swap spreads may in

turn influence the timing and amount of corporate debt issuance. There are a number of problems, however, which make such a scenario unlikely. Regardless of the level of swap spreads, entering into a swap to receive fixed and pay floating has a net present value of zero. Since the value of a corporation's hedging tool does not change with swap spreads, it is hard to imagine that they will change their issuance behavior based on swap spreads. Corporations are also unlikely to have a view on the path of swap spreads which is more accurate than market consensus so they should not be basing their financing decisions on whether they believe swap spreads are relatively high or low.

This consideration, though, gives rise to the idea that corporate debt issuance is not a completely independent variable. It is highly likely that the amount of issuance depends on the level of interest rates because corporations are more prone to issue debt in a period of low interest rates and cheap financing. To account for this possibility I include the level of interest rates, as measured by the rate on the ten year Treasury note, in the regression. This specification is not perfect, however, because the actual rate that corporations pay on their debt also depends on corporate bond spreads over Treasuries, but I was not able to obtain an appropriate data series to measure this factor.

I have run a number of different regressions, using different measures for the amount of financial debt issuance to test my various research questions. One set of regressions uses the date when the debt was actually brought to market ("Issuance Date"). The "Announce Date" regressions account for the possibility that swap spreads could tighten upon the announcement of future issuance, rather than at the time it is issued. This may occur because people may anticipate swap spreads tightening with future issuance and put on a trade to profit from that tightening. The actual act of executing such a trade

will tend to tighten swap spreads. Since the swap spread I have measured is the ten year swap spread, it may be reasonable to assume that those issuing debt with maturities less than ten years will not hedge with ten year swaps and therefore there will be no effect on this particular swap spread. Thus another regression includes only debt issues with maturities of 10 years or more. Finally, since the swap market is relatively young, financial firms may have only recently started hedging their issuance with swaps. I have run regressions using two separate start dates: May 31, 1998 and January 1, 2004.

The primary regression uses issuance date, all debt issues, and data since 1998 and the results can be found in Table 5. Note that issuance does indeed have a negative sign as hypothesized. The magnitude of the coefficient suggests that for every $9.7 billion of duration-weighted financial issuance, the swap spread should tighten by one basis point. For a reference point, this corresponds to roughly $5.2 billion of 2 year debt, $2.3 billion of 5 year debt, or $1.3 billion of 10 year debt. This coefficient seems reasonable from the standpoint of economic significance. It does not say that swap spreads barely budge when a lot of issuance is brought to market, nor does it imply that

Variable	Coefficient	t-value
Issuance	-1.03E-06**	-2.15
Slope	-0.094**	-35.10
On/Off Spread	0.182**	-65.20
Volatility	-1.16E-03**	-3.31
Budget Expectations	1.49E-05	0.45
MBS Duration	0.045**	14.47
LIBOR/T-Bill Spread	0.154**	15.63
Interest Rates	0.048**	8.88
Constant	0.863**	4.42

Table 5: Results from the primary regression. ** Indicates that the variable is statistically significant at the 5% level. * Indicates the variable is significant at the 10% level

swap spreads experience huge variation every time a corporation decides to issue debt. The 95% confidence interval runs from -1.97e-06 to -9.13e-08. These two values correspond with a 1 basis point tightening for $5.1 billion and $11.0 billion of duration weighted issuance respectively. The coefficient is statistically significant at the 5% level.

The regression also finds all the other variables except for budget expectations are statistically significant. This may confirm earlier suspicions that the measure of budget expectations used is not valid for this study. The coefficients on slope and on/off spread imply that a 10 basis point steepening of the yield curve results in swap spreads that are tighter by approximately one basis point and a five basis point increase in the "liquidity premium" causes swap spreads to widen by one basis point. These results bear moderate resemblance to Cortes's earlier study because he found that slope, volatility, and duration of mortgage backed securities were all statistically significant. The only coefficient whose sign differs from expectations is volatility, but its coefficient is not very economically significant. It suggests that an extremely large 10 point increase in volatility as measured by the VIX would result in swap spreads widening by one basis point. While the hypothesis was that investors may view Treasuries as a "flight-to-safety" instrument in times of high volatility (LTCM Crisis in 1998, September 11, 2001) so that swap spreads widen as volatility increases, the regression does not support this theory. Perhaps one reason is that any increased risk to the banking system that investors perceive is captured in the LIBOR/T-Bill spread. Alternatively, these events could be so rare that their effects are minimized when examining long term averages.

Detailed results of the alternative specifications can be found in the findings appendix. Table 6 (on the following page) contains the coefficients on the issuance

Regression	Coefficient	t-value	p-value
Issuance Date	-1.03E-06**	-2.15	0.03
Issuance Date (2004)	-1.52E-07	-0.64	0.52
Announce Date	-1.31E-06**	-2.68	0.01
Announce Date (2004)	-1.63E-07	-0.69	0.49
Issuance Date (10+ years)	-8.82E-07	-1.50	0.13
Issuance Date (10+ years, 2004)	-9.54E-08	-0.34	0.73
Announce Date (10+ years)	-1.22E-06**	-2.07	0.04
Announce Date (10+ years, 2004)	-2.20E-07	-0.81	0.42
Investment Brokerage (Issuance Date)	-1.10E-06	-1.21	0.23
Regional / Money Center Banks (Issuance Date)	-1.02E-06	-1.62	0.11
Other Financial (Issuance Date)	-2.86E-06	-1.29	0.20
Investment Brokerage (Announce Date)	-1.86E-06**	-2.03	0.04
Regional / Money Center Banks (Announce Date)	-1.00E-06*	-1.65	0.10
Other Financial (Announce Date)	-2.79E-06	-1.24	0.22
Issuance Date (Monthly)	-5.40E-07	-1.26	0.21
Announce Date (Monthly)	-4.21E-07	-1.01	0.31

Table 6: Coefficients on issuance measure for a number of different specifications

measure for the different regressions. In general, the results align with the results of the main regression in that the coefficient is always negative with a magnitude of around -1E-06. The coefficient is statistically significant in four of the sixteen regressions at the 5% level and one additional regression at the 10% level.

A number of other observations can be made from the results in Table 6. First note the difference in coefficient and significance in the regressions with data from 1998 to today and those with data from 2004 to today. In each of the four cases the magnitude of the coefficient decreases and in the three cases where it was previously statistically significant it turns statistically insignificant. This runs counter to the intuition which says that as more and more firms become more aware of the hedging opportunities with swaps, they will tend to hedge more which will increase the effect of issuance on the swap spread. A trivial cause for this could be that in 1998 financial firms were just as knowledgeable about swaps as they were in 2004 and are in 2007. Another possible explanation for this phenomenon is that as the swap market has matured, transactions of similar size have less of an effect on the overall market price. In other words, the market

can now "absorb" larger amounts of issuance without needing to adjust the price as much as before.

Another interesting finding is that swap spreads tend to tighten on both the issuance date and the announce date when looking at the financial firms as one group. This finding suggests another regression which regresses the swap spread on both issuance by issue date and issuance by announce date. The results of these regressions are contained in Table 7. Both measures of issuance remain statistically significant, though the announce date coefficient is slightly larger. These findings mesh well with the theory that some tightening will occur on the announce date, presumably caused by market participants anticipating future hedging, followed by the actual tightening on the date the new debt is issued.

No obvious claims can be made from the regressions containing different types of firms on the issuance date, but there are noticeable differences on the announce date. There is a statistically significant tightening for both the investment brokerages and the regional/money center banks at the 5% and 10% level respectively, but the effect is not

Variable	Coefficient	t-value
Issuance (Issue Date)	-9.47E-07**	-1.97
Issuance (Announce Date)	-1.24E-06**	-2.53
Slope	-0.094**	-35.15
On/Off Spread	0.182**	65.27
Volatility	-1.17E-03**	-3.36
Budget Expectations	1.96E-05	0.58
MBS Duration	0.045**	14.46
LIBOR/T-Bill Spread	0.153**	15.56
Interest Rates	0.048**	8.87
Constant	0.082**	4.58

Table 7: Regression containing both the issuance and the announce date since 1998

Variable	Coefficient	t-value
Issuance (Investment Brokerage)	-1.98E-06*	-1.74
Issuance (Regional/Money Center Banks)	-8.08E-07	-1.07
Issuance (Other Financial)	-2.43E-06	-0.87

Table 8: Regression containing all three types of firms separately by announce date since 1998

significant for other financial firms. When including all three in a regression by announce date, only the investment brokerage is significant at the 10% level (Table 8). One may be tempted to suggest that issuance by other financial firms has the greatest tightening effect on swap spreads because the coefficient is the largest, but the lack of statistical significance for all but one of the factors means that interpreting these results should be done with caution.

Finally, note that the magnitude of the coefficient on issuance is significantly smaller when the regression is carried out on a monthly scale. These coefficients of roughly -5E-07 imply that the swap spreads tighten by 1 basis point for about $20 billion of duration-weighted issuance, a number that is not too unreasonable and may in fact be a better estimate because some of the market noise has been eliminated by looking at it on a monthly basis. Note, however, that these coefficients are not statistically significant.

The coefficients on the other variables in the model generally follow the pattern established in the main regression[14]. All factors except for budget expectations are statistically significant in the majority of the alternative specifications. Budget expectations are never statistically significant. The sign of the coefficients generally fits for most of the regressions. Exceptions exist for the regressions which were run using only data after January 1, 2004 and for the volatility and budget expectations variables. Therefore justification exists for including nearly all of the variables in the regression,

[14] See the findings appendix for further details

though a future study may want to obtain a data series for budget expectations which more accurately represents the long term funding needs of the U.S. Treasury.

VI. Conclusions

This paper set out to discover whether corporate use of swaps has an identifiable effect on swap spreads. The results section contains details showing that corporate issuance does appear to be associated with a tightening of swap spreads, though the result is not always statistically significant. Practical interpretation of the coefficients obtained in the regressions is difficult, even in the cases where the results are statistically significant. Knowing that swap spreads should tighten by about a basis point for duration weighted issuance between $5.1 billion and $11.0 billion is not a very narrow estimate. Also note that, contrary to expectations, the effect of issuance on swap spreads may be decreasing over time as the swap market grows even larger.

Despite the apparent negative relationship between financial debt issuance and swap spreads, readers must be cautious in making any broad conclusions regarding financial corporations' swap use since large assumptions have been made about using their issuance as a proxy for their swap use and about their use of ten year swaps, in particular, to hedge the issuance. While a general pattern may exist, specific methods of implementing swap hedges probably vary widely amongst financial firms.

In a similar manner, the dynamics of the relationship between corporate debt issuance and swap spreads are constantly changing. As more people in the market become aware of the spread tightening that may occur with issuance, expectations and anticipation of future issuance may begin driving spreads more than actual issuance. Indeed, if corporations end up issuing less than the market expects, swap spreads could potentially widen on the issuance date. Future studies could investigate whether swap spreads at time t are actually dependent on issuance at some point after time t. Another

factor to consider is that the negative relationship is based on the idea that financial firms wish to borrow at floating rates, but the market demand for floating rate debt is rather limited so that they must issue fixed rate debt and swap into floating rate debt. If conditions change and market demand for floating rate debt increases, these firms are likely to skip the intermediate step of using the swap market and simply issue floating rate debt.

A potential flaw of this study is its limited scope. Corporate swap use is certainly not limited to financial corporations. Favorable interest rate environments in which financials choose to issue debt may also coincide with non-financial corporations issuing debt and swapping into paying fixed rather than swapping into receiving fixed. This would have an opposing, widening effect on swap spreads, making the net effect ambiguous. The actual performance of swap spreads would then depend on the probability that financial firms use swaps alongside their debt issuance compared to the probability that non-financial firms use them and the relative magnitudes of the debt issuance by the two types of corporations.

Another implication of this study is that more theoretical work may need to be pursued to more clearly understand the rationale for corporations to enter into swaps to receive fixed. Much of the literature currently focuses on the decision for firms to pay fixed in swaps. Since this paper finds, however, that financial debt issuance tends to have a tightening effect on swap spreads, a more rigorous framework may need to be developed to fully explain why financial firms engage in their current behavior.

Finally, this paper further adds to a growing body of empirical work which concludes that corporate use of swaps is fairly prevalent. This confirms that swaps are not

simply another clever financial innovation created for Wall Street to speculate on interest rates, but that they are quite practical for those on Main Street too.

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Appendix A: Data

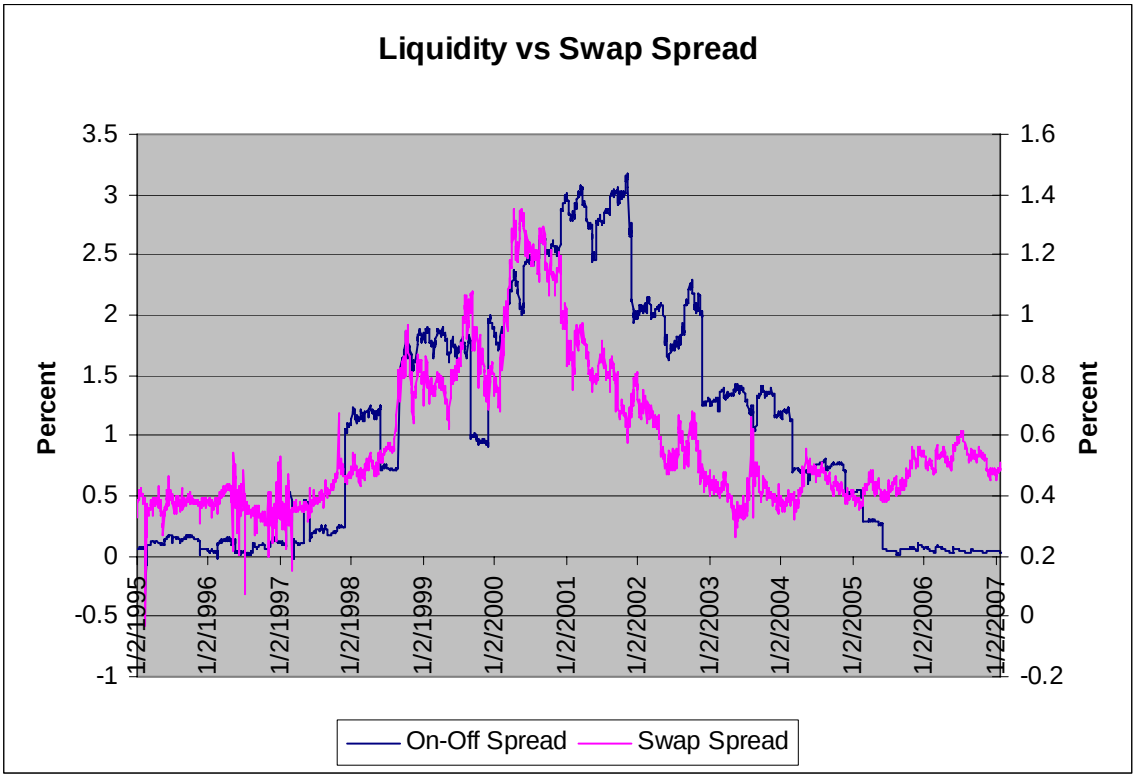

Chart A1: On-the-run / Off-the-run treasury spread (left axis) plotted against the swap spread (right axis). The on-off spread is a measure of liquidity. In environments of lower liquidity, the spread will be wider. In this situation, Treasuries which are seen as the most liquid product would trade at a premium to swaps, increasing the swap spread. Source: Bloomberg

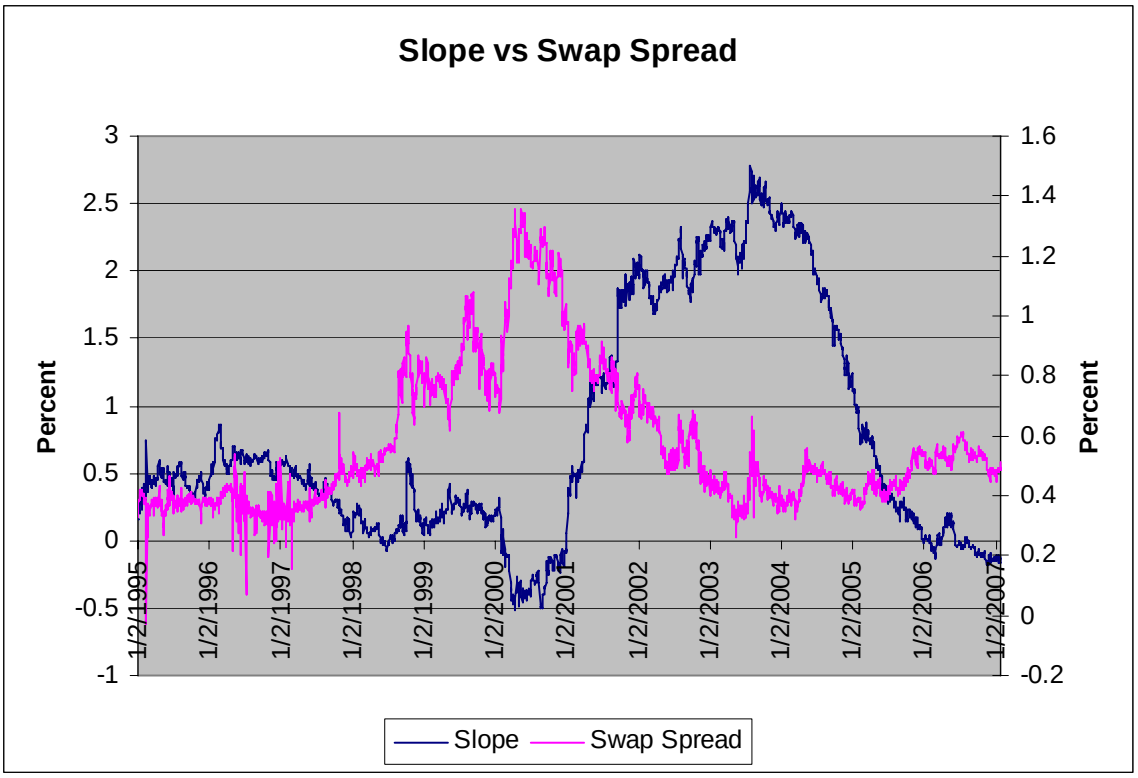

Chart A2: Slope of the swap curve (left axis) plotted against the swap spread (right axis). When the yield curve is flat (low slope), it is relatively more difficult to finance short positions in Treasuries. This will tend to decrease Treasury yields relative to swaps, increasing the spread. Source: Bloomberg

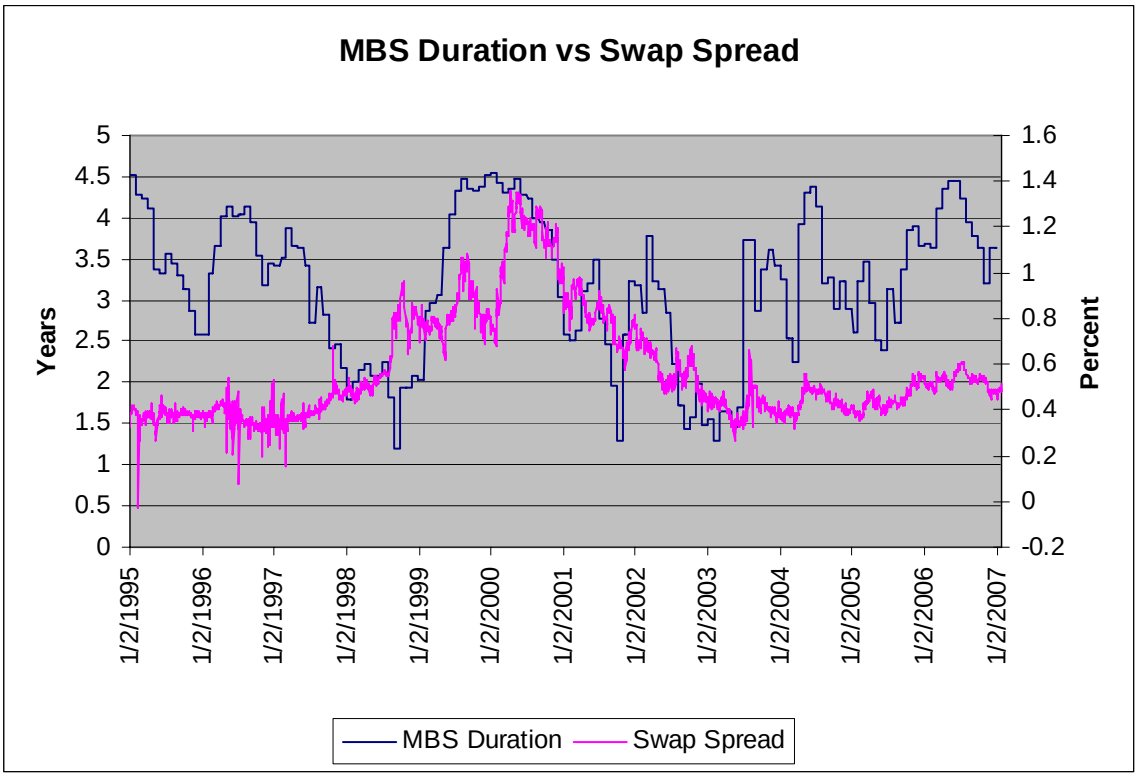

Chart A3: Effective duration of mortgage backed securities (left axis) plotted against the swap spread (right axis). As MBS duration decreases due to prepayments, holders of these portfolios may receive fixed in swaps to maintain constant duration. Therefore spreads tend to tighten. Source: Bloomberg

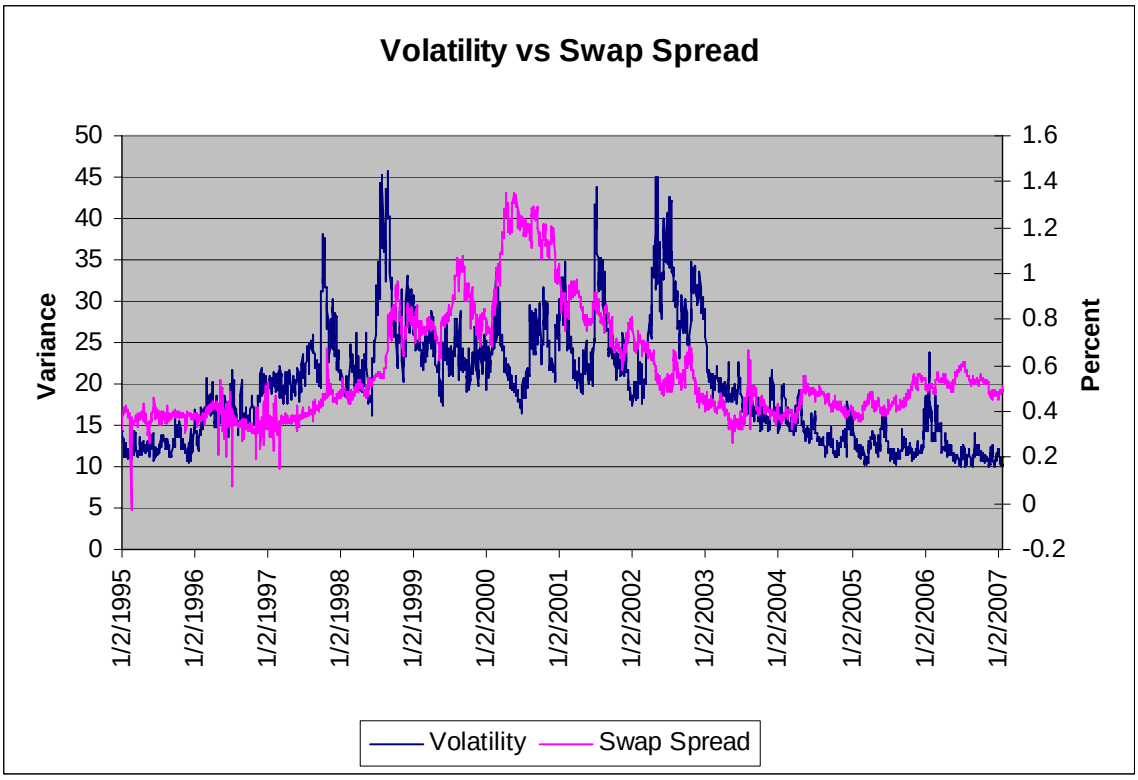

Chart A4: Volatility, as measured by the Chicago Board Options Exchange volatility index (left axis), plotted against the swap spread (right axis). Treasuries are seen as more valuable than swaps in times of uncertainty and high volatility. Thus greater volatility implies wider spreads. Source: Bloomberg

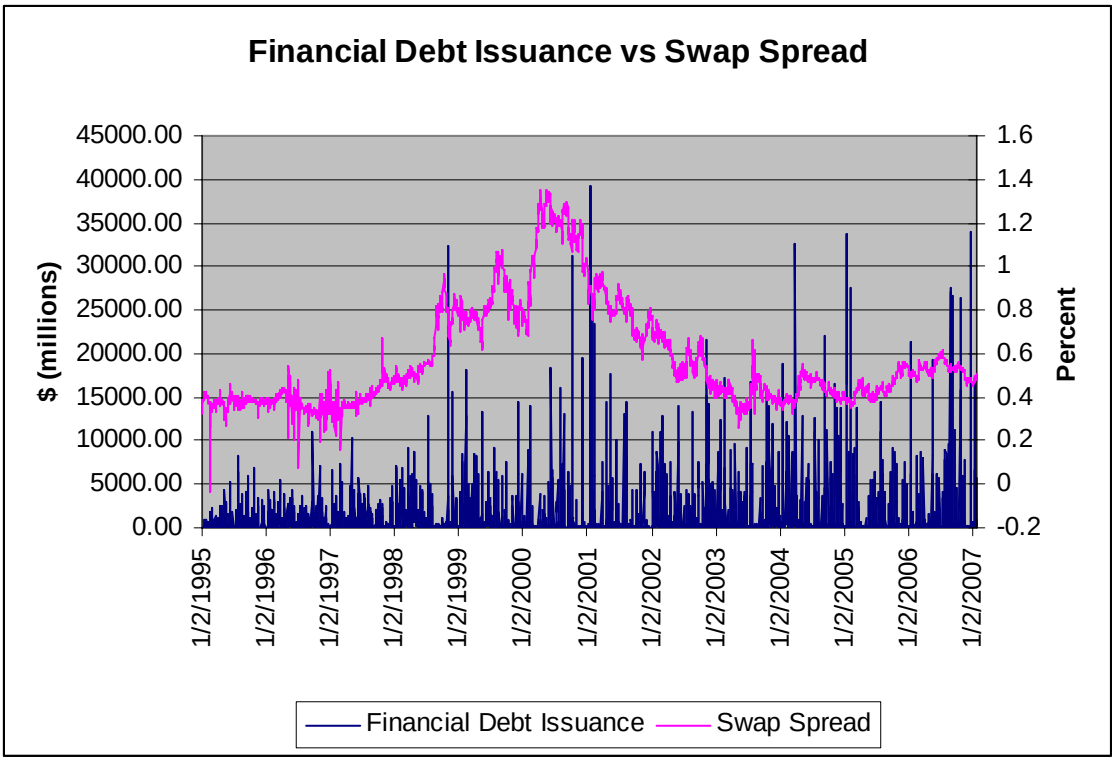

Chart A5: Financial debt issuance (left axis), plotted against the swap spread (right axis). Upon issuing debt, financial firms may enter into swaps to receive fixed, which would decrease swap spreads. Source: Bloomberg.

Financial Firms

Ticker	Firm	Firm Type	Category
BSC	The Bear Stearns Companies	Investment Brokerage	A
GS	Goldman Sachs Group	Investment Brokerage	A
LEH	Lehman Brothers Holdings	Investment Brokerage	A
MER	Merrill Lynch	Investment Brokerage	A
MS	Morgan Stanley	Investment Brokerage	A
BAC	Bank of America	Money Center Banks	B
BBT	BB&T Corporation	Regional Banks	B
BCS	Barclays PLC	Money Center Banks	B
C	Citigroup	Regional Banks	B
CS	Credit Suisse Group	Money Center Banks	B
DB	Deutsche Bank	Money Center Banks	B
JPM	JPMorgan Chase	Money Center Banks	B
KEY	KeyCorp	Money Center Banks	B
PNC	PNC Financial Services	Money Center Banks	B
RY	Royal Bank of Canada	Money Center Banks	B
STI	SunTrust	Money Center Banks	B
UBS	UBS AG	Money Center Banks	B
USB	U.S. Bancorp	Regional Banks	B
WB	Wachovia	Money Center Banks	B
WFC	Wells Fargo	Money Center Banks	B
AXP	American Express	Credit Services	C
CFC	Countrywide Financial	Mortgage Investment	C
COF	Capital One Financial	Credit Services	C
WM	Washington Mutual	Savings & Loans	C

Table A1: Financial firms included in the index of financial debt issuance. The firms have been divided up into 3 categories: Investment Brokerage (A), Regional and Money Center Banks (B), and Other Financial (C).

Years	Duration
1	0.96
2	1.86
3	2.71
5	4.26
7	5.65
10	7.44
12	8.47
15	9.80
20	11.55
30	13.83

Table A2: Duration weights assuming 6% coupon and bond priced at par. I fit a curve to these weights: the equation is Duration = (-.0127)*Years^2 + (0.8275)*Years + 0.3186. I use this curve to calculate durations, given the maturity and issue date of a bond.

Appendix B: Findings and Results

	Issuance	Slope	On/Off Spread	Volatility	Budget Expectations	MBS Duration	Libor-Tbill Spread	Rates	Constant
By Issuance									
Coefficient	-1.03e-06**	-0.094**	0.182**	-1.16e-03**	1.49e-05	0.045**	0.154**	0.048**	0.863**
t-value	-2.15	-35.10	-65.20	-3.31	0.45	14.47	15.63	8.88	4.42
By Issuance (2004)									
Coefficient	-1.52e-07	7.86e-03**	-0.063**	1.79e-04**	-8.75e-05**	0.041**	0.072**	0.071**	-0.024
t-value	-0.64	2.18	-6.72	3.44	-4.66	14.87	5.62	12.63	-1.09
By Announce									
Coefficient	-1.31e-06**	-0.094**	0.182**	-1.17e-03**	1.72e-05	0.045**	0.154**	0.048**	0.080**
t-value	-2.68	-35.11	65.23	-3.34	0.51	14.46	15.63	8.89	4.46
By Announce (2004)									
Coefficient	-1.63e-07	7.89e-03**	-0.063**	1.79e-03**	-8.72e-05**	.041**	0.072**	0.071**	-0.024**
t-value	-0.69	2.19	-6.72	3.44	-4.64	14.83	5.61	12.65	-1.11
By Issuance (10+ Yrs)									
Coefficient	-8.82e-07	-0.094**	0.181**	-1.14e-03**	1.38e-05	0.045**	0.154**	0.048**	0.078**
t-value	-1.5	-35.08	65.14	-3.28	0.41	14.48	15.68	8.85	4.37
By Announce (10+ Yrs)									
Coefficient	-1.22e-06**	-0.094**	0.181**	-1.15e-03**	1.51e-04	0.045**	0.154**	0.048**	0.079**
t-value	-2.07	-35.10	65.15	-3.30	0.45	14.47	15.66	8.86	4.41
Investment Brokerage (Issuance)									
Coefficient	-1.10e-06	-0.094**	0.182**	-1.17e-03**	1.25e-05	0.045**	0.155**	0.048**	0.077**
t-value	-1.21	-35.05	65.15	-3.33	0.37	14.44	15.71	8.90	4.32
Regional and Money Center Banks (Issuance)									
Coefficient	-1.02e-06	-0.094**	0.182**	-1.15e-03**	1.44e-05	0.045**	0.154**	0.048**	0.078**
t-value	-1.62	-35.08	65.17	-3.28	0.43	14.47	15.63	8.89	4.36
Other Financial Firms (Issuance)									
Coefficient	-2.08e-06	-0.094**	0.182**	-1.16e-03**	1.23e-05	0.045**	0.154**	0.048**	0.077**
t-value	-1.29	-35.06	65.17	-3.31	0.37	14.49	15.68	8.86	4.34
Investment Brokerage (Announce)									
Coefficient	-1.86e-06**	-0.094**	0.182**	-1.17e-03**	1.37e-05	0.045**	0.155**	0.048**	0.078**
t-value	-2.03	-35.07	65.19	-3.34	0.41	14.45	15.74	8.89	4.39
Regional and Money Center Banks (Announce)									
Coefficient	-1.00e-06*	-0.094**	0.182**	-1.16e-03**	1.48e-05	0.045**	0.154**	0.048**	0.078**
t-value	-1.65	-35.08	65.17	-3.31	0.44	14.45	15.63	8.91	4.35
Other Financial Firms (Announce)									
Coefficient	-2.79e-06	-0.094**	0.182**	-1.15e-03**	1.31e-05	0.045**	0.154**	0.048**	0.077**
t-value	-1.24	-35.06	65.16	-3.30	0.39	14.50	15.68	8.86	4.34
Issuance (Monthly)									
Coefficient	-5.40e-07	-0.106**	0.201**	1.11e-03	-2.34e-04	0.088**	0.180**	-0.020	0.213**
t-value	-1.26	-8.50	15.23	0.65	-1.53	5.01	3.97	-0.68	2.47
Announce (Monthly)									
Coefficient	-4.21e-07	-0.106**	0.201**	1.15e-03	-2.20e-04	0.088**	0.181**	-0.020	0.207**
t-value	-1.01	-8.45	15.16	0.67	-1.43	5.02	3.99	-0.68	2.40

Table B1: Results of alternative specification regressions. ** represents statistical significance at the 5% level. * represents significance at the 10% level