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ABSTRACT

This dissertation is a collection of three essays in corporate finance and bond interest rate volatility. Chapter 1 investigates the impact of TARP preferred stock on two different types of outstanding preferred stock. The October 14, 2008 TARP program mandated a forced issuance of TARP preferred stock by the largest U.S. banks. Soon after, many smaller banks were not forced but chose to issue TARP preferred stock after being approved for issuance. We investigate the impact of TARP preferred on two different types of outstanding preferred stock. These two different types of preferred stock are (1) trust preferred stock, which is senior to TARP preferred stock, and (2) non-trust preferred stock, which has equal claim to TARP preferred stock. We present competing theories for expecting that trust preferred should enjoy greater or lesser returns relative to non-trust. Consistent with the priority rule theory, but inconsistent with the default theory, we find that trust preferred enjoyed greater benefits from TARP issuance than did non-trust preferred for both forced and non-forced banks on the October 14 TARP announcement date. In contrast, there is no clear priority rule effect on the approval dates for non-forced banks. Chapter 2 examines whether share ownership structure plays a role in determining the ex-day pricing of dividends. If share ownership structure, specifically the proportion of the firm's stock held by individuals versus institutions, has an effect on the ex-dividend day stock price behavior, the ex-day premium is expected to be different for firms with different ownership structures. Consistent with both the tax-based theory and the dynamic trading clientele theory, I find that the ex-day premium decreases with

the level of individual ownership. Consistent with the short-term trading theory, I also find that the ex-day premium increases with the degree of investor heterogeneity, defined as the product of the proportion of the firm's stock held by individual investors and the proportion held by institutional investors. The results suggest that the cross-sectional variation in the ex-day premium is related to the firm-specific share ownership structure. In addition, I find that the ex-day premium is positively related to the ex-day excess trading volume, indicating that a high level of dividend capture increases the ex-day premium. Chapter 3 investigates the relationship between interest rate volatility and yield spreads on noncallable bonds. If greater interest rate volatility increases a firm's debt volatility, the firm is more likely to reach a critical value for default, thereby leading to a higher yield spread. We find that interest rate volatility is positively related to yield spreads on noncallable bonds. Our finding is consistent with the structural models of default, which suggest that a firm's volatility should include its debt volatility as well as its equity volatility. This study also explores whether the positive effect of interest rate volatility on yield spreads is stronger or weaker for callable bonds than for noncallable bonds. We find that the positive effect of interest rate volatility on yield spreads is weaker for callable bonds. This result indicates there is a negative relation between default spreads and call spreads, which is consistent with Acharya and Carpenter (2002) but in contrast to King (2002).

CHAPTER 1

IMPACT OF THE TARP FINANCING CHOICE ON EXISTING REFERRED STOCK[1]

I. Introduction

On October 14th, 2008, the U. S. Treasury announced that the largest U.S. banks would necessarily receive TARP capital through *forced* issuance of preferred stock and that other (smaller) banks could later apply to issue TARP preferred stock but would *not be forced* to issue preferred stock.[2] The financing choice, preferred stock, was surprising and anticipated by very few if any. According to Landler and Dash (2008), even the bank CEOs present at the meeting were surprised and some had to be coaxed into the plan to issue preferred stock.

Pre-existing preferred stockholders would seem obviously affected by TARP preferred issuance. Interestingly, Veronesi and Zingales (2010) estimate that there was a greater absolute total impact upon existing preferred stock than upon common stock in the forced banks.[3] In their analysis of preferred, Veronesi and Zingales (2010) correctly maintain that many shares of preferred stock do not trade frequently enough to make a credible analysis of the change in value of each outstanding preferred stock. Thus, their estimate of the impact upon total preferred stock valuation of a firm is based only upon the *most recently issued* preferred stock of the

[1] This chapter is based on collaborative work with Duane Stock.
[2] The large banks in their study were Bank of America, Bank of NY Mellon, Citigroup, Goldman Sachs, JPMorgan Chase, Merrill Lynch, Morgan Stanley, State Street Corporation, Wachovia, and Wells Fargo.
[3] This can be partially explained by the fact that some common stocks had a positive reaction while others had a negative reaction.

bank that was actively traded. In contrast, we find trading in numerous other preferred shares was quite active, thereby allowing us to analyze important differential preferred valuation impacts described below.

Many banks issuing TARP preferred had various different issues of preferred stock outstanding with widely varying features. For example, among forced banks, Bank of America had 56 issues outstanding where there was great variation in features. One broad and important way to classify preferred stock is trust preferred (TP) versus non-trust preferred (NTP). Trust preferred stock is a relatively new and controversial instrument that has been a popular way for banks to raise capital in recent years.

The purpose of this research is to determine the impact of the largest government financial intervention ever, which was executed with preferred stock as the instrument of choice, upon different types of pre-existing bank preferred stock: trust preferred (TP) and non-trust preferred (NTP). Fundamental theory says that any security issuance should be a concern to those with claims on a firm's cash flows where a claimant may be particularly concerned about claims of similar seniority. We focus upon the above two classes of preferred. That is, what were the differential impacts of TARP upon the value of pre-existing trust preferred (TP) and non-trust preferred (NTP) of banks issuing TARP preferred stock? We present alternative theories and hypotheses for the impact of TARP on these two classes of preferred stock. NTP and TARP preferred have equal priority claim where both are lower priority than TP. We suggest that TP may have the strongest reaction because the issuance of TARP preferred, which is junior to TP, created more assets financed by a lower priority claim. There is no such clear positive priority effect for NTP because TARP preferred had equal seniority to NTP. Alternatively, NTP may exhibit the stronger reaction because the announcement of TARP preferred issuance may have more strongly reduced the near term probability of runs and loss for NTP than for TP.

As pointed out by Myers and Majluf (1984) and Miller and Rock (1985), new issuance may convey unfavorable endogenous information thus confounding tests of the priority rule. New information suggested by issuance of a particular type of security affects other security prices by revising investor forecasts about the value of the issuing firm. For example, issuance of junior debt may convey unfavorable information about the value of the firm, thereby negatively affecting the value of senior debt. In such a setting, priority rule effects will not be cleanly tested since it is very difficult to separate the priority rule effect from the endogenous information effects. Therefore, previous studies that have investigated the impact of the issuance of one type of security on a different type of security could not separate the information effect from other effects.

Our study compares the difference in the impact of the issuance of TARP preferred stock on the two types of existing preferred stock with different priorities of claims. Any potential differential impacts on TP and NTP result from the difference in seniority of TP and NTP. Therefore, comparing the differential impacts of TARP preferred stock issuance on TP versus NTP provides an attractive setting to purely test the impact of the priority rule on the values of individual classes of claims.

Of course, one may ask the same questions of both *forced and non-forced* banks. Additionally, did the impact of TARP issuance on *non-forced* smaller banks differ from that of forced banks? We ask this because conditions surrounding TARP issuance for non-forced were much different than for forced banks. Non-forced banks had to be approved, and, also, had a choice of whether to issue or not issue. We investigate whether any potential difference in returns between TP and NTP occurred on October 14 or on the approval date.

Even more interesting, the news that a non-forced bank applied and was subsequently approved to issue was very complex information.[4] That is, some investors may have perceived approval to issue as a sign of weakness (the bank needed special access to capital) while other investors may have seen the approval as a strong indication that the bank was healthy enough to be permitted to issue TARP preferred.[5] Furthermore, some investors may have seen TARP as a smart, inexpensive subsidized way to raise capital while, on the other hand, other investors may have seen it as an unwelcome opportunity for the government to impose undesirable restrictions and regulations on the bank which would reduce future flexibility and profitability.

[4] The public was not informed that a bank had applied and not been approved. Only eventual acceptance of an application was public.
[5] The U. S Treasury announced that for a non-forced bank to be eligible to issue TARP preferred, the bank must show that it was financially healthy.

Relatively little attention has been paid to preferred equity issuance in the finance literature. However, according to Kallberg, Liu, and Villupuram (2008), from 1999 to 2005 U.S. firms issued practically as much preferred stock as through common equity IPOs and seasoned equity offerings. TARP preferred stock substantially increased the amount of outstanding bank preferred stock. For example, the TARP plan increased the outstanding preferred stock of JPMorgan Chase from $8.1 billion (third quarter of 2008) to $31.94 billion (fourth quarter of 2008). Furthermore, State Street bank had no preferred stock outstanding. We note that the impact of preferred stock issuance on the banking firm's capital structure had become an important issue even before October 2008. Kwan (2009) notes many banks raised capital by issuing preferred stock in response to economic conditions prior to that time. Salutric and Wilcox (2009) report a very strong growth in number of bank holding companies with preferred stock outstanding in the last decade.

We find that, consistent with the priority rule, TP for forced banks clearly enjoyed greater returns than NTP for forced banks on the October 14 TARP announcement date. TP appears to have benefited more from the forced TARP preferred issuance than NTP because the TARP issuance provided an additional asset base for TP. Any potential greater reduction in default risk for NTP was not strong enough to dominate this effect. In addition, weaker forced banks realized greater benefits from TARP on October 14.

With regard to the difference between TP and NTP for non-forced banks, TP had a stronger positive return for the October 14 TARP announcement but not for the approval announcement. It appears that the market expected some banks to apply for and receive TARP upon the October 14 announcement. For non-forced banks the evidence regarding TP and NTP pooled is that there was a positive return for the announcement of approval to issue TARP preferred. That is, the market seems to have perceived potential approval to issue TARP preferred as net favorable information.

Section one describes the financial crisis that peaked in 2008 and alternative hypotheses about the impact of TARP preferred upon previously existing preferred. We include financial theory and hypotheses for why announcement effects may differ due to firm-specific and security-specific characteristics such as TP and NTP, and, also, why the pattern of TARP announcement effects may differ across forced and non-forced banks. The second section describes the data and the results are reported in the third section. We present conclusions in the last section.

II. The Crisis and Hypotheses

In 2008, the financial system was frequently in turmoil. One of the most important events was the September 15 Chapter 11 bankruptcy of Lehman Brothers. It was the largest bankruptcy filing in U. S. history and made some suspect that the world's financial system was at risk of failing. A few days later, September 18, in an effort to convince world markets that the U.S. financial system would not fail, the U. S. Treasury proposed a $700 billion system wide plan to provide any needed rescue where the plan was called TARP (Troubled Asset Relief Program). Previous (summer 2008) preliminary plans had frequently advocated using the rescue funds for government purchase of troubled assets, such as stressed mortgage backed securities, from banks. The plan was very controversial in numerous ways and on September 30, the House of Representatives defeated President Bush's TARP plan. On October 3, 2008, TARP finally passed Congress assuring that $700 billion of some type of aid was forthcoming. However, this legislation did not designate how the aid would be administered. The U.S. stock market did not seem impressed with the TARP plan as stock indices declined dramatically in the week after the October 3 TARP passage; for example, the S&P 500 declined more than 10%.

How would the $700 billion of aid be administered and how would it affect bank balance sheets? The October 3 passage of TARP allowed the purchase of troubled assets, although this was very controversial. Some suggested the Treasury should buy common stock of banks but this was strongly criticized partially because, for example, common stock ownership would give a strong appearance of government-owned banks due to common stock holder voting rights.

The surprising final form of the TARP program for banks turned out to be U. S. Treasury purchase of bank preferred stock. More specifically, the preferred was non-trust (NTP) stock paying a 5% dividend for the first five years where, after five years, the rate would be reset at 9%. The TARP preferred stock had no maturity date (perpetuity) and qualified as Tier 1 capital. Importantly, the priority ranking of payment was equal to NTP but junior to TP.[6] There were no voting rights except for

[6] See http://bankbryancave.com/tarp-capitial-faq/

authorization of shares senior to senior preferred.[7] Warrants to purchase common stock (with a term of 10 years) having aggregate market price of 15% of TARP preferred were attached. Redemption rules were complex as the TARP preferred stock was not redeemable for three years except from a qualified common equity offering which resulted in gross proceeds to the bank of not less than 25% of the issue price of TARP preferred. After three years, it was redeemable in whole or in part at any time.

Figure I describes the basic framework of our analysis. We analyze the impact of the October 14 announcement on both forced and non-forced banks (that eventually issued TARP preferred). As discussed and given below, forced banks are classified as either voluntary (VB) or involuntary (IVB). Furthermore, we analyze the subsequent announcement effect of non-forced bank approval to issue TARP preferred. That is, we analyze two announcements for non-forced banks.

**** Insert Figure I here ****

A. Hypotheses on the Impact of TARP Preferred Issuance: Forced Banks

Previously existing preferred stock on bank balance sheets (before October 2008) was heterogeneous with regard to seniority. See Table I for seniority variation of bank claims. Rose and Hudgins (2010) report that preferred stock had increased its share of bank financing in the early part of the century partially due to the emergence of TP which is a hybrid security.

***** Insert Table I here ****

[7] Also, there were voting rights for amendments to the rights of senior preferred and mergers and other events which could adversely affect rights of senior preferred.

Figure II illustrates the TP issuance process. In order to create trust preferred stock, the issuing firm creates a special purpose trust. The trust then issues trust preferred stock to investors and lends the proceeds to the issuing firm. In return for the proceeds that the issuing firm borrows from the trust, the issuing firm issues junior subordinated debt to the trust. As a result, the interest payments to the trust are equal to the dividend payments to the shareholders with the trust preferred stock. This process explains why TP stock has higher priority than NTP stock. Very importantly, TP was considered Tier 1 capital and was particularly popular for large banks. Classification as Tier 1 was controversial where many analysts suggested it should be disallowed where we note that Dodd-Franks legislation passed in 2010 does not permit TP to be considered Tier 1 capital.

**** Insert Figure II here ****

It is clear that bank preferred stockholders had much to fear in the fall of 2008 as many preferred stockholders suffered large losses when firms failed or were reorganized just prior to October 2008. Lehman Brothers, Washington Mutual, Fannie Mae and Freddie Mac were all cases where preferred claims were essentially erased.[8]

Numerous researchers have empirically examined the impact of an issuance of one type of security on the value of common equity. For example, with respect to the impact of security issuance on common equity, Mikkelson and Partch (1986) and Eckbo (1986) document an insignificant common equity price reaction to debt

[8] See Spence (2008) and Bary (2009).

issuance. Spiess and Affleck-Graves (1999) find that straight and convertible debt issuance lead to significantly negative abnormal common equity returns in the long-term.[9] In contrast, the impact of security issuance upon existing preferred stock is scarce.[10]

Relative to our first hypothesis, given below, and the impact of security issuance on outstanding debt, Linn and Stock (2005) investigate the impact of the issuance of a lower priority claim, junior debt, upon a higher claim, senior unsecured debt. First, they hypothesize that if junior debt is issued to replace bank debt, senior unsecured is enhanced because claims of higher standing (bank debt) are eliminated. Second, and particularly relevant to our analysis of preferred issuance, they hypothesize that if junior debt is issued for investment purposes, the new issue provides an additional asset base for the senior unsecured debt, thus enhancing the value of senior unsecured debt.

We present four hypotheses where the first and second apply to forced banks and the third and fourth apply to non-forced banks.

Hypothesis 1a. Trust preferred (TP) stock of forced banks should have greater returns than non-trust preferred (NTP) stock.

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[9] According to the signaling theory of Ross (1977) and the pecking order theory of Myers and Majluf (1984), issuances of securities disclose information on the value of the issuing firm. For example, the signaling model of Ross (1977) predicts that leverage-increasing announcement conveys favorable information. On the other hand, the pecking order theory of Myers and Majluf (1984) suggests that external financing announcements convey unfavorable information. Denis (2004) argues that managers signal their confidence in the firm's prospects by agreeing to issue a senior claim like preferred stock.

[10] Harvey, Collins, and Wansley (2003) find positive impacts of trust-preferred issuance on both equity and debt. Kallberg, Liu, and Villupuram (2008) also investigate the impact of preferred issuance on both equity and debt.

Table I shows the seniority of claims on banks where TP is senior to NTP. If the priority rule holds, TP stockholders may benefit more from the October 14th announcement than NTP stockholders because the issuance of TARP preferred stock, which is junior to TP, provides an additional asset base. That is, there are more assets to generate greater revenue to service TP and, also, distribute to TP in event of bankruptcy. This effect is similar to an issuance of common stock reducing the risk of the firm's debt because the firm has greater assets and is less levered. [11]

Hypothesis 1b. Non-trust preferred (NTP) stock should have greater returns than trust preferred (TP) stock.

Given the uncertainty about the soundness of the financial system and how effective TARP would be, we suggest there was very significant default (bankruptcy) and "run" risk for both types of preferred stock before the October TARP plan was announced. In general, one might expect lower priority claims to likely be more sensitive to changes in the firm's outlook. For example, common stock is typically

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[11] Another reason for TP returns to be greater than NTP returns is that conditions surrounding TARP preferred issuance may be viewed as roughly similar to the conditions describing debt overhang (underinvestment). Related to this, Veronisi and Zingales (2009) refer to a co-insurance effect. Banks were highly levered in October 2008 and economic conditions suggested potential future scenarios where debt holders would not be paid in full. Many U.S. Treasury and Federal Reserve economists likely hoped the banks would issue more common equity to reduce the turmoil in financial markets but banks would certainly have to sell common equity at depressed prices if they could sell common equity at all. A common equity issuance would likely have benefitted claims on bank debt more than bank common equity claims; in other words, common equity would potentially transfer wealth to bond holders and the value of existing common equity may have declined. The same logic can be applied to existing NTP stock as NTP is, like common equity, a lower claim than debt. Thus the value of existing preferred NTP could have declined upon TARP issuance whereas TP would not be affected in such a process. In fact, TP may have benefitted at the expense of NTP in this process as TP is a higher claim. The fact that the U.S. government intervened may have reduced the magnitude of debt overhang effects upon returns but not eliminated debt overhang effects.

thought to be more sensitive to changes in a firm's outlook than the firm's debt and, furthermore, junior debt is typically thought more sensitive to changes in the firm's outlook than senior debt. Similarly, if the October 14 TARP announcement reduced the overall default (run) risk of banks, then the default risk of lower priority (NTP) preferred stock may decline more than that of higher priority (TP) preferred stock. Therefore, lower priority lower priority (NTP) claims may be more enhanced than higher priority (TP) preferred stock claims.

As evidence that default risk could potentially decline more for NTP than TP, we consider a day where assumedly favorable news reducing the likelihood of default was released. As mentioned above, on September 18, 2008 the Treasury announced that the government was very willing to provide an injection of funds into the financial system to prevent widespread panic but, as stated above, did not specify the nature of the injection. This was apparently received as very positive news because bank stock prices rose dramatically soon after September 18.

We gathered matching pairs of September 18, 2008 TP and NTP raw returns. For the match, we first required the two matched preferred stocks to have the same issuer. Second, the matches were required to have similar maturities and dividend yields. We allowed a maximum of one year's difference for maturity. For a perpetuity, our match required at least 59 years maturity. Regarding dividend yield, we allow a maximum of one percent difference.

These criteria resulted in sixteen TP/NTP pairs as given in panel A of Table II. In nine of these pairs, the raw return for NTP was greater than TP and, also, the average return (0.137) for NTP was greater than the average return (0.102) for TP in panel B of Table II. Furthermore, we additionally treated each firm's preferred stock as a portfolio of individual returns in which case there were four portfolios where NTP was greater and one portfolio where TP was greater. In summary, this table suggests that there clearly are cases where NTP returns can be stronger than TP returns due to news that can be construed as reducing credit risk and default potential. Of course, unlike the October 14 announcement, this particular news event did not have an indication that preferred stock would be issued.

***** Insert Table II here ****

Hypothesis 2: The greater the Treasury OVERPAYMENT for TARP preferred stock, the greater the returns to pre-existing preferred stock.

There was strong agreement that the U.S. Treasury overpaid for TARP preferred stock by purchasing 5% dividend yield preferred. According to Wilson and Wu (2009), just prior to the government capital infusion, the preferred stock of many of the banks receiving TARP funds traded at yields between 9.62 percent and 11.7 percent.[12] The government's overpayment for TARP preferred stock thus led to a favorable, low cost of funds for the banks. Such a favorable funding source may have resulted in an increase in preferred stockholders' wealth. Table III shows average preferred stock yields and overpayment, defined as the difference in preferred yield just before TARP and the 5% of the TARP preferred.

***** Insert Table III here ****

[12] See Wilson and Wu (2009) and Veronesi and Zingales (2009).

We suggest that the degree of overpayment may be related to the idea that some forced banks voluntarily participated (VB banks) in TARP while others were largely involuntary participants (IVB banks). See Figure I. VBs are roughly represented by those associated with greater overpayment in Table III whereas IVBs are those with lesser overpayment. Preferred stock yields reflect risk premia and a bank paying a higher risk premium was more likely to benefit from the government rescue and overpayment for TARP preferred. Based on this reasoning, we classify Morgan Stanley, Citigroup, and Bank of America as VBs, and, in contrast, Goldman Sachs, JPMorgan Chase, Bank of NY Mellon, and Wells Fargo as IVBs. VBs may realize greater returns than IVBs as they more clearly needed the help and paid for the needed funding at the same below market yields.

B. Hypotheses on the Impact of TARP Preferred Issuance: Non-Forced Banks

Non-forced banks were also part of the TARP preferred stock program and some of the above theories and hypotheses obviously also apply to non-forced banks. However, we now note some important differences for analysis of non-forced banks. We again refer to Figure I. Smaller banks were not forced to issue preferred stock, i.e. they had an option of applying or not applying. Additionally, the U.S. Treasury announced that banks that were particularly weak and in danger of failing would not be approved. Some banks may have applied to issue TARP preferred stock in order to signal to the market that they were healthy enough to receive TARP. On the other hand, some banks likely took pride in not applying for TARP funds and thought that the lack of need for TARP signaled strength. If a bank did apply, the Treasury would grant (or not) preliminary approval. If a bank was denied, there was no public announcement. In summary, for non-forced banks, we observe that the timing of the non-forced TARP issuance was not a surprise (exogenous) financing requirement forced on the bank. Instead, for a non-forced bank, TARP financing was an endogenous decision.

We call our sample of smaller banks with actively traded existing preferred stock outstanding that soon subsequently soon issued TARP preferred (before 2009) *non-forced* banks. Of course the same questions plus additional questions can be posed about their participation and the impact on their existing preferred stock.

Consideration of two obviously separate events for non-forced banks (that ultimately issued TARP preferred stock) leads to the following hypothesis. These two events are a.) the October 14 announcement and b.) the subsequent approval day for a non-forced bank. See Figure I.

Hypothesis 3a: Any potential difference in returns between TP and NTP resulting from hypothesis 1a (priority effect) or hypothesis 1b (default effect) occurred on the October 14 TARP announcement date. That is, expectations were formed on October 14 with regard to which non-forced banks would apply for and receive TARP.

Simply put, the October TARP announcement contained information that TARP capital would also be available to other "healthy" banks that would apply for TARP. If the market *expected* a particular bank to apply for and receive TARP upon the October 14 announcement, the prices of TP and NTP would reflect this expectation on the October 14 announcement date.[13]

Hypothesis 3b: Any potential difference in returns between TP and NTP resulting from hypothesis 1a (priority effect) or hypothesis 1b (default effect) occurred on the date the bank was approved to issue TARP preferred.

That is, on October 14 the market for bank preferred stocks may have been slow to realize the application procedures for non-forced banks to issue TARP preferred. Furthermore, banks themselves may have been indecisive concerning the wisdom of applying for TARP. Thus, any potential impact on TP versus NTP, described in hypothesis 1a (priority effect) or hypothesis 1b (default effect), may have been delayed until approval date. In other words, only weak expectations were formed on October 14 with regard to which non-forced banks would be approved for TARP.

Given the complexities surrounding TARP issuance for non-forced banks, an important question is whether the announcement of TARP approval was good or bad news for existing preferred stockholders.

Hypothesis 4a: The approval day impact upon the pool of preferred stock (TP and NTP pooled) was positive.

As mentioned above, announcement of approval could be construed as good news by investors if it meant the bank had passed a test as being healthy enough to

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[13] O'Hara and Shaw (1990) examined how the announcement that some banks were "too big to fail" affected stock prices of banks. They find that investors reacted to *Wall Street Journal* reports of a list of banks that were expected to be announced as too big to fail by the Comptroller of the Currency. Curiously, the *Wall Street Journal* list turned out to be different from the Comptroller's list.

issue TARP. Also, approval may be construed as good news because the bank may have found an inexpensive source of preferred financing where this is clearly related to the government overpayment for TARP preferred.

Hypothesis 4b: The approval day impact upon the pool of preferred stock (TP and NTP pooled) was negative.

On the other hand, the news of approval to issue TARP preferred may have been negative because investors may have perceived such an announcement as an admission that the bank needed help, and furthermore, the government would be inefficiently intervening in the management of the bank. More specifically, TARP issuance forced such banks to accept government regulations that could hinder future bank profitability and reduce returns for preferred stockholders. For example, banks taking TARP funds had to accept limits on employee pay where the common complaint was that banks could not retain and attract the best talent. According to Ertimur, Ferri, and Stubben (2010), firms receiving TARP funds must hold an annual advisory vote on executive compensation. Furthermore, the TARP program imposed complex dividend restrictions on preferred stock. Finally, the government had the right to change the terms of the TARP issuance at any time until the funds were repaid.

III. Data and Methodology

The data for forced preferred stock prices, TP versus NTP classification, maturity, and dividend yield were obtained from the Bloomberg information system.

We restrict the sample to nonconvertible preferred stock that traded on more than 100 dates before TARP in the period November 1, 2007 to October 6, 2008 in order to assure credible pricing information. The forced-bank sample includes 121 preferred stocks of which 53 are TP while 68 are NTP. Maturities range from November 30, 2009 to perpetual maturity.

The forced sample with respect to issuing bank, TP versus NTP, callability, and dividend are summarized in Panel A of Table IV. Bank of America clearly had the most different preferred shares outstanding with 56 while Morgan Stanley had 22. Note that State Street had no preferred (neither TP nor NTP) outstanding. Bank of NY Mellon had only TP outstanding. The Bank of America preferred stock included preferred stock of Merrill Lynch while Wells Fargo preferred stock included preferred stock of Wachovia as it was announced Bank of America (Wells Fargo) would take over Merrill Lynch (Wachovia) before October 14, 2008.[14]

***** Insert Table IV here ****

For non-forced banks, the data is similarly gathered from Bloomberg and given in Panel B of Table IV. The criteria for inclusion in the sample of non-forced banks were the same as for forced: traded on more than 100 dates before TARP in the period November 1, 2007 to October 6, 2008. The TARP preferred in the non-forced sample was announced as approved between October 24 and December 23, 2008.

[14] In regressions reported later, firm characteristics of Bank of America and Wells Fargo were combined with those of Merrill Lynch and Wachovia.

To measure returns or abnormal returns for each preferred stock we used raw returns, the mean-adjusted return, and the OLS market model returns.[15] Mean-adjusted returns, as described by Brown and Warner (1980, 1985) and others, are the returns over the event windows less the average returns from a recent extended time frame. For our analysis, we use the average of November 1, 2007 to October 6, 2008. The S&P *preferred* index was used as the market index. The beta was estimated using daily returns from November 1, 2007 to October 6, 2008. We calculated raw returns or abnormal returns for four different windows where we emphasize the two-day event window (-1,0); that is, the period from close October 12 to close October 14. This is because U.S. Treasury Secretary Henry Paulson held a meeting with the CEOs of the nine largest banks on October 13th and the Treasury announced its plan to purchase bank preferred stock on October 14th.[16]

Even though we report raw, mean-adjusted, and market model returns, we feel the following comment critical of market model returns is appropriate where we note market model returns of the forced banks are reported in Appendix B. If one estimates the excess return on existing preferred with a market model, where betas

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[15] See Brown and Warner (1985) for a comparison between the mean-adjusted model and the market model. Linn and Pinegar (1988) used the mean-adjusted model in their examination of the effects of preferred stock issuance on preferred stock returns. On the other hand, Veronesi and Zingales (2009) used the market model based on the S&P 500 index in their event study on preferred stock. Our market model is based on the S&P *preferred* index. The S&P preferred index represents the U.S. preferred stock market by including all preferred stocks issued by U.S. corporations and those trading in major exchanges. To our best knowledge, no previous event study on preferred stock has been done using the S&P preferred index.

[16] U.S. Treasury Secretary Henry Paulson called the CEOs of the nine largest banks to a meeting at 3:00 p.m. on October 13th, and the CEOs turned in their time sheets by 6:30 p.m. According to the Dow Jones News Service, at 5:10 p.m. on October 13th, the *Wall Street Journal* reported that the nine largest banks would receive TARP capital through issuance of preferred stock. On October 14th, the Treasury announced its plan to purchase preferred stock of the nine largest banks.

are estimated, the positive impact of the October 14 announcement is clearly *underestimated* because the market return was strongly (positively) affected by the announcement. That is, the market model leads to biased results if the event study focuses on the impact of an event on abnormal returns *and* the event influences the market index. If this is the case, it does not make sense to control for the market movement since the market movement was *also* affected by the event.[17] In light of the above, it would seem that using mean-adjusted returns and, also, using raw returns, are better approaches than the market model because they do not underestimate the response of our sample preferred stocks.

IV. Empirical Results

We now examine the realized reaction of different preferred stock issues to the October TARP announcement in Tables V through IX with forced results reported in Tables V to VII and non-forced results reported in Tables VIII and IX. Did TP or NTP experience greater returns? We first report the event study for banks forced to issue TARP preferred. We immediately follow this event study with a cross-sectional regression of forced bank returns to help analyze how the effects may have varied due to firm and issue-specific effects such as TP versus NTP, Treasury overpayment for TARP preferred, and control variables.

[17] We attempted to create an index consisting of only non-financial institutions. However, we note that non-financial institutions also showed high raw returns on Oct. 13 and Oct. 14. The average raw returns for non-financial institutions whose preferred stock price information was available on Bloomberg was 17.88% on [-1,0] while those for financial institutions was 20.74%.

After the analysis of forced banks, we then examine the reaction of non-forced banks that announced they had been approved to issue TARP preferred stock soon after the October TARP announcement. Did any difference in TP and NTP returns occur on the October 14 announcement, or the approval day, or both? Did the approval announcement have a positive or negative impact on non-forced returns? In this context, we conduct event studies (for *both* October 14 and approval day) followed by cross-sectional regression analysis of returns. See Figure I.

A. Forced Bank Empirical Results

Table V represents the event study results for forced banks. There are four different windows (0,0), (-1,0) (-2,+2), and (-5,+5) where (0,0) is the close of October 13 to close of October 14 and (-1,0) is the close of October 12 to close of October 14. There are four panels composed of raw and mean adjusted returns. For each type of return there is 1.) *an equal weighted* return which is an average of all individual preferred stocks and 2.) a *portfolio-based return* which is the portfolio (all preferred of a particular bank) average return of all forced banks. In Panels B and D for portfolio returns, the ALL portfolio has only 13 portfolios where each bank (except Bank of New York Mellon) had a portfolio of both TP and NTP.[18] Thus, there are only 7 TP portfolios and 6 NTP portfolios in Panels B and D.

***** Insert Table V here ****

The first line in each of the four panels (All) does not distinguish between TP and NTP and thus reflects the generalized average reaction of all (TP and NTP

[18] As noted above, Bank of New York Mellon had only TP and State Street had no preferred outstanding.

pooled) preferred stock. For example, the raw returns for all preferred stock in the (-1,0) window of Panel A is 0.2467 (24.67%). Immediately below that line we give both the conventional T-statistics and, also, T-statistics using the crude dependence adjustment of Brown and Warner (1980, 1985). For the (-1,0) window the conventional T-statistic is 15.68 and the crude dependence adjustment T-statistic is 9.53 where both are clearly positive and significant. Thus, the impact of the October 14 announcement upon TP and NTP treated as a combined pool of preferred stock is to enhance existing preferred stock value.[19]

The next lines in each panel show similar results for trust preferred (TP) returns (only). Below that, non-trust (NTP) returns (only) are shown. Finally, we report a T-statistic for the difference in mean between TP and NTP. For example, in the (-1,0) window, the T-statistic for the difference is 5.72 which is clearly significant suggesting that TP returns are stronger than NTP. Thus, hypothesis 1a is supported and hypothesis 1b is not supported. In other words, the results support the priority rule hypothesis that TARP issuance provided a significant additional margin

[19] There are two reasons for expecting a pooled positive reaction. First, in early October 2008, the risk that some banks could become bankrupt thus causing default for some claim holders, including preferred stock, was significant. Veronesi and Zingales (2009) computed the probability of early bankruptcy less that of later bankruptcy and suggested the difference is an indicator of the likelihood of a run on the bank. Here a strong likelihood of a run suggests near term bankruptcy. In fact, for the forced banks, Veronesi and Zingales (2009) show that Citigroup, Wachovia and all three investment banks showed clear indications of a run. In our work, if TARP preferred issuance potentially reduces the near term risk of runs and early bankruptcy for existing preferred, then the impact could be positive. In other words, forestalled bankruptcy may have had a positive impact on existing preferred stock. A second reason to expect a positive reaction is that there was a strong agreement that the U.S. Treasury overpaid for TARP preferred stock. On the other hand, the effect could have been negative. That is, the requirement that large banks would have to issue preferred stock could be perceived as negative news for preferred stockholders because banks may have chosen alternative ways, mentioned above, to receive aid. Some may have wanted the Treasury to instead purchase troubled assets, as was commonly expected in the months before the October TARP program. Some forced banks were clearly not happy with the TARP preferred stock program and had to be coaxed to accept it.

of safety (asset base) for TP where this effect dominated any potential stronger reduction in default risk of NTP. Note that in Panels B and D the small sample sizes for the portfolio approach make it extremely difficult to find statistical significance. Still, the signs are positive as in Panels A and C and there is a large positive difference in TP versus NTP.

Table VI represents cross-sectional regression results of returns. Firm specific characteristics are controlled by using dummy variables that refer to particular bank names. Wells Fargo is used as the benchmark. Since Wells Fargo is one of Involuntary Banks (IVBs), positive signs on Voluntary Banks (VBs) are expected. There are two panels consisting of raw (Panel A) and mean adjusted (Panel B) returns. There are three different regression specifications where certain independent variables are omitted. For our purposes, the most important factor is the TP / NTP dummy where TP has value one and NTP is zero.

***** Insert Table VI here ****

We include numerous control variables that may affect returns where the most interesting control variable may be callability. That is, some preferred stock has an embedded call option where the firm can redeem the claim at a specified price. The value of preferred stock with a call will tend to decline with greater call value as the claim holder is short (issuer is long) in the call option. One might suggest that callable preferred stock had greater returns than non-callable preferred stock due to the October 14 announcement. To support this suggestion, King (2002) maintains that there is a positive relationship between default risk and option value in bonds because of a higher volatility in the underlying instrument that occurs due to greater default risk. If TARP reduces default risk and related volatility on preferred stock, the call option value decreases and returns for callable preferred stock may thus be higher than returns for non-callable preferred stock.

Alternatively, callable preferred stock may have lower returns than non-callable preferred stock, as suggested by Lakshmivarahan, Stock, and Qian (2009) and Acharya and Carpenter (2002). They note that the preferred stock and any call value is extinguished upon default. Therefore, if TARP reduces default risk, the call option value may increase and returns for callable preferred stock may thus be lower than non-callable preferred stock. Remaining time to maturity is included as longer maturity securities would be expected to be more sensitive to news.

Consistent with results in the above event study, Table VI shows that existing TP stockholders enjoy greater returns than NTP stockholders. For example, the coefficients of TRUST in the three columns of Panel A based upon raw returns are 0.1087, 0.1228, and 0.1041, respectively where all are positive and clearly significant. This means the hypothesis that TP enjoyed greater returns than NTP due to their higher priority is supported. In fact, these coefficients suggest the difference between returns is very large where TP returns were approximately 10% greater than NTP on the announcement day.

With regard to dummy variables representing individual banks, Table VI results illustrate that existing preferred stockholders of voluntary banks (VBs) enjoyed higher returns (VBs have larger coefficients) than those of involuntary banks

(IVBs). Such a result is consistent with our hypothesis that preferred stockholders in banks with greater need for aid, as measured by U. S. Treasury overpayment for preferred stock, benefited much more than others. As previously mentioned, Morgan Stanley, Citigroup, and Bank of America are designated as VBs while Goldman Sachs, JPMorgan Chase, Bank of NY Mellon, and Wells Fargo are designated IVBs. Consistent with the hypothesis, Morgan Stanley, Citigroup, and Bank of America coefficients are all significant and positive when Wells Fargo (an IVB) is used as a benchmark. More specifically, the Morgan Stanley coefficient suggests that average returns for Morgan Stanley preferred stockholders (TP and NTP pooled) were approximately 37% more than for Wells Fargo preferred stockholders. Furthermore, note that Goldman Sachs and JP Morgan Chase coefficients were not significant which suggests that average TP and NTP preferred returns were not significantly greater than Wells Fargo.

Callable preferred stocks enjoyed greater returns than non-callable preferred stocks. This result is consistent with the idea that there is a positive relation between default risk and option value. That is, it seems likely that TARP issuance strongly reduced future default risk and price volatility for preferred stock and therefore reduced call option values. Prices of callable preferred increased on the announcement date due to this effect more than for non-callable preferred. Preferred stocks with longer maturity show higher returns. This is logically because preferred stock with longer maturity enjoyed the reduction in the overall default risk of forced banks more than preferred stock with shorter maturity; longer maturity instruments tend to be more sensitive to TARP.[20]

Table VII presents an alternative cross-sectional specification. As opposed to the previous table, which uses the particular bank names, government overpayment for preferred (OVERPAYMENT) is used to represent the particular bank's need for government help and credit quality. Like the previous set of regressions, there are panels for both raw and mean adjusted regressions and there are three different specifications (columns) in each panel where certain independent variables are omitted.

***** Insert Table VII here ****

The main results are again that TP enjoys returns about 10% greater than NTP in all estimations. Furthermore, the greater the government overpayment, the greater the return which means that banks paying greater risk premia benefitted more from TARP issuance. For a robustness check, we also ran a separate regression to correct for any potential clustering problem. Appendix A shows that the TRUST coefficient is robust and remains positive and significant.

We furthermore tried many other variables in the regressions of forced banks to determine if our results were robust. For example, we included preferred stock ratings obtained from S&P preferred stock ratings because stronger firms might not need the capital infusion as much as weaker firms. In addition, we considered Tier 1

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[20] For example, longer time bonds are more price sensitive to inflation and interest rate news as their coupon stream is longer.

capital as an explanatory variable. Specifically, Tier 1 capital is defined as a bank's Tier 1 capital divided by its total risk-weighted assets. We included Tier 1 capital because one may have expected that banks with lower Tier 1 capital ratios may have enjoyed a stronger return from issuing TARP preferred as it was counted in Tier 1. However, regressions with rating and Tier 1, not reported here, did not change our basic results with respect to our hypotheses.[21]

B. Non-Forced Bank Empirical Results

Table VIII contains analysis for banks not forced to issue preferred stock but who chose to apply for approval after October 14 and were approved. As in Table V, Table VIII shows panels composed of raw and mean adjusted returns. Again, for each type of return, there are both the *equal weight* (individual issue) approach and the *portfolio* (all preferred of a particular bank) approach. The difference from Table V is that Table VIII has two windows as reflected in the last two columns. See Figure III for the windows used. The first window is (-1,0) which is the same window (reflecting the October 14 announcement) as the forced banks. The second

[21] Furthermore, we considered the size of the issue relative to total assets for non-forced banks. For forced banks, the amount of TARP to be issued was prescribed and forced by the Treasury such that the banking firm had no choice on size of issue. Some forced banks wanted to issue TARP preferred whereas others did not (voluntary versus involuntary). If a forced bank had been permitted to choose the size of issue and also clearly needed a preferred capital infusion (VB), it could well be that the more TARP preferred the better for the bank. On the other hand, if a forced bank did not want to issue any TARP preferred (IVB), the less the better. The scenario for non-forced banks was different. That is, it is logical to assume the bank, having an option, actually wanted to issue TARP preferred and also chose, up to the mandated limit, the amount thought optimal for the bank. Non-forced banks choosing to issue more TARP apparently foresaw greater benefit to the optional government program. However, size of issue for non-forced banks turned out to not have a significant effect on our empirical results. We also included a zero dividend dummy because Bessembinder, Kahle, Maxwell, and Xu (2009) argue that zero-coupon bonds are more volatile. However, the zero dividend dummy did not have a significant effect on our empirical results.

window is the day the bank announced that it had received preliminary approval for TARP preferred issuance.[22]

**** Insert Figure III here ****

***** Insert Table VIII here ****

As we did for forced banks, we first consider the impact of the announcement upon all (pooled) preferred stock in Table VIII. For the October 14 window, which is the (-1,0) window of the table, the announcement has positive and significant impact in the first lines of Panels A,B, C, and D. The results for the approval window are also positive which supports hypothesis 4a; that is, the preferred stockholders perceived the information that a firm was approved for TARP preferred as positive news.

Did any differential between TP and NTP occur in the (-1,0) window because the market expected non-forced banks to soon issue TARP preferred? Or, did any differential in TP and NTP occur upon approval to issue TARP preferred? The results for comparing TP versus NTP returns are that TP enjoyed greater returns than NTP only in the (-1,0) window but not in the "approval" window which supports hypothesis 3a. For example, the T-statistic for difference in mean between TP and NTP in Panel A is 5.27 in the (-1,0) window, but 0.00 in the "approval" window.[23]

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[22] The sample sizes of all pooled preferred, TP, and NTP are different for (-1,0) and "upon approval" announcement because a preferred stock is included in the sample only if trading occurs on the event window. For example, in panel A, 54 preferred stocks traded in (-1,0) while only 50 preferred stocks traded on the announcement window of approval for TARP.

[23] The value is 8.29 for the T-statistic using crude dependence adjustment in the (-1,0) window.

Table IX presents cross-sectional regression results for non-forced banks. Given that non-forced banks tend to have fewer different preferred issues outstanding, it is econometrically impossible to use bank names to control for firm specific effects. Instead, OVERPAYMENT is used. As for the forced bank results, there are panels representing regressions for both raw (panel A) and mean adjusted returns (panel B) for the two different windows.

***** Insert Table IX here ****

The first column of panel A reports the effects of the October 14 announcement. OVERPAYMENT is clearly positive and significant thus supporting the hypothesis that more needy banks benefited more from the TARP announcement. Furthermore, the TP coefficient is even larger than for forced banks. Specifically, the estimation is that TP stockholders receive 15% greater returns than NTP stockholders. Clearly the hypothesis that the priority rule was strong on October 14 for non-forced banks is supported. In contrast to forced banks, maturity is not significant.

The second column of panel A (approval date as opposed to October 14) reports that OVERPAYMENT is also significant on the approval date although the coefficient is less than half of the October 14 estimation. Nonetheless, this is further evidence that weaker banks benefited more from TARP upon announcement of approval. In contrast to the October 14 window, TP is not significant. Thus, the priority effect on approval date does not appear significant for this window. As in the first column, maturity is not significant. The results for mean adjusted returns (panel B) are very similar to the raw returns (panel A).

Thus, the main results are consistent with our hypothesis that the non-forced banks enjoyed higher returns for TP than NTP on October 14 but not their approval dates. In addition, supporting hypothesis 2, we find strong evidence that OVERPAYMENT affected preferred stock return on October 14 and, also, the approval day. [24] As for forced banks, numerous other variables were used in the regression to test for effects on returns. For example, we used Tier 1 capital. However, as for forced regressions, none of the additional variables were significant in additional estimations.

V. Summary and Conclusion

The 2008 TARP program to stabilize the financial system resulted in large issuances of preferred stock by numerous banks. We examine the impact upon the valuation of existing preferred stock for two groups of banks: large forced banks and smaller non-forced banks. The forced group provided evidence that TP stock experienced higher returns relative to NTP stock for the October 14 TARP announcement, consistent with the priority rule. TP stock appears to have benefited more from the TARP preferred issuance than NTP stock because the TARP issuance provided an additional asset base for the TP. Any potential greater reduction in default risk for NTP was not strong enough to dominate this effect.

[24] As shown in a previous table, all non-forced observations were callable.

For non-forced banks it appears that the market expected some banks to apply for and receive TARP upon the October 14 announcement. In addition, the evidence regarding non-forced pooled preferred stock is that there was a positive return for the announcement of approval to issue TARP preferred. The market seems to have perceived application and approval to issue TARP preferred as favorable information for preferred stockholders even though government interference in bank ownership concerned many investors.

In summary, TARP benefited some investor groups more than other investor groups. Existing preferred stockholders of more voluntary banks likely enjoyed higher returns than those of involuntary banks. This might explain why Wells Fargo chairman Richard Kovacevich said that Wells Fargo, which was classified as one of the involuntary banks in the sample, would not have issued TARP preferred if Wells Fargo had not been forced to.

In addition, it seems likely that TARP transferred wealth from one group to another group. Our results are consistent with the perception of government overpayment for preferred stock. In other words, TARP transferred wealth from taxpayers to preferred shareholders. Taxpayers seemed to specially subsidize preferred stockholders of selected weaker banks.

CHAPTER 2

THE EFFECT OF SHARE OWNERSHIP STRUCTURE ON EX-DIVIDEND DAY STOCK PRICE BEHAVIOR

I. Introduction

The question of whether firms derive value from investment banking relationships has received considerable attention in the literature, especially since the increasingly competitive market for investment banking services would suggest that firms can switch investment banks costlessly. Extant research has failed to come up with an unambiguous answer, due in part to the difficulty in measuring the value of relationship capital.

Elton and Gruber (1970) assume that one particular tax clientele sets the ex-day prices and argue that the marginal investor that sets the ex-day prices is the long-term individual investor. According to the tax-based theory, the average price drop on the ex-dividend day should be less than the dividend amount because individual investors likely face a tax disadvantage on dividends relative to capital gains. However, the short-term trading theory argues that the ex-day pricing of dividends is determined by short-term traders who engage in a practice referred to as dividend capturing. As long as there are any short-term traders, such as institutions, who do not face a tax disadvantage on dividends relative to capital gains, those short-term traders would buy stocks prior to the ex-dividend day and sell them afterwards to capture dividends.

On the other hand, Michaely and Vila (1995) propose a dynamic equilibrium model in which investors with different relative tax rates between dividends and capital gains trade with each other around the ex-dividend day. The dynamic trading clientele theory argues that the ex-day price drop is determined by the interaction of investors with different relative tax rates between dividends and capital gains. Extending the dynamic trading clientele theory, Dhaliwal and Li (2006) find that the proportion of the firm's stock held by institutions has an effect on ex-dividend day stock behavior. However, their empirical work is restricted to the effect of ownership structure on ex-dividend day trading volume, not the ex-day price drop itself.

Despite the possibility that share ownership structure could affect the ex-day pricing of dividends, there is surprisingly little empirical work regarding the impact of share ownership structure on the ex-day pricing of dividends. One exception is Perez-Gonzales (2003), who classifies firms into two groups based on whether their largest shareholder is an individual or an institution and investigates whether the ex-day pricing of dividends is different across the two groups.[25] However, his classification of share ownership structure is too broad to reflect the cross-sectional variation in share ownership structure. In addition, he implicitly assumes that the marginal investor is the largest shareholder even though a firm's stock held by the largest shareholder accounts for on average 16.7 percent of the outstanding stock in 1994 belonging to the sample period.

The purpose of this study is to investigate whether the ex-day pricing of dividends is affected by the proportion of the firm's stock held by individuals versus

[25] His classification of share ownership structure is based on firms' proxy statements in 1994.

institutions. Specifically, the proportion of the firm's stock held by individuals versus institutions is defined as the number of shares held by individuals divided by the total number of shares outstanding versus the number of shares held by institutions divided by the total number of shares outstanding. I explore two questions where the ex-day price drop varies with the firm-specific share ownership structure. First, I examine whether the level of individual ownership decreases the ex-day price drop because individual investors likely have a tax disadvantage on dividends. Second, I also examine whether investor heterogeneity, defined as the product of the proportion of the firm's stock held by individual investors and the proportion held by institutional investors, is associated with the level of dividend capture, thus affecting the ex-day price drop.

Elton and Gruber (1970) model the ex-day premium as follows:

$$PREM = \frac{P_B - P_A}{D} = \frac{1 - t_d}{1 - t_g} \quad (1)$$

where P_B is the closing price on the cum-dividend day, P_A is the closing price on the ex-dividend day, D is the amount of the dividend, t_d is the personal tax rate on dividends of the marginal investor, and t_g is the personal tax rate on capital gains of the marginal investor. In their model and this paper, $(1 - t_d) / (1 - t_g)$ is referred to as the marginal rate of substitution between dividends and capital gains. This ratio reflects the value of $1 of dividends relative to $1 of capital gains, thereby representing the tax preference of dividends relative to capital gains.

The first question is whether a firm with a higher level of individual ownership shows a lower ex-day premium because of the unfavorable taxation of dividends relative to capital gains for individual investors. As discussed in Dhaliwal and Li (2006), the marginal rate of substitution between dividends and capital gains for individual investors has been less on average than that for institutional investors. The marginal rate of substitution between dividends and capital gains has been generally less than one for individual investors.[26] On the other hand, it has been greater than or equal to one for most institutional investors.[27] In addition, as pointed by Chay, Choi, and Pontiff (2006), individual investors value $1 of dividends lower than $1 of unrealized capital gains since taxes on capital gains are deferred until the assets are sold. Therefore, I hypothesize that the cross-sectional variation in the ex-day premium is negatively related to the level of individual ownership.

The second question is whether the firm specific degree of investor heterogeneity increases the ex-day premium by increasing dividend capture on the cum-day and the ex-day. According to Dhaliwal and Li (2006), investor heterogeneity can be expressed as the product of the proportion of the firm's stock held by individual investors and the proportion held by institutional investors. They

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[26] Dhaliwal, Krull, Li, and Moser (2005) report that individual income tax rates on dividends vary between 28% and 70% from 1980 to 2001 while individual income tax rates on capital gains vary between 20% and 33%.

[27] According to Dhaliwal et al. (2005), the marginal rate of substitution between dividends and capital gains for non-corporate short-term traders such as brokerage firms and pension funds is one. On the other hand, the marginal rate of substitution between dividends and capital gains for corporate short-term traders is greater than one because U.S. corporations are allowed to exclude taxes on at least 70 percent of dividends. However, to be eligible for this dividend deduction, they must hold the stock for a certain period of time. The risk involved in holding the stock for this time period likely reduces the role played by corporations with the highest marginal rate of substitution between capital gains and dividends in determining the ex-day premium. That is, without the minimum holding period, corporations could play a more dominant role in determining the ex-day pricing of dividends.

argue that ex-dividend day excess trading volume is driven by different relative tax rates on dividends and capital gains for individual and institutional investors. They also point out that ex-dividend day excess trading volume must be concurrent with tax-induced investor heterogeneity. If most investors belong to the same tax category, ex-day excess trading volume should be weak and difficult to observe in spite of the difference in relative tax rates between dividends and capital gains for individual and institutional investors. They document that the effect of dividend yield on ex-day excess trading volume is a concave function of the level of institutional ownership, implying that it increases with the degree of investor heterogeneity.

However, no existing studies have investigated whether tax-induced investor heterogeneity also affects the ex-day premium. Individual investors likely receive unfavorable tax treatment of dividends while institutional investors likely receive favorable tax treatment of dividends. Without dividend capture by institutional investors, the ex-day premium would be determined by individual investors whose marginal rate of substitution between dividends and capital gains is expected to be lower than that for institutional investors (Karpoff and Walkling (1988) and Karpoff and Walkling (1990)). If this is the case, the ex-day premium would reflect the marginal rate of substitution between dividends and capital gains for individual investors, resulting in a relatively low ex-day premium. However, the short-term trading theory argues dividend capture by institutional investors plays a determining role in setting the ex-day price drop. Given that institutional investors do not face the tax disadvantage on dividends relative to capital gains that individual investors likely face, the short-term trading theory predicts that a high degree of investor heterogeneity results in a high level of dividend capture, thereby increasing the ex-day premium.

I find that ownership structure plays an important role in explaining ex-dividend stock price behavior. The firm-specific share ownership structure affects the ex-day premium in various ways. Consistent with the tax-based theory and the dynamic trading clientele theory, the cross-sectional variation in the ex-day premium is negatively related to the level of individual ownership. Consistent with the short-term trading theory, the ex-day premium increases with the firm-specific degree of investor heterogeneity. Further, the positive relationship between investor heterogeneity and the ex-day premium is more significant for high dividend yield stocks. Finally, the positive effect of investor heterogeneity seems to be greater than the negative effect of the level of individual ownership, especially for high dividend yield stocks. In addition, I find that the ex-day premium is positively related to the ex-day excess trading volume, which suggests that dividend capture by institutional investors increases the ex-day price drop.

The remainder of the paper is organized as follows. Section 1 develops the hypotheses of the effect of share ownership structure on the ex-day premium. Section 2 describes data and methodology. Empirical results are provided in Section 3 and Section 4 concludes.

II. Hypotheses

Both the tax-based theory and the short-term trading theory agree that the marginal investor determines the ex-day pricing of dividends. The tax-based hypothesis argues that investors in high tax brackets tend to hold low dividend yield stocks while investors in low tax brackets tend to hold high dividend yield stocks. According to this theory, the change in the price when the stock goes ex-dividend is determined by the dividend and capital gains tax rates faced by the long-term individual investor. The ex-day premium should be less than one because individual investors likely face a tax disadvantage on dividends relative to capital gains. However, Kalay (1982) challenges the tax-based theory by showing that tax arbitrage occurs if transaction costs are low enough. The short-term trading theory argues that the existence of transaction costs explains why the average price drop on the ex-dividend day is less than the dividend amount.

An alternative theory, the dynamic trading clientele theory argues that the ex-day premium is the result of the interaction of traders with different relative tax rates between dividends and capital gains. Michaely and Murgia (1995) and Michaely and Vila (1995) model the ex-day premium as follows:

$$E(PREM) = \frac{P_c - E(P_e | P_c)}{D} = \overline{\alpha} - \frac{v}{D / P_c} \qquad (2)$$

where $\overline{\alpha} = \dfrac{\sum_{i=1}^{N} K_i \alpha_i}{\sum_{i=1}^{N} K_i}$.

Where $E(PREM)$ is the expected ex-day premium, P_c is the cum-dividend day price, P_e is the ex-dividend day price, α_i is the marginal rate of substitution between dividends and capital gains for trader i, K_i is the tax-adjusted risk tolerance for trader i, $\overline{\alpha}$ is the average of α_i weighted by K_i, D is the amount of the dividend, and v is the risk premium.

According to equation (2), the expected ex-day premium consists of two parts: the average of the marginal rates of substitution between dividends and capital gains for the various trading groups, weighted by their risk tolerance ($\overline{\alpha}$) and the risk involved in the ex-day trading ($\frac{v}{D/P_c}$). However, given that reliable data on who trades on the ex-dividend day is unavailable, it is almost impossible to directly test equation (2).

A. Effect of the Level of Individual Ownership on the Ex-Day Premium

Consider two firms with different share ownership structures. Suppose for firm A, 30% of shares are owned by individual investors and 70% of shares by institutional investors, while for firm B, 70% of shares are owned by individual investors and 30% of shares by institutional investors. Assume that because of the different tax regimes faced by institutions and individuals, the marginal rate of substitution between dividends and capital gains is lower for individual investors than for institutional investors. If the proportion of the firm’s stock held by individual investors proxies for the likelihood that the long-term individual investor sets the ex-day price drop, the ex-day premium for firm B is likely to be lower than that for firm A.

Table X presents stylized marginal rates of substitution between dividends and capital gains for the various holding groups before and after the 2003 dividend tax cut based on taxes faced by investors in the highest tax brackets.[28] Although Table X shows different marginal rates of substitution between dividends and capital gains for non-corporate institutional investors and corporate investors, I assume homogeneity within institutional investors. The reason for this assumption is that there is no reliable data on institutional owner classifications based on different tax treatments.[29]

***** Insert Table X here ****

Table X shows 0.77 and 1.00 as the marginal rates of substitution between dividends and capital gains for the individual investor before and after 2003, respectively. However, the actual marginal rates of substitution between dividends and capital gains for the individual investor are likely lower than 0.77 and 1.00 because taxes on capital gains are deferred until the assets are sold.[30] Therefore, individual investors are expected to receive unfavorable tax treatment of dividends

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[28] For simplicity, pension funds are assumed to represent non-corporate institutional investors.

[29] Dhaliwal et al. (2005) investigate whether the level of tax-advantaged institutional ownership affects the implied cost of equity capital. Using CDA Spectrum institutional owner classifications, they attempt to divide institutional owners into five groups: banks, insurance companies, mutual funds, brokerage firms, and others (pensions and endowments). However, they find little evidence that the effect of institutional ownership on the implied cost of equity capital varies according to the institutional owner classifications. They attribute their results to the fact that CDA Spectrum institutional owner classifications are not based on different tax treatments.

[30] Zhang, Farrell and Brown (2008) report that the ex-day premium was significantly lower than one during 2004-2005. They suggest that individual investors' ability to defer capital gains might lead the ex-day premium to be lower than one after the 2003 tax cut.

relative to institutional investors even after the 2003 tax cut. Since individual investors likely receive unfavorable tax treatment of dividends, the tax-based theory predicts that there should be a negative relationship between the level of individual ownership and the ex-day premium. This leads to the first hypothesis.

Hypothesis 1: The ex-day premium of a firm's stock is negatively related to the proportion of that stock held by individual investors.

As discussed earlier, since reliable data on who trades on the ex-dividend day is unavailable, it is almost impossible to directly test whether the dynamic trading clientele theory could explain the ex-day premium. As pointed out by Li (2005), those investors who hold the stock prior to the ex-day *do not necessarily* trade around the ex-day while those investors who do not hold stocks prior to the ex-day *may* trade around the ex-day. Nevertheless, Dhaliwal and Li (2006) document that the proportion of the firm's stock held by individuals versus institutions are correlated with the proportion of trading by individuals versus institutions around ex-dividend days.[31] If the level of individual ownership versus institutional ownership is a proxy for the level of trading by individuals versus institutions around ex-days, the dynamic trading clientele theory predicts the same results as predicted by hypothesis 1.

[31] Since investor heterogeneity can be expressed as a concave function of institutional ownership, Dhaliwal and Li (2006) use the number of shares held by institutions divided by the total number of shares outstanding as a holding-based proxy for investor heterogeneity. Their implicit assumption is that most trade around the ex-days occurs between existing holders of the stock. Of course traders who are not existing holders of the stock trade around the ex-days. To examine whether the level of institutional ownership is correlated with the level of trading by institutions around ex-days, they use the ratio of the number of large trades to the number of all trades as a trading –based proxy for investor heterogeneity. They find that the holding-based proxy and the trading-based proxy are correlated.

As expressed by equation (2), the dynamic trading clientele theory argues that the ex-day premium increases as $\overline{\alpha}$ increases. Assuming homogeneity within individual investors and, also, within institutional investors, $\overline{\alpha}$ is expressed as

$$\overline{\alpha} = \frac{n_{ind}K_{ind}\alpha_{ind} + n_{ins}K_{ins}\alpha_{ins}}{n_{ind}K_{ind} + n_{ins}K_{ins}} = w_{ind}\alpha_{ind} + w_{ins}\alpha_{ins} = w_{ind}\alpha_{ind} + (1 - w_{ind})\alpha_{ins}$$

$$= w_{ind}(\alpha_{ind} - \alpha_{ins}) + \alpha_{ins} \qquad (3)$$

where n_{ind} is the number of individual traders, n_{ins} is the number of institutional traders, α_{ind} is the marginal rate of substitution between dividends and capital gains for individual traders, α_{ins} is the marginal rate of substitution between dividends and capital gains for institutional traders, K_{ind} is the tax-adjusted risk tolerance for individual traders, K_{ins} is the tax-adjusted risk tolerance for institutional traders, w_{ind} is the weight placed on the individual traders, and w_{ind} is the weight placed on institutional traders.

The derivative of equation (2) with respect to n_{ind} is:

$$\frac{\partial E(PREM)}{\partial n_{ind}} = \frac{\partial \overline{\partial}}{\partial n_{ind}} = (\alpha_{ind} - \alpha_{ins})\frac{n_{ins}K_{ind}K_{ins}}{(n_{ind}K_{ind} + n_{ins}K_{ins})^2} < 0 \qquad (4)$$

Since the actual marginal rate of substitution between dividends and capital gains for individual investors (α_{ind}) is likely lower than that for institutional investors (α_{ins}), ($\alpha_{ind} - \alpha_{ins}$) in equation (4) is expected to be negative, leading to a negative $\frac{\partial E(PREM)}{\partial n_{ind}}$. Therefore, equation (4) suggests that the ex-day premium is negatively related to the proportion held by individual investors, which is consistent with hypothesis 1. As suggested by equation (4), to the extent that the level of individual ownership versus institutional ownership proxies for the level of trading by individuals versus institutions around ex-days, hypothesis 1 is also consistent with the dynamic trading clientele theory.

B. Effect of Investor Heterogeneity on the Ex-Day Premium

As long as individual investors face a tax disadvantage on dividends relative to capital gains while institutional investors do not, individual investors who trade for reasons unrelated to the dividend may time their trades in such a way as to avoid holding the stock on the cum-dividend day; on the other hand, institutional investors most likely engage in dividend capture. Such a different valuation of dividends between individual investors and institutional investors is expected to motivate trading between individuals and institutions around the ex-day.

Defining investor heterogeneity as the product of the proportion of the firm's stock held by individual investors and the proportion held by institutional investors, I hypothesize that investor heterogeneity is positively associated with the ex-day premium. As mentioned earlier, Dhaliwal and Li (2006) document that the effect of dividend yield on ex-day excess trading volume first increases and then decreases with the level of institutional ownership, suggesting that dividend capture is associated with the degree of investor heterogeneity.

If dividend capture does not occur, the ex-day premium should be lower, reflecting the marginal rate of substitution between dividends and capital gains for individual investors. However, the short-term trading theory argues that the ex-day premium is determined by short-term traders who engage in dividend capture. Since the actual marginal rate of substitution between dividends and capital gains for short-term traders is likely greater than that for individual investors, the short-term trading theory predicts that the ex-day premium should increase as dividend capture increases. Therefore, I hypothesize that a high level of dividend capture resulting from a high degree of investor heterogeneity increases the ex-day premium.

Hypothesis 2: The ex-day premium of a firm's stock is positively related to the degree of investor heterogeneity.

It should be noted that hypothesis 1 and hypothesis 2 are not mutually exclusive, but both hypotheses can hold. Consider three firms with different share ownership structures. Suppose for firm A, 30% of shares are owned by individual investors and 70% of shares by institutional investors, for firm B, 50% of shares are owned by individual investors and 50% of shares by institutional investors, and for firm C, 70% of shares are owned by individual investors and 30% of shares by institutional investors. Hypothesis 1 predicts that the ex-day premium is negatively associated with the proportion held by individual investors. If hypothesis 1 holds, the ex-day premium for firm A is the highest and the ex-day premium for firm C is the lowest. On the other hand, hypothesis 2 predicts that the ex-day premium is positively associated with the degree of investor heterogeneity. Since the degree of investor heterogeneity is a concave function of the level of individual ownership, hypothesis 2 predicts that the ex-day premium for firm B is the highest and the ex-day premiums for firm A and firm C are the same. However, if both hypothesis 1 and hypothesis 2 hold, the ex-day premium should be highest for firm A or firm B while it should be lowest for firm C.

Relative to hypothesis 3, given below, I compare the hypothesized positive relationship between the degree of investor heterogeneity and the ex-day premium for high dividend yield stocks and that for low dividend yield stocks. Institutional investors are more motivated to capture dividends for high dividend yield stocks around ex-days because the benefits of dividend capture are greater for high dividend yield stocks. On the other hand, institutional investors are less likely to engage in dividend capture for low dividend yield stocks because the marginal cost of engaging in dividend capture is expected to be greater than the marginal benefit. As a result, a high degree of investor heterogeneity is more likely to increase the level of dividend capture and therefore increase the ex-day premium for high dividend yield stocks. If a firm's stock is associated with a higher degree of investor heterogeneity, but the dividend yield of that stock is low, the hypothesized positive effect of investor heterogeneity on the ex-day premium is likely weaker for that stock than for a high dividend yield stock associated with a higher degree of investor heterogeneity. This leads to the third hypothesis.

Hypothesis 3: The hypothesized positive relationship between the degree of investor heterogeneity and the ex-day premium is more significant for high dividend yield stocks.

Many studies show that the excess trading volume around the ex-dividend day is significant.[32] However, none to the author's knowledge have explored whether the excess trading volume increases the ex-day premium. If hypothesis 2 and hypothesis 3 hold, a high level of dividend capture should increase the ex-day premium. Since excess trading volume around ex-dividend days indicates more dividend capture, a positive relationship between excess trading volume and ex-day premium is expected. This leads to the fourth hypothesis.

Hypothesis 4: The ex-day premium is positively related to the ex-day excess volume.

C. Other Explanatory Variables

The control variables used to explain the ex-day premium based on the tax-based theory are the dividend yield, the 2003 tax cut, and the interaction between the dividend yield and the 2003 tax cut. The tax-based theory argues that investors in high tax brackets tend to prefer low dividend yield stocks. Since the ex-day premium reflects the marginal rates of substitution between dividends and capital gains, the ex-day premium should increase with the dividend yield. A positive relationship between the dividend yield and the ex-day premium is expected.

Previous studies have investigated the effect of tax changes on the ex-day pricing of dividends. Poterba and Summers (1984) study the British market during different tax regimes and conclude that taxes determine the ex-dividend day stock price behavior. Barclay (1987) focuses on the enactment of the federal income tax in 1913. By finding that the ex-day premium is not less than one before 1913 and the

[32] See Lakonishok and Vermaelen (1986), Kato and Lowenstein (1995), and Michaely and Vila (1996).

ex-day premium is less than one during the period 1962 to 1985, he lends support to the tax-based theory. The 2003 tax cut reduced the tax disadvantage of dividends relative to capital gains and therefore increased the marginal rate of substitution between dividends and capital gains for individual investors.[33] The tax-based theory predicts that the 2003 tax cut should increase the ex-day premium. I also include an interaction term between dividend yield and the 2003 tax cut. Zhang et al. (2008) hypothesize that the effect of the dividend yield on the ex-day premium weakens after the 2003 tax cut since the 2003 tax cut reduced tax heterogeneity among investors. Therefore, the interaction term between yield and the 2003 tax cut is expected to be negatively related to the ex-day premium.

The control variables used to explain the ex-day premium based on the short-term trading theory are the dividend yield, transaction costs, and risk exposure. The short-term trading theory predicts that the ex-day premium should increase with the dividend yield since high dividend yield stocks make dividend capture more profitable. Several studies document that the ex-day premium increases with the dividend yield.[34]

According to the short-term trading hypothesis, dividend capture should be negatively related to transaction costs and risk involved in the transaction because those factors are likely frictions to trade around ex-dividend days. Michaely and Vila

[33] The 2003 tax cut reduced the maximum tax rate on dividend income of individual investors from 38.6% to 15% and reduced the maximum tax rate on capital gains income of individual investors from 20% to 15%. On the other hand, the 2003 tax cut left the tax rates for institutional investors unchanged.

[34] Elton and Gruber (1970), Kalay (1982), and Michaely (1991) find that the ex-day premium is positively related to the dividend yield. Naranjo, Nimalendran, and Ryngaert (2000) find that the ex-day abnormal returns are negatively related to the dividend yield, implying a positive relationship between the dividend yield and the ex-day premium.

(1996) find that the trading volume around ex-dividend days decreases with transaction costs and risk exposure. Naranjo et al. (2000) also find that higher transaction costs and higher risk discourage dividend capture by corporate traders. Boyd and Jagannathan (1994) show that risk exposure reduces dividend capture trading. If the level of dividend capture trading is positively associated with the ex-day premium, transaction costs and risk exposure that discourage the short-term trader from trading around ex-dividend days should decrease the ex-day premium. More directly, Karpoff and Walkling (1990) find transaction costs are negatively related to the ex-day premium. Grammatikos (1989) investigates the effect of the 1984 Tax Reform Act, whose purpose was to increase the risk of short-term trading of taxable corporations. He finds that the 1984 Tax Reform Act deterred short-term trading, leading to a decrease in the ex-day premium.

On the other hand, the dynamic trading clientele model allows for the role played by both long-term individual traders and short-term traders in determining the ex-day premium. Specifically, in the dynamic trading clientele model, the ex-day premium is influenced by different tax rates among traders, the dividend yield, transaction costs, and the risk involved in the transaction. Therefore, it should be noted that the expected relationships between explanatory variables above and the ex-day premium from either the tax-based theory or the short-term trading theory reconcile with the dynamic trading clientele theory.

III. Data and Methodology

The common stock data is obtained from the Center for Research in Security Prices (CRSP). I collect data from February 1, 2001 to December 31, 2007. Zhang et al. (2008) exclude year 2003 from their sample since there might be a lag in investors' decisions on their portfolios. Thus, following Zhang et al. (2008), I exclude year 2003 from my sample. Following Zhang et al. (2008), I collect data from February 1, 2001. All NYSE stocks had converted their price quotations from $1/16 ticks to decimals by the end of January 2001.[35] I examine firms that pay taxable cash dividends (CRSP distribution codes 1222, 1232, 1242, and 1252). Ex-dividend day events are included in the sample if trading occurs on both the cum-dividend day and the ex-dividend day. I exclude ADRs and REITs because of their different tax treatment. Ex-dividend day events are excluded from the sample if the price is less than five dollars.[36] In addition, following Chetty, Rosenberg, and Saez (2007), ex-dividend day events are excluded from the sample if the dividend yield is less than 0.1%.

Furthermore, I require each ex-dividend day event for a given quarter to have data on the level of institutional ownership at the end of the preceding quarter. Institution investors with more than $100 million are required to file form 13f and 13f filings are obtained from Thomson Financial.[37] The firm-specific level of institutional ownership is calculated by dividing the number of shares held by

[35] See Graham, Michaely, and Roberts (2003) and Jakob and Ma (2004)

[36] Elton, Gruber, and Blake (2005) eliminate observations with prices below five dollars from the sample because low priced securities are associated with the relatively high ratio of the bid-ask spread to the dividend.

[37] Institutional investors include banks, insurance companies, brokerage firms, investment advisors, mutual funds, and others (pension funds, university endowments, and foundations).

institutions by the total number of shares outstanding at the end of each quarter; the firm-specific level of individual ownership is calculated by subtracting the firm-specific level of institutional ownership from one. Each firm's institutional holdings are obtained for a total of 24 quarters (year 2001-2002 and year 2004-2007). Matching ex-dividend day event data for a given quarter with ownership data at the end of the preceding quarter results in 34,559 observations.

Following Michaely (1991), I adjust the ex-dividend day closing price by the daily expected return, estimated by the OLS market model.[38] The ex-day premium for each ex-day observation is calculated as follows:

$$PREM_i = \frac{P_{i,B} - \dfrac{P_{i,A}}{1+E(R_i)}}{D_i} \tag{5}$$

where $P_{i,B}$ is the closing price on the cum-dividend day, $P_{i,A}$ is the closing price on the ex-dividend day, $E(R_i)$ is the expected daily return estimated by the OLS market model, and D_i is the amount of the dividend. I use [-45,-6] and [6,45], where Day 0 is the ex-dividend day, to estimate the market model for each observation. The market return is obtained from the CRSP value-weighted portfolio including dividends.

In addition, following Michaely (1991), I correct for heteroskedasticity that the preceding statistic suffers from.[39] There are two sources of heteroskedasticity: the

[38] Elton, Gruber, and Blake (2005) point out that the opening price on the ex-dividend day is biased because a market order on the ex-dividend day is adjusted by the amount of the dividend. Therefore, I use the ex-dividend day closing price by adjusting it by the market movement on the ex-dividend day.
[39] Following Michaely (1991), Wu and Hsu (1996), Chay et al. (2006), and Zhang et al. (2008) correct for heteroskedasticity.

stock specific variance and the dividend yield. Michaely (1991) shows that the heteroskedasticity is negatively related to the stock specific variance and positively related to the dividend yield. Therefore, for a regression analysis, weighted least squares are employed to correct for heteroskedasticity by using the ratio of the squared dividend yield to the residual variance obtained from the OLS market model. Following Graham, Michaely, and Roberts (2003), I trim the data at the upper and lower 2.5 percent level of the premium distribution to avoid the effect of outliers on the results.[40]

Following Michaely and Vila (1995), I estimate the ex-dividend day excess trading volume. First, I calculate the average daily turnover during the 80-day estimation period:

$$ATO_i = \frac{\sum_{t \in [-45,-6] \cup [+6,+45]} TO_{it}}{80} \tag{6}$$

where TO_{it} is the daily turnover for security i on day t. Second, I calculate the excess trading volume for each day in the event period [-5,+5]:

$$EXVOL_{it} = \frac{TO_{it} - ATO_i}{ATO_i} \; t \in [-5,+5] \tag{7}$$

Then, the average daily excess trading volume for each ex-dividend day observation is calculated as

40 Alternatively, I winsorize the data at the same level of the premium distribution. Winsorizing the data has no impact on the results.

$$EXVOL_i = \frac{\left[\frac{\sum_{t\in[-5,+5]} TO_{it}}{11}\right] - ATO_i}{ATO_i} \quad t \in [-5,+5] \tag{8}$$

IV. Empirical Results

To investigate the relationship between share ownership structure and the ex-day premium, I divide the sample into deciles according to the level of individual ownership. Decile 1 consists of the lowest level of individual ownership and decile 10 consists of the highest level of individual ownership. For each decile, the mean ex-day premium is computed. Table XI shows that the ex-day premiums from decile 1 to decile 6 are greater than the ex-day premiums from decile 7 to decile 10. In addition, in the higher level of individual ownership (from decile 7 to decile 10), the ex-day premium decreases with the level of individual ownership. This is consistent with what will occur if both hypothesis 1 and hypothesis 2 are true.

***** Insert Table XI here ****

Hypothesis 1 predicts that there is a negative relationship between the level of individual ownership and the ex-day premium. On the other hand, hypothesis 2 predicts that the ex-day premium is positively related to the degree of investor heterogeneity. The measure of investor heterogeneity is expressed as:

$$HETERO = IND * INS = IND * (1 - IND) \tag{9}$$

where IND is measured as the number of shares held by individual investors divided by the total number of shares outstanding and INS is measured as the number of shares held by institutional investors divided by the total number of shares outstanding. Since the degree of investor heterogeneity is a concave function of the level of individual ownership, hypothesis 2 predicts that the ex-day premium first increases and then decreases with the level of individual ownership. If both hypotheses hold, the ex-day premium should be greater in the lower and middle level of individual ownership than in the higher level of individual ownership. Further, the ex-day premium should decrease with the level of individual ownership in the higher level of individual ownership. Therefore, the results in Table XI appear to support hypothesis 2 as well as hypothesis 1.

Next I turn to evidence in the cross-sectional regression results with respect to determinants of the relationship between ownership structure and the ex-day premium. The variables that are expected to affect the ex-day premium include the dividend yield, the level of individual ownership, the degree of investor heterogeneity, the 2003 tax cut, transaction costs, risk involved in the transaction, the interaction between the dividend yield and the 2003 tax cut, the interaction between the level of individual ownership and the 2003 tax cut, and the interaction between investor heterogeneity and the dividend yield. The following cross-sectional regression is employed with some variables omitted for various specifications:

$$\begin{aligned} PREM_i = {} & \beta_0 + \beta_1 YIELD_i + \beta_2 YIELD_i \cdot T2003_i + \beta_3 IND_i + \beta_4 HETERO_i \\ & + \beta_5 HETERO_i \cdot YLD_i + \beta_6 EXVOL_i + \beta_7 T2003_i + \beta_8 TC_i + \beta_9 RISK_i + \varepsilon_i \end{aligned} \quad (10)$$

where for each ex-day observation, $PREM_i$ is the ex-day premium, $YIELD_i$ is measured as the amount of the dividend divided by the cum-day price, $T2003_i$ is a dummy variable that takes the value 1 if the observation falls in a year after 2003,

IND_i is defined as the number of shares held by individual investors divided by the total number of shares outstanding, $HETERO_i$ is defined as the product of the number of shares held by individual investors divided by the total number of shares outstanding and the number of shares held by institutional investors divided by the total number of shares outstanding, $EXVOL_i$ is defined as the difference between the average daily turnover (the ratio of shares traded to shares outstanding) during the 11-day event period [-5,5] and the average daily turnover during the 80-day estimation period [-45,-6] and [6,45], divided by the average daily turnover during the 80-day estimation period, TC_i, transaction costs, is measured by dividing one by the cum-day price, and $RISK_i$ is calculated by dividing the stock return variance by the market return variance during the estimation period [-45,-6] and [6,45].[41]

Table XII presents summary statistics for the dependent and independent variables. The mean ex-day premium is 0.6594 which is lower than 1.00. This is consistent with both the tax-based theory and the short-term trading theory. According to the tax-based theory, individual investors should value dividends less than capital gains before the 2003 tax cut because of the adverse tax treatment of long-term individual investors' dividend income. Due to individual investors' ability to defer their capital gains until the assets are sold, individual investors most likely value dividends less than capital gains even after the 2003 tax cut, which reduced the

[41] Karpoff and Walkling (1988) and Naranjo et al. (2000) use the inverse of the stock price as a measure of transaction costs. They argue that the inverse of the stock price is positively related to bid-ask spreads and brokerage commissions. Following Naranjo et al. (2000), I use the ratio of the stock return variance to the market return variance as a measure of risk involved in the transaction.

tax disadvantage of dividends relative to capital gains for individual investors. On the other hand, the short-term trading theory argues that the existence of transactions costs results in an ex-day premium less than one.

***** Insert Table XII here ****

In order to test whether the expected positive relationship between the degree of investor heterogeneity and the ex-day premium is more significant for high dividend yield stocks, I divide the sample into two groups: high dividend yield stocks and non-high dividend yield stocks. Observations are sorted into three dividend yield quantiles. Stocks in the highest dividend yield quantile are defined as high dividend yield stocks and stocks in the other two dividend yield quantiles are defined as non-high dividend yield stocks. I then run separate regressions for high dividend yield stocks and non-high dividend yield stocks.

The regression results are presented in Panel A of Table XIII where weighted least squares estimation procedures are employed. All the regression results in this paper are based on weighted least squares estimation procedures. The coefficient on *IND* is significantly negative, which suggests that the proportion of the firm's stock held by individuals is negatively related to the ex-day premium due to unfavorable tax treatment of long-term individual investors' dividend income. This result is consistent with both the tax-based theory and the dynamic trading clientele theory. The coefficient on *HETERO* is positive, which is expected if a high degree of investor heterogeneity that is expected to increase dividend capture is positively associated with the ex-day premium. This result is consistent with the short-term trading theory. On the other hand, one cannot expect the sign on *HETERO* to be positive from either the tax-based theory or the dynamic trading clientele model expressed by equation (2). The coefficient and t-stat on *HETERO* seem to be more significant for high dividend yield stocks than those for non-high dividend yield stocks, as predicted by the short-term trading theory. It appears that the positive relationship between investor heterogeneity and the ex-day premium is more significant for high dividend yield stocks because dividend capture occurs more for high dividend yield stocks.

***** Insert Table XIII here ****

The estimated coefficients on other explanatory variables are also as predicted. If investors in high tax brackets are more likely to hold low dividend yield stocks and investors in low tax brackets are more likely to hold high dividend yield stocks, a positive relationship between the dividend yield and the ex-day premium is expected. Consistent with the tax-based theory, the coefficient on *YIELD* is positive and significant. The positive relationship between the dividend yield and the ex-day premium is also consistent with the short-term trading hypothesis because the existence of transaction costs leads to the positive relationship between the dividend yield and the ex-day premium. As documented by Chetty et al. (2007) and Zhang et al. (2008), *T2003* is positively related to the ex-day premium, suggesting that the reduction in the tax disadvantage of dividends relative to capital gains for individual investors increased the ex-day premium after the 2003 tax cut. *TC* is negatively and significantly correlated with the ex-day premium, consistent with the short-term trading theory. *RISK* is marginally significant (10% level) for the full sample. Since the dynamic trading clientele model argues that the interaction of long-term individual traders and short-term traders plays a role in determining the ex-day premium, it should be noted that the signs of coefficients on other explanatory variables above, predicted by either the tax-based theory or the short-term trading theory, reconcile with the dynamic trading clientele theory.

To gain further insight into the relationship between ownership structure and the ex-day premium, I compare the negative effect of individual ownership on the ex-day premium and the positive effect of investor heterogeneity on the ex-day premium. Since *HETERO* is a concave function of the level of individual ownership, expressed as *IND*(1-IND)*, I decompose *HETERO* into *IND* and IND^2 and run regressions. The sign of the coefficient on *IND* is expected to indicate which hypothesis dominates the ex-day pricing of dividends. If the tax-based hypothesis or the dynamic trading clientele hypothesis dominates, the coefficient on *IND* should be negative; if the short-term trading hypothesis dominates, the coefficient on *IND* should be positive.

The results are shown in Panel B of Table XIII where the only change from Panel A of Table XIII is that *HETERO* is decomposed into *IND* and IND^2. The coefficient on *IND* for non-high dividend yield stocks is not significantly different from zero. The negative effect of the level of individual ownership on the ex-day premium seems to be offset by the positive effect of investor heterogeneity on the ex-day premium. However, the coefficient on *IND* for high dividend yield stocks is significantly positive, suggesting that the short-term trading hypothesis dominates the ex-day pricing of dividends for high dividend yield stocks. The coefficient on *IND* for the full sample is also significantly positive, implying that the positive effect of investor heterogeneity is greater than the negative effect of the level of individual ownership.

The positive sign on *IND* is consistent with predictions of the short-term trading theory, but inconsistent with predictions of both the tax-based theory and the dynamic trading clientele theory. This result is also inconsistent with the findings of Perez-Gonzales (2003). He classifies firms into two groups based on whether their largest shareholder is an individual or an institution and finds that firms whose largest shareholder is an individual show lower ex-day premiums than firms whose largest shareholder is an institution. This evidence is consistent with the tax-based theory. Since a firm's stock held by the largest shareholder accounts for an average of 16.7 percent of the outstanding stock in 1994 belonging to the earlier sample period, his broad classification of share ownership structure into two groups based on the ownership characteristics of large shareholders might lead to different results.

The regression results with interaction terms are shown in Table XIV. The signs of most of the coefficients are the same as in Table XIII. The positive sign on *HETERO*YIELD* is consistent with the results in Table XIII. The positive relationship between the degree of investor heterogeneity and the ex-day premium is greater for high dividend yield stocks probably because the benefits of dividend capture increase with the dividend yield. The coefficient on *YIELD*T2003* is significantly negative, implying that the reduction in tax heterogeneity among investors makes dividend clienteles weaker. This evidence is consistent with the tax-based theory.

***** Insert Table XIV here ****

Finally, I investigate whether the ex-day premium is affected by dividend capture. I regress the ex-day premium on the ex-day excess volume, since excess trading volume around ex-dividend days indicates more dividend capture. The regression results are shown in Table XV. The coefficient on *EXVOL* is significantly positive, indicating that dividend capture by short-term traders increases the ex-day premium.

***** Insert Table XV here ****

V. Conclusions

In this paper, I examine whether share ownership structure affects the ex-day pricing of dividends. The main empirical results are as follows: first, the level of individual ownership is negatively related to the ex-dividend day premium and this negative relationship weakens when the tax disadvantage of dividends relative to capital gains for individual investors is reduced. Second, investor heterogeneity is positively associated with the level of dividend capture, thus leading to an increase in the ex-day premium. Such an increase in the ex-day premium is positively associated with the dividend yield. Finally, the positive effect of investor heterogeneity on the ex-day premium seems to be greater than the negative effect of the level of individual ownership on the ex-day premium, especially for high dividend yield stocks.

In summary, as pointed out by Karpoff and Walkling (1988) and Karpoff and Walkling (1990), the tax-based theory and the short-term trading theory are not mutually exclusive, but are complementary; accordingly, relying on just one theory cannot fully explain ex-day stock price behavior. Individual investors are motivated to time their trades in order to avoid dividends, resulting in a difference between the price drop and the dividend. If dividend capture does not occur, the ex-day premium is more likely to reflect the marginal rate of substitution between capital gains and dividends for those individual investors, thus resulting in a lower ex-day premium. However, if short-term traders find it profitable to exploit the difference between the price drop and the dividend, those short-term traders seem to be the price setter on the cum-day and the ex-day. The role played by institutional investors in determining the ex-day stock price drop depends on trading circumstances under which a firm's stock lies. This is why the ex-day premium increases with the dividend yield and investor heterogeneity, while the ex-day premium decreases with transaction costs and risk involved in the transaction.

CHAPTER 3

THE EFFECT OF INTEREST RATE VOLATILITY ON CORPORATE YIELD SPREADS ON BOTH NONCALLABLE AND CALLABLE BONDS[42]

I. Introduction

The volatility of interest rates plays numerous important roles in finance theory and practice. As one example, the potential for significant adverse changes in interest rates has caused banks, insurance companies, mutual funds and other financial institutions to devise strategies (such as immunization and others) to protect their fixed income portfolios. Sophisticated ways to measure interest rate risk exposure such as value at risk (VAR) have been developed.

The theory of how interest rate volatility affects bond pricing has been developed by numerous authors. For example, advanced bond pricing theory includes interest rate volatility as an important factor where a stochastic process for continuous changes in the short rate is given in terms of a drift term and a volatility term. Continuous changes in bond prices are derived from the short rate process. Veronesi (2010) and others derive the expected bond returns as a function of interest rate volatility. In a classic article, Heath, Jarrow, and Morton (1990) derive a bond pricing model where the drift in the short (forward) rate is, in fact, a function of the volatility of short rates.

Empirical estimations of interest rate volatility have investigated alternative specifications of short rate volatility. For example, classic interest rate theories of

[42] This chapter is based on collaborative work with Duane Stock.

Merton (1973)[43] and Vasicek (1977) suggest short rate volatility is independent of the level of interest rates while others such as Cox, Ingersoll, and Ross (1985), Pearson and Sun (1994) and Black and Karasinki (1991) maintain the volatility of rates depends on the level of interest rates. Brenner, Harjes and Kroner (1996) have found evidence that volatility depends on level of rates and, also, GARCH processes.

Yield spreads have similarly played numerous important roles in finance theory and practice. For example, the spread between long and short rates has been of great interest where some think this spread predicts economic growth. More relevant to this research, the yield spread between instruments of equal maturity is also a topic of great importance. If one considers two equal maturity corporate debt instruments, what is the market determined yield spread and what underlying features determine this spread? Perhaps the most obvious factor is any differential in credit quality (default risk). However, recently, the importance of other factors has also been stressed.

Duffee (1998), in testing the Longstaff and Schwarz (1995) model on both callable and noncallable bonds, found that a greater *level* of interest rates suggests a stronger growth in firm value and thus reduces the spread over U. S. Treasury bonds. Elton, Gruber, Agrawal, and Mann (2001) find that expected default explains a surprisingly small part of spreads while a greater portion of the spread is simply systematic risk similar to that of equities. Chen, Lesmond and Wei (2007) find default risk does not fully explain spreads and stress that liquidity explains a large

[43] In contrast, the Merton (1974) structural default risk model has no interest rate process, only a firm value process.

part of corporate bond spreads. Bao, Pan and Wang (2011) find that liquidity is a very strong determinant of spreads and, in fact, over-shadows credit risk. However, these papers have not addressed the impact of interest rate volatility on yield spreads.

The purpose of this research is to investigate the effect of interest rate volatility on corporate yield spreads for both noncallable and callable bonds. Specifically, interest rate volatility is defined as the standard deviation of the daily one-month Treasury constant maturity rate for the 12 months prior to the bond transaction date. We explore two important and broad questions: 1) how does interest rate volatility affects yield spread for noncallable corporate bonds? 2) how does the effect of interest rate volatility on yield spreads differ for noncallable corporate bonds versus callable corporate bonds? While theory suggests that interest rate volatility should be priced in corporate yield spreads, surprisingly, there is no empirical work testing the effect of interest rate volatility on the above types of yield spreads.

We first investigate the effect of interest rate volatility on yield spreads on noncallable bonds. Merton (1974) relates a firm's default risk to the firm's asset volatility. Many studies have considered a firm's equity volatility in the investigation of the yield spread of its bonds by assuming that a firm's (total) asset volatility is determined by its equity. However, as noted by Campbell and Taksler (2003), the asset volatility of a firm with risky debt is determined by both its equity and debt. For example, if a firm has a high level of interest rate volatility and therefore a high level of debt volatility, the firm is more likely to reach a critical value for default, thereby resulting in a high probability of default. Thus, interest rate volatility should be priced in corporate yield spreads.

Acharya and Carpenter (2002) also provide theoretical support for the positive effect of interest rate volatility on noncallable bond spreads. They model a defaultable bond where its spread increases with the volatility of the difference between the host bond price and the firm value.[44] The details of their model are given in the theory and hypotheses section.

We also investigate whether the effect of interest rate volatility on yield spreads is greater or smaller for callable bonds than for noncallable bonds. Since interest rate volatility affects both default risk reflecting the firm's option to default and call option values, the effect of interest rate volatility on yield spreads is complex. We note that default and call options are interactive because, for example, a bond default, which tends to be more likely when interest rate volatility is high, makes call option value disappear. As a result, the effect of interest rate volatility on yield spreads may be smaller for callable bonds than for noncallable bonds. On the other hand, interest rate volatility tends to increase call option values because greater interest rate volatility increases the volatility of the underlying instrument and thus increases the likelihood that the bond price reaches the call price and total spread is thus larger with greater interest rate volatility. In sum, the differential effect of interest rate volatility on yield spreads for callable bonds is not immediately obvious.

It is important to understand the importance of callable corporate yield spreads. Even though most empirical studies exclude callable bonds from their

[44] The host bond is a coupon paying bond with no default risk.

sample, Berndt (2004) reports that as of April, 2003, roughly 60% of U.S. corporate bonds in the Fixed Income Securities Database (FISD) are callable. Acharya and Carpenter (2002) point out that practitioners generally quote corporate bond prices as yield spreads and most corporate bonds are callable. Therefore, our empirical work includes yield spreads of callable corporate bonds.

We find that interest rate volatility clearly has a strong impact upon noncallable bond spreads after controlling for common bond-level, firm-level, and macroeconomic variables. This result is robust to using individual issuers' fixed effects and differencing the time-series. For a noncallable bond, a one percent increase in interest rate volatility increases the yield spread by a very significant amount. We find that this positive effect of interest rate volatility on yield spreads is smaller for callable bonds than for noncallable bonds. This result indicates that an increase in default risk reduces call option values, which is consistent with Kim, Ramaswamy, and Sundaresan (1993), Acharya and Carpenter (2002), and Jacoby and Shiller (2010), but is not consistent with King (2002). Also, we find that the positive effect of equity volatility on yield spreads is smaller for callable bonds than for noncallable bonds. Finally, we find that the average yield spread on callable bonds is greater than that on noncallable bonds, supporting the existence of positive call spreads. This is inconsistent with Bao, Pan, and Wang (2011), who include callable bonds in their regressions of yield spreads, but find either negative or insignificant call spreads. Also, Ederington and Stock (2002) point out that studies on the impact of a call option on corporate bond yields such as Kidwell, Marr, and

Thompson (1984) and Fung and Rudd (1986) often find that a call option does not affect yields significantly.

Section I of the paper explains the theory of how interest rate volatility may affect spreads and also presents our hypotheses. The next section describes the data used and our control variable selection. Section III presents the main empirical results. Finally, section IV concludes and summarizes the research.

II. Interest Rate Volatility and Credit Spreads: Theory and Hypotheses

A. Effect of Interest Rate Volatility on Yield Spreads for Noncallable Bonds

Academic research typically classifies models of credit spreads as reduced form versus structural form. In reduced form models there is no process for valuing the assets of the firm as dependent upon the level or volatility of interest rates. Instead, the analyst develops and examines exogenous stochastic processes for probability of default and the recovery rate (in the event of default). The time to default is central to these models and is dependent upon exogenous variables, not firm specific variables. Default is a surprise in reduced form models. Reduced form econometric estimations of swap spreads and corporate bonds yields have been performed by, among others, Jarrow and Turnbull (1995), Duffee (1999), and Liu, Longstaff and Mandell (2006).

In structural models, default is frequently triggered by asset value falling below the firm’s liabilities. Some structural models are one factor models while others include two or more (multiple) factors. The first structural model was the one factor model of Merton (1974) where the single factor is a stochastic process for value of the firm. Leland and Toft (1996) also developed a one factor model. More recent models tend to have more than one factor where the second factor is commonly a stochastic process for the short rate. Longstaff and Schwartz (1995) developed an early two factor model where the short rate was given as the Vasicek (1977) process for the short rate. Colin-Dufresne and Goldstein (2001) develop a multi-factor structural model where leverage is one of the factors. It is obvious that two factor structural models where the factors (processes) are 1.) the risk free short rate and 2.) the value of firm assets have strong intuitive appeal because corporate debt yields are often considered to have a risk free component and a risk premium related to default risk.

When the short risk free rate is a factor in a structural model, it is important to note that volatility of the short rate can be described as a constant, as in Longstaff and Schwartz (1995). Alternatively, volatility of the short rate may not be constant but a function of the level of short rates and time as in Acharya and Carpenter (2002) where the short rate is the well known Cox, Ingersoll and Ross (1985) interest rate process. More specifically, interest rate volatility is not constant but potentially a function of the level of interest rates where higher rates tend to be associated with greater volatility. See Brenner, Harjes and Kroner (1996) who, among others, find that interest volatility depends upon the level of interest rates.

Some structural models maintain that strategic default is the appropriate perspective. That is, instead of a default being solely triggered by the condition of assets being less than liabilities, the firm constantly assesses the option to default. In other words, default is viewed more as an endogenous voluntary decision where the firm follows optimization rules. For our analysis, we utilize the multifactor endogenous model of Acharya and Carpenter (2002) as given below. It is appealing for our purposes because it suggests theory of how interest rate volatility can affect yield spreads.

$$\frac{dV_t}{V_t} = (r_t - \gamma_t)dt + \sigma_{v,t} d\tilde{W}_t \tag{11}$$

$$dr_t = \mu(r_t, t)dt + \sigma(r_t, t)d\tilde{Z}_t \tag{12}$$

$$E[d\tilde{W}_t, d\tilde{Z}_t] = \rho_t dt \tag{13}$$

Here V_t is firm value, r_t is the short term interest rate, γ_t is the firm's payout rate, $\sigma_{v,t}$ reflects volatility of firm value, $\tilde{W}_t$ and is a Brownian motion. In the interest rate process, $\mu(r_t, t)$ is the drift, $\sigma(r_t, t)$ is the volatility of the short rate, and $\tilde{Z}_t$ is a second Brownian motion. ρ_t is the instantaneous correlation between the short-term interest rate and firm value processes. It seems intuitive that if the drift for value of the firm is dependent upon r_t, then spreads likely depend on the level of and volatility of the short rate.

By considering a firm with a single bond outstanding, Acharya and Carpenter (2002) model a pure defaultable bond where the option to default is treated as a particular kind of a call option on its host bond. The host bond is a coupon paying bond with no default risk. The host bond has price P_t at time t. At each time t, the firm decides whether to service the debt or not (by defaulting). The pure defaultable bond is a host bond less a call option to default where the strike price is $V_{t,}$.[45] This is because the firm owners are long in the assets, short on the host bond, and long on the option to default.

How is the yield spread related to interest rate volatility (σ_r) for pure defaultable bonds? Does σ_r increase or decrease the spread?[46] Acharya and Carpenter (2002) theoretically analyze the effect of σ_r on yield spreads on pure defaultable bonds. They view the yield spread of a pure defaultable bond over its host bond as a transformation of the default option value.[47] They begin with the idea that option value should increase with variance in P_t-V_t, where the time subscript is omitted for brevity. One can decompose the variance of P_t-V_t into the below parts.

$$\mathrm{Var}(P_t - V_t) = \mathrm{Var}(P_t) + \mathrm{Var}(V_t) - 2\,\mathrm{Cov}(P_t, V_t) \tag{14}$$

Then, one can analyze how interest rate volatility affects each term on the right side.

While Acharya and Carpenter (2002) analyze the impact of σ_r on yield spreads by focusing on *Cov* (P_t, V_t), We focus on *Var* (P_t) and *Var* (V_t). Because Eom, Helwege, and Huang (2004) find that the covariance between the V and r processes is small and insignificant, we do not analyze its impact on the spread.[48] It is obvious that greater σ_r increases the variance of the default free host bond price, P_t, the first term of equation (4). The impact of interest rate volatility upon the second term, variance of V_t, is not as obvious but would appear to tend positive because the

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[45] This call option is not the option to refund high coupon debt with lower coupon debt. We deal with this type of call option later.
[46] Acharya and Carpenter (2002) analyze the impact of interest rate volatility by using the correlation between r and V. We suggest that the above process is an alternative that lends more insight.
[47] This is equation (15) in Acharya and Carpenter (2002).
[48] Of course, P_t is determined by r_t

variance of *V* is the weighted average of the volatility of the firm's debt and the firm's equity. Note that Campbell and Taksler's (2003) focus is upon the volatility of equity but they also note the importance of volatility in the firm's debt in determining variance of *V*.

As in Campbell and Taksler (2003), the volatility of *V* is expressed as follows:

$$\sigma_v = (\frac{D}{D+E})\sigma_d + (\frac{E}{D+E})\sigma_e \qquad (15)$$

where σ_v is the volatility of the firm, σ_d is the volatility of the firm's debt, σ_e is the volatility of the firm's equity, *D* is the market value of the firm's debt, and *E* is the market value of the firm's equity. Since the volatility of the firm is an increasing function of the volatility of the firm's debt, interest rate volatility is expected to have a positive effect on the volatility of the firm. In sum, we expect yield spreads to increase as σ_r rises because interest rate volatility increases both the host bond price volatility and firm volatility. This leads to the first hypothesis.

<u>Hypothesis 1</u>: Interest rate volatility increases yield spreads.

Our next hypothesis is motivated by the result of Duffee (1998) where he finds that bonds with weaker credit quality show a more negative relationship between yield spreads and levels of interest rates than bonds with stronger credit quality. As a consequence, the prices of junk bonds are expected to be more responsive to interest rate volatility than those of investment grade bonds. Therefore, the effect of hypothesis 1 is expected to be greater for junk bonds than for investment grade bonds. This leads to our second hypothesis.

Hypothesis 2: The relationship between interest rate volatility and yield spreads is more strongly positive for junk bonds than for investment grade bonds.

B. Differential Effect of Interest Rate Volatility on Yield Spreads: Noncallable versus Callable Bonds

The next question is whether the expected positive effect of σ_r on yield spreads is stronger or weaker for callable bonds. Chance (1990) views a noncallable corporate bond as a portfolio of a riskless bond and a short position in a put option written on the firm's assets. On the other hand, Kihn (1994) and Jacoby and Shiller (2010) view a callable corporate bond (where callability here means the ability to refund at a call price) as a portfolio of the above noncallable corporate bond and a short position in a refunding call option written on the bond. Therefore, yield spreads of callable corporate bonds consist of both default spreads and call spreads. If interest rate volatility increases default risk, as suggested by Hypothesis 1, the impact of σ_r on call spreads should be affected by the interaction between the call provision and default risk. An important question is whether default risk increases or decreases the call option value.

Kim, Ramaswamy, and Sundaresan (1993) find that a call option value in a government bond is more valuable than that in a corporate bond, suggesting that there should be a negative relation between default risk and a call option value. To address this issue, Acharya and Carpenter (2002) built their theory of corporate bond valuation upon three types of coupon paying bonds: a.) pure defaultable, b.) pure callable, and c.) both defaultable and callable. As previously mentioned, they treat the option to default for the pure defaultable bond as a kind of a call option on its host bond. While the strike price of the pure defaultable bond is firm value (V_t), the strike price of the pure callable bond is a call price (k_t). Since the issuer of a defaultable and callable corporate bond has the option to both default and call, the firm may stop servicing the debt by either a.) exercising the call (paying k_t to replace the bond with lower coupon debt), or b.) giving up the firm where the value is V_t. Importantly, the strike price is the minimum of k_t and V_t..[49]

By noting that the presence of one option destroys the other option, they suggest that there should be a negative relation between default risk and a call option value. Jacoby and Shiller (2010) find empirical evidence to support this negative relation. Thus, if σ_r increases default risk but the increase in default risk weakens the call option value, the positive effect of interest rate volatility on yield spreads will be weaker for callable bonds than for noncallable bonds. This leads to the following hypothesis.

Hypothesis 3A: The hypothesized positive relation between interest rate volatility and yield spreads is *weaker* for callable bonds than for noncallable bonds.

In contrast to hypothesis 3A, interest rate volatility may increase call option values because greater σ_r increases the volatility of the underlying instrument and thus increases the likelihood that the bond price reaches the call price, k_t. King (2002) finds that σ_r has a positive effect on call option values. Since greater call values increase call spreads for callable bonds, σ_r may increase call spreads for

[49] Here the endogenous model assumes no minimum net worth or cash flow covenants which force the issuer to default.

callable bonds. If so, the expected positive impact of interest rate volatility on yield spreads will be stronger for callable bonds than for noncallable bonds. Thus, we suggest the alternative hypothesis below.

Hypothesis 3B: The hypothesized positive relation between interest rate volatility and yield spreads is *stronger* for callable bonds than for noncallable bonds.

C. Differential Effect of Credit Ratings and Equity Volatility on Yield Spreads: Noncallable versus Callable Bonds

The credit rating is the most common proxy for default risk. A bond with weaker credit quality should have a greater credit yield spread. However, it is not clear whether the effect of the credit rating on yield spreads is stronger or weaker for callable bonds than for noncallable bonds. A greater default risk associated with weaker credit quality destroys the exercise of the call option and thus reduces the call option value, as suggested by Acharya and Carpenter (2002). On the other hand, King (2002) empirically finds that a bond with weaker credit quality is associated with a higher call option value. She explains this by suggesting the bond with weaker credit quality is more sensitive to the level of interest rates, thereby leading to a higher price volatility and a higher probability that the bond price reaches the call price. The result of King (2002) is consistent with the finding of Duffee (1998) that bonds with weaker credit quality show a more negative relationship between yield spreads and level of interest rates. This leads to the following alternative hypotheses.

Hypothesis 4A: The positive relation between credit ratings and yield spreads is *weaker* for callable bonds than for noncallable bonds.

Hypothesis 4B: The positive relation between credit ratings and yield spreads is *stronger* for callable bonds than for noncallable bonds.

Campbell and Taksler (2003) find that a firm's equity volatility (σ_e) is positively related with the yield spread on its debt in the cross-section. King (2002) analyzes the determinants of call option values, but she does not take into account the impact of σ_e on call option values. One interesting question is whether σ_e increases or decreases the call option value. As mentioned above, Acharya and Carpenter (2002) suggest that default risk destroys call option value. If σ_e increases the default risk and the increase in the default risk reduces the call option value, the expected positive relation between a firm's equity volatility and the yield spread on its debt should be weaker for callable bonds.

Hypothesis 5: The positive relation between a firm's equity volatility and the yield spread on its debt is weaker for callable bonds than for noncallable bonds.

III. Data and Summary Statistics

A. Data

We use transaction data from Trade Reporting and Compliance Engine (TRACE). Following Edwards, Harris and Piwowar (2007), we eliminate cancelled, corrected, and repeated interdealer trades. According to Chen, Fabozzi, and

Sverdlove (2010), there seem to be some errors in the TRACE yield computations.[50] Therefore, we calculated the yield-to-maturity and used these calculated yields to maturity instead of the yields to maturity provided by TRACE. In order to compute yields, we use the volume-weighted average of all transaction prices during the last trading day of the month in which the bond traded as the end-of-month bond price rather than the last transaction price of the day. Bessembinder, Kahle, Maxwell, and Xu (2009) find that a volume-weighted approach leads to better specified and more powerful statistical tests than an equal-weighted approach. We eliminate observations where the last transaction does not fall between five business days before the last trading day and the last trading day of the month.

We obtain the Treasury constant maturity yields from H.15 release of the Federal Reserve System and measure yield spreads as the difference between the daily yield on the corporate bond and the constant maturity Treasury yield with the same time to maturity. To estimate the entire yield curve, we use a linear interpolation scheme from 1, 2, 3, 5, 7, 10, 20, and 30-year Treasury constant maturity rates. Interest rate volatility is measured by the standard deviation of the daily one-month Treasury constant maturity rate for the 12 months prior to the bond transaction date.

Bond characteristics are obtained from the Fixed Income Securities Database (FISD) and the issuer's accounting information is obtained from the Compustat database. We exclude bonds unrated by S&P, as Chen, Lesmond, and Wei (2007) do. The credit rating is assigned a cardinalized S&P rating, where AAA=1, . . . , D=22.

[50] They report that some of these apparent errors include entering the time of day in the yield field.

As in Guntay and Hackbarth (2010), we exclude bonds with special features such as putability, convertibility, and sinking fund provisions. Bonds with make-whole provisions are also eliminated. Furthermore, as in Elton, Gruber, Agrawal, and Mann (2001), we exclude floating-rate bonds and bonds with an odd frequency of coupon payments. Following Duffee (1999) and Eom, Helwege, and Huang (2004), we eliminate bonds whose maturity is less than one year because they are less likely to trade. Finally, we obtain equity prices from the Center for Research in Security Prices (CRSP). Equity volatility is calculated as the standard deviation of daily excess returns over the CRSP value-weighted index using 252 daily returns prior to the bond transaction date.

Following Campbell and Taksler (2003), we exclude the top and bottom 1% of yield spreads from our analysis. The imposition of all the screens above results in a sample of 134,167 different bond-month transactions for noncallable bonds and 88,273 different bond-month transactions for callable bonds.

B. Control Variables

The existing literature has included a large number of variables that affect yield spreads for noncallable bonds. Thus, we employ a set of control variables that has been proven to affect noncallable yield spreads. Given that call values should affect call spreads for callable bonds, we also include the determinants of call values expected to influence yield spreads for callable bonds. We use interaction terms between some of these variables and a callable dummy variable.

The short-term interest rate is defined as the one-month Treasury constant maturity rate. According to, among others, Longstaff and Schwartz (1995) and Collin-Dufresne and Goldstein (2001), an increase in the short-term interest rate leads to an increase in the drift of firm value under the risk-neutral measure. Such an increase in the drift of firm value decreases the probability of default, thereby decreasing any default spread. Longstaff and Schwartz (1995) and Duffee (1998) empirically find that there is a negative relation between the level of interest rates and yield spreads. Therefore, we expect the short-term interest rate has a negative impact on yield spreads.

Furthermore, call spreads should be positively related to the short-term interest rate. The price of a bond declines as the level of the short-term interest rate rises due to default risk. Since a call option value is based on the price of the underlying asset, an increase in the level of the short-term interest rate should decrease the call value and call spread. Consistent with this claim, Duffee (1998) finds that the negative relation between interest rates and yield spreads is stronger for callable bonds than for noncallable bonds. Therefore, we expect any negative relation between short, risk free interest rates and yield spreads to be stronger for callable bonds. In addition, as mentioned above, Duffee (1998) finds that the negative relation between short-term interest rates and yield spreads is stronger for lower rated bonds because the prices of lower rated bonds associated with higher default risk are more sensitive to the level of interest rates. The negative relation between short, risk free interest rates and yield spreads is thus expected to be stronger for lower rated bonds.

The slope of the yield curve is measured by the difference between the 10-year and 1-year Treasury constant maturity rates. Estrella and Hardouvelis (1991), Estrella and Mishkin (1996), Ederington and Stock (2002), and Breeden (2011) suggest that the slope of the yield curve reflects the market's expectation about the future strength of the economy. Simply put, a strongly positive yield curve suggests the economy will strongly grow while a flat or negative yield curve suggests the economy will grow slowly and even experience negative growth. Of course, a stronger (weaker) outlook for the economy suggests fewer (greater) defaults and less (greater) credit spreads. Thus, the slope of the yield curve is expected to have a negative impact on yield spreads.

The slope of the yield curve could also affect call spreads. As in Stanhouse and Stock (1999), the slope of the term structure may reflect the market's expectation of future interest rates. A greater slope of the term structure reflects the market's expectation of rising interest rates in the future. If the market expects interest rates to rise, call option values are expected to decline. King (2002) finds that call option values are negatively related to the slope of the yield curve. Thus, the negative relation between the slope of the yield curve and total yield spreads is expected be stronger for callable bonds than for noncallable bonds.

A number of recent studies find that liquidity plays an important role in determining yield spreads (Chen, Lesmond, Wei (2007), Guntay and Hackbarth

(2010), Bao, Pan, and Wang (2011), and Rossi (2009)). Even though their liquidity measures vary, they all find that liquidity is priced in corporate yield spreads. Guntay and Hackbarth (2010) use the number of *months* a bond traded for the 12 months prior to the bond transaction date divided by 12 as their measure of liquidity. In this measure, a bond may trade only once a month and appear to be as liquid as one that trades every day of a given month. Our measure of liquidity is obtained by dividing the number of *days* a bond traded for the 12 months prior to the bond transaction date by the number of business days during the corresponding period. A negative coefficient is expected for this variable.

We also include remaining time to maturity and coupon rate. The effect of remaining maturity on yield spreads depends on whether the slope of the corporate yield curve is steeper or flatter than that of the government yield curve. If the slope of the corporate yield curve is steeper than that of the government risk free yield curve, the coefficient on maturity will have a positive sign. On the other hand, King (2002) finds that remaining maturity is positively related to call option values in the callable period.

Following Elton, Gruber, Agrawal, and Mann (2001) and Longstaff, Mithal, and Neis (2005), we include coupon rates (in percent) to control for tax effects. While interest payments on Treasury bonds are exempt from state taxes, interest payments on corporate bonds are subject to state taxes. Corporate bonds with higher coupons are taxed more than corporate bonds with lower coupons, so investors should demand a higher rate of return to be compensated for holding bonds with higher coupons.[51] Therefore, we expect a positive relation between coupon rates and yield spreads. In addition, according to King and Mauer (2000), firms tend to call higher coupon bonds first. A higher option value associated with a higher coupon rate is expected to lead to a greater call spread. Thus, the expected positive relation between coupon rates and yield spreads should be greater for callable bonds than for noncallable bonds.

Finally, we include accounting information because it is unclear to investors how credit rating agencies use public information to set credit ratings. Following Blume, Lim, and Mackinlay (1998), Campbell and Taksler (2003), and Chen, Lesmond, and Wei (2007), we include long-term debt to assets and operating income to sales. The ratio of long-term debt to assets is measured by dividing long-term debt by total assets and the ratio of operating income to sales is measured by dividing operating income before depreciation by net sales. Each variable is obtained in the year prior to the yield spread measurement.[52] Since financially risky firms are likely associated with a high level of long-term debt to assets and a low level of operating income to sales, we expect a positive sign on the long-term debt to assets and a negative sign on the operating income to sales.

C. Summary Statistics

Summary statistics for the mean and median yield spreads are reported in Table XVI. We report results by industry, year, rating, and maturity for noncallable

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[51] Tax rates on capital gains are lower than those on coupons for many investors. Also, capital gains taxes can be deferred.

[52] Following Blume, Lim, and Mackinlay (1998) and Campbell and Taksler (2003), we use the calendar year assigned by COMPUSTAT for comparability of data.

bonds and callable bonds, respectively. Not surprisingly, Panel B of Table XVI shows that the mean and median yield spreads were greater during the financial crisis of 2008 (2008 and 2009 data), reflecting the increase in credit spreads caused by the financial crisis.

**** Insert Table XVI here ****

Table XVII provides summary statistics on the variables we use in our analysis. The mean and median yield spreads of callable bonds are higher than those of noncallable bonds. Many studies have found no significant relation between the call provisions and yield spreads. For example, Bao, Pan, and Wang (2011) include callable bonds in their regressions of yield spreads, but find either negative or insignificant call spreads. On the other hand, King (2002) reports that the average call option value is 2.25% of par. Our results suggest that call spreads exist. In addition, callable bonds are associated with longer maturity, which is consistent with Chen, Mao, and Wang (2010). We also find that callable bonds are associated with weaker credit quality and lower liquidity, which should lead to higher yield spreads for callable bonds.[53]

**** Insert Table XVII here ****

IV. Empirical Results

A. Effect of Interest Rate Volatility on Yield Spreads for Noncallable Bonds

We first examine time-series variations of our measure of interest rate volatility and yield spreads of noncallable bonds. We plot interest rate volatility and

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[53] Crabbe and Helwege (1994) found that lower rated bonds are more likely to have a call feature.

the mean yield spread of each month from 2003 to 2009. A positive time-series relation between interest rate volatility and the yield spreads of noncallable bonds is illustrated in Figure IV.

**** Insert Figure IV here ****

To further explore the effect of interest rate volatility on yield spreads of noncallable bonds, we estimate the following regression for only noncallable bonds with some variables omitted for various specifications:

$$\begin{aligned} Yield\,Spread_{it} &= \beta_0 + \beta_1(\sigma_r)_t + \beta_2 R_t + \beta_3 Slope_t + \beta_4 Rating_{it} + \beta_5(\sigma_e)_{it} \\ &+ \beta_6 Liquidity_{it} +_7 Maturity_{it} + \beta_8 Coupon_i + \beta_9 Incometo\,Sales_{it} \\ &+ \beta_{10} Debt\,toAssets_{it} + \beta_{11} Industrial_i + \beta_{12} Financial_i + \varepsilon_{it} \end{aligned} \tag{16}$$

For each bond-month observation, $Yield\,Spread_{it}$ is defined as the difference between the daily yield on the corporate bond and the constant maturity Treasury yield with the same time to maturity, $(\sigma_r)_t$ is defined as the standard deviation of the one-month Treasury constant maturity rate for the 12 months prior to the bond transaction date, r_t is the one-month Treasury constant maturity rate, $Slope_t$ is defined as the difference between the 10-year and 1-year Treasury constant maturity rates, $Rating_{it}$ is defined as a cardinalized S&P rating, where AAA=1, . . . , D=22, $(\sigma_e)_{it}$ is defined as the standard deviation of daily excess returns over the CRSP value-weighted index for firm *i* using 252 daily returns prior to the bond transaction date, $Liquidity_{it}$ is defined as the number of trading days for the 12 months prior to the bond transaction date, $Maturity_{it}$ is defined as the remaining maturity in years for bond *i*, $Coupon_i$ is defined as the coupon rate measured in percent, $Debt\,toAssets_{it}$

is defined as the ratio of long-term debt to total assets, $Income\,to\,Sales_{it}$ is defined as the ratio of operating income before depreciation to net sales, $Industrial_i$ is a dummy variable that takes the value 1 if the bond is an industrial bond, and $Financial_i$ is a dummy variable that takes the value 1 if the bond was issued by a financial firm such as a bank.

The regression results for only noncallable bonds are presented in Table XVIII. The coefficients on σ_r have the hypothesized signs and are significant at the 1% level in all specifications. The last column of Table XVIII shows that a one percent increase in interest rate volatility increases the yield spread by 1.63%. The yield spread is positively related to σ_r after we control for bond-specific, issuer-specific, and macroeconomic variables. The positive sign of σ_r supports our hypothesis that σ_r increases yield spreads.

**** Insert Table XVIII here ****

The negative coefficients on *r* and *Slope* have the expected signs and are significant at the 1% level in all specifications. The negative sign of *r* is consistent with the empirical findings of Longstaff and Schwartz (1995) and Duffee (1998). As expected, the estimated coefficient on the slope of the yield curve is also significantly negative. This result is consistent with the findings that the slope of the yield curve reflects the market's expectation of future interest rates. As in all the previous studies, the positive and significant sign of *Rating* implies that a bond with weaker credit quality has a greater yield spread. In addition, the effect of σ_e on yield spreads is positive and significant at the 1% level, which is consistent with the findings with Campbell and Taksler (2003). The negative sign of *Liquidity* supports the existence of liquidity premium. Finally, the negative sign of *Income to Sales* indicates that firms with high levels of operating income to sales are less likely to default, thereby leading to low yield spreads.

We examine whether our findings are robust to different σ_r and σ_e specifications and a different measure of credit ratings. According to the Black-Scholes model in deriving implied volatilities, the effects of σ_r and σ_e on the default option value should be proportional to the square root of the time to maturity. Thus, we use a different specification by replacing σ_r and σ_e with σ_r* (Maturity)$^{1/2}$ and σ_e * (Maturity)$^{1/2}$. In addition, we use a different measure of credit ratings because the yield spread between AAA and AA+ is likely smaller than that between C and D. Furthermore, we reverse the rating scale such that D=1, …, AAA=22 and take logs of all rating levels. The results are shown in Table XIX. The coefficients on σ_r* (Maturity)$^{1/2}$ and σ_e * (Maturity)$^{1/2}$ are both significantly positive and the coefficients on *Rating* are significantly negative.[54] Using the different specification and the different measure of credit ratings does not change the major results reported above.

**** Insert Table XIX here ****

In order to investigate whether the positive relation between σ_r and yield spreads was caused by the 2008 financial crisis, we run separate regressions for different time periods: the pre-crisis period (2003-2007) and the crisis period(2008-

[54] We also add these two interaction terms instead of substituting for σ_r and σ_e. However, the coefficients on these two interaction terms are not significantly positive.

2009).[55] As reported in the first two columns of Table XX, the relation between σ_r and the yield spreads is significantly positive at the 5% and 1% levels during the pre-crisis period and crisis period, respectively. We also run separate regressions for investment grade bonds and junk bonds. The positive relation between σ_r and the yield spreads is still significant for both investment grade bonds and junk bonds. We also perform fixed effect regressions to investigate whether the positive relation between σ_r and the yield spreads is the product of spurious cross-sectional or time-series correlations. As shown in Table XXI, the coefficients on σ_r are positive and significant at the 1% level.

***** Insert Table XX here ****

**** Insert Table XXI here ****

Finally, we perform regressions of monthly changes in yield spreads on monthly changes in all variables to remove any time-series trends:

$$\begin{aligned}\Delta Yield\,Spread_{it} &= \beta_0 + \beta_1\Delta(\sigma_r)_t + \beta_2\Delta R_t + \beta_3\Delta Slope_t + \beta_4\Delta Rating_{it} \\ &+ \beta_5\Delta(\sigma_e)_{it} + \beta_6\Delta Liquidity_{it} + \varepsilon_{it}\end{aligned} \tag{17}$$

where Δ denotes the first difference in each variable and $\Delta Yield\,Spread_{it}$ is the change in yield spreads between two consecutive months. Unlike the previous regressions, here we eliminate Δ*Maturity* and the variables that do not change on a monthly basis. In addition, our measures of σ_r, σ_e, and *liquidity* are different from those of the previous regressions. σ_r is measured as the standard deviation of the daily one-month Treasury constant maturity rate for the *one month* (not the *12 months*) prior to the bond transaction date. σ_e is calculated as the standard deviation

[55] Following Bao et al. (2011), the pre-crisis period excludes 2008 and 2009.

of daily excess returns over the CRSP value-weighted index using *one month* of daily returns (not *252* daily returns) prior to the bond transaction date. *Liquidity* is measured by dividing the number of *days* a bond traded for the *one month* (not the *12 months*) prior to the bond transaction date by the number of business days during the corresponding period. We find a significantly positive relation between monthly changes in σ_r and monthly changes in yield spreads.[56] The last column in Table XXII shows that a one percent change in interest rate volatility results in a 0.936% change in the yield spread.

**** Insert Table XXII here ****

B. ***Differential Effect of Interest Rate Volatility, Credit Ratings, and Equity Volatility on Yield Spreads: Noncallable versus Callable Bonds***

The regression results for callable bonds are presented in Table XXIII. We find a positive and significant relation between σ_r and the yield spreads. It is interesting to note that the coefficients on σ_e are not significant in all specifications, supporting the hypothesis that the positive relation between a firm's equity volatility and the yield spread on its debt is weaker for callable bonds. This can be explained by Acharya and Carpenter (2002) who suggest that default risk destroys call option values. An increase in default risk, driven by an increase in σ_e, seems to reduce the call spread, thereby offsetting the positive effect of σ_e on the default spread.

**** Insert Table XXIII here ****

[56] The results are similar when we use Newey-West (1987) Standard errors and standard errors that are clustered at the firm and year level.

We also compare *Maturity* in this table with those in Table XXI. While the coefficients on *Maturity* for noncallable bonds are insignificant, we find a significantly negative relation between *Maturity* and the yield spreads for callable bonds. King (2002) finds that call option values decrease with the remaining time to maturity in the call protection period. Given that a callable bond cannot be exercised in the call protection period, a call option value should become greater as the callable bond approaches the first call date. Therefore, call option values are expected to be negatively related to the remaining time to maturity. This effect might explain the negative relation between remaining maturity and yield spreads.

We now explore whether the positive relationship between σ_r and yield spreads is different for junk bonds and callable bonds. We run regressions for the full sample of both noncallable and callable bonds with interaction terms. *Junk* is used as a dummy variable that takes the value 1 if the bond is a junk grade bond, and *Call* is used as a dummy variable that takes the value 1 if the bond is callable. As shown in Table XXIV, the coefficients on *Junk** σ_r show the expected positive sign, supporting our hypothesis that the prices of junk bonds are more sensitive to interest rate volatility than those of investment grade bonds.

**** Insert Table XXIV here ****

One interesting question is whether the positive effect of interest rate volatility on yield spreads is stronger or weaker for callable bonds. As previously hypothesized, the two conflicting theories expect different effects of σ_r on yield spreads on callable bonds relative to noncallable bonds. The negative sign of

*Call**σ_r supports the hypothesis that the positive relation between σ_r and yield spreads is *weaker* for callable bonds, because an increase in default risk resulting from an increase in σ_r reduces a call option value.

Similarly, the coefficients on *Call**σ_e are negative and significant in every specification, supporting the hypothesis that an increase in default risk resulting from an increase in σ_e reduces a call option value. On the other hand, the coefficients on *Call*Rating* are significantly positive, which is consistent with the hypothesis that the positive relation between credit ratings and yield spreads is *stronger* for callable bonds than for noncallable bonds. This is consistent with the findings of King (2002), who empirically finds that a bond with weaker credit quality is associated with a higher call option value.

We find a positive and significant relation between *Call* and the yield spreads, suggesting that positive call spreads exist. The estimated coefficients on other explanatory interaction variables are also as predicted. The coefficients on *Junk*r* show the expected negative sign, which is consistent with the findings of Duffee (1998), who reports that the negative relation between yield spreads and the level of interest rates is stronger for lower rated bonds. All the other interaction variables with the call option have the expected signs. The negative effect of the short-term interest rate on yield spreads is significantly stronger for callable bonds, suggesting that call option values are negatively related to the short-term interest rate. This is because the value of a call option is positively related to the bond's price. Furthermore, the sign of *Call*Slope* is as expected. The slope of the yield curve seems to reflect the market's expectation of future interest rates. The call spread becomes smaller as the slope of the yield curve becomes steeper, which indicates that interest rates are expected to rise. The positive sign of *Call*Coupon* suggests that call options are worth more when coupon rates are greater because firms want to lower the cost of borrowing by calling bonds with higher coupons first.

Finally, we examine whether the relation between the determinants of call values and yield spreads on callable bonds is stronger or weaker for high-priced bonds than for low-priced bonds.[57] *HP* is used as a dummy variable that takes the value 1 if the bond price is greater than 100.[58] Following King (2002), we divide callable bonds in the sample into two groups: callable bonds that are in the call protection period and callable bonds that are in the callable period. The results are shown in Table XXV. We find that the effects of σ_r, σ_e, and *Rating* on yield spreads on callable bonds are generally weaker for high-priced callable bonds. Acharya and Carpenter (2002) suggest that an increase in default risk reduces call option values. This effect seems to be stronger for high-priced callable bonds, because call option values are more sensitive to the change in default risk when they are in-the-money.

**** Insert Table XXV here ****

V. Conclusions

[57] While a call price is identifiable if it is par, the FISD does not provide clear information of non-par call prices until the bond issues are called. Therefore, we eliminate callable bonds whose call prices are not par. Fourteen percent of callable bonds are eliminated due to call price being unequal to par.

[58] Nineteen percent of callable bonds in the sample are high-price bonds.

This paper examines the impact of interest rate volatility on yield spreads for noncallable bonds. Campbell and Taksler (2003) argue that a firm with a higher level of equity volatility is more likely to default. Given that the total firm volatility also includes the volatility of a firm's bonds, interest rate volatility should affect default risk. The greater the interest rate volatility, the more volatile the price of a bond. As the bond price becomes more volatile, the volatility of the assets' market value increases, thereby leading to an increase in default spread. We find that interest rate volatility is positively related to yield spreads on noncallable bonds.

We find the relationship between interest rate volatility and yield spreads is more strongly positive for junk bonds than for investment grade bonds. Investment grade bonds are unlikely to default, pointed out by Campbell and Taksler (2003). As a consequence, the positive effect of interest rate volatility on the default spread should be more significant for junk bonds. In addition, we find that the average yield spread on callable bonds is greater than that on noncallable bonds, indicating that the embedded options in callable bonds are priced in yield spreads on callable bonds.

We also investigate whether the effect of interest rate volatility on yield spreads is greater or smaller for callable bonds than for noncallable bonds. The two conflicting theories predict different effects of interest rate volatility on yield spreads on callable bonds versus noncallable bonds. Acharya and Carpenter (2002) suggest that default (call) risk destroys call (default) option values. An increase in default risk, driven by an increase in interest rate volatility, should reduce the call spread, thereby offsetting the positive effect of interest rate volatility on the default spread.

On the other hand, interest rate volatility might increase call spreads by inducing a higher price volatility of callable bonds, which is consistent with the finding of King (2002) that a bond with weaker credit quality shows a higher call option value. We find that the effect of interest rate volatility on yield spreads is smaller for callable bonds than for noncallable bonds. Similarly, we find that the positive relation between a firm's equity volatility and the yield spread on its debt is weaker for callable bonds.

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APPENDIX A

Regressions Adjusting for Clustering for Forced banks

The dependent variable is the abnormal returns based on the mean-adjusted model. Abnormal returns are corrected for heteroskedasticity and clustering. TRUST is a dummy variable equal to one if the observation is a TP. CALLABLE is a dummy variable equal to one if the observation has a call option. MATURITY is measured as the natural log of remaining time to maturity.

	(1)	(2)	(3)
Intercept	0.1248***	0.1335*	0.1308
	(3.03)	(1.96)	(1.94)
TRUST (TP)	0.1319***	0.1463***	0.1329***
	(3.07)	(2.94)	(2.93)
CALLABLE	0.0881***		0.1042
	(4.59)		(1.86)
MATURITY		0.0179	-0.0063
		(1.17)	(-0.23)
Sample Size	121	121	121
F, (p-value)	14.78	7.62	25.64
	(0.0048)	(0.0225)	(0.0008)
R-squared	0.2639	0.2447	0.2648

APPENDIX B

Abnormal Returns around the October 14th Announcement for Forced Banks: Market Model

Abnormal returns over various event windows based on the market model are reported for the equal weight approach and the portfolio approach. For the portfolio approach, each portfolio consists of all preferred stock belonging to a particular bank. The second t-stats in Panel A are computed using the "Crude Dependence Adjustment" of Brown and Warner (1980, 1985). For the second t-stats, the standard deviations of abnormal returns are estimated from the average abnormal returns between 11/1/2007 and 10/6/2008.

Panel A: The Market Model (Equal Weight)

	[0,0]	[-1,0]	[-2,+2]	[-5,+5]
ALL (n=121) (pooled)	0.0212	0.0324	0.0359	0.004
Conventional T-stats	(3.73) ***	(2.67) ***	(3.72) ***	(0.41)
T-stats Using "Crude Dependence Adjustment"	(3.98) ***	(4.30) ***	(3.01) ***	(0.23)
TRUST (TP) (n=53)	0.0349	0.0425	0.0758	0.0463
Conventional T-stats	(4.18) ***	(2.36) **	(4.99) ***	(2.46) **
T-stats Using "Crude Dependence Adjustment"	(4.98) ***	(4.29) ***	(4.84) ***	(1.99)*
NONTRUST (NTP) (n=68)	0.0101	0.0242	0.0033	-0.0295
Conventional T-stats	(1.33)	(1.46)	(0.30)	(-2.59)***
T-stats Using "Crude Dependence Adjustment"	(1.87)*	(3.17) ***	(0.27)	(-1.64)
T-test for difference in mean between two subsamples	2.19**	0.74	3.85 ***	3.45 ***

Panel B: The Market Model (Portfolio Approach)

	[0,0]	[-1,0]	[-2,+2]	[-5,+5]
ALL (n=13) (pooled)	0.006	0.0134	0.0273	0.0060
	(0.32)	(0.30)	(0.98)	(0.34)
TRUST (TP) (n=7)	0.0378	0.0718	0.0733	0.0399
	(1.65)	(1.60)	(1.75)	(1.62)
NONTRUST (NTP) (n=6)	-0.0295	-0.05461	-0.0264	-0.0335
	(-0.90)	(-0.72)	(-1.25)	(-2.58) **

The dependent T-stat for difference in mean between two subsamples is not significant for the portfolio approach due to the small sample size even though the sign for the difference between trust and non-trust is positive.

Table I. The Ranking Order of Claims on Bank

This table describes the priority of claims on banks. Non-Trust preferred (NTP) and TARP preferred have equal priority and both have a lower claim than Trust preferred (TP).

Priority of Claims	Claims on Bank
1	Insured Deposits
2	Uninsured Deposits
3	Senior Debt
4	Junior Subordinated Debt
5	Trust Preferred (TP) Stock
6	Non-trust Preferred (NTP) Stock and TARP Preferred Stock
7	Common Stock

Table II. Matching Pairs of NTP and TP Raw Returns based on September 18 announcement

Panel A presents matching pairs of each type of preferred stock according to the issuer, maturity, and dividend yield. The two matched preferred stocks are required to have the same issuer, similar maturities, and similar dividend yields. For the match, we allowed a maximum of one year's difference for maturity. For a perpetuity, our match required at least 59 years maturity. Regarding dividend yield, we allow a maximum of one percent difference. Panel B shows the average raw returns of each type of preferred stock and compares returns of TP and NTP.

Panel A: Matching Pairs of each type of preferred stock

Firm	TP/NTP	Maturity (years)	Dividend Yield (%)	Raw Returns
Bank of America	NTP	24	8.125	0.221
	TP	25	8.1	0.095
Bank of America	NTP	24	6.5	-0.011
	TP	25	6.75	-0.019
Bank of America	NTP	25	5.875	0.043
	TP	25	5.875	0.081
Bank of America	NTP	25	5.5	0.126
	TP	25	6	0.014
Bank of America	NTP	26	6	0.097
	TP	26	6	0.075
Bank of America	NTP	perpetual	6.7	0.151
	TP	perpetual	7	0.077
Bank of America	NTP	perpetual	7.25	-0.113
	TP	perpetual	7.28	0.12
Bank of America	NTP	perpetual	7.25	0.146
	TP	perpetual	7.28	0.121
Citigroup	NTP	perpetual	8.125	0.18
	TP	59	7.25	0.229
Citigroup	NTP	perpetual	8.5	0.221
	TP	59	7.875	0.105
Goldman Sachs	NTP	perpetual	float	0.085
	TP	perpetual	float	0.109
Goldman Sachs	NTP	perpetual	float	0.095
	TP	perpetual	flooat	0.109
JPMorgan Chase	NTP	24	7	0.147
	TP	23	7.2	0.04
JPMorgan Chase	NTP	perpetual	6.1	0.021
	TP	69	6.875	0.033
Wells Fargo	NTP	perpetual	7.25	0.31
	TP	59	7.85	0.405
Wells Fargo	NTP	perpetual	8	0.476
	TP	60	7.875	0.036

Panel B: Average of Raw Returns of Each Type of Preferred Stock

	NTP	TP	Total
Equal Weight (Individual Issues)	0.137	0.102	0.119
(number of shares with higher raw returns)	9	7	16
Portfolio Approach (portfolio of all issues by same firm)	0.170	0.121	0.145
(number of banks with higher raw returns)	4	1	5

Table III. Average Preferred Stock Yields and Overpayment of the banks

OVERPAYMENT is measured by the difference between average preferred stock yields of each bank on 10/6/2008, prior to TARP, and the 5 percent yield on the government's preferred stock purchase. Preferred stock yields were obtained from the Bloomberg information system.

	Bank of America	Morgan Stanley	Wells Fargo	JPMorgan Chase	Citigroup	Goldman Sachs	Bank of NY Mellon
Mean	12.09	14.55	10.07	9.22	12.48	8.26	9.38
OVERPAYMENT (Mean less 5%)	7.09	9.55	5.07	4.22	7.48	3.26	4.38

Table IV. Description of Preferred Stock Outstanding

Panel A shows the number of each type of preferred stock in the largest banks. Panel B shows the number of each type of preferred stock of the non-forced banks that announced that they had received preliminary approval for TARP issuance.

Panel A: Type of preferred stock outstanding for the forced banks

	Trust	Non-trust	Callable	Non-callable	Zero-Dividend	Fixed-rate	Floating-rate	Total Sample
Bank of America	20	36	41	15	14	34	8	56
Citigroup	11	2	13	0	0	13	0	13
Goldman Sachs	1	3	4	0	0	1	3	4
JPMorgan Chase	4	9	13	0	0	12	1	13
Morgan Stanley	6	16	10	12	9	12	1	22
Bank of NY Mellon	2	0	2	0	0	2	0	2
Wells Fargo	9	2	11	0	0	11	0	11
Total Sample	53	68	94	27	23	85	13	121

Panel B: Type of preferred stock outstanding of the non-forced banks that announced that they had received preliminary approval for the TARP fund

	Trust	Non-trust	Callable	Non-callable	Zero-Dividend	Fixed-rate	Floating-rate	Total Sample
Associated Bancorp	1	0	1	0	0	1	0	1
BB&T	2	0	2	0	0	2	0	2
Popular Inc	1	3	4	0	0	4	0	4
Capital One	1	0	1	0	0	1	0	1
Citizens Republic Bancorp	1	0	1	0	0	1	0	1
First Bancorp	0	5	5	0	0	5	0	5
Fifth Third Bancorp	3	0	3	0	0	0	3	3
Huntington Bancshares Inc	0	1	1	0	0	1	0	1
Independent Banc Corp	0	1	1	0	0	1	0	1
Keycorp	5	0	5	0	0	5	0	5
M&T Bank Corp	1	0	1	0	0	1	0	1
National Penn Bancshares Inc	1	0	1	0	0	1	0	1
Old National Bancorp	1	0	1	0	0	1	0	1
Old Second Bancorp	1	0	1	0	0	1	0	1
PNC Financial Services Group	5	1	6	0	0	5	1	6
Regions Financial Corporation	1	0	1	0	0	1	0	1
Sterling Bancshares Inc	1	0	1	0	0	1	0	1
Southern Community Financial Corp	0	1	1	0	0	1	0	1
SVB Financial Group	1	0	1	0	0	1	0	1
SunTrust Banks	1	1	2	0	0	1	1	2
Sterling Bancorp	1	0	1	0	0	1	0	1
Susquehanna Bancshares Inc	0	1	1	0	0	0	1	1
Taylor Capital Group Inc	1	0	1	0	0	1	0	1
U.S. Bancorp	7	1	8	0	0	7	1	8
Valley National Bancorp	1	0	1	0	0	1	0	1
Webster Financial Corp	0	1	1	0	0	1	0	1
Zions Bancorp	1	1	2	0	0	1	1	2
Total Sample	38	17	55	0	0	47	8	55

Table V. Returns around Oct. 14 Announcement for Forced Banks

Raw returns and the mean-adjusted returns over various event windows are reported for the equal weight approach and the po rtfolio approach. For the portfolio approach, each portfolio consists of all preferred stock belonging to a particular bank. The second t-stats in Panel A and Panel C are computed using the "Crude Dependence Adjustment" of Brown and Warner (1980, 1985).

	[0,0]	[-1,0]	[-2,+2]	[-5,+5]
Panel A: The Raw Returns (Equal Weight)				
ALL (n=121) (pooled)	0.0911	0.2467	0.1808	0.0743
Conventional T-stats	(13.25) ***	(15.68) ***	(12.19) ***	(5.81) ***
T-stats Using "Crude Dependence Adjustment"	(4.97)***	(9.53)***	(4.41)***	(1.22)
TRUST (TP) (n=53)	0.1329	0.3404	0.2832	0.1496
Conventional T-stats	(12.22) ***	(13.80) ***	(12.89) ***	(7.18) ***
T-stats Using "Crude Dependence Adjustment"	(5.31)***	(9.63)***	(5.06)***	(1.80)*
NONTRUST (NTP) (n=68)	0.0585	0.1737	0.1010	0.0156
Conventional T-stats	(8.92) ***	(11.23) ***	(7.29) ***	(1.31)
T-stats Using "Crude Dependence Adjustment"	(4.39)***	(9.23)***	(3.39)***	(0.35)
T-test for difference in mean between two subsamples	(5.85) ***	(5.72) ***	(7.01) ***	(5.59) ***
Panel B: The Raw Returns (Portfolio Approach)				
ALL (n=13) (pooled)	0.0888	0.2638	0.2008	0.0924
	(3.96) ***	(5.51) ***	(4.42) ***	(3.52) ***
TRUST (TP) (n=7)	0.1174	0.3140	0.2433	0.1239
	(3.29) ***	(3.76) ***	(3.32) ***	(3.06) ***
NONTRUST (NTP) (n=6)	0.0554	0.2053	0.1513	0.0556
	(2.73) **	(6.79) ***	(3.15) ***	(1.99) *
Panel C: The Mean-Adjusted Model (Equal Weight)				
ALL (n=121) (pooled)	0.0931	0.2505	0.1900	0.0940
Conventional T-stats	(13.48) ***	(15.86) ***	(12.68) ***	(7.15) ***
T-stats Using "Crude Dependence Adjustment"	(5.19)***	(9.88)***	(4.74)***	(1.58)
TRUST (TP) (n=53)	0.1347	0.3440	0.2922	0.1694
Conventional T-stats	(12.30) ***	(13.86) ***	(13.04) ***	(7.74) ***
T-stats Using "Crude Dependence Adjustment"	(5.52)***	(9.98)***	(5.35)***	(2.09)**
NONTRUST (NTP) (n=68)	0.0606	0.1776	0.1104	0.0352
Conventional T-stats	(9.21) ***	(11.45) ***	(7.89) ***	(2.95) ***
T-stats Using "Crude Dependence Adjustment"	(4.62)***	(9.58)***	(3.76)***	(0.81)
T-test for difference in mean between two subsamples	5.80 ***	5.68 ***	6.88 ***	5.38 ***
Panel D: The Mean-Adjusted Model (Portfolio Approach)				
ALL (n=13) (pooled)	0.0908	0.2674	0.2095	0.1112
	(4.04) ***	(5.54) ***	(4.53) ***	(3.96) ***
TRUST (TP) (n=7)	0.1192	0.3168	0.2504	0.1394
	(3.32) ***	(3.76) ***	(3.33) ***	(3.12) ***
NONTRUST (NTP) (n=6)	0.0576	0.2097	0.1619	0.0782
	(2.81) **	(6.80) ***	(3.31) ***	(2.62) **

The dependent T-stat for difference in mean between two subsamples is not significant for the portfolio approach due to the s mall sample size even though the sign for the difference between trust and non-trust is positive.

Table VI. Estimated Parameters for Returns of the Forced Banks

The dependent variable is the raw returns and the mean-adjusted returns over the announcement window. WELLS FARGO is used as a benchmark. BANK OF AMERICA is a dummy variable that takes the value 1 if the observation belongs to BANK OF AMERICA. CITIGROUP is a dummy variable that takes the value 1 if the observation belongs to CITIGROUP. BANK of NY MELLON is a dummy variable that takes the value 1 if the observation belongs to Bank of NY Mellon. JPMORGAN CHASE is a dummy variable that takes the value 1 if the observation belongs to JPMORGAN CHASE. MORGAN STANLEY is a dummy variable that takes the value 1 if the observation belongs to MORGAN STANLEY. GOLDMAN SACHS is a dummy variable that takes the value 1 if the observation belongs to GOLDMAN SACHS. TRUST is a dummy variable equal to one if the observation is a trust preferred stock. TRUST is a dummy variable equal to one if the observation is a trust preferred stock. CALLABLE is a dummy variable equal to one if the observation has a call option. MATURITY is measured as the natural log of remaining time to maturity.

Panel A: The Raw Returns Based on [-1,0]

	(1)	(2)	(3)
Intercept	-0.1149***	-0.1493***	-0.1533***
	(-3.09)	(-4.00)	(-4.14)
BANK OF AMERICA	0.1249***	0.1324***	0.1316***
	(4.91)	(5.51)	(5.61)
CITIGROUP	0.2354***	0.2370***	0.2365***
	(10.75)	(11.67)	(12.06)
BANK OF NY MELLON	0.1246***	0.1622***	0.1444***
	(5.70)	(6.64)	(6.30)
JPMORGAN CHASE	0.0501	0.0703**	0.0539
	(1.46)	(1.98)	(1.64)
MORGAN STANLEY	0.3724***	0.3889***	0.3912***
	(8.03)	(8.38)	(8.88)
GOLDMAN SACHS	0.0221	0.0035	0.0069
	(0.44)	(0.07)	(0.14)
TRUST (TP)	0.1087***	0.1228***	0.1041***
	(4.65)	(5.78)	(4.79)
CALLABLE	0.1996***		0.1367**
	(6.13)		(2.64)
MATURITY		0.03586***	0.0276**
		(7.25)	(2.03)
Sample Size	121	121	121
F, (p-value)	43.37	53.13	45.86
	(0.0000)	(0.0000)	(0.0000)
R-squared	0.6673	0.6474	0.6812

Table VI-*Continued*

Panel B: The Mean-Adjusted Model Based on [-1,0]			
	(1)	(2)	(3)
Intercept	-0.1123***	-0.1476***	-0.1516***
	(-3.01)	(-3.95)	(-4.09)
BANK OF AMERICA	0.1267***	0.1344***	0.1337***
	(4.99)	(5.61)	(5.71)
CITIGROUP	0.2390***	0.2406***	0.2401***
	(10.83)	(11.79)	(12.18)
BANK OF NY MELLON	0.1238***	0.1616***	0.1440***
	(5.25)	(6.11)	(5.80)
JPMORGAN CHASE	0.0484	0.0685*	0.0523
	(1.41)	(1.93)	(1.59)
MORGAN STANLEY	0.3750***	0.3920***	0.3942***
	(8.03)	(8.42)	(8.91)
GOLDMAN SACHS	0.0255	0.065	0.0099
	(0.51)	(0.13)	(0.21)
TRUST (TP)	0.1089***	0.1227***	0.1042***
	(4.65)	(5.79)	(4.80)
CALLABLE	0.1995***		0.1352**
	(6.09)		(2.59)
MATURITY		0.0589***	0.0283**
		(7.30)	(2.07)
Sample Size	121	121	121
F, (p-value)	42.89	52.81	45.79
	(0.0000)	(0.0000)	(0.0000)
R-squared	0.6677	0.6494	0.6821

Table VII. Estimated Parameters for Returns of the Forced Banks Using Firm Specific Characteristics

The dependent variable is the raw returns and the mean-adjusted returns over the announcement window. OVERPAYMENT is measured by the difference between average yields of each bank immediately prior to TARP and the 5 percent yield on the government's preferred stock. TRUST is a dummy variable equal to one if the observation is a trust preferred stock. CALLABLE is a dummy variable equal to one if the observation has a call option. MATURITY is measured as the natural log of remaining time to maturity.

Panel A: The Raw Returns Based on [-1,0]			
	(1)	(2)	(3)
Intercept	-0.3824***	-0.3991***	-0.4238***
	(-5.81)	(-5.70)	(-6.27)
OVERPAYMENT	0.0613***	0.0614***	0.0638***
	(7.46)	(7.06)	(7.77)
TRUST (TP)	0.1083***	0.1244***	0.1041***
	(4.57)	(5.60)	(4.51)
CALLABLE	0.2022***		0.1506***
	(6.62)		(2.83)
MATURITY		0.0559***	0.0222
		(6.72)	(1.46)
Sample Size	121	121	121
F, (p-value)	40.85	38.19	33.31
	(0.0000)	(0.0000)	(0.0000)
R-squared	0.5787	0.5464	0.5881
Panel B: The Mean-Adjusted Model Based on [-1,0]			
	(1)	(2)	(3)
Intercept	-0.3826***	-0.4012***	-0.4256***
	(-5.78)	(-5.73)	(-6.29)
OVERPAYMENT	0.0620***	0.0621***	0.0645***
	(7.50)	(7.15)	(7.84)
TRUST (TP)	0.1087***	0.1244***	0.1044***
	(4.58)	(5.59)	(4.52)
CALLABLE	0.2023***		0.1486***
	(6.59)		(2.78)
MATURITY		0.0563***	0.0231
		(6.79)	(1.52)
Sample Size	121	121	121
F, (p-value)	40.77	38.68	33.47
	(0.0000)	(0.0000)	(0.0000)
R-squared	0.5797	0.5495	0.5898

Table VIII. Returns of Non-forced Banks for Different Windows

The raw returns and the mean-adjusted returns on the October 14th TARP announcement and the later announcement of bank specific approval for TARP capital are reported for the equal weight approach and the portfolio approach. For the portfolio approach, each portfolio consists of all preferred stock belonging to a particular bank. The second t-stats in Panel A and Panel C are computed using the "Crude Dependence Adjustment" of Brown and Warner (1980,1985).

Panel A: The Raw Returns (Equal Weight)

	Oct. 14 [-1,0]	Approval
ALL (pooled)	0.2384	0.0398
Conventional T-stats	(8.96) ***	(3.30) ***
T-stats Using "Crude Dependence Adjustment"	(8.02) ***	(1.89)*
	(n=54)	(n=50)
TRUST (TP)	0.3049	0.0399
Conventional T-stats	(10.27) ***	(3.18) ***
T-stats Using "Crude Dependence Adjustment"	(8.29) ***	(1.53)
	(n=38)	(n=36)
NONTRUST (NTP)	0.0805	0.0398
Conventional T-stats	(2.64) **	(1.32)
T-stats Using "Crude Dependence Adjustment"	(4.37) ***	(3.06) ***
	(n=16)	(n=14)
T-test for difference in mean between two subsamples	5.27 ***	0.00

Panel B: The Raw Returns (Portfolio Approach)

	Oct. 14 [-1,0]	Approval
ALL (pooled)	0.2143	0.0390
	(8.08) ***	(2.53) **
	(n=30)	(n=29)
TRUST (TP)	0.2581	0.0342
	(8.29) ***	(2.25) **
	(n=20)	(n=19)
NONTRUST (NTP)	0.1266	0.0482
	(3.19) ***	(1.38)
	(n=10)	(n=10)
T-test for difference in mean between two subsamples	2.47**	-0.35

Panel C: The Mean-Adjusted Model (Equal Weight)

	Oct. 14 [-1,0]	Approval
ALL (pooled)	0.2428	0.0414
Conventional T-stats	(9.00) ***	(3.41) ***
T-stats Using "Crude Dependence Adjustment"	(8.21) ***	(1.98)*
	(n=54)	(n=50)
TRUST (TP)	0.3098	0.0424
Conventional T-stats	(10.28) ***	(3.33) ***
T-stats Using "Crude Dependence Adjustment"	(8.49) ***	(1.64)
	(n=38)	(n=36)
NONTRUST (NTP)	0.0838	0.0388
Conventional T-stats	(2.70) ***	(1.32)
T-stats Using "Crude Dependence Adjustment"	(4.56) ***	(2.98) ***
	(n=16)	(n=14)
T-test for difference in mean between two subsamples	5.22 ***	0.11

Panel D: The Mean-Adjusted Model (Portfolio Approach)

	Oct. 14 [-1,0]	Approval
ALL (pooled)	0.2143	0.0390
	(8.08) ***	(2.53) **
	(n=30)	(n=29)
TRUST (TP)	0.2581	0.0342
	(8.29) ***	(2.25) **
	(n=20)	(n=19)
NONTRUST (NTP)	0.1266	0.0482
	(3.19) ***	(1.38)
	(n=10)	(n=10)
T-test for difference in mean between two subsamples	2.44**	-0.33

Table IX. Estimated Parameters for Returns of the Non- Forced Banks

The dependent variable is the raw returns and the mean-adjusted returns on (1) the October 14th announcement, (2) the later announcement of preliminary approval for the TARP fund. OVERPAYMENT is measured by the difference between average yields of each bank immediately prior to TARP and the 5 percent yield on the government's preferred stock. TRUST is a dummy variable equal to one if the observation is a trust preferred stock. MATURITY is measured as the natural log of remaining time to maturity. All preferred stocks are callable stocks.

Panel A: The Raw Returns

	(1) Oct. 14 [-1,0]	(2) Approval
Intercept	-0.1420	0.0096
	(-0.93)	(0.11)
OVERPAYMENT	0.0237***	0.0109***
	(5.35)	(3.63)
TRUST (TP)	0.1521***	-0.0415
	(5.79)	(-1.28)
MATURITY	0.0210	-0.0087
	(0.54)	(-0.43)
Sample Size	54	50
F, (p-value)	27.45	4.78
	(0.0000)	(0.0056)
R-squared	0.6529	0.4226

Panel B: The Mean-Adjusted Model

	(1) Oct. 14 [-1,0]	(2) Approval
Intercept	-0.1462	-0.0136
	(-0.95)	(-0.17)
OVERPAYMENT	0.0242***	0.0111***
	(5.41)	(3.68)
TRUST (TP)	0.1522***	-0.0359
	(5.76)	(-1.20)
MATURITY	0.0221	-0.0037
	(0.56)	(-0.19)
Sample Size	54	50
F, (p-value)	27.57	4.97
	(0.0000)	(0.0045)
R-squared	0.6571	0.4287

Table X. Stylized Marginal Rates of Substitution between Dividends and Capital Gains for the Various Holding Groups before and after the 2003 Tax Cut

This table is constructed based on maximum tax rates and ignoring benefits of delaying capital gain taxes.

	Before the 2003 tax cut	After the 2003 tax cut
Individual investors	$\frac{1-t_d}{1-t_g}=\frac{1-0.386}{1-0.2}=0.77$	$\frac{1-t_d}{1-t_g}=\frac{1-0.15}{1-0.15}=1.00$
Non-corporate institutional investors	$\frac{1-t_d}{1-t_g}=\frac{1-0.00}{1-0.00}=1.00$	$\frac{1-t_d}{1-t_g}=\frac{1-0.00}{1-0.00}=1.00$
Corporate investors	$\frac{1-t_d}{1-t_g}=\frac{1-0.105}{1-0.35}=1.37$	$\frac{1-t_d}{1-t_g}=\frac{1-0.105}{1-0.35}=1.37$

Table XI. The Ex-Day Premium Grouped by the Level of Individual Ownership

This table shows the mean ex-day premium within each decile of individual ownership. Individual ownership is defined as the number of shares held by individual investors divided by the total number of shares outstanding.

Decile	Individual Ownership	N	Mean	S.D.
1	0.0310	3284	0.7018	4.1415
2	0.1784	3283	0.7620	4.0278
3	0.2615	3283	0.6937	3.8041
4	0.3426	3283	0.7096	3.4921
5	0.4239	3283	0.7286	3.4213
6	0.5228	3283	0.7418	3.1888
7	0.6367	3283	0.6709	3.2657
8	0.7532	3283	0.5985	3.2574
9	0.8560	3283	0.5125	3.2634
10	0.9526	3283	0.4740	3.2706

Table XII. Summary Statistics

PREM is the ex-day premium. *YIELD* is measured as the amount of the dividend divided by the cum-day price. *IND* is defined as the number of shares held by individual investors divided by the total number of shares outstanding. *HETERO* is defined as the product of the number of shares held by individual investors divided by the total number of shares outstanding and the number of shares held by institutional investors divided by the total number of share outstanding. *EXVOL* is defined as the difference between the average daily turnover (the ratio of shares traded to shares outstanding) during the 11-day event period [-5,5] and the average daily turnover during the 80-day estimation period [-45,-6] and [6,45], divided by the average daily turnover during the 80-day estimation period. *TC* (Transaction Cost) is measured by dividing one by the cum-day price. *RISK* is calculated by dividing the variance of a stock's variance by the variance of the market returns during the estimation period [-45,-6] and [6,45].

Variable	N	Mean	Median	S.D.
PREM	32831	0.6594	0.7058	3.5298
YIELD	32831	0.0060	0.0052	0.0042
IND	32831	0.4959	0.4680	0.2914
HETERO	32831	0.1650	0.1899	0.1250
EXVOL	32831	0.0762	-0.0612	0.8133
TC	32831	0.0447	0.0372	0.0283
RISK	32831	5.7665	3.9116	6.6025

Table XIII. Regressions Analyzing the Effect of Ownership Structure on the Ex-Day Premium

The sample is divided into two groups: high dividend yield stocks and non-high dividend yield stocks. Observations are sorted into three dividend yield quantiles. High dividend yield stocks consist of stocks in the highest dividend yield quantile and non-high yield dividend stocks consist of stocks in the other two dividend yield quantiles. The dependent variable is the ex-day premium. Following Michaely (1991), weighted least squares are used to correct for two sources of heteroskedasticity: the disturbance variance and the dividend yield. *YIELD* is measured as the amount of the dividend divided by the cum-day price. *IND* is defined as the number of shares held by individual investors divided by the total number of shares outstanding. *HETERO* is defined as the product of the number of shares held by individual investors divided by the total number of shares outstanding and the number of shares held by institutional investors divided by the total number of share outstanding. *T2003* is a dummy variable that takes the value 1 if the observation falls in a year after 2003. *TC* (Transaction Cost) is measured by dividing one by the cum-day price. *RISK* is calculated by dividing the variance of a stock's variance by the variance of the market returns during the estimation period [-45,-6] and [6,45].

Panel A: Regressions Including *IND* and *HETERO*

	Non-High Dividend Yield	High Dividend Yield	Full Sample
Intercept	0.9857***	0.7824***	0.8288***
	(10.89)	(13.27)	(20.70)
YIELD	2.7047	1.7333***	2.1477***
	(0.20)	(4.88)	(7.02)
IND	-0.2183***	-0.1893***	-0.1906***
	(-3.12)	(-3.49)	(-4.85)
HETERO	0.3680**	1.1475***	0.8761***
	(2.51)	(7.51)	(8.65)
T2003	-0.049	0.1232***	0.0902***
	(-1.19)	(4.13)	(4.00)
TC	-5.3797***	-3.7709***	-3.8584***
	(-6.15)	(-7.63)	(-9.82)
RISK	-0.0041	-0.0034	-0.0056*
	(-0.78)	(-0.83)	(-1.84)
Sample Size	21888	10943	32831
F, (p-value)	14.22	45.47	63.28
	(0.0000)	(0.0000)	(0.0000)
Adjusted-R^2	0.0036	0.0238	0.0113

Table XIII-*Continued*

Panel B: Regressions Including *IND* and IND^2	Non-High Dividend Yield	High Dividend Yield	Full Sample
Intercept	0.9857***	0.7824***	0.8288***
	(10.89)	(13.27)	(20.70)
YIELD	2.7047	1.7333***	2.1477***
	(0.20)	(4.88)	(7.02)
IND	0.1496	0.9582***	0.6855***
	(0.95)	(5.49)	(6.05)
IND^2	-0.3680**	-1.1475***	-0.8761***
	(-2.51)	(-7.51)	(-8.65)
T2003	-0.049	0.1232***	0.0902***
	(-1.19)	(4.13)	(4.00)
TC	-5.3797***	-3.7709***	-3.8584***
	(-6.15)	(-7.63)	(-9.82)
RISK	-0.0041	-0.0034	-0.0056*
	(-0.78)	(-0.83)	(-1.84)
Sample Size	21888	10943	32831
F, (p-value)	14.22	45.47	63.28
	(0.0000)	(0.0000)	(0.0000)
Adjusted-R^2	0.0036	0.0238	0.0113

Table XIV. Regressions with Interaction Terms between Ownership Structure and Other Factors Including the Dividend Yield and the 2003 Tax Cut

The dependent variable is the ex-day premium. Following Michaely (1991), weighted least squares are used to correct for two sources of heteroskedasticity: the disturbance variance and the dividend yield. *YIELD* is measured as the amount of the dividend divided by the cum-day price. *T2003* is a dummy variable that takes the value 1 if the observation falls in a year after 2003. *IND* is defined as the number of shares held by individual investors divided by the total number of shares outstanding. *HETERO* is defined as the product of the number of shares held by individual investors divided by the total number of shares outstanding and the number of shares held by institutional investors divided by the total number of share outstanding. *TC* (Transaction Cost) is measured by dividing one by the cum-day price. *RISK* is calculated by dividing the variance of a stock's variance by the variance of the market returns during the estimation period [-45,-6] and [6,45].

	(1)	(2)	(3)
Intercept	0.8272***	0.8252***	0.8760***
	(20.27)	(18.95)	(22.85)
YIELD		7.9145	
		(2.46)**	
*YIELD*T2003*	-6.3443***	-17.06***	-11.31***
	(-3.02)	(-6.09)	(-7.32)
IND	-0.1800***	-0.1958***	-0.1867***
	(-4.57)	(-4.96)	(-4.75)
HETERO	0.4917***		
	(3.49)		
*HETERO*YIELD*	40.8312***	55.3561***	65.6745***
	(3.99)	(6.53)	(8.92)
T2003	0.1609***	0.2784***	0.2173***
	(4.98)	(7.44)	(7.77)
TC	-3.6378***	-3.8719***	-3.6974***
	(-9.26)	(-9.71)	(-9.42)
RISK	-0.0058*	-0.0071**	-0.0068**
	(-1.92)	(-2.36)	(-2.24)
Sample Size	32831	32831	32831
F, (p-value)	55.22	54.33	62.37
	(0.0000)	(0.0000)	(0.0000)
Adjusted-R^2	0.0116	0.0112	0.0111

Table XV. Regressions Analyzing the Effect of the Ex-Day Excess Volume on the Ex-Day Premium

The dependent variable is the ex-day premium. Following Michaely (1991), weighted least squares are used to correct for two sources of heteroskedasticity: the disturbance variance and the dividend yield. *YIELD* is measured as the amount of the dividend divided by the cum-day price. *T2003* is a dummy variable that takes the value 1 if the observation falls in a year after 2003. *IND* is defined as the number of shares held by individual investors divided by the total number of shares outstanding. *EXVOL* is defined as the difference between the average daily turnover (the ratio of shares traded to shares outstanding) during the 11-day event period [-5,5] and the average daily turnover during the 80-day estimation period [-45,-6] and [6,45], divided by the average daily turnover during the 80-day estimation period. *TC* (Transaction Cost) is measured by dividing one by the cum-day price. *RISK* is calculated by dividing the variance of a stock's variance by the variance of the market returns during the estimation period [-45,-6] and [6,45].

	(1)	(2)	(3)
Intercept	0.7318***	0.9800***	0.8299***
	(17.06)	(30.11)	(19.07)
YIELD	15.7311		19.2222
	(5.63)		(6.86)***
*YIELD*T2003*	-15.4068***		-17.3979***
	(-5.48)		(-6.19)
IND	-0.3687***	-0.2415***	-0.2460***
	(-9.84)	(-6.18)	(-6.30)
EXVOL	0.0690***	0.0706***	0.0606
	(6.91)	(7.27)	(6.06)
T2003	0.2803***	0.1273***	0.3003***
	(7.49)	(5.62)	(7.95)
TC		-3.4303***	-4.3501***
		(-9.29)	(-11.15)
RISK		-0.0044	-0.0067**
		(-1.46)	(-2.22)
Sample Size	32831	32831	32831
F, (p-value)	43.19	59.03	53.47
	(0.0000)	(0.0000)	(0.0000)
Adjusted-R^2	0.0064	0.0088	0.0111

Table XVI. Yield Spreads on Corporate Bonds

This table reports mean and median yield spreads. We provide the breakdown by industry (Panel A), year (Pane B), rating (Panel C), and maturity (Panel D). Yield spreads are defined as the difference between the daily yield on the corporate bond and the constant maturity Treasury yield with the same time to maturity. To estimate the entire yield curve, we use a linear interpolation scheme from 1, 2, 3, 5, 7, 10, 20, and 30-year Treasury constant maturity rates. Following Campbell and Taksler (2003), we exclude the top and bottom 1% of yield spreads from our analysis.

	Noncallable Bonds			Callable Bonds		
	N	Mean	Median	N	Mean	Median
Panel A: Breakdown by Industry						
Industrial	39,715	2.667	1.374	17,229	5.070	3.606
Financial	89,947	2.123	0.997	68,788	3.366	2.007
Utility	4,505	2.160	1.305	2,256	2.708	2.346
Panel B: Breakdown by Year						
2003	10,519	0.937	0.762	540	3.608	2.733
2004	15,228	0.868	0.685	2,988	2.202	1.726
2005	25,801	1.405	0.776	12,886	2.813	1.962
2006	25,525	1.395	0.827	18,161	2.344	1.453
2007	20,956	1.586	1.147	19,407	2.216	1.611
2008	17,857	4.716	3.163	16,685	5.244	3.229
2009	18,281	5.158	3.313	17,606	6.089	3.552
Panel C: Breakdown by Rating						
AAA-AA	33,774	1.392	0.865	27,116	1.859	1.501
A-BBB	86,556	1.940	1.014	39,643	3.139	2.107
BB-B	11,528	5.346	3.957	17,278	5.601	4.371
CCC-D	2,309	13.046	9.208	4,236	12.608	9.937
Panel D: Breakdown by Maturity						
2-7 years	99,043	2.165	0.946	24,170	6.314	4.186
7-15 years	22,724	2.295	1.226	34,435	2.845	2.001
>15 years	12,400	3.233	2.157	29,128	2.440	1.830
Total	134,167	2.286	1.100	88,273	3.682	2.267

Table XVII. Summary Statistics

This table reports summary statistics on the bonds in our sample. Panel A provides summary statistics on noncallable bonds and Panel B provides summary statistics on callable bonds. *Yield spread* is defined as the difference between the daily yield on the corporate bond and the constant maturity Treasury yield with the same time to maturity. Following Campbell and Taksler (2003), we exclude the top and bottom 1% of yield spreads from our analysis. σ_r is measured as the standard deviation of the daily one-month Treasury constant maturity rate for the 12 months prior to the bond transaction date. r is the one-month Treasury constant maturity rate. *Slope* is the difference between the 10-year and 1-year Treasury constant maturity rates. *Rating* is assigned a cardinalized S&P rating, where AAA=1, . . . , D=22. σ_e is calculated as the standard deviation of daily excess returns over the CRSP value-weighted index using 252 daily returns prior to the bond transaction date. *Liquidity* is measured by dividing the number of *days* a bond traded for the 12 months prior to the bond transaction date by the number of business days during the corresponding period. *Maturity* is the bond's remaining time to maturity in years and *Coupon* is the bond's coupon rate in percent. *Long-term debt to assets* is measured by dividing long-term debt by total assets and *operating income to sales* is measured by dividing operating income before depreciation by net sales.

	N	Mean	St.Dev.	Min	Median	Max
Panel A: Noncallable Bonds						
Spread	134,167	2.286	3.543	0.108	1.100	39.800
σ_r	134,167	0.495	0.292	0.053	0.529	1.281
r	134,167	2.598	1.781	0.010	2.600	5.270
Slope	134,167	1.203	1.215	-0.470	1.170	3.390
Rating	134,167	6.396	3.451	1.000	6.000	22.000
σ_e	115,697	1.790	1.637	0.465	1.242	15.367
Liquidity	87,940	0.507	0.339	0.004	0.474	1.000
Maturity	134,167	6.072	6.554	1.000	3.967	92.282
Coupon	134,167	5.942	1.611	0.940	5.875	16.500
Long-Term Debt to Assets	104,282	0.225	0.162	0.000	0.187	1.554
Operating Income to Sales	104,282	0.187	0.946	-9.518	0.259	5.139
Panel B: Callable Bonds						
Spread	88,273	3.682	4.433	0.108	2.267	38.797
σ_r	88,273	0.559	0.306	0.053	0.550	1.281
r	88,273	2.718	1.907	0.010	2.850	5.270
Slope	88,273	1.070	1.208	-0.450	0.720	3.390
Rating	88,273	7.124	4.954	1.000	6.000	22.000
σ_e	74,425	2.256	2.011	0.465	1.479	0.227
Liquidity	59,422	0.306	0.243	0.004	0.229	1.000
Maturity	88,273	12.422	7.088	1.003	11.389	87.285
Coupon	88,273	6.179	1.336	0.250	5.850	14.000
Long-Term Debt to Assets	66,888	0.276	0.216	0.000	0.283	1.555
Operating Income to Sales	66,888	0.201	5.432	-421.436	0.269	5.139

Table XVIII. Regressions of Noncallable Corporate Yield Spreads on Explanatory Variables
This table reports the pooled OLS regression results on noncallable bonds. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3	4
Intercept	-3.983***	3.040***	2.623***	2.601***
	(-4.84)	(5.81)	(4.99)	(3.66)
σ_r	2.770***	1.623***	1.478***	1.630***
	(7.36)	(6.83)	(8.34)	(6.90)
r		-1.2382***	-1.289***	-1.373***
		(-6.74)	(-7.04)	(-6.70)
Slope		-1.763***	-1.707***	-1.765***
		(-6.21)	(-6.99)	(-6.22)
Rating	0.293***	0.339***	0.331***	0.329***
	(4.93)	(5.20)	(4.79)	(5.09)
σ_e	0.914***	0.729***	0.989***	0.733***
	(6.69)	(4.73)	(4.12)	(4.78)
Liquidity	-0.188	-0.313*	-0.408***	-0.307*
	(-1.00)	(-1.81)	(-2.67)	(-1.80)
Maturity	0.005		0.002	0.003
	(0.53)		(0.20)	(0.35)
Coupon	0.100**		0.020	0.063
	(2.20)		(0.56)	(1.41)
Long-Term Debt to Assets	1.106	1.148		1.214
	(1.16)	(1.25)		(1.30)
Operating Income to Sales	-0.620***	-0.705***		-0.713***
	(-5.46)	(-6.27)		(-6.25)
Industrial	0.465**	0.493**	0.378	0.507**
	(2.04)	(2.19)	(1.54)	(2.31)
Financial	0.930***	0.960***	0.625**	1.043***
	(3.07)	(3.17)	(1.98)	(3.33)
Sample Size	64,875	64,875	75,742	64,875
Adjusted-R^2	0.5850	0.6130	0.5822	0.6136

Table XIX. Regressions for Different σ_r and σ_e Specifications and a Different Measure of Credit Ratings

This table reports the pooled OLS regression results for different σ_r and σ_e specifications and a different measure of credit ratings. σ_r and σ_e are replaced with σ_{r^*}(Maturity)$^{1/2}$ and σ_{e^*}(Maturity)$^{1/2}$. Furthermore, we reverse the rating scale such that D=1, …, AAA=22 and take logs of all rating levels. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3	4
Intercept	12.175***	23.609***	22.177***	21.660***
	(9.67)	(13.09)	(16.54)	(11.33)
σ_{r^*}(Maturity)$^{1/2}$	0.943***	0.136***	0.369***	0.440***
	(7.34)	(2.52)	(5.86)	(6.14)
r		-1.990***	-1.643***	-1.718***
		(-7.02)	(-8.55)	(-6.98)
Slope		-2.373***	-1.946***	-2.050***
		(-6.21)	(-7.63)	(-6.14)
Rating	-4.397***	-5.204***	-5.125***	-5.002***
	(-13.22)	(-17.33)	(-16.45)	(-15.39)
σ_{e^*}(Maturity)$^{1/2}$	0.279***	0.119***	0.290***	0.180***
	(7.92)	(4.58)	(3.25)	(5.52)
Liquidity	-0.323**	-0.512***	-0.666***	-0.508***
	(-2.06)	(-3.76)	(-5.82)	(-3.82)
Maturity	-0.169***		-0.132***	-0.098***
	(-7.36)		(-3.34)	(-5.42)
Coupon	0.093		-0.015	0.043
	(1.64)		(-0.24)	(0.70)
Long-Term Debt to Assets	0.740 (0.93)	0.931 (1.27)		0.905 (1.20)
Operating Income to Sales	-0.961*** (-15.47)	-1.102*** (-16.46)		-1.017*** (-16.05)
Industrial	0.477**	0.426**	0.495*	0.525***
	(2.47)	(2.19)	(1.94)	(2.96)
Financial	1.046***	1.229***	0.806***	1.155***
	(4.30)	(5.44)	(3.07)	(4.94)
Sample Size	64,875	64,875	75,742	64,875
Adjusted-R^2	0.5335	0.5799	0.5209	0.5932

Table XX. Regressions of Noncallable Corporate Yield Spreads for Different Time Periods and Different Credit Qualities

This table reports the pooled OLS regression results on noncallable bonds. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	Pre-Crisis	Crisis	Investment Grade Bonds	Junk Bonds
Intercept	-1.374***	1.421	3.330***	7.396**
	(-5.39)	(1.42)	(4.59)	(2.03)
σ_r	0.958**	2.766***	1.361***	3.633***
	(2.29)	(4.89)	(9.90)	(2.94)
r	-0.049	-2.578***	-1.115***	-3.976***
	(-0.75)	(-7.07)	(-8.55)	(-5.74)
Slope	-0.021	-2.546***	-1.452***	-5.406***
	(-0.40)	(-6.54)	(-6.49)	(-4.44)
Rating	0.196***	0.612***	0.140***	0.524***
	(3.77)	(7.83)	(3.94)	(4.37)
σ_e	0.393***	0.637***	0.684***	1.572***
	(2.90)	(3.20)	(4.74)	(6.13)
Liquidity	-0.144	-0.529**	-0.485***	-0.088
	(-1.57)	(-2.08)	(-3.56)	(-0.25)
Maturity	0.031***	-0.033	0.004	-0.002
	(10.24)	(-2.62)	(0.51)	(-0.08)
Coupon	0.026	0.115	0.056	0.146*
	(1.17)	(0.98)	(1.64)	(1.77)
Long-Term Debt to Assets	0.989*	2.717	0.860	-1.706**
	(1.67)	(1.59)	(1.38)	(-2.09)
Operating Income to Sales	-0.810	-0.730***	-0.650***	-0.155
	(-1.32)	(-5.54)	(-6.98)	(-0.98)
Industrial (relative to Utility)	0.206	1.474***	0.216**	1.499*
	(1.40)	(3.70)	(1.97)	(1.90)
Financial (relative to Utility)	0.710**	2.362***	0.506***	3.007***
	(2.46)	(3.82)	(2.83)	(3.47)
Sample Size	41,623	23,252	57,488	7,387
Adjusted-R^2	0.5185	0.6027	0.5983	0.6408

Table XXI. Regressions of Noncallable Corporate Yield Spreads with Fixed Effects
This table reports the pooled OLS regression results on noncallable bonds. We include fixed effects for each firm and 6 year dummies. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3
Intercept	3.440***	4.355***	3.800***
	(4.76)	(5.78)	(3.37)
σ_r	1.565***	1.683***	1.743***
	(6.50)	(4.36)	(4.39)
r	-1.417***	-1.616***	-1.641***
	(-7.19)	(-7.95)	(-8.53)
Slope	-1.822***	-2.028***	-2.075***
	(-6.48)	(-7.03)	(-7.32)
Rating	0.440***	0.315***	0.452***
	(5.81)	(4.37)	(5.71)
σ_e	0.736***	0.785***	0.760***
	(4.47)	(4.35)	(3.43)
Liquidity	-0.483***	-0.205	-0.433***
	(-5.69)	(-1.27)	(-4.65)
Maturity	0.002	-0.004	-0.002
	(0.26)	(-0.54)	(-0.22)
Coupon	0.118***	0.009	0.114***
	(2.89)	(0.23)	(2.79)
Long-Term Debt to Assets	-2.242	0.897	-2.206
	(-1.64)	(0.95)	(-1.42)
Operating Income to Sales	-0.574***	-0.681***	-0.577***
	(-3.83)	(-5.90)	(-3.36)
Firm Fixed Effects	Yes	No	Yes
Year Dummies	No	Yes	Yes
Sample Size	64,875	64,875	64,875
F-Statistic	7,118.64	474.89	7,758.78

Table XXII. Regressions of Changes in Noncallable Corporate Yield Spreads on Changes in Explanatory Variables

We regress monthly changes in the yield spreads of noncallable bonds on monthly changes in σ_r and monthly changes in other independent variables. We include fixed effects for each firm and 6 year dummies.The dependent variable is the difference in yield spreads between two consecutive months. σ_r is measured as the standard deviation of the daily one-month Treasury constant maturity rate for the one month, not the 12 months, prior to the bond transaction date. *r* is the one-month Treasury constant maturity rate. *Slope* is the difference between the 10-year and 1-year Treasury constant maturity rates. *Rating* is assigned a cardinalized S&P rating, where AAA=1, . . . , D=22. σ_e is calculated as the standard deviation of daily excess returns over the CRSP value-weighted index using one month daily returns, not 252 daily returns, prior to the bond transaction date. *Liquidity* is measured by dividing the number of *days* a bond traded for the one month, not the 12 months, prior to the bond transaction date by the number of business days during the corresponding period. Δ denotes the first difference in each variable listed below. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3
Intercept	0.014**	-0.303***	-0.306***
	(2.03)	(-15.77)	(-4.43)
$\Delta\ \sigma_r$	0.774***	0.938***	0.936***
	(5.89)	(14.54)	(7.15)
$\Delta\ r$	-0.287***	-0.192***	-0.192***
	(-4.79)	(-16.44)	(-3.91)
Δ Slope	-0.232***	-0.147***	-0.146**
	(-3.20)	(-4.83)	(-2.11)
Δ Rating	0.352	0.362***	0.358
	(1.10)	(5.77)	(1.12)
$\Delta\ \sigma_e$	0.196***	0.187***	0.188***
	(4.34)	(14.82)	(4.20)
Δ Liquidity	-0.334***	-0.328***	-0.330***
	(-8.19)	(-11.63)	(-8.54)
Firm Fixed Effects	Yes	No	Yes
Year Dummies	No	Yes	Yes
Sample Size	82,338	82,338	82,338
F-Statistic	15.95	186.34	33.41

Table XXIII. Regressions of Callable Corporate Yield Spreads on Explanatory Variables
This table reports the pooled OLS regression results on callable bonds. We include fixed effects for each firm and 6 year dummies. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3
Intercept	6.226***	10.806***	7.319***
	(4.74)	(4.37)	(3.99)
σ_r	1.270*	1.966**	1.981**
	(1.90)	(2.49)	(2.49)
r	-2.224***	-2.133***	-2.167***
	(-5.07)	(-5.05)	(-5.22)
Slope	-2.618***	-2.722***	-2.799***
	(-5.79)	(-5.50)	(-5.77)
Rating	0.687**	0.455***	0.683**
	(2.52)	(4.25)	(2.55)
σ_e	0.263	0.236	0.230
	(0.97)	(1.00)	(0.75)
Liquidity	-1.091	0.177	-1.026
	(-1.46)	(0.23)	(-1.37)
Maturity	-0.061***	-0.076***	-0.061***
	(-5.46)	(-4.37)	(-5.74)
Coupon	0.344**	-0.319*	0.326**
	(2.23)	(-1.67)	(2.13)
Long-Term Debt to Assets	-3.519	0.734	-5.260
	(-0.75)	(0.59)	(-1.03)
Operating Income to Sales	0.019***	0.006**	0.017***
	(3.42)	(2.18)	(2.71)
Firm Fixed Effects	Yes	No	Yes
Year Dummies	No	Yes	Yes
Sample Size	42,959	42,959	42,959
F-Statistic	20.99	33.20	37.85

Table XXIV. Interaction Effects for Callable Bonds

This table reports the pooled OLS regression results on both noncallable and callable bonds. We use interaction terms between the determinants of call values and a callable dummy variable (*Call*) that takes the value 1 if the bond is callable. Junk is a dummy variable that takes the value 1 if the bond is a junk grade bond. We also include fixed effects for each firm and 6 year dummies. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	1	2	3	4
Intercept	4.225**	2.583**	5.513***	4.332***
	(2.43)	(2.09)	(4.75)	(3.21)
σ_r	1.959***	1.079***	1.356***	1.498***
	(3.58)	(4.64)	(3.54)	(4.20)
r	-1.810***	-1.286***	-1.406***	-1.445***
	(-6.74)	(-7.69)	(-8.84)	(-10.11)
Slope	-2.389***	-1.887***	-2.160***	-2.230***
	(-7.22)	(-6.12)	(-6.38)	(-6.88)
Rating	0.647***	0.565***	0.294***	0.568***
	(3.92)	(4.10)	(3.58)	(3.98)
σ_e	0.665**	0.906***	1.017***	0.925***
	(2.23)	(4.15)	(3.62)	(3.34)
Liquidity	-0.571***	-0.623***	-0.198	-0.572***
	(-3.09)	(-4.82)	(-0.98)	(-3.79)
Maturity	-0.571***	-0.006	-0.009	-0.010
	(-4.23)	(-0.80)	(-1.03)	(-1.36)
Coupon	-0.036**	0.100***	-0.010	0.097***
	(2.36)	(3.54)	(-0.23)	(3.91)
Long-Term Debt to	-3.032	-2.529	0.549	-3.050
Assets	(-0.93)	(-1.02)	(0.64)	(-1.15)
Operating Income to	-0.044	-0.019	-0.050	-0.022
Sales	(-0.35)	(-0.48)	(-0.83)	(-0.54)
Junk* σ_r		3.828***	4.625***	3.866***
		(3.34)	(3.33)	(3.31)
Junk* r		-0.946***	-0.752***	-0.940***
		(-9.28)	(-8.60)	(-9.55)
Call	0.523***	3.939***	6.516***	3.212**
	(2.64)	(2.93)	(2.97)	(2.42)
Call* σ_r		-0.729***	-0.982***	-0.804**
		(-2.96)	(-3.01)	(-2.55)
Call* r		-0.735***	-0.655**	-0.584**
		(-2.60)	(-2.22)	(-2.01)
Call*Slope		-0.980***	-0.616	-0.665*
		(-2.79)	(-1.64)	(-1.71)
Call*Rating		0.111**	0.132***	0.112**
		(2.21)	(2.66)	(2.31)
Call* σ_e		-0.550**	-0.701**	-0.559**
		(-2.14)	(-2.25)	(-2.04)
Call*Maturity		-0.048***	-0.047***	-0.042***
		(-3.67)	(-2.64)	(-3.83)
Call* Coupon		0.183**	-0.306	0.179**
		(2.17)	(-1.61)	(2.11)
Firm Fixed Effects	Yes	Yes	No	Yes
Year Dummies	Yes	No	Yes	Yes
Sample Size	107,834	107,834	107,834	107,834
F-Statistic	51.10	157.47	97.86	180.43

Table XXV. Interaction Effects for High-Priced Callable Bonds

This table reports the pooled OLS regression results on callable bonds. We use interaction terms between the determinants of call values and a high-priced dummy variable (*HP*) that takes the value 1 if the bond price is greater than 100. We also include fixed effects for each firm and 6 year dummies. The dependent variable is the yield spread. t-statistics based on robust standard errors, clustered at the firm level, are reported in parentheses below estimated coefficients. *, **, and *** signify significance at the 10%, 5%, and 1% level, respectively.

	Call Protection Period	Callable Period
Intercept	5.438***	10.404**
	(4.31)	(2.59)
σ_r	0.879**	3.256**
	(2.37)	(2.49)
r	-1.262***	-2.598***
	(-6.97)	(-3.93)
Slope	-1.975***	-3.368***
	(-4.92)	(-4.18)
Rating	0.003	1.218***
	(0.02)	(7.48)
σ_e	0.526***	0.078
	(4.65)	(0.22)
Liquidity	0.167	-1.483
	(1.26)	(-1.24)
Maturity	-0.031***	-0.143***
	(-7.39)	(-4.18)
Coupon	0.242***	0.822***
	(3.26)	(3.94)
Long-Term Debt to Assets	-7.473*	-37.580**
	(-1.74)	(-2.50)
Operating Income to Sales	4.244	2.286
	(1.47)	(0.80)
HP* σ_r	-0.652***	-2.599**
	(-2.96)	(-2.26)
HP* r	0.476***	0.732
	(3.67)	(1.48)
HP*Slope	0.980***	1.036*
	(4.07)	(1.79)
HP*Rating	-0.012	-0.252***
	(-0.92)	(-3.19)
HP* σ_e	-0.302***	-22.437*
	(-5.43)	(-1.74)
HP*Maturity	0.003	0.012
	(0.28)	(0.23)
HP* Coupon	-0.297***	-0.147
	(-2.72)	(-0.63)
Firm Fixed Effects	Yes	Yes
Year Dummies	Yes	Yes
Sample Size	14,976	19,059
F-Statistic	1,514.10	231.45

Figure I
October 14 Announcement and Approval Date Announcement

October 14 Announcement Effect			Approval Date Effect
Forced Banks	**Non-forced Banks**		**Non-forced Banks Only**
Voluntary (VB) versus Involuntary (IVB)	All non-forced banks that were eventually approved to issue TARP preferred stock		⇩
			Bank specific approval date effect (subsequent to October 14)

October 14 Effect

Forced Banks

The U.S. Treasury forced nine large banks (forced banks) to issue TARP preferred stock on October 14. Some forced banks were obviously more agreeable (voluntary, VB) to issuing TARP preferred while other forced banks were not as agreeable (involuntary, IVB). We classify banks as VB or IVB based on existing preferred stock yield before October 14.

Non-forced banks

Other banks were not forced to issue TARP preferred but became aware that they could apply to issue TARP preferred stock.

Approval Date Effect (non-forced banks only)

The U.S. Treasury permitted other banks (non-forced) to apply to issue TARP preferred stock after October 14. Approval was announced by the government some time after application. If not approved, the government made no announcement and, furthermore, the public never knew if the bank applied for TARP. All non-forced banks were voluntary. For non-forced banks, the impact of TARP preferred may be distributed across both the October 14 announcement and the bank specific approval date.

Figure II
Trust Preferred Stock (TP)

In order to create trust preferred stock, the issuing firm creates special purpose trust. The trust issues trust preferred stock to investors and lends the proceeds to the issuing firm. In return for the proceeds that the issuing firm borrows from the trust, the issuing firm issues junior subordinated debt to the trust.

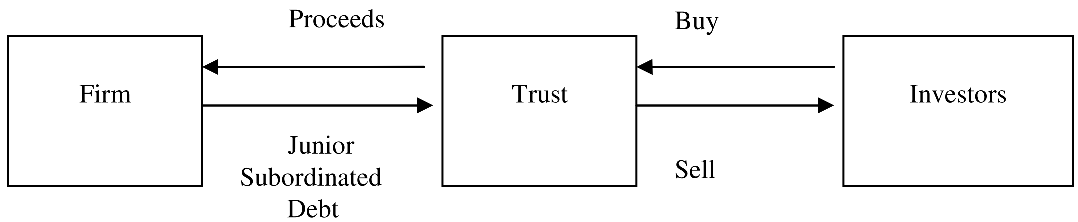

Figure III
Representation of different windows for non-forced banks

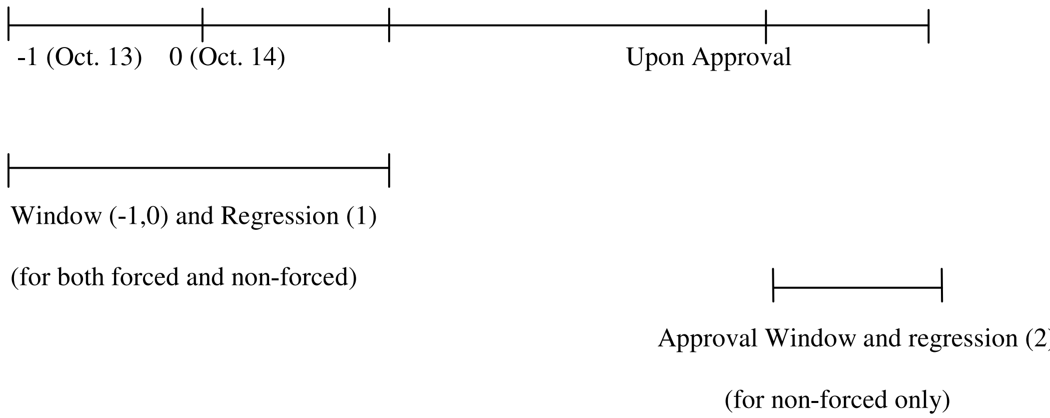

Figure IV. Time-Series Variations in Interest Rate Volatility and Yield Spreads

This figure plots interest rate volatility and the mean yield spread of each month from 2003 to 2009. Interest rate volatility is measured as the standard deviation (in %) of the daily one-month Treasury constant maturity rate for the 12 months prior to the bond transaction date. Yield spreads are defined as the difference between the daily yield on the corporate bond and the constant maturity Treasury yield with the same time to maturity. To estimate the entire yield curve, we use a linear interpolation scheme from 1, 2, 3, 5, 7, 10, 20, and 30-year Treasury constant maturity rates.