Three essays on corporate finance

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2014

Xu, L. (2014). Three essays on corporate finance. Doctoral thesis, Nanyang Technological University, Singapore.

https://hdl.handle.net/10356/55738

https://doi.org/10.32657/10356/55738

NANYANG TECHNOLOGICAL UNIVERSITY

THREE ESSAYS ON CORPORATE FINANCE

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NANYANG BUSINESS SCHOOL

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Nanyang Business School

A thesis submitted to Nanyang Technological University
in fulfillment of the requirements for the degree of
Doctor of Philosophy

2014

Acknowledgements

I would like to express my sincere gratitude to my supervisor, Professor Jun-Koo Kang. This thesis would not have been completed without his guidance. His commitment to the highest standards inspired and motivated me. Thanks also go to Professor Lei Zhang and Professor Young Han Kim. It is my honor to have them serving on my dissertation committee. My dissertation has benefited a lot from their insightful comments.

I would also like to thank all the other professors in the Division of Banking and Finance. In particular, Professor Hwang Chuan Yang, and Professor Angie Low were extremely nice to offer many useful comments. Professor Huasheng Gao, Professor Jiang Luo, Professor Suman Banerjee and Professor Stephen Dimmock have all tried to engage me in certain research projects.

I would like to acknowledge the financial and academic support of the Nanyang Business School PhD Program. I appreciate the help from Ms Quek Bee Hua, Ms Amarnisha Mohamed and Ms Karen Barlaan in the PhD Program Office.

I dedicate my dissertation to my beloved families, who have always supported, encouraged and believed in me.

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Introduction

The dissertation comprises three essays on corporate finance.

Essay one examines the impact of executive stock ownership guideline on the company's cost of debt financing. We find that the adoption of executive ownership guideline is associated with lower loan spread, fewer restrictive capital expenditure covenants, and fewer collateral requirements, suggesting that creditors prefer firms adopting the ownership guideline. These results are particularly pronounced when the ownership guideline is more likely to be binding, that is, when the CEO stock ownership is lower, or when the CEO is a newly hired manager. We also find that after the adoption of executive ownership guideline, firms' risk taking incentives are reduced and the quality of their financial reporting is improved, further supporting the view that creditors benefit from the adoption of executive ownership guideline.

Essay two investigates the relation between a firm's hedging policy and its major customer relationships. We find that the likelihood of a supplier using derivatives to hedge interest rate risk is higher when a major customer has high leverage. This result is increasing in the supplier's dependence on a major customer, such as when the customer represents a large share of its sales, when the supplier operates in a durable goods industry, or when the supplier makes high relationship-specific investments. We also find that hedging helps the supplier maintain durable relationships with customers, especially highly leveraged customers. Further, we find that announcements of customers' bond offers, credit rating downgrades, and bankruptcy have significant negative effects on the market value of non-hedging suppliers while they have no such effects on that of hedging suppliers. These results suggest that a major customer's financial distress risk is an important determinant of a supplier's hedging policy, and that supplier hedging helps increase the perceived viability of the future customer relationship and alleviate potential negative spillover effects along the supply chain.

Essay three studies whether the change in the local housing market condition has significant impacts on stock liquidity of local firms. We find that stock liquidity of local firms significantly improve when the local housing price growth is high, even after controlling for extensive state economic related factors. This result is robust to alternative measures of stock liquidity and the estimation of Two Stages Least Square Model. The increase in the stock liquidity of local firms is only observed for firms with high retail concentration (i.e., small size, low stock price, low institutional ownership or low analyst coverage). Further, when the residential property price growth is high, the R^2 of local stocks with high retail concentration would significantly increase, indicating that less firm-specific information is incorporated into the stock price under strong housing market conditions. We also find that firms located in the state with higher housing price growth pay lower underwriting fees if they conduct seasoned equity offerings. This effect of lower cost of equity financing is also more pronounced for firms with high retail concentration. To the extent that rising home values strengthen households' financial conditions, lower their leverage and encourage them to participate more in the equity market, especially, to trade more frequently in the local stocks due to their local bias, the liquidity of local stocks will improve as the local housing market is booming.

Contents

Essay One: Executive Stock Ownership Guideline and Cost of Debt

Abstract

Using hand collected information on executive stock ownership guideline, we investigate the impact of ownership guideline on the company's cost of debt financing. We find that the adoption of executive ownership guideline is associated with lower loan spread, fewer restrictive capital expenditure covenants, and fewer collateral requirements, suggesting that creditors prefer firms adopting the ownership guideline. These results are particularly pronounced when the ownership guideline is more likely to be binding, that is, when the CEO stock ownership is lower, or when the CEO is a newly hired manager. We also find that after the adoption of executive ownership guideline, firms' risk taking incentives are reduced and the quality of their financial reporting is improved, further supporting the view that creditors benefit from the adoption of executive ownership guideline.

Keywords: CEO, Executive, Stock ownership guideline, Cost of debt, Bank loan

JEL Classification: M12, G32.

I. Introduction

Does the equity-based compensation succeed in increasing managerial ownership in the firm? Ofek and Yermack (2000) find that executives rebalance their holdings after stock and option grants: managers tend to sell shares, particularly almost all shares acquired through option exercises, in response to new equity grants. To limit this unwinding of equity-based compensation and ensure that managers maintain an appropriate equity stake in the firm, the minimum shareholding policies (executive stock ownership guidelines), which specify a target level of stock ownership that executives must achieve within a time frame and maintain, are advocated.[1] Many large U.S. firms now voluntarily adopt executive stock ownership guidelines to encourage the alignment of management and shareowner interests.[2] For example, according to a 2010 survey by Equilar (2010), 80.6% of Fortune 250 firms have adopted ownership guidelines as of 2009 with a median CEO target share ownership of $6 million.[3]

Reflecting the importance of ownership guidelines as a mechanism to align the interests of executive officers with those of stockholders, several studies show a significant increase in the level of managerial ownership and firm performance after implementing such policy (Core and Larcker (2002), Benson et al. (2011)). Specifically, Core and Larcker (2002) find that prior to the adoption of ownership guideline, firms exhibit low managerial equity ownership and poor stock performance, but after the adoption of ownership guideline, managerial equity ownership and stock performance increase significantly. Benson et al. (2011) document that after the implementing of ownership guideline, a significant increase in the sensitivity of CEO wealth to stock price and a better operating performance are observed. Furthermore, TIAA-CREF, one of leading retirement providers and

[1] The stock ownership guideline is voluntarily adopted by the company and is usually applied to the CEO and other named executives who have the strongest impact on firm performance. Under a typical ownership guideline, the executives are required to meet and maintain pre-determined equity ownership goals within a specified period of time, generally ranging from three to five years. Multiples of base salary are the overwhelming terms of ownership target design, and for most companies, stock options are not counted toward the ownership targets.
See the survey by Equilar (2010): http://www.executive-compensation.com/ceo_blog/?cat=6.

[2] For expositional purposes, we use the terms executive stock ownership guidelines and ownership guidelines interchangeably.

[3] http://www.executive-compensation.com/ceo_blog/?cat=6.

activist institutions, argues in its policy statement that "Companies should require and specify minimum executive stock ownership requirements for directors and company executives".[4]

In spite of the growing importance of executive stock ownership guidelines to firms' operation and their role as a mechanism to align the interests of management with those of shareholders, we know little about how nonshareholder stakeholders react to and are affected by the implementation of these policies.

In this study, we investigate how creditors perceive firms' implementation of ownership guidelines by examining the impact of such implementation on bank loan interest rates and other nonpricing terms. We also examine the post-implementation changes in firms' risk taking behavior and financial reporting policy to test how the implementation of ownership guidelines affects creditors. Among various stakeholders, we focus on creditors because debtholders represent one of the key stakeholders of a firm and debt capital is seen as an important source of corporate financing. Sufi (2009) finds that about 80 % of all public firms maintain private credit agreements.

There are two competing views on how the adoption of ownership guidelines affects creditor interests and thus loan pricing and nonpricing terms, namely, the conflict of interest view and the interest alignment view. The conflict of interest view suggests that while the adoption of ownership guideline benefits the shareholders, it hurts the debtholders because it increases the agency cost of debt. Although the adoption reduces the agency cost of equity by aligning the interests of managers with those of shareholders, it can increase the agency cost of debt by providing managers who act on behalf of shareholders with strong incentives to take actions that benefit shareholders at the expense of debtholders (Jensen and Meckling (1976), John and John (1993), Begley and Feltham (1999)). For instance, managers whose incentives are closely aligned with the shareholders are more likely to expropriate debtholders' wealth by investing in risky, high expected return projects. Debtholders, anticipating such incentives, will demand higher interest rates, put more covenants that restrict the borrowers from making risky investments, or require more collateral.[5] Supporting this argument,

[4] https://www.tiaa cref.org/public/pdf/pubs/pdf/governance_policy.pdf.

[5] Nini, Smith, and Sufi (2009) argue that the conflict of interest between borrower and creditor has a significant impact on a firm's future investments policy and show that to alleviate such conflict, 32 percent of their sample private credit agreements

while Morck, Shleifer and Vishny (1988) and McConnell and Servaes (1990) find that manager's and shareholder's interest become more closely aligned as managerial ownership increases, Bagnani et al. (1994), Begley and Feltham (1999), Molina (2006), and Vasvari (2008) document a positive relation between managerial equity incentives and borrowing costs.

Moreover, most of firms in our sample indicate in their proxy statements that the motivation for adopting executive stock ownership guidelines is to ensure that their managers have the appropriate equity incentives to increase shareholder value.[6] However, the debtholders may view these guidelines as corporate policies that increase shareholder value at the expense of their wealth. The debtholders anticipating such incentives, therefore, require higher interest, put more restrictive covenants, or require more collateral in the credit agreement.

In contrast to the conflict of interest view, the interest alignment view suggests that the adoption of ownership guideline benefits the debtholders by reducing the asset substitution risk and mitigating the information risk. Thus, the interest alignment view predicts that creditors demand lower interest rates, put fewer covenants that restrict the borrowers from making risky investments, or require less collateral if borrowers adopt ownership guidelines. There are two reasons for this prediction. First, the incentives of managers and those of shareholders might not be well aligned if ownership guidelines increase the stock ownership of risk-averse managers too much, because their significant personal wealth in the firms increase the concerns about their non-diversifiable risk associated with the firms. For example, if risk-averse managers have to increase their ownership interest to the level above their optimal risk aversion due to the ownership guideline requirements, they would have strong incentives to reduce firm risk by undertaking low risk investments, that potentially mitigate debtholders' asset substitution concerns.

Consistent with this argument, Stulz (1984) and Smith and Stulz (1985) conclude that when risk-averse managers receive large stock ownerships in the firm, they pursue risk reducing corporate

use an explicit restriction on capital expenditures. They also find that the creditors are more likely to impose a capital expenditure restriction in the debt contract as the riskiness of debt increases. Berger and Udell (1990), John, Lynch, and Puri (2003), and Jimenez, Salas, and Saurina (2006) suggest that collateral requirement is often associated with riskier borrowers.

[6] For example, 3M states in its proxy statement that the stock ownership guideline are designed to increase an executive's equity stake in 3M, which can closely align her interests with those of 3M's stockholders. See https://materials.proxyvote.com /Approved/88579Y/20090313 / NPS_36407 /PDF/3m Proxy2009_0043.pdf.

strategies that can be beneficial to debtholders. Lambert, Larcker and Verrecchia (1991) and Ross (2004) also argue that risk-averse, underdiversified managers have a strong incentive to adopt risk reducing corporate policies if their compensation has high pay-performance sensitivity. Empirically, Anderson, Mansi, and Reeb (2003) find that bondholders perceive founding family ownership as an organizational structure that better protects their interests and show that family firms enjoy lower cost of debt. Billett, Mauer, and Zhang (2010) document a positive bond price reaction to an increase in CEO pay for performance sensitivity, and Shaw (2012) shows that yield spreads on new debt issues are lower for firms with higher CEO pay for performance sensitivity.

Anecdotal evidences also support this view. During the recent 2008 financial crisis, some investors and regulators blamed banks' executive compensation scheme for its influence to induce excessive risk taking by managers. Reflecting this concern, in 2010, Securities and Exchange Commission (SEC) required listed companies to discuss the level of risk inherent in their compensation plans in the proxy statements. According to the survey by Equilar (2010), about 59 percent of the U.S. surveyed firms believe that ownership guidelines contribute to mitigating managers' excessive risk taking.[7] In addition, U.S. Treasury's new regulations mandate that TARP (The Troubled Asset Relief Program) recipients preclude executives from cashing out granted shares before TARP funds are repaid.[8] All these lines of evidence suggest that the executive stock ownership guideline may serve as a tool to mitigate managers' excessive risk taking.

Second, prior literature shows that managers with short-term performance pressure are more likely to pursue strategies that attempt to boost stock prices artificially in the short run. For example, Burns and Kedia (2006) and Johnson, Ryan and Tian (2009), respectively, find that firms whose managers have greater short term incentives from stock options and vesting stocks are more likely to engage in earnings management. Gopalan et al. (2012) document that longer executive pay duration is negatively related to the extent of earnings increasing accruals. These misreporting behaviors induced by short-termism can increase the information asymmetry between the firms and their debtholders,

[7] http://www.equilar.com/company/press-release/press-release-2010/long-term-performance-compensation-is-most-popular-risk-management-strategy.html.
[8] http://online.wsj.com/article/SB124516105628518981.html.

thus affecting the cost of bank loans and nonpricing terms such as covenants and collateral requirements.[9]

Ownership guidelines can mitigates these short-termism and misreporting incentives because they require top executives to hold certain amount of shares until they leave the firms, which potentially impose a significant liquidity constraint on top executives. The ownership guidelines limit the freedom of executives to unload their equity holdings, and thus may prevent executives from benefiting by using inside information to time their stock sales or even inflating stock price by engaging in earnings management and other financial misreporting behaviors prior to stock sales. To the extent that ownership guidelines reduce the information asymmetry between the managers and the debtholders, for firms that adopt ownership guidelines, we expect a negative relation between the adoption of ownership guideline and the cost of debt financing.

We expect that the predicted effects of ownership guidelines on the pricing and nonpricing terms of bank loan under the two competing views are more pronounced when the top executive's equity ownership is lower, or when he is newly hired. If the executives have already had high equity ownership, they may not need to increase their stock holdings to satisfy the minimum requirement imposed by ownership guideline and thus be able to sell part of their equity holdings without much constraint.[10] For example, GUESS adopted the executive ownership guideline in 2006, which requires its CEO, Paul Marciano, to achieve a target stock ownership with a market value equal to five times of Paul Marciano's annual base salary ($1 million in 2006). However, Paul Marciano held almost $952 million worth of GUESS' stocks prior to the adoption of ownership guidelines.[11] Thus, the target stock value required by GUESS' ownership guidelines represents only 0.52% of its CEO's total stock holdings. Under this situation, the ownership guideline is not likely to be a binding policy.

[9] Graham, Li, and Qiu (2008) show that information risk is a key factor that determines debt contracts. Graham, Li and Qiu (2008), Prevost, Skousen and Rao (2008), and Shen and Huang (2013) also find that earnings management increase the cost of debt financing.

[10] Bebchuk and Fried (2010) are sceptical about the effectiveness of the ownership guideline and argue that the target ownership goal is set at too low level.

[11] Proxy statement of GUESS can be found at http://www.sec.gov/Archives/edgar/data/912463 /000104746908006714 /a2185695zdef14a.htm. We calculate the market value of the CEO's stock holdings based on the stock price at the fiscal year end of 2006.

Moreover, the typical ownership guideline requires the executives to meet the ownership target within 3-5 years while the average CEO tenure is almost 7 years.[12] These statistics suggest that the guideline would be less binding for the CEOs with longer tenure because they are likely to leave the firms soon before the ownership target reaches. For example, if the CEO is going to retire in the next year and the firm just adopts a guideline, this guideline will not serve as a mechanism to align the interests of the CEO with those of stockholders.

Using hand-collected data on ownership guideline obtained from firms' proxy statements, we find that the adoption of ownership guidelines is associated with a statistically and economically significant reduction of the cost of debt financing: firms with executive stock ownership guidelines enjoy lower loan spreads of about 15 basis points compared with the average loan spread of 128.5 basis points for our sample firms. Moreover, firms' adoption of ownership guideline is associated with a lower probability of having a capital expenditure covenant in their loan agreements by about 7 percentage points, compared with the average probability of about 22.2 percentage points for our sample firms. We also find that the likelihoods of banks requiring collateral to secure their loans are lower by approximately 15 percentage points for firms adopting ownership guidelines. These results are consistent with the interest alignment view and suggest that minimum ownership holding policy for executives is preferred by debtholders.

Our further analysis shows that the impacts of ownership guidelines on loan rates and nonpricing terms are more pronounced when these guidelines are more likely to be binding, that is, when the executives' equity ownership is lower, or when the executives are newly hired managers.

To check the robustness of our results, we perform a variety of additional tests that control for potential endogeneity problems. First, we control for various governance characteristics in the regressions. For example, it is possible that omitted governance characteristics affect both a firm's implementation of ownership guidelines and loan rates, resulting in a spurious correlation between these two. To alleviate this concern, we control for various governance variables, such as CEO tenure, CEO-chairman duality, institutional block ownership, governance index (G-index), and board size and

[12] Based on the S&P Execucomp database, the average CEO tenure from 1992 to 2011 is 6.85 years.

the fraction of outside directors on the board, in the regressions. We find that our results are robust to including these additional variables. Second, to control for the possibility that omitted unobservable firm characteristics affect both a firm's implementation of ownership guidelines and loan rates, we include firm fixed effects in the regressions.[13] Our conclusion remains the same. Finally, we explicitly address the potential endogeneity problems using two-stage least squares (2SLS) regressions in which we employ the change in state marginal capital gain tax rate as an instrumental variable. We find that most of our results do not change. Overall, our series of robustness checks show that our key results are robust to controlling for potential endogeneity biases.

Finally, to test whether banks indeed benefit from the adoption of executive ownership guideline, we examine the post-implementation changes in firms' risk taking behavior and financial reporting policy. We find that after the adoption of executive ownership guideline, firms are more likely to pursue risk reducing corporate policy (i.e., adopt corporate hedging policies, engage more in diversified merger and acquisition activities, have lower future cash-flow volatility, and improve in S&P long term credit ratings) and the quality of their financial reporting (as measured by the absolute value of discretionary accruals and accrual quality) is improved. These findings suggest that the executive ownership guideline indeed alleviates the creditors' concerns on top executives' incentive to invest in risky projects and their misreporting behavior.

We contribute to the literature in several ways. First, to the best of our knowledge, our study is the first to investigate how executive stock ownership guideline affects the pricing and nonpricing terms of bank loan contracts. Unlike other studies on ownership guidelines (Core and Larcker (2002), Cao, Gu, and Yang (2010), Benson et al. (2011)), which show that the adoption of ownership guideline is associated with an increase in managerial ownership and better stock performance, we examine the channel through which the implementing of ownership guidelines affects firm value from the creditors' point of view and show that the adoption of ownership guidelines lowers the cost of debt financing and thus increases firm value.

[13] We merge the S&P ExecuComp database with the Loan Pricing Corporation's DealScan and Compustat databases from 1996 to 2005.This sample consists of 6,266 firm-loan observations.

Second, our paper contributes to the literature on agency costs. We find that the involuntary increase in managerial ownership and lack of freedom to sell managerial equity could mitigate the asset substitution and information risk concern of debtholders, which help to increase firm value.

Third, by examining how creditors perceive firms' implementation of ownership guidelines, our paper adds to the literature on the determinants of bank loan contract terms (Graham, Li, and Liu (2008), Chava, Livdan, and Purnanandam (2009), Lin et al. (2011), Lin et al. (2012)). We show that the existence of a binding ownership guideline is an important factor when banks determine their loan contract terms.

The rest of the paper is organized as follows. In Section II, we describe the data and sample characteristics. Section III investigates the impact of executive stock ownership guideline on pricing and nonpricing terms of bank loan. Section IV explores the cross time variation of executive ownership guideline. In Section V, we investigate the post-adoption changes in firms' risk taking behavior and financial reporting policy. Section VI discusses the results from robustness tests. Section VII summarizes and concludes the paper.

II. Data and Summary Statistics

II.1 Sample

Our initial sample includes all firms covered in S&P ExecuComp database for the period from 1996 to 2010.[14] We restrict our sample to those firms whose stock return and financial data are available in CRSP and Compustat, respectively. We also exclude firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) from the sample.

We obtain each firm's information on the usage of executive ownership guideline by extensively searching its proxy statement on Form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. Specifically, we use the following keywords to locate the firm's executive ownership guideline information in Form DEF14A:

[14] We require our sample firms to be included in S&P ExecuComp because we need information on CEO stock and option holdings for the tests of our two competing hypotheses.

"ownership guideline," "ownership target," "ownership requirement," "ownership goal," "ownership program," "ownership policy," and *"ownership plan"*. When we find at least one of these keywords, we carefully read its surrounding text to determine the firm's use of ownership guideline. If the firm's proxy statement makes no reference to the adoption of ownership guidelines, we treat the firm in that year as a non-adoption firm. We are able to identify executive ownership guideline information for 2,249 firms (20,522 firm-year observations).

We then merge the list of these firms in S&P ExecuComp database with that of the firms used in Nini, Smith, and Sufi (2009) and that of the firms covered in LPC's DealScan database.[15] To be included in our final sample, we require a firm to have at least one loan agreement covered in the database used by Nini, Smith, and Sufi (2009). The sample used in Nini, Smith, and Sufi (2009) contains unique information on investment restrictions in loan covenants. This information allows us to examine whether executive ownership guidelines affect nonpricing terms of bank loans through capital investment restrictions. LPC's DealScan database allows us to obtain important characteristics on loan contracts, such as loan size, loan maturity, loan type and loan purpose. We obtain corporate governance characteristics from RiskMetrics. Our final sample consists of 778 firms (1,557 firm-loan observations), of which 201 firms (353 firm-loan observations) have executive stock ownership guidelines.

II.2 Summary Statistics

Panel A (B) of Table I reports the distribution of the sample of 1,557 firm-loan observations (covered by S&P ExecuComp database, the dataset used in Nini, Smith, and Sufi (2009), and the LPC's DealScan database) according to year (industry) and whether firms have adopted executive stock ownership guideline. 22.7% of the sample firms adopted the ownership guideline during our sample period. Further, the fraction of firms with ownership guidelines increases over time, from 0% in 1996 to 41.9% in 2005.[16] It is highest in the agriculture, forestry, and fishing industries (42.9%),

[15] We thank Amir Sufi for making these data available on his website (http://faculty.chicagobooth.edu/amir.sufi/data.html).
[16] We do not find any firms that abandon the ownership guidelines after they initiated such policies.

followed by manufacturing (28.4%), wholesale and retail trade (18.1%), transportation (18%), mining and construction (16.8%) and services industries (12.3%).

Table II presents firms and bank loan characteristics for our sample firms. Several observations are noteworthy. First, compared to non-adoption firms, adoption firms are significantly larger, have lower market to book ratio and cash holdings. Second, consistent with the previous studies (Core and Larcker (2002), Benson et al. (2011)), CEOs in adoption firms have significant lower stock ownership, option holdings and CEO tenure, and are more likely to be the chairman of the board. Third, adoption firms borrow more from the banks and enjoy lower loan spreads (interest rate minus LIBOR rate) (mean loan spreads of 96.18 basis points versus 137.96 basis points). Finally, bank loans by adoption firms have a longer median maturity, a lower frequency of carrying capital expenditure restrictions (mean frequency ratios of 11.6% versus 25.3%), and a lower frequency of being secured by collateral (mean frequency ratios of 20.4% versus 40.6%). Detailed definitions of these variables are provided in the appendix.

III. Impact of Executive Stock Ownership Guidelines on Terms of Bank Loans

III.1 Impact of Executive Stock Ownership Guidelines on Capital Expenditure Restriction

To investigate how creditors perceive the adoption of the executive stock ownership guidelines by borrowers, we estimate a Probit regression of the likelihood of having capital expenditure restrictions in their loan agreements in which the dependent variable is an indicator that takes the value of one if the bank loan contains a capital expenditure restriction and zero otherwise. Nini, Smith, and Sufi (2009) argue that the capital expenditure restriction is particularly important in understanding borrowers' credit risk because the elasticity of the capital expenditure restriction with respect to borrower credit quality is often larger than the elasticity of other loan contract terms.

Following Graham, Li, and Liu (2008), Lin et al. (2011), and Lin et al. (2012), we control for several firm- and contract-specific characteristics that could affect cost of bank loans, such as firm size, book leverage, profitability, market-to-book ratio, tangibility, cash flow volatility, loan amount,

loan maturity, loan type, and loan purpose. Following Bagnani et al. (1994), Molina (2006), and Shuto and Kitagawa (2011), we also control for CEO stock ownership, CEO option holdings, and total CEO compensation.

Previous literature shows that corporate governance may affect the agency costs of debt (Shleifer and Vishny (1997), Chava, Livdan, and Purnanandam (2008), Li, Tuna and Vasvari (2013)). To mitigate the concern that the adoption of stock ownership guidelines simply proxies for good corporate governance, we control for various governance measures such as CEO-chairman duality, CEO tenure, institutional block ownership, G-index, board size, and the proportion of independent directors on the board. Finally, we control for year and industry fixed effects. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the standard errors by the firms.

The results are reported in Table III. In column (1), we include a guideline adoption indicator as our key explanatory variable of the interest. Since we do not find any firms that abandon the ownership guidelines after they initiated such policies, the guideline adoption indicator will always equal to one after the initiation of the policy. We find that the coefficient estimate on the indicator is negative and significant at the 5% level. This result suggests that firms with executive ownership guidelines are less likely to have a capital expenditure restriction in their credit agreements. Its marginal effect has a coefficient estimate of -0.071, suggesting that the probability of having a capital expenditure restriction in the credit agreement is 7.1% points lower for firms with an ownership guideline than for firms without such a guideline. Given that the unconditional probability of having a capital expenditure restriction is 22.2% in our sample, this effect seems to be economically significant.

In column (2), we include the S&P long term credit rating[17] as an additional independent variable to control for the possibility that banks infer the credit risk of borrowers from the rating agency.[18] Consistent with the previous literature, we find that the coefficient estimate on this variable is positive and highly significant at the 1% level. However, even after controlling for the borrower's

[17] We convert categorical S&P long term credit rating into a cardinal variable measured on a 23-point scale (1 for rating AAA and 23 for rating D).

[18] Nini, Smith, and Sufi (2009) show that creditors are more likely to limit firm investment in response to increases in the borrower's credit risk, as measured by the credit rating.

credit rating, our key result does not change: the coefficient estimate on the guideline adoption indicator is negative and significant at the 1% level, with a marginal effect of -0.065.

In columns (3) and (4), we control for several important governance variables. Chava, Livdan, and Purnanandam (2008) indicate that firms that rely too much on external corporate control market as a governance device are punished by bank loans. Li, Tuna, and Vasvari (2013) find that bond contracts have fewer restrictions when the borrowing firm's board has larger size or is more independent. We find that the coefficient estimates on G-index, board size, and the proportion of independent directors on the board are not significant. However, the guideline adoption indicator still shows a negative and significant coefficient estimate. These results are consistent with the interest alignment hypothesis that if borrowers adopt the executive ownership guideline, their creditors are less concerned about the riskiness of the debt contract and thus, relax the capital investment restrictions in the loan agreement.

III.2 Impact of Executive Stock Ownership Guidelines on Collateral Requirement

Berger and Udell (1990), John, Lynch, and Puri (2003), and Jimenez, Salas, and Saurina (2006) show that collateral requirement is most often associated with riskier borrowers and riskier loans. Reflecting the importance of the collateral as the measure of loan covenants, Bradley and Roberts (2004) include collateral requirement in estimating loan covenant strictness index.[19] Thus, to further distinguish between the conflict of interest hypothesis and the interest alignment hypothesis, in this subsection, we examine how the adoption of ownership guidelines affects the likelihood of borrowers having to pledge collateral. We use a Probit regression in which the dependent variable is an indicator that takes the value of one if the bank loan is secured by collateral and zero otherwise.[20] We use the same control variables as those in Table III.

The results are reported in Table IV. In column (1), the coefficient estimate on the guideline adoption indicator is negative and significant at the 1% level. This result suggests that firms with

[19] Bradley and Roberts (2004) measure the covenant intensity index as the sum of six covenant indicators: collateral, dividend restriction, more than two financial covenants, asset sales sweep, equity issuance sweep, and debt issuance sweep.
[20] If the secure information is missing in LPC's DealScan database, we set the collateral requirement indicator equal to zero.

executive ownership guidelines are less likely to be required to pledge collateral in their loan contracts. Its marginal effect has a coefficient estimate of -0.158, suggesting that the probability of having a collateral requirement in the loan agreement is 15.8% points lower for firms with an ownership guideline than for firms without such an ownership guideline. Given the unconditional probability being 36.0% in our sample, this magnitude seems to be economically significant.

In column (2), we control for the S&P long term credit rating and in column (3) and (4), we control for corporate governance measures. We find similar results as those in column (1): the coefficient estimate on the guideline adoption indicator is negative and significant at the 1% level. These results provide strong support for the interest alignment hypothesis.

III.3 Impact of Executive Stock Ownership Guidelines on Loan Spreads

The results in the previous subsections suggest that the ownership guideline relaxes the capital expenditure restriction and collateral requirement in the loan contracts. In this subsection, we examine the effects of ownership guidelines on the price of bank loans. We estimate an ordinary least squares (OLS) regression in which the dependent variable is the all-in-drawn loan spread. The key independent variable of interest is the guideline adoption indicator. Other control variables are the same as those used in Tables III and IV regressions.

The results are presented in Table V. In column (1), we find that the coefficient estimate on the adoption indicator is negative and significant at the 1% level. The coefficient estimate is -0.151, suggesting that the loan spread charged by banks is 15.1 basis points lower for firms with an ownership guideline than for firms without an ownership guideline. Since the average loan spread is about 128.98 basis points in our sample, this number seems to be economically significant. The results do not change when we control for the S&P long term credit rating and governance measures in the regressions (columns (1)-(4)). Thus, firms whose top executives are subjected to the ownership guideline pay lower borrowing costs in the syndicated loan market than those whose top executives are not subjected to the ownership guideline, supporting the interest alignment hypothesis.

III.4 Correcting Endogeneity Bias: Instrumental Variables Approach

The endogeneity problem could potentially bias our results. Although we take several steps to alleviate concerns arising from reverse causality (we measure firm characteristics as of the fiscal year-end before the loan active date) and omitted variable problems (we control for an extensive set of variables in the regressions, including corporate governance measures, industry fixed effects, loan type and purpose fixed effects, etc.), it is still possible that some unobserved firm specific characteristics affect both the adoption of ownership guideline and the cost of bank debt. We attempt to address this issue by using 2SLS model with the change in state marginal capital gain tax rate as an instrumental variable.

Landsman and Shackelford (1995), Jin and Kothari (2008) suggest that a high capital gain tax rate discourages managers from selling firm equity due to the lock-in effect of capital gains tax. Moreover, the effective long-term marginal capital gain tax rate varies widely across different states and years. For example, California State has the highest marginal long-term capital gain tax rate (33.0%), and Texas State, Florida State etc. have the lowest marginal long-term capital gain tax rate (23.8%) in 2013.[21] The long-term capital gain tax rate of Florida State was 29.2% in 1996, and 15% in 2012.[22] Therefore, firms located in different states may have different incentive to initiate the ownership guidelines. For example, firms located in the states with higher capital gain tax rate or with a significant increase in capital gain tax rate would less likely to initiate the ownership guideline policy, because the higher capital gain tax rate has already imposed a significant limitation on the unwinding of equity incentives of top executives. Based on our hand-collected data in 2010, we indeed find that the average ownership guideline adoption rate in California State is around 51.5%, but the average adoption rate in Texas and Florida State is 59.2%, and 60.3% respectively[23]. Furthermore, it is unlikely that the change in personal capital gain tax rate directly affects the firm's cost of debt, satisfying the exclusion condition for the instrumental variable.

[21] See "The High Burden of State and Federal Capital Gains Taxes" (http://taxfoundation.org/article/high-burden-state-and-federal-capital-gains-taxes).
[22] The state long-term capital gain tax rate is obtained from NBER website (http://users.nber.org/~taxsim/state-rates/).
[23] The state level ownership guideline adoption rate is calculated based on S&P Execucomp database.

We use 2SLS regressions to address potential endogeneity problems. In the first stage, we estimate an OLS regression of the adoption indicator on the change in state marginal capital gain tax rate and the set of control variables included in the Table III regressions. In the second stage, we estimate the likelihood of including loan covenants (OLS regression of loan spreads) using the instrumented adoption guideline indicator and the control variables used in the first-stage regression as explanatory variables.

Table VI reports the results from our 2SLS regressions. In column (1), we present the result from the first stage OLS regression. Consistent with our prediction, the increase in state marginal capital gain tax rate has strong negative impact on a firm's guideline adoption decision. The value of the Anderson Canon. Corr. LR statistic is 13.570, which is significant at the 1% level, suggesting that our instrumental variable is relevant in explaining the variation of the potentially endogenous variable, the adoption guideline indicator.

Columns (2) to (4) show the estimates from the second-stage regressions. The dependent variable in column (2) is an indicator that takes the value of one if the bank loan contains the capital expenditure restriction and zero otherwise. The dependent variable in column (3) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. The dependent variable in column (4) is the loan spread charged by the bank over LIBOR. In columns (3) to (4), we find that the coefficients estimates on the instrumented adoption guideline indicator remain negative and statistically significant.[24] These results confirm our prior results that the adoption of ownership guidelines relaxes restrictive collateral requirements and lowers loan spreads, mitigating the potential endogeneity concern that our main results are driven by omitted unobservable firm characteristics or reverse causality.

[24] We also estimate the treatment selection models in which the first-stage regression is estimated by a Probit model and the second-stage regressions is estimated by an OLS. We obtain similar results on collateral requirement and loan spread regressions.

III.5 Subsample Analysis Based on CEO Stock Ownership

Given existing arguments that the target ownership ratio tends to be set at a relative low level (Bebchuk and Fried (2010)) and the ownership guideline could just act as window dressing after 2002 (Cao, Gu and Yang (2010)[25], it is possible that the ownership guideline yields a smaller impact on the cost of debt when the CEO stock ownership is too high. For example, if the executives have already had high equity ownership, they may not need to increase their stock holdings to satisfy the minimum requirement imposed by ownership guideline and thus still be able to sell part of their equity holdings without much constraint.

To investigate this issue, we decompose the full sample into two subgroups according to the sample median (0.804%) of CEO stock ownership.[26] The results are reported in Table VII. The dependent variable in columns (1) and (2) is an indicator that takes the value of one if the bank loan contains a capital expenditure restriction and zero otherwise. The dependent variable in columns (3) and (4) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. The dependent variable in columns (5) and (6) is the loan spread charged by the bank over LIBOR.

Consistent with our predictions that the impact of ownership guidelines on the cost of private debt is much stronger when the CEO maintains relatively low level of stock ownership, we observe that the negative and significant relation between the adoption guideline indicator and the likelihood of having a capital expenditure restriction in the loan agreement exists only in the low CEO stock ownership group. Economically, we find that for a low (high) CEO stock ownership group, the adoption indicator is associated with a 10.1% points decrease (0.2% points increase) in the likelihood of having a capital expenditure restriction in the loan agreement. We obtain similar results with respects to the collateral requirement and loan spread. For a low (high) CEO stock ownership group, the adoption indicator is associated with a 16.8% points (9.4% points) decrease in the likelihood of

[25] Cao, Gu, and Yang (2010) show that pre-2002 adoptions appear to be driven primarily by efficient contracting between managers and shareholders, while post-2002 adoptions appear to be driven mainly by public pressure. The significant post-adoption improvements in performance and increases in long-term investment are observed among early adopters but not among recent adopters, except for a subset that is likely to have made the adoptions for efficient contracting reasons.

[26] In a high CEO stock ownership group, the average value of CEO stock holdings is $196.76 million (median = $30 million); but in a low CEO stock ownership group, the average value of CEO stock holdings is only $14.51 million (median = $5.92 million). We also find that 112 (241) firms have stock ownership guidelines in the high (low) CEO stock ownership group. We use the stock price at the end of fiscal year to calculate the value of the CEO stock holdings.

having a collateral requirement in the loan agreement, and with a 18.5 (6.7) basis points decrease in loan spreads.

III.6 Subsample Analysis Based on CEO Tenure

The typical ownership guideline requires the executives to meet the ownership target within 3-5 years while the average CEO tenure is almost 7 years. [27] Thus, it is possible that the guideline has less impact if the CEO with a longer tenure is likely to leave the firms soon before the ownership target reaches.

To investigate this issue, we decompose the full sample into two subgroups according to the sample median (4 years) of the CEO tenure.[28] The results are reported in Table VIII. We find that consistent with our predictions, the impact of ownership guideline is stronger when the CEO has a shorter tenure. Specifically, we find that the coefficient estimate on the adoption indicator in the regression of the likelihood of having a capital expenditure restriction is negative and significant only in the low CEO tenure group (columns (1) and (2)): for a low (high) CEO tenure group, the adoption indicator is associated with a11.3% points decrease (0.7% points increase) in the likelihood of having a capital expenditure covenant in the loan agreement. We find similar results for loan spreads (columns (5) and (6)): for a low (high) CEO tenure group, the guideline indicator is associated with a 17.8 (9.5) basis points decrease in loan spreads. However, we find that the coefficient estimate on the adoption indicator in the regression of the likelihood of having a collateral requirement is negative and significant in both groups (columns (3) and (4)).

Overall, the above results suggest that the adoption of executive ownership guidelines lowers the cost of debt financing, supporting the interest alignment hypotheses. These results are robust to

[27] For example, Western Digital indicate in its proxy statement that "Covered executives are required to achieve ownership of a number of qualifying shares meeting the required market value within the later of five (5) years after the adoption of these executive stock ownership guidelines or three (3) years after first being designated as a covered executive", http://www.wdc.com/en /company /governance/executivestockownershipguidelines.aspx.

[28] In the high CEO tenure group, there are 139 firms with stock ownership guidelines while in the low CEO tenure group, there are 214 firms having such a policy.

controlling for endogeneity concerns and more pronounced when the policy is more likely to be binding such as when the CEO stock holdings is lower or when the CEO has a short tenure.

IV. Cross Time Variation of Executive Ownership Guideline

Thus far, we mainly focus on the cross sectional difference between adoption and non-adoption firms. In this section, we investigate the cross time variation of the impact of ownership guidelines on the cost of loan by including firms that are beyond the coverage of the dataset used in Nini, Smith, and Sufi (2009).

Specifically, we merge the S&P ExecuComp database with the Loan Pricing Corporation's DealScan and Compustat databases from 1996 to 2005.[29] We exclude firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999). To be included in the sample, we require a firm to have at least one bank loan agreement covered in the DealScan database. Our final sample consists of 1,189 firms (6,266 firm-loan observations), of which 333 firms (1,456 firm-loan observations) have executive stock ownership guidelines. Since Nini, Smith, and Sufi (2009) find that information about the capital expenditure restriction is mostly missing in the DealScan database, we focus only on the regression analyses using a collateral requirement indicator and loan spreads as the dependent variables. We use the same control variables as those used in Table III. We also include firm fixed effects to control for omitted unobservable firm characteristics and estimate the regressions with an OLS method.

The results are reported in Table IX and Table X. In Table IX, the dependent variable is an indicator that takes the value of one if the bank loan is secured and zero otherwise. We find that the coefficient estimates on the adoption indicator are all negative and significant in columns (1)-(4), suggesting that the banks are less likely to require collateral to secure their loans after the borrowers adopt the ownership guideline. In Table X, the dependent variable is the loan spread charged by the bank over LIBOR. We again find that the coefficient estimates on the adoption indicator are negative

[29]We thank Michael Roberts for sharing the DealScan-Compustat link file on his website (http://finance.wharton.upenn.edu/~mrrobert/).

and significant except for column (4), suggesting that the banks charge lower interests after the borrower adopts ownership guideline. These results further support the interest alignment hypothesis.

V. Difference in Difference Approach

In this section, we apply a similar approach used by Chan, Chen, and Chen (2013). Specifically, we estimate a logit model in which we regress the ownership guideline adoption indicator on a set of firm characteristics, including firm size, CEO stock ownership, ROA, book leverage, market to book ratio, cash-flow volatility, year and industry fixed effects (Propensity score matching method). For every adoption firm, we choose three firms with the closest probability of having ownership guideline policies (even though they have not adopted such policies until 2006). Next, we match this list of firms with the DealScan database from 1996 to 2005. We exclude firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999). To be included in the sample, we require that ownership guideline adoption firms and control firms must have at least one loan contract issued during the pre-adoption period and at least one loan contract issued during the post-adoption period. Finally, we have 226 firms (80 adoption firms and 146 control firms), and 1,821 firm-loan observations from 1996 to 2005. Since Nini, Smith, and Sufi (2009) find that information about the capital expenditure restriction is mostly missing in the DealScan database, we focus only on the regression analyses using a collateral requirement indicator and loan spreads as the dependent variables. We use the same control variables as those used in Table III.

The results are reported in Table XI. The treatment group indicator is equal to one if the firm adopted the ownership guideline before 2004, and zero otherwise (the treatment group indicator is equal to one for the 80 adoption firms, and is equal to zero for the 146 control firms). The after adoption indicator is equal to one after the firm initiated the ownership guideline policy, and zero otherwise. The dependent variable in column (1) and (3) is the loan spread charged by the bank over LIBOR. The dependent variable in column (2) and (4) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. In column (3) and (4), we apply firm fixed effect models. We

find that the coefficient estimates on the after adoption indicator are all negative and significant in columns (1)-(4), suggesting that the banks are less likely to require collateral to protect their interests, and charge lower interest after the borrowers initiate the ownership guideline than the non-adoption control firms.

VI. Post-Adoption Changes in Firms' Risk Taking Behavior and Financial Reporting Policy

In this section, we examine the channels through which the ownership guideline affects the cost of bank loans. We focus on two channels: 1) post-adoption changes in risk-reducing corporate policies such as adopting hedging policies, reducing future cash-flow volatility, engaging more in diversified merger and acquisition (M&A) activities, and experiencing higher S&P long term credit ratings possibly due to implementation of low risk corporate policies[30], and 2) post-adoption changes in financial reporting policies such as adopting policies that lead to higher financial reporting quality as measured by lower absolute value of discretional accruals and higher accruals quality.[31] Because the creditors have significant concerns about borrowers' risk and financial reporting quality, we expect examining these measures to show important channels through which executive ownership guidelines affect the cost of debt.

The sample used in this section consists of 12,385 firm-year observations covered in Compustat, CRSP, and ExecuComp databases from 1996 to 2005. Firms in the financial industries and utility industries are excluded. We obtain each firm's information on the usage of interest rate derivatives to hedge for interest rate risk by extensively searching its annual report on Form 10-K filed electronically in EDGAR database. If the firm's annual report on Form 10-K makes no reference

[30] Campello et al. (2011) show that compared with non-hedging firms, hedging firms pay lower loan spreads and are less likely to have capital expenditure restrictions in their loan agreements. Lewellen (1971) states that the joining-together of two firms whose earnings streams is less-than-perfectly correlated would reduce the risk of default of the merged firms. Amihud and Lev (1981) assert that a conglomerate merger generally leads to reduced risk for the combined entity. Acharya, Amihud, and Litov (2011) consider diversified merger as risk reducing corporate policy, and find that stronger creditor rights induce greater propensity of firms to engage in diversifying acquisitions. Hann, Ogneva, and Ozbas (2012) observe that diversified firms have on average a lower cost of debt than standalone firms because the coinsurance among a diversified firm's business segments can reduce systematic risk through the alleviation of countercyclical deadweight costs.

[31] Graham, Li, and Qiu (2008), Prevost, Skousen, and Rao (2008), Qi, Subramanyam, and Zhang (2010), and Shen and Huang (2013) document that earnings managements, such as earnings restatement, higher discretional accrual, and lower accrual quality, increase the cost of debt financing.

to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm.[32] We obtain the information about M&As from Thomson Financial SDC Platinum Mergers and Acquisitions Database. We require that the value of M&A transactions be larger than $1 million and that the acquirers obtain 100% ownership of the target firms after the transactions.

Following Jones (1991) and Dechow, Sloan, and Sweeney (1995), we remove components of accruals that are beyond the control of the CEO when we estimate discretionary accruals. We use a version of the Jones (1991) model of accruals, which estimates nondiscretionary accruals as the fitted value from a regression of total accruals on lagged firm size, the change in firm sales, and gross property plant and equipment scaled by total firm assets for our sample firms in the same 2-digit SIC code industry group. As suggested by Bergstresser and Philippon (2006), the absolute discretionary accrual is calculated as the absolute value of the estimated residual from the previous regressions.[33] Following Francis et al. (2005), we measure the accrual quality as the standard deviation of the residuals from the regressions of current accruals on past, current, and future cash flows from operations, calculated over five-year rolling window.

The results are presented in Table XII. The dependent variable in column (1) is an indicator that takes the value of one if the firm use derivative to hedge for interest rate risk and zero otherwise. The dependent variable in column (2) is the firm's future cash flow volatility. The dependent variable in column (3) is an indicator that takes the value of one if the firm engage in diversified M&A activities (the acquirer and the target operate in different industries as measured by 2-digits of SIC code) and zero otherwise. The dependent variable in column (4) is the S&P long term credit rating (1 for rating AAA and 23 for rating D). The dependent variable in column (5) is the absolute value of total accruals. The dependent variable in column (6) is the absolute value of discretionary accrual. The dependent variable in column (7) is accrual quality. We estimate all these regressions with an OLS method with firm fixed effects. We find that managers are more likely to pursue risk reducing policies

[32] We use the following keywords to locate the firm's use of interest rate derivative in Form 10-K: "derivative," "hedge," "swap," "market risk," "forward contract," "option contract," and "risk management." When we find at least one of these keywords, we carefully read its surrounding text to determine the firm's use of interest rate derivative.

[33] Bergstresser and Philippon (2006) consider that earnings management involves the transfer of earnings from one period to another. The absolute measure of accruals measures the total amount of earnings transfer without being sensitive to the precise timing of when earnings are increased or decreased.

and less likely to engage in earnings management after the adoption of ownership guidelines, suggesting that managers who are subject to ownership guidelines are concerned about the undiversifiable risk associated with their personal wealth and the managerial myopic problems are mitigated, thereby benefiting creditors.

Specifically, in columns (1), (2) and (3), the coefficient estimate on the adoption indicator is significant at the 5% level, suggesting that after the adoption of the ownership guideline, the firm is more likely to hedge for interest rate risk, applies corporate policy to reduce future cash-flow volatility and engages more in diversified M&As. In column (4), conditional on the firm having a S&P long term credit rating, the coefficient estimate on the adoption indicator is negative and significant at the 5% level, suggesting that after the adoption of the ownership guideline, the firm's default risk is reduced, possibly due to the fact that it implements less risky financial and investment policies after the adoption of guideline. In columns (5), (6) and (7), the coefficient estimates on the adoption indicator are negative and significant. Thus, after the adoption of the ownership guideline, earnings are less manipulated and accrual quality is improved.

In untabulated tests, we also examine the change in CEO stock ownership and change in operating performance after the adoption of the ownership guideline, and find that the CEO stock ownership and operating performance increases significantly, suggesting that the adoption of ownership guideline further align the interest of manager and shareholder together. In sum, the results in this section show that the adoption of ownership guideline would lead to higher CEO equity ownership, improved firm performance, lower risk taking corporate policy and better financial reporting quality. Therefore, not only the shareholders but also debtholders benefit from the implementation of ownership guideline. A possible explanation for these results is that the firms' total values (the value for shareholders and debtholders) increase after the adoption of ownership guidelines due to the mitigation of managerial misreporting or excessive risk taking incentives. Debtholders benefit from the risk reducing corporate policy and the improved financial reporting

quality. For shareholders, the potential cost of the implementation of ownership guideline[34] is lower than the potential benefit, especially for long term shareholders.

VII. Robustness Tests

To check the robustness of our key results, we conduct several additional tests. Below, we briefly summarize the results of these untabulated tests.

First, since the executive stock ownership guidelines are not only applied to the CEO but also to the other top executives, such as CFO, COO, president, and vice president, we replace the CEO stock and option ownership with the top 5 executives' stock and option ownership. We find that our results remain qualitatively similar.

Second, to examine whether our results are robust to controlling for additional CEO characteristics and CEO compensation plan, we further include various measures of the CEO's compensation structure, such as option compensation ratio, stock compensation ratio, and CEO's risk taking incentive measures (pay-performance sensitivity (delta) and the sensitivity of CEO wealth to stock volatility (vega), which are measured following Guay (1999) and Core and Guay (2001), respectively). Our results remain similar.

Third, we replace the adoption guideline indicator with the natural log of the market value of target equity holding for CEO (if the firm has adopted the ownership guideline but the target value is not available, we use the industry median value as a substitute; if the firms do not adopt stock ownership guideline, we set the target value equal to zero). Our results remain significant.

Fourth, since the credit risk of the borrower is the key concern for the lender and the S&P long term credit rating is only available for firm with public debt, we replace the S&P long term credit rating with the KMV distance-to-default measure based on the Merton (1977) model (Crosbie and Bohn (2001)). Our results remain similar.

[34] The value of the stock will be reduced if the firm with ownership guideline takes too little risk, since the stock value is like an option value for leveraged firm.

Fifth, in order to examine whether our results are robust to including other firms that are not covered by the S&P ExecuComp database, we collect information on executive stock ownership guidelines for all firms used by Nini, Smith and Sufi (2009) and use these firms in the analyses. Our results do not change.

Sixth, to examine whether our results are robust to other model specifications, we use the simultaneous equation approach in which we estimate the firm's adoption guideline decision regression (using the change in state marginal capital gain tax rate as an instrument), the capital expenditure restriction regression, the collateral requirement regression, and the loan spread regression simultaneously. We obtain similar results.

Seventh, we employ a propensity score matching technique to examine the differences in the costs of bank loan between firms with and without executive stock ownership guidelines. The matching procedure controls for selection based on the observable firm characteristics. We experiment with three different matching techniques: nearest neighborhood, Gaussian kernel, and local linear regressions. All matches are conducted without replacement. Bootstrapped standard errors based on 50 replications are used to conduct statistical inferences. We find that firms with ownership guidelines still have significantly lower cost of debt (lower probability of having capital expenditure restriction and lower probability of having collateral requirement in the credit agreement) than matching nonadoption firms.

Eighth, we hand-collect the specific information about ownership guideline adoption month from the form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database.[35] For example, Autodesk, Inc indicated in the proxy statement that "In December 2004, the Board of Directors established stock ownership guidelines for directors and executive officers designed to encourage long term stock ownership in the Company and more closely link their interests with those of the stockholders". We are able to identify 212 firms' information about ownership guideline adoption month and we treat the adoption month as the announcement window. We find that the market-adjusted abnormal stock return in the adoption month is positive 1.347%,

[35] Most of the firms do not provide the information about the ownership guideline adoption date in their proxy statements.

significant at 10% level. Next, after merging the list of firms with the Bank of America Merrill Lynch US Corporate and High Yield Master Bond Index Database, we have 68 firms (148 bond-firm observations). In the adoption month, the average change in monthly bond yield spread is negative 0.108%, significant at 1% level.

VIII. Summary and Conclusion

In this paper, we investigate how the executive stock ownership guideline affects the firm's cost of debt financing. Using a large sample of firms with private bank loan agreements from 1996 to 2005 and hand-collected data on executive ownership guidelines, we find that the adoption of executive ownership guidelines are associated with lower loan spreads, less restrictive capital expenditure covenants, and less restrictive collateral requirement. These results are more pronounced when the ownership guideline is likely to be a binding policy, that is, when the CEO stock ownership is maintained at low level, or when the CEO has a short tenure. Our findings suggest that the adoption of executive stock ownership guidelines would be favored by the creditors.

We further show that firms' risk-reducing financial and investment policies and high quality of financial reporting induced by the implementation of ownership guidelines are the important channels through which ownership guidelines reduce the cost of bank loans. Specifically, we find that after the adoption of ownership guidelines, firms are more likely to hedge for interest rate risk, more likely to make diversified M&As, less likely to default, and less likely to engage in earnings management.

Overall, these results are consistent with the interest alignment hypothesis that an effective minimum shareholding policy prevents top executives from excessive risk taking and mitigates the managerial myopic problems, thereby benefiting creditors. Our study provides the first empirical evidence showing how debtholders view the adoption of executive stock ownership guideline and contributes to the literature by specifying a channel through which the ownership guidelines increase firm value.

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Table I: Sample Distribution by Year and Industry

The sample consists of 1,557 firm-loan observations covered in the dataset used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a nonadoption firm. Panel A and B present the distribution of sample firms and the percentage of firms adopting an executive stock ownership guideline by year and industry, respectively.

Panel A. Distribution of Adoption Firms and Non-Adoption Firms by Year

Year	Number of Firms	Number (Percentage) of Adoption Firms	Number (Percentage) of Non-Adoption Firms
1996	9	0 (0.0%)	9 (100.0%)
1997	138	22 (15.9%)	116 (84.1%)
1998	126	8 (6.3%)	118 (93.7%)
1999	159	14 (8.8%)	145 (91.2%)
2000	164	22 (13.4%)	142 (86.6%)
2001	184	29 (15.8%)	155 (74.2%)
2002	175	46 (26.3%)	129 (73.7%)
2003	178	35 (19.7%)	143 (80.3%)
2004	233	97 (41.6%)	136 (58.4%)
2005	191	80 (41.9%)	111(58.1%)
Total	1,557	353 (22.7%)	1,204 (77.3%)

Panel B. Distribution of Adoption Firms and Non-Adoption Firms by Industry

Two-digit SIC industry	Number of Firms	Number (Percentage) of Adoption Firms	Number (Percentage) of Non-Adoption Firms
Agriculture, Forestry and Fishing (Two-digit SIC =01-09)	14	6 (42.9%)	8 (57.1%)
Mining and construction (Two-digit SIC =10-17)	137	23 (16.8%)	114 (83.2%)
Manufacturing (Two-digit SIC=20-39)	821	233 (28.4%)	588 (71.6%)
Transportation (Two-digit SIC =40-48)	100	18 (18.0%)	82 (82.0%)
Wholesale and retail trade (Two-digit SIC=50-59)	232	42 (18.1%)	190 (81.9%)
Services (Two-digit SIC=70-89)	253	31 (12.3%)	222 (87.7%)
Total	1,557	353 (22.7%)	1,204 (77.3%)

Table II: Firm and Bank Loan Characteristics

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. The Appendix provides a detailed description of the construction of the variables. The numbers in the test-of-difference columns are *t*-values or *z-values*. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Adoption Firms (N=353): A		Non-Adoption Firms (N=1,204): B		Test of Difference (A-B)	
	Mean	Median	Mean	Median	t-test	Wilcoxon test
Firm Characteristics						
Firm size ($ millions)	8367.9	2868.8	3867.2	1163.8	5.514***	11.027***
Book leverage	0.271	0.265	0.256	0.249	1.33	1.739*
Cash holdings	0.071	0.037	0.082	0.039	-1.816*	-0.589
Profitability	0.154	0.143	0.148	0.139	1.040	0.810
Market to book	1.746	1.458	1.913	1.537	-2.659**	-1.094
Institutional block ownership	0.154	0.149	0.151	0.133	0.526	1.504
CEO Characteristics						
CEO total compensation ($ millions)	6.722	4.255	5.054	2.222	1.506	9.475***
CEO stock ownership (%)	1.564	0.420	4.016	1.017	-6.270***	-8.699***
CEO option ownership (%)	1.288	0.910	1.500	1.114	-2.303**	-1.721*
CEO age	55.966	56	55.672	56	0.740	1.157
CEO-chairman duality	0.733	1	0.643	1	3.145***	3.136***
CEO tenure	4.963	3	6.941	4.5	-4.361***	-3.531***
Bank Loan Characteristics						
Loan amount ($ millions)	869.361	500	529.108	255	5.087***	9.244***
Loan maturity (years)	3.526	5	3.601	4	-0.711	0.017
Loan spread (basis point)	96.181	75	137.965	112.5	-7.034***	-8.035***
Capital expenditure restriction indicator	0.116	0	0.253	0	-5.457***	-5.408***
Secured loan indicator	0.204	0	0.406	0	-7.066***	-6.959***

Table III: Probit Regression of the Likelihood of Capital Expenditure Restriction on Firm Characteristics

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable is an indicator that takes the value of one if the bank loan contains capital expenditure restriction and zero otherwise. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. The coefficients reported are estimates of the marginal effect on the probability. Industry is classified according to the first digit of SIC code. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Adoption guideline indicator	-0.071**	-0.065***	-0.057**	-0.057**
	(0.0297)	(0.0096)	(0.0198)	(0.0180)
CEO and governance characteristics				
CEO stock ownership	0.183	0.036	-0.130	-0.017
	(0.2560)	(0.7946)	(0.4223)	(0.9075)
CEO option ownership	1.561**	0.647	1.311**	1.002*
	(0.0296)	(0.2315)	(0.0360)	(0.0689)
Ln (CEO compensation)	-0.005	0.003	-0.011	-0.007
	(0.6589)	(0.7478)	(0.3106)	(0.4676)
Ln (CEO age)	0.083	0.117*	0.078	0.073
	(0.2992)	(0.0991)	(0.2954)	(0.2775)
Ln (CEO tenure)	-0.017	-0.005	-0.002	-0.003
	(0.1416)	(0.6411)	(0.8330)	(0.7448)
CEO-chairman duality	0.020	-0.006	0.004	-0.002
	(0.4181)	(0.7724)	(0.8482)	(0.9108)
Institutional block ownership	0.148*	0.078	0.037	0.049
	(0.0891)	(0.2182)	(0.5728)	(0.4120)
Ln (S&P credit rating)		0.285***	0.244***	0.239***
		(0.0001)	(0.0005)	(0.0003)
G-index			-0.000	-0.001
			(0.9437)	(0.7554)
Ln (board size)				0.008
				(0.8348)
Independent board ratio				0.090
				(0.1123)
Firm and bank loan characteristics				
Ln (total asset)	-0.074***	-0.036**	-0.024	-0.022
	(0.0001)	(0.0183)	(0.1378)	(0.1460)
Profitability	-0.208	-0.024	0.001	-0.121
	(0.2482)	(0.8745)	(0.9953)	(0.4682)
Book leverage	0.231***	0.031	0.033	0.026
	(0.0007)	(0.5573)	(0.5592)	(0.6451)
Market to book	-0.056***	-0.042***	-0.034**	-0.025
	(0.0006)	(0.0087)	(0.0371)	(0.1057)
Tangibility	0.028	0.012	0.026	0.037
	(0.6360)	(0.8103)	(0.6004)	(0.4193)
Cash flow volatility	0.579**	0.361	0.327	0.330
	(0.0479)	(0.1806)	(0.2768)	(0.2626)
Ln (Loan amount)	0.018	0.018	0.017	0.015
	(0.2455)	(0.1276)	(0.1797)	(0.2045)
Ln (Loan maturity)	-0.009	-0.001	-0.008	-0.006
	(0.6900)	(0.9760)	(0.6734)	(0.7110)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Pseudo R^2	0.238	0.371	0.366	0.380
Number of observations	1,555	1,016	889	842

Table IV: Probit Regression of the Likelihood of Collateral Requirement on Firm Characteristics

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable is an indicator that takes the value of one if the bank loan is secured and zero otherwise. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. The coefficients reported are estimates of the marginal effect on the probability. Industry is classified according to the first digit of SIC code. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Adoption guideline indicator	-0.158***	-0.134***	-0.108***	-0.114***
	(0.0000)	(0.0005)	(0.0040)	(0.0026)
CEO and governance characteristics				
CEO stock ownership	0.087	-0.057	-0.042	0.024
	(0.6686)	(0.8115)	(0.8797)	(0.9319)
CEO option ownership	2.398**	2.655**	2.612**	2.381**
	(0.0235)	(0.0140)	(0.0188)	(0.0269)
Ln (CEO compensation)	0.024	0.030*	0.016	0.005
	(0.1677)	(0.0630)	(0.3851)	(0.7735)
Ln (CEO age)	-0.162	-0.093	-0.156	-0.154
	(0.1469)	(0.4402)	(0.2314)	(0.1976)
Ln (CEO tenure)	-0.013	-0.003	-0.014	-0.018
	(0.4134)	(0.8456)	(0.3878)	(0.2644)
CEO-chairman duality	0.059*	0.013	0.026	0.031
	(0.0609)	(0.6856)	(0.4403)	(0.3405)
Institutional block ownership	0.285**	0.203*	0.042	0.061
	(0.0167)	(0.0827)	(0.7355)	(0.5923)
Ln (S&P credit rating)		0.920***	0.852***	0.767***
		(0.0000)	(0.0000)	(0.0000)
G-index			-0.002	-0.003
			(0.7547)	(0.6180)
Ln (board size)				-0.072
				(0.3085)
Independent board ratio				0.007
				(0.9339)
Firm and bank loan characteristics				
Ln (total asset)	-0.136***	-0.088***	-0.070***	-0.051**
	(0.0000)	(0.0003)	(0.0073)	(0.0368)
Profitability	-1.034***	-0.569*	-0.556*	-0.659**
	(0.0001)	(0.0623)	(0.0671)	(0.0377)
Book leverage	0.515***	0.147	0.123	0.086
	(0.0000)	(0.1201)	(0.2173)	(0.3998)
Market to book	-0.064***	-0.043	-0.034	-0.021
	(0.0023)	(0.1010)	(0.2293)	(0.4564)
Tangibility	0.104	0.125*	0.143*	0.160**
	(0.1585)	(0.0853)	(0.0570)	(0.0242)
Cash flow volatility	2.843***	0.925*	0.947*	0.956*
	(0.0000)	(0.0666)	(0.0657)	(0.0520)
Ln (Loan amount)	0.044**	0.031	0.025	0.028
	(0.0381)	(0.1394)	(0.2663)	(0.1962)
Ln (Loan maturity)	0.010	0.006	-0.012	-0.006
	(0.7566)	(0.8691)	(0.7610)	(0.8713)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Pseudo R^2	0.314	0.487	0.482	0.479
Number of observations	1,555	1,023	896	849

Table V: OLS Regression of Loan Spreads on Firm Characteristics

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat, and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable is the loan spread charged by the bank over LIBOR. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Industry is classified according to the first digit of SIC code. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Adoption guideline indicator	-0.151***	-0.134***	-0.125**	-0.143***
	(0.0043)	(0.0096)	(0.0187)	(0.0052)
CEO and governance characteristics				
CEO stock ownership	-0.369	-0.378	-0.046	0.264
	(0.1687)	(0.2475)	(0.9001)	(0.4911)
CEO option ownership	4.336***	4.756***	5.012***	5.257***
	(0.0019)	(0.0023)	(0.0095)	(0.0086)
Ln (CEO compensation)	-0.035	-0.060*	-0.061*	-0.058
	(0.1929)	(0.0610)	(0.0765)	(0.1099)
Ln (CEO age)	0.009	0.092	0.082	0.042
	(0.9526)	(0.6124)	(0.6948)	(0.8467)
Ln (CEO tenure)	0.000	0.004	0.002	-0.011
	(0.9978)	(0.8756)	(0.9437)	(0.6994)
CEO-chairman duality	-0.001	-0.002	0.017	0.047
	(0.9804)	(0.9671)	(0.7683)	(0.4038)
Institutional block ownership	0.406**	0.359*	0.344*	0.399**
	(0.0151)	(0.0618)	(0.0822)	(0.0373)
Ln (S&P credit rating)		1.410***	1.335***	1.200***
		(0.0000)	(0.0000)	(0.0000)
G-index			-0.019**	-0.020**
			(0.0342)	(0.0223)
Ln (board size)				-0.169
				(0.1427)
Independent board ratio				0.198
				(0.1583)
Firm and bank loan characteristics				
Ln (total asset)	-0.165***	-0.037	-0.036	-0.042
	(0.0000)	(0.3643)	(0.4050)	(0.3444)
Profitability	-3.186***	-2.189***	-2.019***	-2.381***
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Book leverage	1.462***	0.850***	0.943***	0.807***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Market to book	-0.021	0.061*	0.034	0.040
	(0.3905)	(0.0993)	(0.3785)	(0.2630)
Tangibility	0.353***	0.376***	0.432***	0.472***
	(0.0014)	(0.0012)	(0.0003)	(0.0001)
Cash flow volatility	3.772***	1.397**	1.773**	2.291***
	(0.0000)	(0.0305)	(0.0285)	(0.0051)
Ln (Loan amount)	-0.009	-0.001	0.010	0.032
	(0.7688)	(0.9708)	(0.7930)	(0.3909)
Ln (Loan maturity)	-0.041	-0.028	-0.037	-0.005
	(0.4504)	(0.6807)	(0.6450)	(0.9515)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Adjusted R^2	0.523	0.643	0.643	0.640
Number of observations	1,555	1,023	896	851

Table VI: Instrument Variable Regressions

The sample consists of 1,537 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. Column (1) shows results from the first-stage regressions in which the dependent variable is an indicator that takes the value of one if the firm has an executive ownership guideline and zero otherwise and the instrumental variable is the change in state marginal personal capital gain tax rate (obtained from http://users.nber.org/~taxsim/state-rates/). Columns (2)-(4) show results from the second-stage regressions in which the adoption guideline indicator is instrumented with fitted values from the first-stage OLS regression on the change in state marginal personal capital gain tax rate. The dependent variable in column (2) is an indicator that takes the value of one if the bank loan contains capital expenditure restriction and zero otherwise. The dependent variable in column (3) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. The dependent variable in column (4) is the loan spread charged by the bank over LIBOR. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Appendix provides a detailed description of the construction of the variables. P-values are in parentheses. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	First Stage	Second Stage		
	OLS Regression	Probit Regression	Probit Regression	OLS Regression
	(1)	(2)	(3)	(4)
Change in state capital gain tax rate	-0.040***			
	(0.0000)			
Instrumented adoption guideline indicator	-	-1.255	-1.855***	-0.884**
	-	(0.1992)	(0.0016)	(0.0335)
CEO and governance characteristics				
CEO stock ownership	-0.334**	0.483	-0.235	-0.620**
	(0.0189)	(0.5788)	(0.6911)	(0.0428)
CEO option ownership	0.081	6.563**	5.699*	4.042***
	(0.9214)	(0.0461)	(0.0539)	(0.0080)
Ln (CEO compensation)	0.016	0.004	0.091**	-0.012
	(0.2236)	(0.9476)	(0.0482)	(0.6735)
Ln (CEO age)	-0.062	0.294	-0.459	-0.016
	(0.5160)	(0.4212)	(0.1327)	(0.9183)
Ln (CEO tenure)	-0.033***	-0.104*	-0.075*	-0.013
	(0.0100)	(0.0694)	(0.0900)	(0.6066)
CEO-chairman duality	0.048*	0.154	0.231**	0.034
	(0.0912)	(0.1802)	(0.0113)	(0.5472)
Institutional block ownership	-0.006	0.596	0.676*	0.407**
	(0.9496)	(0.1350)	(0.0672)	(0.0274)
Firm and bank loan characteristics				
Ln (total asset)	0.047***	-0.260**	-0.260**	-0.139***
	(0.0094)	(0.0291)	(0.0218)	(0.0007)
Profitability	0.530***	-0.229	-1.636	-2.749***
	(0.0029)	(0.8221)	(0.1156)	(0.0000)
Book leverage	0.018	0.996***	1.266***	1.483***
	(0.8230)	(0.0018)	(0.0002)	(0.0000)
Market to book	-0.031***	-0.278***	-0.210***	-0.057**
	(0.0098)	(0.0001)	(0.0001)	(0.0367)
Tangibility	0.109	0.250	0.429**	0.449***
	(0.1033)	(0.3592)	(0.0417)	(0.0002)
Cash flow volatility	0.247	2.757**	7.324***	4.061***
	(0.4459)	(0.0397)	(0.0000)	(0.0000)
Ln (Loan amount)	0.003	0.066	0.104*	-0.007
	(0.8294)	(0.3301)	(0.0727)	(0.8281)
Ln (Loan maturity)	-0.014	-0.035	0.013	-0.033
	(0.4581)	(0.7093)	(0.8809)	(0.5219)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Adjusted R^2 /Pseudo R^2	0.218	-	-	0.451
Number of observations	1,527	1,527	1,527	1,527

Table VII: Subsample Analysis Based on CEO Stock Ownership

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable in columns (1) and (2) is an indicator that takes the value of one if the bank loan contains capital expenditure restriction and zero otherwise. The dependent variable in columns (3) and (4) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. The dependent variable in columns (5) and (6) is the loan spread charged by the bank over LIBOR. Columns (1)-(4) are estimated using a Probit regressions and the coefficients reported are estimates of the marginal effect on the probability. Columns (5) and (6) are estimated by an OLS regression. Firms are divided into two subgroups according to the sample median of CEO stock ownership. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Industry is classified according to the first digit of SIC code. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Capital Expenditure Restriction		Collateral Requirement		Loan Spreads	
	CEO Stock Ownership		CEO Stock Ownership		CEO Stock Ownership	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Adoption guideline indicator	0.002	-0.101***	-0.094	-0.168***	-0.067	-0.185***
	(0.9760)	(0.0030)	(0.1527)	(0.0000)	(0.4776)	(0.0053)
CEO and governance characteristics						
CEO option ownership	3.031***	0.464	2.792**	1.971	3.343**	6.821***
	(0.0079)	(0.5929)	(0.0467)	(0.2331)	(0.0401)	(0.0064)
Ln (CEO compensation)	-0.017	0.009	0.003	0.057**	-0.015	-0.064
	(0.4162)	(0.5081)	(0.8974)	(0.0109)	(0.6306)	(0.1187)
Ln (CEO age)	0.225*	-0.007	-0.211	-0.137	0.159	-0.186
	(0.0816)	(0.9349)	(0.1870)	(0.3593)	(0.4283)	(0.4155)
Ln (CEO tenure)	-0.013	-0.024	-0.008	-0.015	0.016	-0.026
	(0.5026)	(0.1260)	(0.7054)	(0.4966)	(0.5634)	(0.4734)
CEO-chairman duality	0.016	0.013	0.057	0.043	-0.025	0.030
	(0.6961)	(0.6266)	(0.2354)	(0.2650)	(0.7048)	(0.6575)
Institutional block ownership	0.185	0.012	0.250	0.384***	0.115	0.744***
	(0.1796)	(0.8812)	(0.1917)	(0.0030)	(0.6200)	(0.0007)
Firm and bank loan characteristics						
Ln (total asset)	-0.111***	-0.044**	-0.167***	-0.098***	-0.195***	-0.130***
	(0.0002)	(0.0202)	(0.0000)	(0.0012)	(0.0000)	(0.0091)
Profitability	-0.628*	0.105	-0.910**	-1.110***	-3.069***	-3.172***
	(0.0719)	(0.4947)	(0.0198)	(0.0007)	(0.0000)	(0.0000)
Book leverage	0.278**	0.212***	0.505***	0.448***	1.650***	1.355***
	(0.0110)	(0.0024)	(0.0006)	(0.0000)	(0.0000)	(0.0000)
Market to book	-0.056**	-0.055***	-0.082**	-0.058**	-0.048	-0.009
	(0.0300)	(0.0027)	(0.0108)	(0.0315)	(0.1833)	(0.7865)
Tangibility	0.110	-0.023	0.121	0.079	0.504***	0.189
	(0.2508)	(0.7228)	(0.2450)	(0.4141)	(0.0011)	(0.2207)
Cash flow volatility	1.444**	0.043	2.744***	2.966***	5.200***	3.100***
	(0.0178)	(0.8670)	(0.0002)	(0.0000)	(0.0000)	(0.0001)
Ln (Loan amount)	0.020	0.012	0.077**	-0.001	-0.014	-0.013
	(0.4293)	(0.5089)	(0.0148)	(0.9699)	(0.7283)	(0.7878)
Ln (Loan maturity)	-0.019	-0.006	0.004	0.033	-0.024	-0.031
	(0.6177)	(0.8084)	(0.9339)	(0.3663)	(0.7256)	(0.7046)
Loan type and purpose fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES
Adjusted R^2 */Pseudo* R^2	0.225	0.286	0.262	0.383	0.504	0.510
Number of observations	770	729	770	781	774	781

Table VIII: Subsample Analysis Based on CEO Tenure

The sample consists of 1,557 firm-loan observations covered in the data set used in Nini, Smith and Sufi (2009), Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable in columns (1) and (2) is an indicator that takes the value of one if the bank loan contains capital expenditure restriction and zero otherwise. The dependent variable in columns (3) and (4) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. The dependent variable in columns (5) and (6) is the loan spread charged by the bank over LIBOR. Columns (1)-(4) are estimated using a Probit regressions and the coefficients reported are estimates of the marginal effect on the probability. Columns (5) and (6) are estimated by an OLS regression. Firms are divided into two subgroups according to the sample median of CEO tenure. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Industry is classified according to the first digit of SIC code. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Capital Expenditure Restriction		Collateral Requirement		Loan Spreads	
	CEO Tenure		CEO Tenure		CEO Tenure	
	Long	Short	Long	Short	Long	Short
	(1)	(2)	(3)	(4)	(5)	(6)
Adoption guideline indicator	0.007	-0.113***	-0.160***	-0.148***	-0.095	-0.178***
	(0.8919)	(0.0062)	(0.0052)	(0.0018)	(0.2805)	(0.0047)
CEO and governance characteristics						
CEO stock ownership	0.273	0.002	0.165	-0.031	-0.606	-0.244
	(0.2103)	(0.9912)	(0.5743)	(0.9098)	(0.1179)	(0.5307)
CEO option ownership	1.653*	1.702	2.323*	3.347*	3.913**	5.964**
	(0.0568)	(0.1348)	(0.0682)	(0.0545)	(0.0201)	(0.0200)
Ln (CEO compensation)	-0.039**	0.011	-0.009	0.041*	-0.082**	0.003
	(0.0325)	(0.4527)	(0.7322)	(0.0958)	(0.0369)	(0.9469)
Ln (CEO age)	0.045	0.108	-0.353**	0.008	0.048	-0.014
	(0.6966)	(0.3179)	(0.0301)	(0.9572)	(0.8339)	(0.9473)
CEO-chairman duality	-0.001	0.030	0.018	0.079*	-0.094	0.073
	(0.9739)	(0.3413)	(0.6963)	(0.0596)	(0.3008)	(0.1527)
Institutional block ownership	0.108	0.132	0.091	0.409**	0.219	0.510**
	(0.3286)	(0.2629)	(0.5928)	(0.0121)	(0.3906)	(0.0177)
Firm and bank loan characteristics						
Ln (total asset)	-0.052**	-0.088***	-0.103***	-0.145***	-0.154***	-0.178***
	(0.0247)	(0.0005)	(0.0016)	(0.0000)	(0.0011)	(0.0001)
Profitability	-0.201	-0.208	-0.753**	-1.120***	-3.122***	-3.189***
	(0.4254)	(0.3428)	(0.0404)	(0.0014)	(0.0000)	(0.0000)
Book leverage	0.246***	0.220**	0.536***	0.516***	1.654***	1.318***
	(0.0085)	(0.0139)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Market to book	-0.048**	-0.056**	-0.079***	-0.050	-0.008	-0.029
	(0.0207)	(0.0108)	(0.0045)	(0.1124)	(0.8091)	(0.4344)
Tangibility	-0.038	0.080	0.004	0.217**	0.428***	0.241
	(0.6140)	(0.3492)	(0.9691)	(0.0344)	(0.0043)	(0.1000)
Cash flow volatility	0.649	0.474	2.657***	3.336***	3.658***	3.948***
	(0.1427)	(0.2016)	(0.0001)	(0.0000)	(0.0023)	(0.0000)
Ln (Loan amount)	0.016	0.020	0.043	0.042	-0.019	-0.004
	(0.3997)	(0.3880)	(0.1057)	(0.1778)	(0.6618)	(0.9331)
Ln (Loan maturity)	0.007	-0.014	0.026	0.002	-0.113	0.048
	(0.8259)	(0.6456)	(0.5058)	(0.9719)	(0.1223)	(0.5220)
Loan type and purpose fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES	YES	YES
Adjusted R^2 /Pseudo R^2	0.271	0.237	0.357	0.314	0.503	0.525
Number of observations	740	809	740	815	740	815

Table IX: OLS Regression of Collateral Requirement on Firm Characteristics: Firm Fixed Effects

The sample consists of 6,266 firm-loan observations covered in the Loan Pricing Corporation's DealScan database, Compustat, and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable is an indicator that takes the value of one if the bank loan is secured and zero otherwise. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980). The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Adoption guideline indicator	-0.049**	-0.065***	-0.066***	-0.051**
	(0.0282)	(0.0051)	(0.0052)	(0.0350)
CEO and governance characteristics				
CEO stock ownership	-0.167	-0.326*	-0.153	-0.036
	(0.2833)	(0.0721)	(0.4317)	(0.8562)
CEO option ownership	-0.656	-0.018	0.414	0.778
	(0.3506)	(0.9827)	(0.6660)	(0.4230)
Ln (CEO compensation)	0.005	-0.001	-0.000	0.008
	(0.5193)	(0.8693)	(0.9910)	(0.3998)
Ln (CEO age)	0.109	0.077	0.098	0.039
	(0.1316)	(0.3777)	(0.2826)	(0.6798)
Ln (CEO tenure)	-0.010	-0.010	-0.007	-0.002
	(0.3083)	(0.3584)	(0.5630)	(0.8378)
CEO-chairman duality	0.008	0.004	0.012	0.008
	(0.6209)	(0.8497)	(0.5564)	(0.6946)
Institutional block ownership	0.013	0.072	0.028	0.087
	(0.8184)	(0.2550)	(0.6790)	(0.2216)
Ln (S&P credit rating)		0.196***	0.187***	0.128**
		(0.0002)	(0.0006)	(0.0208)
G-index			-0.003	0.002
			(0.6887)	(0.7906)
Ln (board size)				-0.057
				(0.2773)
Independent board ratio				0.006
				(0.9291)
Firm and bank loan characteristics				
Ln (total asset)	-0.066***	-0.076***	-0.069***	-0.047*
	(0.0002)	(0.0004)	(0.0040)	(0.0664)
Profitability	-0.595***	-0.374**	-0.248	-0.154
	(0.0000)	(0.0168)	(0.1410)	(0.3734)
Book leverage	0.082	-0.051	-0.078	-0.104
	(0.1523)	(0.4668)	(0.3237)	(0.2031)
Market to book	-0.026**	-0.024*	-0.029**	-0.036***
	(0.0110)	(0.0580)	(0.0264)	(0.0057)
Tangibility	0.243**	-0.005	-0.022	-0.020
	(0.0139)	(0.9673)	(0.8550)	(0.8660)
Cash flow volatility	0.836**	0.606	0.526	0.684
	(0.0133)	(0.1692)	(0.3311)	(0.2093)
Ln (Loan amount)	-0.004	-0.011*	-0.012*	-0.018***
	(0.4439)	(0.0776)	(0.0744)	(0.0077)
Ln (Loan maturity)	-0.039***	-0.047***	-0.043***	-0.038***
	(0.0001)	(0.0000)	(0.0002)	(0.0009)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES
Adjusted R^2	0.091	0.106	0.097	0.091
Number of observations	6,266	4,539	4,173	3,940

Table X: OLS Regression of Loan Spreads on Firm Characteristics: Firm Fixed Effects

The sample consists of 6,266 firm-loan observations covered in the Loan Pricing Corporation's DealScan database, Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable is the loan spread charged by the bank over LIBOR. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980). The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Adoption guideline indicator	-0.127***	-0.109**	-0.101**	-0.051
	(0.0053)	(0.0241)	(0.0402)	(0.2820)
CEO and governance characteristics				
CEO stock ownership	0.316	-0.482	-0.781*	-0.450
	(0.3212)	(0.2041)	(0.0529)	(0.2572)
CEO option ownership	-0.624	0.143	-0.063	2.048
	(0.6659)	(0.9351)	(0.9749)	(0.2882)
Ln (CEO compensation)	-0.057***	-0.042**	-0.038**	-0.008
	(0.0003)	(0.0182)	(0.0360)	(0.6526)
Ln (CEO age)	0.164	0.220	0.262	0.217
	(0.2717)	(0.2276)	(0.1632)	(0.2471)
Ln (CEO tenure)	0.059***	0.052**	0.043*	0.046*
	(0.0025)	(0.0251)	(0.0734)	(0.0526)
CEO-chairman duality	-0.110***	-0.105**	-0.097**	-0.115***
	(0.0018)	(0.0106)	(0.0222)	(0.0054)
Institutional block ownership	0.299***	0.413***	0.452***	0.682***
	(0.0090)	(0.0017)	(0.0013)	(0.0000)
Ln (S&P credit rating)		0.747***	0.786***	0.708***
		(0.0000)	(0.0000)	(0.0000)
G-index			0.023	0.029*
			(0.1705)	(0.0888)
Ln (board size)				-0.051
				(0.6244)
Independent board ratio				-0.119
				(0.3344)
Firm and bank loan characteristics				
Ln (total asset)	-0.176***	-0.102**	-0.089*	-0.037
	(0.0000)	(0.0247)	(0.0722)	(0.4632)
Profitability	-2.825***	-2.093***	-2.196***	-1.696***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Book leverage	1.124***	0.853***	0.668***	0.512***
	(0.0000)	(0.0000)	(0.0000)	(0.0016)
Market to book	-0.031	-0.031	-0.010	-0.028
	(0.1360)	(0.2428)	(0.7129)	(0.2773)
Tangibility	0.787***	0.958***	0.689***	0.551**
	(0.0001)	(0.0001)	(0.0056)	(0.0223)
Cash flow volatility	2.616***	0.714	-0.274	0.815
	(0.0002)	(0.4384)	(0.8071)	(0.4510)
Ln (Loan amount)	-0.192***	-0.204***	-0.201***	-0.199***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Ln (Loan maturity)	-0.044**	-0.037	-0.010	-0.012
	(0.0264)	(0.1098)	(0.6832)	(0.6029)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES
Adjusted R^2	0.291	0.298	0.294	0.292
Number of observations	6,266	4,539	4,173	3,940

Table XI: Difference in Difference Regressions

The sample consists of 1,821 firm-loan observations covered in the Loan Pricing Corporation's DealScan database, Compustat and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. Firstly, for every guideline adoption firms, we apply propensity score matching to obtain three control firms with the closest propensity scores. Next, we match the list of firms with the DealScan database, and we also require that adoption firms and control firms must have at least one loan contract issued during the pre-adoption period and at least one loan contract issued during the post-adoption period. The treatment group indicator is equal to one if the firm has adopted the ownership guideline before 2004, and zero otherwise. The after adoption indicator is equal to one after the firm initiated the ownership guideline policy. The dependent variable in column (1) and (3) is the loan spread charged by the bank over LIBOR. The dependent variable in column (2) and (4) is an indicator that takes the value of one if the bank loan is secured and zero otherwise. All firm characteristics are measured as of the fiscal year-end immediately before the loan active date. Appendix provides a detailed description of the construction of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White 1980). The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Loan spread	Collateral requirement	Loan spread	Collateral requirement
	(1)	(2)	(3)	(4)
Treatment group indicator	-0.041	-0.049		
	(0.6789)	(0.3421)		
After adoption indicator	-0.205**	-0.109**	-0.176***	-0.073**
	(0.0451)	(0.0434)	(0.0061)	(0.0240)
CEO and governance characteristics				
CEO stock ownership	0.356	0.030	0.145	-0.266
	(0.5885)	(0.9013)	(0.7577)	(0.2642)
CEO option ownership	3.647	0.505	7.129***	1.429
	(0.2493)	(0.7328)	(0.0093)	(0.3026)
Ln (CEO compensation)	-0.004	-0.027	0.019	-0.005
	(0.9200)	(0.1879)	(0.4903)	(0.7191)
Ln (CEO age)	0.136	-0.039	-0.022	0.100
	(0.6353)	(0.7657)	(0.9272)	(0.4019)
Ln (CEO tenure)	-0.017	-0.027	0.051	-0.020
	(0.7174)	(0.1740)	(0.1529)	(0.2635)
CEO-chairman duality	-0.004	0.076**	-0.065	-0.001
	(0.9628)	(0.0301)	(0.2779)	(0.9696)
Institutional block ownership	0.254	-0.282**	0.076	-0.079
	(0.3921)	(0.0306)	(0.6818)	(0.4015)
Firm and bank loan characteristics				
Ln (total asset)	-0.058	-0.035	-0.160**	-0.060*
	(0.1923)	(0.1847)	(0.0131)	(0.0641)
Profitability	-3.131***	-0.705**	-4.964***	-1.020***
	(0.0001)	(0.0167)	(0.0000)	(0.0001)
Book leverage	1.758***	0.501***	0.913***	-0.043
	(0.0000)	(0.0000)	(0.0000)	(0.6646)
Market to book	-0.036	-0.075***	0.022	-0.026
	(0.4235)	(0.0042)	(0.5027)	(0.1043)
Tangibility	0.838***	0.165	1.349***	0.674***
	(0.0014)	(0.1442)	(0.0001)	(0.0001)
Cash flow volatility	5.651***	2.386***	3.858***	1.713***
	(0.0000)	(0.0000)	(0.0021)	(0.0070)
Ln (Loan amount)	-0.172***	-0.016	-0.189***	-0.013
	(0.0002)	(0.4316)	(0.0000)	(0.2090)
Ln (Loan maturity)	0.018	0.006	-0.007	-0.004
	(0.7793)	(0.8335)	(0.8446)	(0.8249)
Loan type and purpose fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	NO	NO
Type and purpose fixed effects	YES	YES	YES	YES
Firm fixed effects	NO	NO	YES	YES
Adjusted R^2 */Pseudo* R^2	0.558	0.376	0.334	0.119
Number of observations	1,821	1,681	1,821	1,821

Table XII: OLS Regression of Post-Adoption Firm Behavior on Firm Characteristics

The sample consists of 12,385 firm-year observations covered in Compustat, CRSP, and ExecuComp databases from 1996 to 2005. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain each firm's information on executive stock ownership guideline by extensively searching its proxy statement on form DEF14A filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's proxy statement report on form DEF14A makes no reference to the adoption of executive stock ownership guideline, we treat the firm in that year as a non-adoption firm. The dependent variable in column (1) is an indicator that takes the value of one if the firm uses derivative to hedge for interest rate risk and zero otherwise. The dependent variable in column (2) future 3 year's cash-flow volatility. The dependent variable in column (3) is an indicator that takes the value of one if the firm makes a diversified M&A (the acquirer and the target have different 2-digits of SIC code) and zero otherwise. The dependent variable in column (4) is the S&P long term credit rating (1 for rating AAA and 23 for rating D). The dependent variable in column (5) is the absolute value of total accruals. The dependent variable in column (6) is the absolute value of discretionary accruals. The dependent variable in column (7) is the accrual quality. All firm characteristics are measured as of the fiscal year-end. Appendix provides a detailed description of the construction of the variables. P-values are in parentheses. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980). The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Interest Rate Hedging Indicator	Future Cash-Flow Volatility	Diversified Merger and Acquisition Indicator	S&P Long Term Credit Rating	Absolute Total Accruals	Absolute Discretionary Accruals	Accrual Quality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Adoption guideline indicator	0.037**	-0.002**	0.031**	-0.108**	-0.005*	-0.005**	-0.004***
	(0.0160)	(0.0446)	(0.0287)	(0.0439)	(0.0876)	(0.0378)	(0.0057)
CEO and governance characteristics							
CEO stock ownership	0.203*	0.023***	-0.067	0.768	0.003	0.001	0.032***
	(0.0639)	(0.0048)	(0.5026)	(0.1422)	(0.8735)	(0.9728)	(0.0013)
CEO option ownership	0.171	0.028	0.129	1.791	-0.328***	-0.194***	-0.034
	(0.6792)	(0.3703)	(0.7329)	(0.3767)	(0.0000)	(0.0026)	(0.3761)
Ln (CEO compensation)	0.004	-0.000	0.008**	-0.030*	0.001	0.001	-0.000
	(0.3994)	(0.7633)	(0.0447)	(0.0935)	(0.1548)	(0.1086)	(0.9179)
Ln (CEO age)	0.022***	-0.001**	0.006	-0.077***	-0.004***	-0.001	-0.001
	(0.0002)	(0.0301)	(0.2267)	(0.0008)	(0.0002)	(0.1852)	(0.1805)
Ln (CEO tenure)	-0.139***	0.002	-0.051	0.088	-0.002	-0.010	-0.005
	(0.0007)	(0.5424)	(0.1714)	(0.6164)	(0.8212)	(0.1174)	(0.2097)
CEO-chairman duality	-0.018*	-0.000	0.006	0.051	-0.000	0.003*	0.003***
	(0.0959)	(0.6957)	(0.5145)	(0.2414)	(0.9617)	(0.0846)	(0.0008)
Institutional block ownership	0.022	-0.003	0.021	0.101	-0.003	-0.004	-0.010***
	(0.5419)	(0.2069)	(0.5242)	(0.4852)	(0.6420)	(0.5056)	(0.0019)
Firm characteristics							
Stock return	0.006	-0.000	0.002	0.100***	-0.001	0.000	0.003***
	(0.2408)	(0.6063)	(0.6689)	(0.0000)	(0.4865)	(0.9091)	(0.0000)
Ln (total asset)	0.056***	-0.001**	-0.010	-1.133***	-0.007***	-0.010***	-0.011***
	(0.0000)	(0.0448)	(0.2532)	(0.0000)	(0.0005)	(0.0000)	(0.0000)
Profitability	-0.113**	-0.008**	0.102**	-4.628***	-0.037***	-0.040***	-0.016***
	(0.0342)	(0.0420)	(0.0353)	(0.0000)	(0.0003)	(0.0000)	(0.0008)
Book leverage	0.313***	0.015***	-0.181***	3.165***	-0.003	-0.008	0.015***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.6907)	(0.1315)	(0.0000)
Market to Book	0.001	0.000	0.011***	-0.070***	0.003***	0.003***	0.003***
	(0.8057)	(0.1221)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R&D	0.049	0.023**	-0.518***	-4.167***	-0.088***	-0.051**	0.034**
	(0.7490)	(0.0456)	(0.0002)	(0.0000)	(0.0026)	(0.0314)	(0.0150)
Tangibility	-0.170***	0.007	0.005	-1.466***	0.063***	-0.011	-0.017***
	(0.0039)	(0.1067)	(0.9251)	(0.0000)	(0.0000)	(0.2182)	(0.0017)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.032	0.063	0.013	0.356	0.037	0.032	0.086
Number of observations	12,385	11,912	12,385	6,182	12,360	12,358	10,381

Appendix: Variable Definitions

This appendix provides a detailed description of the construction of all the variables used in the tables.

Variable	Definition
Absolute discretionary accrual	We use a version of the Jones (1991) model of accruals, which estimates nondiscretionary accruals as the fitted value from a regression of total accruals on lagged firm size, the change in firm sales, and gross property plant and equipment scaled by total firm assets for the sample firms in the same 2-digit SIC code industry group. The absolute discretionary accrual is the absolute value of the estimate residual from the previous regression (winsorized at the 1st and 99th percentiles).
Accrual quality	Standard deviation of the residuals from the regressions of current accruals on past, current, and future cash flows from operations, calculated over five-year rolling window (Francis et al. (2005)) (winsorized at the 1st and 99th percentiles).
Absolute Total Accruals	The absolute value of total accruals (winsorized at the 1st and 99th percentiles).
Adoption guideline indicator	Indicator that takes the value of one if the firm's proxy statement makes reference to the adoption of the executive stock ownership guideline and zero otherwise.
Book leverage	Long-term debt plus debt in current liabilities divided by total assets (winsorized at the 1st and 99th percentiles).
Cash flow volatility	Standard deviation of annual cash flows from operations over the past seven fiscal years, divided by the total assets (winsorized at the 1st and 99th percentiles).
Capital expenditure restriction	Indicator that takes the value of one if the bank loan contains capital expenditure restriction in the credit agreement and zero otherwise.
CEO-chairman duality	Indicator that takes the value of one if the CEO is also the chairman of the board and zero otherwise.
CEO option ownership	CEO's number of option holdings divided by the shares outstanding at the fiscal year end (winsorized at the 1st and 99th percentiles).
CEO stock ownership	CEO's number of stock holdings divided by the shares outstanding at the fiscal year end (winsorized at the 1st and 99th percentiles).
Collateral requirement	Indicator that takes the value of one if the bank loan is secured by collateral and zero otherwise (If the information about secured loan is missing, we set the indicator equal to zero).
Diversified M&A	Indicator that takes the value of one if the firm make a diversified M&A (the acquirer and the target have different 2-digits of SIC code) and zero otherwise.
Future cash-flow volatility	Standard deviation of quarterly cash flows from operations over the future three fiscal years, divided by the total assets (winsorized at the 1st and 99th percentiles).
Independent board ratio	The number of independent board members divided by the total number of board members.
Institutional block ownership	The number of shares hold by the institutional investor who holds more than 5% of a firm's equity divided by total shares outstanding (winsorized at the 1st and 99th percentiles).
Interest rate hedging	Indicator that takes the value of one if a firm engages in interest rate hedging in a given year and zero otherwise.
G-index (governance index)	The G-Index is constructed from data compiled by the Investor Responsibility

	Research Center ("IRRC"), as described in Gompers,Ishii, Metrick (2003). A firm's score is based on the number of shareholder rights-decreasing provisions a firm has. The index ranges from 0 to 24. A high G-index means weak shareholder rights
Ln (board size)	Natural log of the number of board members
Ln (CEO total compensation)	Natural log of the sum of cash salary, cash bonus, stock granted and Black-Scholes value of options granted to CEO.
Ln (CEO age)	Natural log of the CEO current age.
Ln (CEO tenure)	Natural log of the CEO current tenure.
Loan spread	All-in-drawn spread over LIBOR charged by the bank for the loan facility.
Loan type dummies	Indicators for loan type (term loan, revolver line of credit, 364-day facility and others).
Loan purpose dummies	Indicators for loan purpose (including corporate purposes, working capital, debt repayment, acquisition, backup line for commercial paper, and others).
Ln (loan amount)	Natural log of loan deal (facility) amount.
Ln (loan maturity)	Natural log of loan maturity.
Ln (S&P long-term credit rating)	Natural log of an issuer's long term S&P credit rating.
Ln (total asset)	Natural log of total assets.
Market to book	Market value of equity plus the book value of debt divided by total assets (winsorized at the 1st and 99th percentiles).
Profitability	Operating income before depreciation divided by total assets (winsorized at the 1st and 99th percentiles).
R&D	R&D expenditures divided by total assets. This variable is set to be zero if R&D expenditure is missing (winsorized at the 1st and 99th percentiles).
S&P long term credit rating	An issuer's long term S&P credit rating. Categorical credit ratings are converted into a cardinal variable measured on a 23-point scale (1 for rating AAA and 23 for rating D).
Tangibility	Net property, plant, and equipment divided by total assets (winsorized at the 1st and 99th percentiles).
Total Accrual	Earnings before extraordinary items and discontinued operations minus operating cash flows from continuing operations scaled by total asset (winsorized at the 1st and 99th percentiles).

Essay two: Supplier-Customer Relationships and Corporate Hedging Policy

Abstract

We investigate the relation between a firm's hedging policy and its major customer relationships. We find that the likelihood of a supplier using derivatives to hedge interest rate risk is higher when a major customer has high leverage. This result is increasing in the supplier's dependence on a major customer, such as when the customer represents a large share of its sales, when the supplier operates in a durable goods industry, or when the supplier makes high relationship-specific investments. We also find that hedging helps the supplier maintain durable relationships with customers, especially highly leveraged customers. Further, we find that announcements of customers' bond offers, credit rating downgrades, and bankruptcy have significant negative effects on the market value of non-hedging suppliers while they have much smaller effects on that of hedging suppliers. These results suggest that a major customer's financial distress risk is an important determinant of a supplier's hedging policy, and that supplier hedging helps increase the perceived viability of the future customer relationship and alleviate potential negative spillover effects along the supply chain.

Keywords: Supplier, Customer, Relationship, Corporate hedging, Risk management

JEL Classification: L14, G32, G33.

I. Introduction

In a Modigliani-Miller (1958) world, corporate hedging policy is irrelevant to firm value because in a perfect capital market, individual investors can always trade hedging instruments in their own accounts. However, corporate risk management using financial derivatives has become increasingly prevalent. For example, according to the Bank for International Settlements, the outstanding notional value of interest rate derivatives held by non-financial firms increased from $6.1 trillion at the end of 2000 to $37.4 trillion at the end of December 2011. Finance theory suggests that hedging increases firm value by reducing the expected costs of bankruptcy and financial distress (Smith and Stulz (1985), Stulz (1996)).[1] Consistent with this view, several studies show that hedging reduces stock mispricing (Lin, Pantzalis, and Park (2010)), increases firm value (Allayannis and Weston (2001), Zou (2010)), and lowers the cost of debt (Campello et al. (2011)).

Previous studies on the factors that affect a firm's hedging policy show that corporate tax convexity, financial distress, CEO risk-taking incentives, capital market imperfection, and industry competition are important determinants of corporate hedging policies (Smith and Stulz (1985), Froot, Scharfstein, and Stein (1993), Nance et al. (1993), Tufano (1996), Mian (1996), Géczy, Minton, and Schrand (1997), Graham and Smith (1999), Graham and Daniel (2002), Knopf, Nam, and Thornton (2002), Adam, Dasgupta, and Titman (2007), Purnanandam (2008)).[2] However, a firm's hedging policy can also depend on the firm's stakeholder relations. For example, Smith and Stulz (1985) and Stulz (1996) argue that important stakeholders such as employees, customers, and suppliers cannot diversify away their relationship disruption risk and thus require extra compensation for bearing the non-diversifiable risk of their claims.[3] Therefore, stakeholders with large claims should have strong incentives to use various hedging techniques to reduce their exposure to this non-diversifiable risk. Yet in spite of the importance of stakeholder relationships in corporate hedging policies, to date the literature has paid little attention to how stakeholder relationships and relationship-specific

[1] These costs include both direct and indirect bankruptcy costs due to the potential loss of customers, suppliers, other stakeholders, and growth opportunities (Bris et al. (2006), Purnanandam (2008)).

[2] Previous studies show that firms with a higher debt ratio, more convex tax functions, managerial compensation that is a concave function of firm value, or more costly external financing are more likely to adopt hedging policies.

[3] For example, if high cash flow uncertainty caused by the changes in interest rates increases the perceived risk of a firm's financial distress, the stakeholders who hold large claims on firm value will have to bear significant non-diversifiable risk due to relationship-specific nature of their claims.

characteristics affect a firm's hedging policy, and how a firm's hedging policy affects stakeholders' incentives to support their relationships and firm value.

In this study, we use a large sample of U.S. firms with major customer relationships to shed light on these unexplored issues. We consider a major customer as one that accounts for 10% or more of the supplier's total sales.[4] We focus on firms with major customer relationships for two reasons. First, major customers serve as the most important stakeholders in many firms. Such durable trading relationship is a prevailing business practice in the U.S. For example, Fee et al. (2006) show that almost 16% of Compustat firms in the U.S. have trading relationships with major public customers during the 1981 to 2001 period. Second, these bilateral relationships are known to create significant operating and financial interdependence between trading partners (Titman (1984), Maksimovic and Titman (1991), Kale and Shahrur (2007), Banerjee, Dasgupta, and Kim (2008), Johnson et al. (2012)). Therefore, the major customer relationship represents an ideal setting to examine how a firm's stakeholder relationships affect its hedging policy and how the hedging policy affects stakeholders' incentives to support their relationships.

Stulz (1996) argues that corporate hedging has significant impacts on the relationship between suppliers and customers. For example, customers should be reluctant to enter into long-term trading relationships with suppliers that have uncertain prospects since the durable trading relationships involve high levels of asset specificity (Williamson (1985, 1991)). Further, customers that use very specialized inputs in their production and are concerned about their suppliers' ability to fulfill warranty obligations in the future should be reluctant to buy products from volatile suppliers since they would suffer significant relationship breakup costs in the event of their suppliers' financial distress or bankruptcy (Titman (1984), Titman and Wessels (1988)).[5]

[4] SFAS 14 requires that public firms disclose the names of their principal customers that account for at least 10% of their total sales or whose purchase has a material impact on their businesses.

[5] Titman (1984) argues that customer incentives to make relationship-specific investments depend on the firm's financial condition since customers have to bear switching costs if the firm is liquidated. Since these switching costs are particularly large when the firm produces unique products, it has strong incentives to maintain lower leverage to reduce customers' concerns about its potential liquidation risk. Supporting this argument, several papers find that firms that produce unique products and those that have bilateral trading relationships maintain a low debt ratio (Titman and Wessels (1988), Kale and Shahrur (2007), Banerjee, Dasgupta, and Kim (2008)).

Previous studies also show that a customer's financial distress risk is transmitted through the supply chain (Hertzel et al. (2008), Kolay, Lemmon, and Tashjian (2012)), increasing the business uncertainty of the supplier. To reduce this uncertainty, the supplier may choose to engage in hedging. In these cases supplier hedging can add value since it reduces its future cash flow volatility and thus encourages more cooperative behavior among trading partners, which allows the supplier to receive more favorable contract terms from its customers. Therefore, supplier hedging should lower the expected switching costs associated with relationship breakup and reduce customer concerns about suppliers' potential liquidation risk, thus benefitting both customers and suppliers.

These arguments suggest several testable predictions. First, supplier that maintain the trading relationships with major customers, especially highly leveraged customers are more likely to adopt hedging policies than those that do not have such relationships. The risk of financial distress tends to increase with a firm's leverage and thus leverage can serve as an important financial indicator for the probability of a firm's financial distress (Nance et al. (1993), Opler and Titman (1994), Purnanandam (2008)). Opler and Titman (1994) show that during industry downturns, more leveraged firms lose market share to their less leveraged competitors, suggesting that suppliers' sales to customers are adversely affected if their customers have high leverage.

Because of the high costs associated with switching to new trading partners, suppliers will face difficulty in redeploying their relationship-specific assets if their trading relationships are terminated due to customers in financial distress. Further, suppliers experience negative stock price reactions around customers' bankruptcy filing announcements (Hertzel et al. (2008), Kolay, Lemmon, and Tashjian (2012)), suggesting that a customer's financial distress risk is transferred along the supply chain.[6] Thus, if a supplier depends on a major customer for sales, then customer leverage, as an indicator of the customer's financial reliability, should affect the supplier's own risk management policy. To the extent that hedging reduces a supplier's overall risk to stakeholders, customers will perceive the supplier's commitment to lower risk as a value-increasing action that benefits suppliers

[6] Consistent with the view that there exists a contagion effect along the supply chain, Planning Perspectives Inc., an auto industry consulting firm that conducted a survey of executives for suppliers of General Motors, finds that 68% of survey firms would have to downsize in the case of General Motors' bankruptcy while 12% would likely close (http://www.time.com/time /business/ article/0,8599,1862737,00.html).

and customers. Therefore, we expect supplier firms with highly leveraged customers to be more likely to implement hedging policies than other supplier firms.[7]

Second, previous studies show that supplier-customer relationships are governed largely by implicit contracts (Shleifer and Summers (1988)). Suppliers are more likely to abide by their implicit contracts when their relationships with trading partners involve high relationship-breakup costs, such as when a customer accounts for a large share of their sales, when they are required to make large relationship-specific investments (Williamson (1985)), or when their post-sale product support is important (Titman (1984)). Since switching costs associated with terminating existing relationships and establishing new relationships are high in these cases, the adverse effect of a customer's financial distress risk on suppliers is likely to be more severe. Therefore, we expect the positive effect of customer leverage on the likelihood of suppliers adopting hedging policies should be more pronounced when a supplier's sales to a major customer are higher, when the supplier's relationship-specific investments (R&D intensity) are larger[8], or when the supplier operates in a durable goods industry in which post-sale guarantees are important.

Third, the arguments above suggest that supplier hedging should help increase the durability of major customer relationships, particularly when customers have high leverage. Indeed, Stulz (1996) argues that customers prefer suppliers characterized by low uncertainty, such as hedging suppliers. Supplier hedging tends to increase supply chain stability by strengthening customers' incentives to commit to the trading relationship. In particular, since highly leveraged customers are vulnerable to an unexpected weakening of trading relationships, they are more fragile to supply chain disruptions than low leverage customers. Thus, we expect that customers with high leverage have strong incentives to maintain and strengthen the trading relationships with suppliers that engage in hedging activities.

[7] In this paper, we focus only on the supplier's hedging decision and examine how it affects major customer relationships. We focus on the supplier's hedging decision because the impact of a major customer's cash flow shock on suppliers is much more severe than a supplier's cash flow shock on customers. For example, Hertzel et al. (2008) show that customers do not suffer significant wealth effects when suppliers file for bankruptcy.

[8] Titman (1984), Titman and Wessels (1988), Fee et al. (2006), Kale and Shahrur (2007), Banerjee, Dasgupta, and Kim (2008), Katik, and Shahur (2008), and Johnson et al. (2012), consider that some of the R&D investments undertaken by suppliers and customers are specific to their relationship, and use the R&D intensity as a proxy for relationship specific investment.

Fourth, we expect that the negative contagion effect of customers' financial distress risk on supplier value is lower for hedging suppliers than for non-hedging suppliers. Negative news about a customer's financial reliability (e.g., new bond offering, credit rating downgrade, and bankruptcy announcement) can trigger negative spillover effects along the supply chain by transmitting adverse information about its financial health to the trading partner (Hertzel et al. (2007), Johnson et al. (2012), Kolay, Lemmon, and Tashjian (2012)). These negative spillover effects are likely to be mitigated for suppliers with hedging programs because hedging makes a supplier's internal capital market more efficient (Froot, Scharfstein, and Stein (1993)) and less vulnerable to customers' financial distress risk. More specifically, Froot, Scharfstein, and Stein (1993) argue that when external financing is more expensive than internal capital, hedging can add value, especially when the firm's ability to obtain external financing and its own cash flow are highly correlated. If a supplier's major customer is in financial distress, not only the supplier's future cash flow but also its ability to raise external capital will be significantly affected. In this case, to the extent that hedging suppliers have lower cash flow uncertainty and more internal resources to support operations or develop new customer relationships than non-hedging suppliers, supplier hedging should mitigate the negative spillover effects of a major customer's financial distress on supplier value. Thus, we expect the negative spillover effects on supplier value induced by customers' bond offerings, credit rating downgrades, and bankruptcy filings to be less pronounced for hedging suppliers than for non-hedging suppliers. We also expect the attenuating effect of supplier hedging to be stronger when a supplier's sales dependence on a major customer is higher, when its relationship-specific investments are larger, and when it operates in a durable goods industry.

Using hand-collected data on interest rate hedging for Standard & Poor's (S&P) 1500 firms from 1999 to 2008,[9] we find that suppliers are significantly more likely to pursue interest rate hedging if their major customers maintain high leverage. This positive relation between customer leverage and the likelihood of supplier hedging is more pronounced when the economic interdependence between a

[9] We do not consider foreign exchange rate hedging in our analysis because we require both the supplier and its major customer to be U.S. firms. Given that a supplier's sales to its major U.S. customer accounts for the main portion of its total sales (73.4% of our sample suppliers do not have any foreign sales), its exposure to foreign exchange risk is likely to be small.

supplier and major customers is higher, when the supplier makes larger relationship-specific investments, or when the supplier operates in a durable goods industry.

We next find that major customer relationships are less likely to be terminated, and a supplier's sales dependence on a major customer is more likely to increase, for hedging suppliers than for non-hedging suppliers. These results are particularly evident when customers have high leverage, suggesting that a supplier's hedging policies play an important role in supply chain stability when customers' perceived financial reliability is lower.

We also find that non-hedging suppliers experience significant negative abnormal returns around announcements of customers' bond offerings and credit rating downgrades, while hedging suppliers experience smaller impacts. This result is more pronounced when a hedging supplier's sales dependence on a major customer is higher, when it makes larger relationship-specific investments, or when it operates in a durable goods industry. We find similar results for customers' bankruptcy announcements.

Further supporting our hypothesis that the negative spillover effects on suppliers induced by an increase in a customer's distress risk is smaller for hedging suppliers, we find that changes in the bond yield spreads of the customer and those in the yield spreads of the supplier comove less if the supplier hedges. While a 100 basis point increase in the bond yield spreads of the customer is associated with a 32 basis point increase in the yield spreads of the non-hedging supplier, the corresponding increase in the yield spreads of the hedging supplier is only 25 basis points. Thus, supplier hedging results in an economically significant 22% [(32 – 25) / 32] reduction in comovement for hedging suppliers compared with that for non-hedging suppliers.

We perform tests to address potential endogeneity concerns related to reverse causality and omitted variable bias. For example, it could be the case that a supplier's hedging decision affects customer leverage, not the other way around. It is also possible that some omitted variables affect both the supplier's hedging decision and customer leverage at the same time, resulting in a spurious correlation. To address these concerns we examine changes in the hedging policies of supplier firms after they establish relationships with new customers. Since a new customer's leverage before

relationship establishment is unlikely to be affected by a supplier's hedging policies after relationship establishment, reverse causality is likely to be largely alleviated in this case. In addition, because we use changes in suppliers' hedging policies around new relationship establishment, the potential endogeneity bias caused by omitted unobservable supplier characteristics should be mitigated. We find that non-hedging suppliers are more likely to adopt hedging policies after they establish relationships with a highly leveraged new customer, particularly when they are more dependent upon the new customer, when they make larger relationship-specific investments, or when they operate in a durable goods industry.[10]

Overall, our results suggest that suppliers with a major customer relationship have an ex-ante incentive to consider the customer's financial distress risk in setting their hedging policies. The results also suggest that supplier hedging lowers the expected switching costs associated with relationship breakup and increases the durability of the supply chain relationship.

Our study contributes to the literature in several ways. First, our study is the first to examine how firms' hedging policies are affected by their stakeholder relations. Prior studies find that factors such as tax convexity (Smith and Stulz (1985), Graham and Smith (1999), Graham and Daniel (2002)), financial distress risk (Smith and Stulz (1985), Nance et al. (1993), Purnanandam (2008)), costly external financing (Froot, Scharfstein, and Stein (1993)), CEO risk-taking incentives (Knopf, Nam, and Thornton (2002)), and industry competition (Adam, Dasgupta, and Titman (2007)) affect firms' hedging policies. We show that firms' hedging policies also depend on their relationships with important stakeholders such as major customers.

Second, our paper extends the literature on product market relationships by examining how a customer's financial distress risk and relationship-specific characteristics affect suppliers' incentives to engage in hedging activities. Titman (1984) and Maksimovic and Titman (1991) argue that stakeholders' incentives to make firm-specific investments depend on the firm's financial condition. Kale and Shahrur (2007) and Banerjee, Dasgupta, and Kim (2008) show that firms that produce unique products and those with a major customer relationship have low leverage. We contribute to

[10] In an unreported test, we find that suppliers that adopt hedging policies after establishing a trading relationship with a highly leveraged new customer are less likely to discard their hedging policies in the future.

these studies by showing that suppliers' incentives to implement hedging policies depend on their customers' financial condition. We also find that the relation between the likelihood of adopting hedging policies by suppliers and customer financial condition is stronger when the supplier's sales are more dependent on a major customer, when their major customer relationship involves larger relationship-specific investment, and when their post-sale guarantees are important to customers.

Third, our study provides new evidence on the benefit of hedging by showing that hedging makes the supplier less vulnerable to customer financial distress risk and thus mitigates the negative spillover valuation effect caused by a weakening in major customer relationships.

The rest of the paper is organized as follows. In Section II, we describe the data and sample characteristics. Section III investigates the impact of customer leverage on the supplier's hedging decision. Section IV studies the effect of the supplier's hedging policy on the durability and strength of the supplier-customer relationship. Section V examines how supplier hedging helps mitigate the negative spillover effect of a customer's distress risk on its value. Section VI discusses robustness tests. Section VII summarizes and concludes the paper.

II. Data and Summary Statistics

II.1 Sample

Our initial sample includes all firms covered in S&P ExecuComp for the period from 1999 to 2008.[11] We restrict our sample to those firms whose stock return and financial data are available in CRSP and Compustat, respectively. We also exclude firms in the financial industry (primary SIC codes 6000-6999) since their hedging policies are known to be more complicated than those of

[11] We require our sample firms to be included in ExecuComp because we need CEO compensation data to control for the effect of CEO risk-taking incentives on a firm's hedging decision. Previous studies show that the firm's hedging decision is significantly affected by the risk attitude of its CEO (Smith and Stulz (1985), Tufano (1996), Knopf, Nam, and Thornton (2002)), suggesting that CEO compensation, particularly CEO option compensation, should be controlled for in analysis of corporate hedging policy.

industrial firms and they may use derivatives contracts for both trading and hedging purposes (Knopf, Nam, and Thornton (2002)).[12]

We obtain information on each firm's usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database.[13] Specifically, we read Item 7A of Form 10-K, "Quantitative and Qualitative Disclosures About Market Risk," to examine whether the firm uses interest rate derivatives for hedging.

If we are not able to obtain information on the usage of interest rate derivatives from Item 7A, we use the following keywords to locate the firm's use of interest rate derivatives in Form 10-K: "derivative," "hedge," "swap," "market risk," "forward contract," "option contract," and "risk management." When we find at least one of these keywords in Form 10-K, we carefully read its surrounding text to determine the firm's use of interest rate derivatives. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. Our sample comprises 2,037 firms (12,052 firm-years), of which 1,050 firms (4,016 firm-years) we identify as using financial derivatives to hedge interest rate risk at least once during our sample period.

We use the Compustat Segment Customer file to identify whether a firm discloses its major public customers.[14] To determine if a major customer is a publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. Out of 12,052 firm-year observations covered in S&P ExecuComp, CRSP, and Compustat from 1999 to 2008, 25.73% have major publicly traded customers. We use this sample of

[12] In untabulated tests, we exclude 14 firms in the utilities industry (primary SIC codes 4910-4940) from our main sample and obtain results that are almost identical to those reported in the paper.

[13] The Financial Accounting Standards Board (FASB) issued new accounting rules for derivatives and hedging transactions (FAS 133) in June 1998 that were effective after 2002. FAS 133, which requires firms to disclose the fair market value of derivatives contracts, replaced FAS 119, which allowed them to disclose the notional value of derivatives contracts. This change in accounting rules during our sample period prevents us from using the notional value of derivatives contracts in our analyses.

[14] SFAS 14 requires that public firms disclose the names of their principal customers that account for at least 10% of their total sales or whose purchase has a material impact on their businesses. The Compustat Segment Customer file provides the names of these principal customers.

12,052 firm-year observations to examine the impact of major customer relationships on the supplier hedging decision.

Since the test of whether customer financial distress risk and relationship-specific characteristics affect the supplier's hedging policy requires detailed financial information on customers, we further require firms to have at least one publicly traded customer covered in the Compustat Segment Customer file for this test. We identify 641 suppliers (4,154 supplier-customer-year observations) that have at least one major public customer.[15]

Finally, to avoid a potential cross-sectional dependence problem in estimating the standard errors when the supplier has multiple public customers, in a further test we only use customer-supplier pairs in which the customer's purchases account for the largest amount of a supplier's sales in a given year. This sample consists of 641 supplier firms (2,616 supplier firm-year observations), of which 263 firms (855 supplier firm-year observations) use interest rate derivatives for hedging. We use this sample to examine the impact of customer leverage and relationship-specific characteristics on supplier hedging and the spillover effects of customer financial distress risk on supplier value.

II.2 Summary Statistics

Panel A (B) of Table I reports the distribution of the sample of 2,616 supplier firms according to year (industry) and whether supplier firms use interest rate derivatives for hedging. Supplier firms using an interest rate derivative account for 32.7% of the sample. This number is comparable to the 35.6% in Campello et al. (2011), who examine the cost of bank loans for hedging firms. The fraction of supplier firms using interest rate derivatives does not vary much across years, ranging from a high in 2001 of 35.8% and a low in 2006 of 29.7%. In terms of industry distribution, the fraction of supplier firms using interest rate derivatives is the highest in the wholesale and retail trade industries (51.2%), followed by the transportation and utilities (48.6%), manufacturing (33.1%), mining and construction (32.7%), and service (20%) industries.

[15] There are 401 unique public firms that serve as major customers of these 641 suppliers.

Table II presents summary statistics for the sample suppliers (Panel A) and their publicly listed customers (Panel B). Several observations are worth noting. First, customers are on average larger than the suppliers. The average total asset for publicly traded customers is $46.3 billion while the corresponding values for hedging and non-hedging suppliers are $6.8 billion and $2.4 billion, respectively.

Second, compared to non-hedging suppliers, hedging suppliers are significantly larger and have higher leverage (long-term debt plus debt in current liabilities/total assets), higher profitability (return on assets), and more tangible assets (net property, plant, and equipment/total assets). They also hold less cash (sum of cash and short-term investments/total assets) and have a lower market-to-book ratio (market value of equity plus book value of debt/total assets), lower R&D intensity (R&D expenditures/total assets), and lower industry competition as measured by the industry Herfindahl index.

Third, compared with non-hedging suppliers, hedging suppliers have longer major customer relationships (median duration of 4 years versus 3 years) and depend more on major customers for their sales, as measured by the ratio of sales to major customers to total assets (median ratios of 15.42% versus 14.01%). Finally, the CEOs of hedging suppliers receive higher total compensation than the CEOs of non-hedging suppliers, and their compensation package consists of more stock compensation but less option and cash compensation. Detailed definitions of each of these variables are provided in the Appendix.

III. Impact of Customer Leverage on Supplier Hedging

III.1 Major Customer Relationships and Suppler Hedging

To investigate whether a firm's hedging decision is affected by its relationships with major customers, we estimate a logit regression of the supplier's hedging policy in which the dependent variable is an indicator that takes the value of one if the supplier uses interest rate hedging derivatives and zero otherwise. We use all nonfinancial firms (12,052 firm-year observations) covered in S&P

ExecuComp, CRSP, and Compustat from 1999 to 2008 for this analysis. Following Nance et al. (1993) and Purnanandam (2007), we control for firm size, book leverage, cash holdings, profitability, market-to-book ratio, R&D intensity, tangibility, and industry competition. We also control for the structure of CEO compensation, that is, CEO total compensation, CEO option compensation ratio, CEO stock compensation ratio, and CEO cash compensation ratio (Tufano (1996), Knopf, Nam, and Thornton (2002)).[16] Finally, we control for year and industry fixed effects. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by supplier firms.

The results are reported in Table III. In column (1), we include an indicator for having a major publicly traded customer as our key explanatory variable. We find that the coefficient estimate on this indicator is positive and significant at the 5% level, suggesting that firms with a major public customer are more likely to use interest rate derivatives for hedging than other firms. Its marginal effect has a coefficient estimate of 0.032, suggesting that the probability of using derivatives to hedge interest rate risk is approximately 3.2% points higher for firms with a major public customer than for firms without a major public customer. Given that the unconditional probability of using interest rate derivative hedging by our sample firms is 33.3%, this effect is economically large and significant.

In column (2), we further decompose major customers into high- and low-leverage customers according to the sample median customer leverage.[17] We find that the coefficient estimate on the high-leverage major public customer indicator is positive and significant at the 1% level while that on the low-leverage major public customer indicator is negative and insignificant. The marginal effect of the high-leverage major public customer indicator has a coefficient estimate of 0.073, suggesting that all else being equal, the probability of hedging interest rate risk is about 7.3% points higher for firms whose major public customer has high leverage than for firms without a major public customer. This result is consistent with our hypothesis that if suppliers are dependent on major customers for their

[16]As robustness tests, we replace the CEO's compensation structure with the CEO's risk-taking incentive measures, pay-performance sensitivity (delta), and sensitivity of CEO wealth to stock volatility (vega). The detailed results are discussed in Section VI.

[17] If the firm has multiple major public customers, we calculate customer leverage as the weighted average book leverage of the customers, where the weight is the ratio of the supplier's sales to each customer divided by its total sales to all major public customers.

sales, the customers' financial reliability is an important consideration for their risk management policy.

III.2 Relationship-specific Characteristics and Supplier Hedging

We next examine the determinants of a supplier firm's hedging decision in greater detail by focusing on customer leverage and relationship-specific characteristics as key variables of interest. Since these variables are only available for public customers, our analysis in this subsection is conducted with a reduced sample of 641 suppliers (4,154 supplier-customer-year observations) that have at least one major public customer.

The results are reported in Panel A of Table IV. The dependent variable is an indicator that takes the value of one if a supplier firm engages in interest rate hedging in a given year and zero otherwise. Our key independent variable of interest is customer leverage. The regressions control for other customer characteristics including firm size, profitability, market-to-book ratio, R&D intensity, and tangibility to mitigate the concern that customer leverage measures firm characteristics other than financial distress risk. We also include other variables used in Table III as additional controls. Finally, we control for two relationship strength variables, namely, the length of the supplier-customer relationship and the supplier's sales dependence on its major customers. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customers.

Column (1) reports the results using the full sample of 4,154 supplier-customer-year observations. We find that the probability that the supplier adopts an interest rate hedging policy increases significantly with customer leverage. A one-standard-deviation increase in customer leverage is associated with a 2.82% points increase in the likelihood of the supplier engaging in a hedging policy.

In columns (2) and (3), we decompose the sample into two subgroups according to the sample median (12.06%) of the supplier's sales dependence on its major customers. Consistent with our hypothesis that suppliers facing higher switching costs are more concerned about their customers'

financial health, we find that the positive and significant relation between customer leverage and the likelihood of supplier hedging exists only in the high-sales dependence group. Economically, for the high- (low-) sales dependence group, a one-standard-deviation increase in customer leverage is associated with a 4.62% (1.26%) increase in the likelihood of suppliers employing interest rate hedging.

In columns (4) and (5), we classify the sample into two subgroups according to whether the supplier operates in a durable goods industry (two digit SIC codes 34-39). Suppliers operating in a durable goods industry are more likely to provide unique products to their customers, thus facing higher switching costs if their customers fail. We therefore expect that suppliers in a durable goods industry are more concerned about their customers' financial distress risk and thus the effect of customer leverage on supplier hedging should be stronger. Consistent with this prediction, we find that the coefficient estimate on customer leverage is positive and significant only for the subgroup of suppliers in a durable goods industry.

In columns (6) and (7), we use the supplier's R&D intensity as another measure of switching costs and divide the sample into two subgroups according to the sample median (0.031) R&D intensity of suppliers. We find that the coefficient estimate on customer leverage is positive and significant only for the subsample of high R&D intensity suppliers, further supporting our hypothesis that suppliers facing high switching costs are more concerned about their customers' financial health.

In Panel B of Table IV, to avoid a potential cross-sectional dependence problem in estimating the standard errors when the supplier has multiple public customers, we only use customer-supplier pairs in which the customer's purchases account for the largest amount of a supplier's sales in a given year. We find results that are qualitatively similar to those presented in Panel A. The leverage of the largest customer has a significant positive impact on supplier hedging and this impact is more pronounced when the suppliers have high sales dependence on their largest customers, when they operate in a durable goods industry, or when their R&D intensity is high.

III.3 Correcting Endogeneity Bias: Suppliers' Hedging Decision after New Customer Relationship Establishment

Thus far, we have not explicitly considered endogeneity bias caused by omitted variables or reverse causality as discussed in the introduction. To address these potential endogeneity problems, we examine whether a supplier adopts a hedging policy after they establish a relationship with a new major customer (i.e., the customer makes a first-time significant purchase from the supplier).[18] Since the new customer's leverage before relationship establishment is unlikely to be affected by the supplier's future hedging policy afterwards, this test should mitigate the potential reverse causality problem that exists in our previous tests. Moreover, we expect this test to alleviate the omitted variable problem since we use the change in the supplier's hedging policy after relationship establishment.

The results are reported in Table V. The dependent variable is an indicator that takes the value of one if a non-hedging supplier adopts an interest rate hedging policy during the first three years of the new customer-supplier relationship establishment and zero otherwise. Our key variable of interest is the leverage ratio of the new customer before relationship establishment. Our control variables are the same as those used in Table IV except that we drop the length of the supplier-customer relationship from the regression.

Column (1) reports the results using the full sample. We find that a non-hedging supplier is more likely to adopt a hedging policy when its new customer has high leverage prior to relationship establishment. A one-standard-deviation increase in the new customer's leverage is associated with a 3.29% points increase in the likelihood of the supplier adopting a hedging policy within the next three years.

Columns (2) through (7) show that this positive relation between customer leverage and supplier hedging policy is more pronounced when non-hedging suppliers have higher sales

[18] The sample used in this subsection consists of 520 supplier-customer-year observations (293 suppliers and 232 new customers) from 1999 to 2005. We end the sample period in 2005 because we examine changes in a supplier's hedging policy during the first three years of the new customer-supplier relationship.

dependence on their new customer, when they operate in a durable goods industry, and when they make higher relationship-specific investments. The coefficient estimates of the regressions suggest that a one-standard-deviation increase in customer leverage is associated with 6.6%, 4.98%, and 2.96% points increases in the likelihood of suppliers employing interest rate hedging, respectively. In untabulated tests, we also find that after a new relationship is established, hedging suppliers are less likely to abandon their hedging policy if new customers have high leverage.

Thus, our results that the likelihood of suppliers engaging in hedging activities increases with customer leverage are robust to controlling for endogeneity concerns, providing further support to our hypotheses.

IV. Impact of Suppliers' Hedging Policy on the Strength of Major Customer Relationships

In this section we analyze the impact of a supplier's hedging policy on the strength of customer-supplier relationships. Using a sample of 851 customer-supplier pairs whose relationships are newly established between 1999 and 2007,[19] we examine whether supplier hedging helps increase relationship strength, as measured by the duration of customer-supplier relationships and the supplier's sales dependence on the new customer.

More specifically, we estimate the duration of customer-supplier relationships at the time when the relationship is newly established using a COX model, and we estimate relationship expansion (i.e., the increase in a supplier's sales dependence) using a logit model in which the dependent variable is an indicator that takes the value of one if the one-year change in a supplier's sales dependence on the new customer after relationship establishment is higher than the sample median and zero otherwise.[20]

[19] We do not include supplier-customer relationships in 2008 since the analysis in this section requires that at least one year be observed after the supplier's hedging policy decision to measure the change in relationship strength. We find that our sample customer-supplier relationships last 3.34 years on average. The average change in a supplier's sales dependence on a new customer is approximately zero.

[20] For the logit model analysis, we require that customer-supplier relationships continue in the year after relationship establishment.

Table VI reports the results. Columns (1) through (3) correspond to the Cox model and columns (4) through (6) to the logit model. Our key variable of interest is an indicator that equals one if the supplier uses interest rate hedging and zero otherwise. Columns (1) and (4) report the results using the full sample and the other columns report the results using the subsamples classified according to the sample median of customer leverage.

We find that supplier hedging increases relationship duration, significant at the 5% level (column (1)).[21] We also find that supplier hedging significantly increases the likelihood of relationship expansion, significant at the 5% level (column (4)): all else being equal, compared to non-hedging suppliers, hedging suppliers experience a 13% points higher probability of an above-median change in sales dependence on the new customer. These results suggest that the effect of supplier hedging on relationship strength is both statistically and economically significant.

Moreover, in columns (2) and (3) we find that the positive effect of supplier hedging on relationship duration is particularly pronounced when the customer has high leverage. Columns (5) and (6) further show that the positive relation between supplier hedging and the likelihood of an increase in the supplier's sales dependence on the new customer is stronger in the high-leverage customer subsample than in the low-leverage customer subsample (marginal effects of 16.9% points compared with 2.0% points).

Overall, these results provide strong support to our hypothesis that supplier hedging increases the durability of major customer relationships as well as the supplier's sales dependence on the major customer, especially when its major customer has high leverage.

V. Supplier Hedging and Spillover Effect

In this section we examine how supplier hedging influences the negative spillover effect of a customer's financial distress risk on supplier value. Using announcements of major customers' new debt issuances, credit rating downgrades, and bankruptcies as signals of an increase in customer

[21] In columns (1) through (3), we report the estimated coefficients. Thus, a positive (negative) coefficient means that the hazard rate is above (below) one, indicating that the relationship duration becomes weaker (stronger).

distress risk, we examine whether announcements of these events have less negative effects on the market value of hedging suppliers than on that of non-hedging suppliers. We also examine whether supplier hedging reduces the comovement of changes in bond yield spreads between the supplier and the customer.

V.1 Abnormal Returns of Suppliers around Announcements of Customers' Bond Offerings, Rating Downgrades, and Bankruptcies

In this subsection, we use bond offering announcements by major customers, the announcements of customer credit downgrades by rating agencies, and customer bankruptcy announcements as events that trigger negative spillover effects since these events are likely to convey unfavorable information about a customer's financial health and thus affect the value of its suppliers. To the extent that hedging makes suppliers less vulnerable to customers' financial distress, we expect that suppliers' abnormal returns around these announcements are less negative when the suppliers have already adopted hedging policies, particularly when their sales dependence on the customer is higher, when their relationship-specific investments are larger, or when they operate in a durable goods industry.

V.1 .1 Univariate Analysis

We obtain information on customer bond offerings from Thompson's SDC New Issues database for the 1999 to 2008 period, customer bond rating downgrades from Mergent Fixed Investment Securities Database (FISD), and customer bankruptcy filings from SDC Bankruptcies database. We only use the major customer whose purchases account for the largest amount of a supplier's sales to avoid a cross-sectional dependence problem in estimating the abnormal returns.[22]

[22] Since we use the market-model approach to estimate abnormal returns for suppliers around their customers' bond offering and credit downgrade announcements, the event windows and estimation periods to compute their abnormal returns for suppliers that share the same customer perfectly overlap. As a result, it is likely that the *t*-statistics in the analyses of abnormal returns using all suppliers of major customers are biased upwards. We therefore use only a supplier and its largest customer in this analysis.

For each bond issue, we use its filing date as the announcement date. If the bond has only the issue date (i.e., private placement), we use its issue date as the announcement date.[23] Following Jorion, Liu, and Shi (2005), we use the effective date of the bond rating downgrade reported in FISD as the rating downgrade announcement date. For bankruptcy events, we follow Hertzel et al. (2007) and use the pre-filing distress date as the bankruptcy announcement date.[24] In addition, we search Factiva for major confounding corporate news (earnings announcements, annual report filings, quarterly report filings, CEO turnover, and mergers and acquisitions) within one trading day before and after the announcement and exclude observations associated with such news. These criteria yield samples of 168 customer bond offerings (including 96 private placements under rule 144A), 202 customer bond rating downgrades, and 15 customer bankruptcy filings. Our final samples consists of 577, 415, and 23 suppliers whose largest customer issues bonds, experiences a rating downgrade, and files for bankruptcy, respectively.[25]

We calculate abnormal returns using a market model. We obtain our estimates of the market model by using one year (255 trading days) of return data, beginning 301 days before and ending 46 days before the announcement date. We use the CRSP equally weighted index as the market portfolio. We aggregate daily abnormal returns to obtain the cumulative abnormal return (CAR) from one day before the announcement date to one day after the announcement date.

Panel A of Table VII reports the mean and median CAR (-1, 1) for supplier firms around bond offering announcements by the largest customer. We find that supplier firms on average earn a negative but statistically insignificant CAR (-1, 1) of approximately -0.14% around the customer bond offer announcement date.[26] The average CAR (-1, 1) for the hedging suppliers is 0.59%, and the corresponding CAR for the non-hedging suppliers is a significant -0.57%. The difference in mean CAR (-1, 1) between the two groups is statistically significant at the 1% level. The median CARs

[23] To check the accuracy of using the filing date or the issue date as the announcement date, we randomly select 20 bonds and search the dates that their issues are first disclosed in *Factiva.* We find that approximately 80% of the news announcement dates fall within one day before and after the filing date. Carayannopoulos and Nayak (2010) use the issue date as the announcement date for private placements under rule 144a.

[24] To have a clean test of the contagion effects along the supply chain, Hertzel et al. (2007) use the distress date as the announcement date, which is the pre-filing date with the most significant abnormal drop in the market value of the filing firm in the year leading up to the bankruptcy filing.

[25] In some cases, multiple suppliers share the same customer as their largest customer.

[26] The mean CAR (-1, 1) for the customers is an insignificant -0.063%. In comparison, Eckbo (1986) finds that the mean CAR (-1, 0) for his sample of straight bond offerings is an insignificant -0.06%.

show a similar pattern. These results suggest that the stock market perceives an increase in customers' financial leverage as a value-decreasing event only for non-hedging suppliers, supporting our hypothesis that hedging makes suppliers less vulnerable to customers' financial distress risk.

Panel B of Table VII reports the mean and median CAR (-1, 1) for suppliers around announcements of customer credit downgrades by rating agencies. The mean CAR (-1, 1) for the full sample of suppliers is a significant -0.43%. In untabulated tests, we find that the mean CAR (-1, 1) for the downgraded customers is a significant -2.11%. These results are consistent with those of Hertzel et al. (2007) and Kolay, Lemmon, and Tashjian (2012), who document a negative contagion effect of a customer's distress risk on supplier value. Dividing suppliers into hedging and non-hedging suppliers, we find that the negative CAR (-1, 1) for the full sample is driven largely by non-hedging suppliers. Thus, the negative spillover effects for suppliers induced by an increase in customer financial distress risk arise only when suppliers do not engage in hedging.

To further examine how supplier hedging affects the negative spillover effects of customer financial distress risk, in untabulated tests we examine whether the valuation effects for hedging suppliers are less negative than those for non-hedging suppliers around major customers' bankruptcy announcements. The average CAR (-1, 1) for hedging suppliers (N = 7) is an insignificant -0.234% while the average CAR (-1, 1) for non-hedging suppliers (N = 16) is a significant -7.36%. The difference in these CARs is significant at the 5% level. These results further support our hypothesis that hedging plays an important role in mitigating adverse spillover effects of customers' financial distress risk.

V.1 .2 Multivariate Analysis

To better understand the cross-sectional variation in abnormal returns for supplier firms around bond offering announcements by their largest customer or around announcements of customer credit downgrades by rating agencies, we now turn to multivariate regressions in which the dependent variable is the supplier CAR (-1, 1) around these announcement dates. Our key variable of interest is

the supplier's hedging indicator, which takes the value of one if the supplier uses derivatives instruments to hedge interest rate risk and zero otherwise. Following Eckbo (1986), Jorion, Liu, and Shi (2005), and Carayannopoulos and Nayak (2010), we control for several variables related to bond offerings and credit rating downgrades.

Table VIII presents the estimates from the multivariate regressions. All regressions are estimated using ordinary least squares (OLS). The dependent variable in columns (1) through (4) is the supplier CAR (-1, 1) around bond offering announcements by the firm's largest customer. In column (1), the coefficient estimate on the supplier's hedging indicator is 0.011 with a p-value of 0.0368. This result indicates that all else being equal, hedging suppliers realize a 1.1% point higher abnormal announcement return than non-hedging suppliers. Therefore, the effect of hedging on supplier value is both statistically and economically significant, suggesting that hedging plays an important role in mitigating adverse spillover effects of customers' deteriorating financial health.

To more closely examine the effect of hedging on supplier value, in next three regressions we include interaction terms between the supplier hedging indicator and indicators that measure the extent of a supplier's switching costs (indicator for high sales dependence on the customer, indicator for operating in the durable goods industry, and indicator for high R&D intensity). Consistent with our expectations, we find that the coefficient estimates on the interaction terms between the supplier hedging indicator and the indicators for durable goods industries and high R&D intensity are positive and significant (columns (3) and (4)). Thus, hedging suppliers experience smaller wealth losses than non-hedging suppliers, particularly when they operate in a durable goods industry in which post-sale guarantees are important (Titman (1984)) or when they make larger relationship-specific investments, suggesting that hedging benefits are particularly strong for suppliers that face greater switching costs.

In columns (5) through (8), we reestimate the regressions in columns (1) through (4) using as the dependent variable the supplier CAR (-1, 1) around announcements of customer credit downgrades by rating agencies. The results echo those in columns (1) through (4). The only difference is that the coefficient estimate on the interaction term between the supplier hedging indicator and the indicator for high sales dependence now is positive and significant at the 10% level (column (6)).

In sum, the results show that customers' deteriorating financial health has significantly smaller negative spillover effects on the value of hedging suppliers than on that of non-hedging suppliers, particularly when hedging suppliers depend on the customers for a significant proportion of their revenues, when they produce relationship-specific products that cannot be easily redeployed to other uses, or when their relationship-specific investments are larger. These results suggest that the value-enhancing role of hedging in customer-supplier relationships is particularly important when these relationships involve greater asset specificity and product customization.

V.2 Supplier Hedging and the Comovement of Yield Spread Changes between the Supplier and the Customer

As a further test of whether supplier hedging alleviates the negative spillover effects, we examine whether it reduces comovement in the changes in bond yield spreads between the customer and the supplier. If a negative cash flow shock to the customer has an adverse effect on the supplier, we expect the change in the customer's bond yield spreads to be positively related to the change in the supplier's bond yield spreads, but that this positive relation is less pronounced for hedging suppliers.

To address this issue, we merge our supplier and customer sample with the Bank of America Merrill Lynch US Corporate and High Yield Master Bond Index Database and identify a sample of 112 supplier-customer pairs (5,238 supplier-customer bond pairs) for which bond yield data are available for both the customer and the supplier.[27] We then regress the monthly (yearly) change in yield spreads of the supplier on the contemporaneous change in yield spreads of the customer and its interaction with the indicator for supplier hedging. The regressions control for the variables used in the Table IV regressions as well as several risk factors that affect bond and equity markets such as the change in credit spread, the change in term spread, the market excess return, SMB, and HML.[28] Our

[27] Bond yield spreads are the option-adjusted yield spreads reported in the Bank of America Merrill Lynch US Corporate and High Yield Master Bond Index Database. The option-adjusted yield spread measures the amount by which a risk-free spot curve must be raised or lowered so that the resulting discounted cash flows equal the market price of the bond. Since this measure simultaneously considers credit risk and contingent cash flow risk, bonds with different cash flow characteristics can be compared on a more equal basis.

[28] Change in term spread is the monthly change in term spread, which is measured as the difference between the yields of 10-year Treasury bonds and 1-year Treasury bonds. Change in credit spread is the monthly change in credit spread, which is

key variable of interest is the interaction term between the changes in yield spreads of the customer and the indicator for supplier hedging.

The results are reported in Table IX. In columns (1) through (3), we use the monthly changes in yield spreads. In column (4), we use yearly changes in yield spreads by aggregating monthly changes in yield spreads. Consistent with our hypothesis, we find that there is a strong spillover effect from the customer to the supplier if the customer's default risk increases. The coefficient estimate on the change in the yield spreads of the customer is 0.315 (column (3)), suggesting that a 100 basis point increase in the yield spreads of the customer is associated with a 32 basis point increase in the yield spreads of the non-hedging supplier. However, the coefficient estimate on the interaction term between the change in yield spreads of the customer and the indicator for supplier hedging is significantly negative (-0.062) at the 1% level, suggesting that a 100 basis point increase in the yield spreads of the customer is associated with an only 25 basis point increase in the yield spreads of the hedging supplier. Thus, the extent of comovement between changes in the customer's yield spreads and those in the supplier's yield spreads is significantly reduced if the supplier engages in hedging.

VI. Robustness Tests

To check the robustness of our key results, we conduct several additional tests. First, we reestimate the key regressions in Tables III and IV by adding several additional control variables. Smith and Stulz (1985), Tufano (1996), and Knopf, Nam, and Thornton (2002) suggest that CEO risk-taking incentives significantly affect a firm's hedging decision. Accordingly, we control for pay-for-performance sensitivity (delta) and the sensitivity of CEO wealth to stock volatility (vega) in the regressions. We also control for the trade credit ratio of the customer and the supplier because the customer's trade credit is part of its debt and it can use its high trade credit to finance its operations. We further control for customer industry fixed effects (first digit of SIC codes) and customer industry

measured as the difference between the yields of the average Moody's BAA corporate bond and AAA corporate bond. Market excess return is measured as the excess return of the market portfolio over the risk-free rate, SMB is measured as the return difference between small and large capitalization stocks, and HML is measured as the return difference between high and low book-to-market stocks. Information on Treasury bond yields and Moody's Baa corporate bond yields are obtained from the FRED database at the Federal Reserve Bank of Saint Louis.

competition as measured by the Herfindahl-Hirschman Index to alleviate the concern that omitted customer industry factors drive our results. Finally, we control for the customer's use of derivatives to hedge interest rate risk.

The results are reported in rows (1), (4), and (7) of Table X. For the sake of brevity, we only report the results for our key variables of interest. We find that all of our previous results continue to hold: the relation between customer leverage and supplier hedging remains strongly positive and significant.

Second, we reestimate these three regressions by replacing customer leverage-related variables with two alternative measures of customer distress risk, namely, the KMV distance-to-default measure based on the Merton (1977) model (Crosbie and Bohn (2001)), a widely used market-based measure of corporate default risk, and the CHZ distress measure (Campbell, Hilscher, and Szilagyi (2008)), an accounting-based measure of corporate default risk. Results using the former measure are reported in rows (2), (5), and (8) of Table X and those using the latter measure are reported in rows (3), (6), and (9) of Table X. We find that the results remain qualitatively similar, suggesting that customer distress risk does indeed have a significant positive effect on suppliers' hedging decision.

Third, it is also possible that the positive relation between customer's leverage and supplier's hedging may be linked through the size factors in both firms. For example, large customers have high leverage and tend to do business with large suppliers, and large suppliers are more financial sophisticated so they are more likely to hedge. In order to address this concern, I set up a large customer indicator (customer's total asset is higher than sample median), large supplier indicator (supplier's total asset is higher than the sample median) and the interaction between large customer and large supplier indicators. We regress supplier hedging decision on these three variables and find that the coefficient on the interaction term is highly insignificant.

Fourth, we refine the definition of durable goods industry, excluding firms from the following industries: SIC 3571: Electronic Computers; SIC 3570: Computer & office Equipment; SIC 3630:

Household Appliances; SIC 3634: Electric Housewares & Fans; SIC 3651: Household Audio & Video Equipment; SIC 3942: Dolls & Stuffed Toys; SIC 3944: Games, Toys & Children's Vehicles; SIC 3949: Sporting & Athletic Goods, and SIC 3950: Pens, Pencils & Other Artists' Materials. We still find that the impact of customer leverage on supplier hedging is more pronounced on the durable intermediate goods industry.

Finally, it is possible that a firm chooses not to hedge interest rate risk if it is not exposed to any significant risk in the first place. To address this possibility, we exclude from the sample 15 firms (121 supplier-customer-year observations) that explicitly state in Item 7A of Form 10-K that they do not have any sizable exposure to interest rate risk and repeat all analyses in the paper. All of our results continue to go through.

VII. Conclusion

In this paper we investigate how a firm's hedging policy is affected by its major customer relationships. Using a large sample of supplier firms with major customer relationship from 1999 to 2008 and hand-collected data on interest rate hedging, we find that customer financial distress risk and relationship-specific characteristics are important determinants of suppliers' hedging decision. We also find that hedging helps strengthen suppliers' relationships with their major customers and alleviates adverse negative spillover effects of customer financial distress risk on supplier value.

More specifically, we find that the likelihood of a supplier firm using an interest rate hedging instrument is significantly higher if a major customer faces high financial distress risk, as measured by a high leverage ratio, a high market-based distance-to-default ratio, or a high accounting-based distress ratio. These results are more pronounced when hedging suppliers depend on the major customer for a significant proportion of their revenues, when they produce relationship-specific products that cannot be easily redeployed to other uses (i.e., they operate in a durable goods industry), or when their relationship-specific investments (i.e., R&D investments) are larger. These results are

robust to controlling for potential endogeneity bias such as reverse causality and omitted variable problems.

We also find that existing major customer relationships are less likely to be terminated and suppliers' sales dependence on their major customers is more likely to increase when the suppliers use interest rate hedging. These results are particularly evident when the major customers have high leverage, suggesting that suppliers' hedging policies play an important role in supply chain stability.

Furthermore, we find significantly negative stock price reactions for non-hedging suppliers around announcements of customers' bond offering and credit rating downgrades, but no such negative stock price reactions for hedging suppliers, suggesting that hedging makes suppliers less vulnerable to customer financial distress risk. The difference in announcement returns between hedging and non-hedging suppliers is particularly strong when hedging suppliers' sales dependence on the major customer is large, when they make large relationship-specific investments, or when they operate in a durable goods industry. We find similar results for customers' bankruptcy announcements.

Overall, these findings suggest that customer financial distress risk and relationship-specific characteristics are important determinants of suppliers' hedging decision. The results also suggest that supplier hedging affects stakeholders' incentives to support the trading relationships, and helps stabilize existing customer-supplier relationships by lowering the expected switching costs associated with potential relationship breakup.

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Table I: Sample Distribution by Year and Industry

The sample consists of 2,616 supplier-year observations covered in Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases from 1999 to 2008. To be included in the sample, the supplier is required to have at least one publicly traded customer. Firms in the financial industries (primary SIC codes 6000-6999) are also excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. Panel A (b) presents the distribution of sample suppliers according to year (industry) and whether supplier firms use interest rate derivatives for hedging.

Panel A. Distribution of Hedging Suppliers and Non-hedging Suppliers by Year

Year	Number of Suppliers	Number of Hedging Suppliers	Number of Non-hedging Suppliers
1999	208	67 (32.2%)	141 (67.8%)
2000	160	52 (32.5%)	108 (67.5%)
2001	237	85 (35.8%)	152 (64.2%)
2002	258	91 (35.2%)	167 (64.8%)
2003	299	103 (34.5%)	196 (65.5%)
2004	312	104 (33.3%)	208 (66.7%)
2005	299	93 (31.1%)	206 (68.9%)
2006	286	85 (29.7%)	201 (70.3%)
2007	295	91 (30.8%)	204 (69.2%)
2008	262	84 (32.1%)	178 (67.9%)
Total	2,616	855 (32.7%)	1,761 (67.3%)

Panel B. Distribution of Hedging Suppliers and Non-hedging Suppliers by Industry

Two-digit SIC industry	Number of suppliers	Number of Hedging Suppliers	Number of Non-Hedging Suppliers
Mining and construction (Two-digit SIC =10-17)	183	60 (32.7%)	123 (67.3%)
Manufacturing (Two-digit SIC=20-39)	1,902	631 (33.1%)	1,271 (66.9%)
Transportation and Utility (Two-digit SIC =40-49)	72	35 (48.6%)	37 (51.4%)
Wholesale and retail trade (Two-digit SIC=50-59)	119	61 (51.2%)	58 (49.8%)
Services (Two-digit SIC=70-89)	340	68 (20.0%)	272 (80.0%)
Total	2,616	855 (32.7%)	1,761 (67.3%)

Table II: Suppliers and Customers Firm Characteristics

The sample consists of 2,616 supplier-year and 1,567 customer-year observations covered in Compustat Segment Customer, CRSP, Compustat and ExecuComp databases from 1999 to 2008. To be included in the sample, the supplier is required to have at least one publicly traded customer. Firms in the financial industries (primary SIC codes 6000-6999) are also excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. All firm characteristics are measured as of the fiscal year-end. The Appendix provides a detailed description of the construction of the variables. The numbers in the test-of-difference columns are *t*-values or *z-values*. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Supplier Characteristics

	Hedging Suppliers (N=855): A		Non-hedging Suppliers (N=1,761): B		Test of Difference (A-B)	
	Mean	Median	Mean	Median	t-test	Wilcoxon test
Firm size ($ billions)	6.824	2.573	2.424	0.690	9.116***	21.234***
Book leverage	0.294	0.287	0.162	0.090	14.384***	20.476***
Cash holdings	0.093	0.046	0.274	0.236	-22.024***	-21.160***
Profitability	0.142	0.135	0.097	0.112	7.247***	7.765***
Market to book	1.903	1.538	2.402	1.721	-6.024***	-6.215***
R&D intensity	0.029	0.010	0.068	0.046	-12.622***	-11.498***
Tangibility	0.295	0.240	0.211	0.150	10.278***	13.526***
Industry competition	0.283	0.231	0.217	0.165	8.384***	8.172***
customer-supplier relationship length	4.860	4.000	4.069	3.000	2.947***	3.026***
Sales dependence (%)	20.711	15.417	19.562	14.011	1.066	1.973**
CEO total compensation ($ millions)	6.115	3.762	4.485	2.062	2.811***	11.507***
CEO option compensation ratio	0.329	0.313	0.371	0.369	-3.151***	-2.737**
CEO stock compensation ratio	0.116	0.000	0.079	0.000	4.943***	7.429***
CEO cash compensation ratio	0.414	0.357	0.451	0.371	-3.036***	-2.015**

Panel B. Customer Characteristics

	Mean	Median
Firm size ($ millions)	46.253	15.283
Book leverage	0.236	0.232
Profitability	0.134	0.136
Market to book	2.177	1.723
R&D intensity	0.0287	0.00262
Tangibility	0.297	0.249

Table III: Logit Regression of Suppliers' Hedging Decision on Supplier Characteristics

The sample consists of 12,052 firm-year observations covered in CRSP, Compustat, and ExecuComp databases from 1999 to 2008. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The dependent variable is an indicator that takes the value of one if firms hedge interest rate risk and zero otherwise. The coefficients reported are estimates of the average marginal effect on the probability. Industries are classified according to the first two digits of the SIC. The Appendix provides a detailed description of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Firms have a major public customer (indicator)	0.032**	
	(0.0497)	
Firms have a low-leveraged public customer (indicator)		-0.008
		(0.6924)
Firms have a high-leverage public customer (indicator)		0.073***
		(0.0028)
CEO total compensation	0.018**	0.018**
	(0.0155)	(0.0152)
CEO option compensation ratio	-0.037	-0.036
	(0.2157)	(0.2321)
CEO stock compensation ratio	-0.060*	-0.058*
	(0.0786)	(0.0872)
CEO cash compensation ratio	-0.034	-0.032
	(0.2768)	(0.3067)
Firm size	0.065***	0.064***
	(0.0000)	(0.0000)
Book leverage	0.370***	0.369***
	(0.0000)	(0.0000)
Cash holding	-0.563***	-0.549***
	(0.0000)	(0.0000)
Profitability	0.254***	0.252***
	(0.0018)	(0.0018)
Market to book	-0.008	-0.008
	(0.1750)	(0.1825)
R&D intensity	-0.295	-0.281
	(0.1007)	(0.1153)
Tangibility	-0.064	-0.066
	(0.1604)	(0.1441)
Industry competition	0.064	0.064
	(0.1499)	(0.1534)
Year fixed effects	YES	YES
Industry fixed effects	YES	YES
Cluster by firm	YES	YES
Pseudo R^2	0.195	0.196
No. of observations	12052	12052

Table IV: Logit Regression of Supplier's Hedging Decision on Customer Firm Characteristics

The sample consists of 4,154 (Panel A) and 2,616 (Panel B) supplier-customer-year observations covered in the Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases from 1999 to 2008. To be included in the sample, the supplier is required to have at least one publicly traded customer. In Panel B, only a supplier and its largest publicly traded customer are considered; when the supplier has multiple customers, the customer purchasing the largest amount of raw materials and intermediate products from the supplier in a given year is identified as the largest customer. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The dependent variable is an indicator that takes the value of one if suppliers hedge interest rate risk and zero otherwise. Suppliers are divided into two subgroups according to the sample median of the supplier's sales dependence on its major customers (columns (2) and (3)), whether the supplier operates in a durable goods industry (columns (4) and (5)), and the sample median of the supplier's R&D intensity (columns (6) and (7)). The coefficients reported are estimates of the average marginal effect on the probability. Industries are classified according to the first two digits of the SIC. The Appendix provides a detailed description of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customer. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Suppliers with Publicly Traded Customers

	Full Sample	Dependence on Customer		Durable Goods Industry		R&D Intensity	
		High	Low	Yes	No	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Customer characteristics							
Book leverage	0.167***	0.272***	0.076	0.180***	0.061	0.166***	0.093
	(0.0008)	(0.0005)	(0.2543)	(0.0006)	(0.4060)	(0.0001)	(0.3397)
Firm size	0.011*	0.021**	0.002	0.010	0.020**	0.019***	0.011
	(0.0629)	(0.0187)	(0.7693)	(0.1965)	(0.0116)	(0.0070)	(0.2303)
Profitability	-0.004	0.256	-0.139	-0.076	-0.003	-0.049	-0.152
	(0.9806)	(0.1979)	(0.5092)	(0.7408)	(0.9874)	(0.8012)	(0.4797)
Market to book	0.013**	0.022**	0.004	0.024***	0.008	0.016**	0.004
	(0.0192)	(0.0114)	(0.6460)	(0.0018)	(0.3740)	(0.0110)	(0.6597)
R&D intensity	-0.016	0.468	-0.455	-0.342	0.367	-0.030	1.159**
	(0.9389)	(0.2169)	(0.1080)	(0.1773)	(0.3208)	(0.8666)	(0.0200)
Tangibility	-0.006	-0.007	0.043	-0.046	-0.037	-0.101	0.061
	(0.9264)	(0.9334)	(0.5651)	(0.4603)	(0.5812)	(0.1431)	(0.5238)
Supplier characteristics							
CEO total compensation	0.006	-0.013	0.028*	-0.007	0.005	0.016	0.019
	(0.5851)	(0.2918)	(0.0889)	(0.6266)	(0.7198)	(0.1990)	(0.3777)
CEO option compensation ratio	-0.006	0.028	-0.024	0.020	-0.052	0.069	-0.073
	(0.8828)	(0.6404)	(0.6671)	(0.7771)	(0.3555)	(0.1866)	(0.3245)
CEO stock compensation ratio	-0.020	-0.056	0.005	0.108	-0.098	0.095	-0.094
	(0.6281)	(0.3312)	(0.9419)	(0.1644)	(0.1457)	(0.1261)	(0.1876)
CEO cash compensation ratio	-0.052	-0.110**	0.002	-0.107	-0.051	0.044	-0.093
	(0.2162)	(0.0425)	(0.9747)	(0.1266)	(0.4173)	(0.4411)	(0.1665)
Firm size	0.074***	0.092***	0.056***	0.069***	0.093***	0.059***	0.065***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0064)
Book leverage	0.379***	0.416***	0.380***	0.390***	0.356***	0.173***	0.603***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Cash holding	-0.531***	-0.451***	-0.553***	-0.479***	-0.604***	-0.340***	-0.650***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
Profitability	0.468***	0.459***	0.550***	0.731***	0.223	0.242***	0.706**
	(0.0000)	(0.0009)	(0.0002)	(0.0000)	(0.1080)	(0.0018)	(0.0107)
Market to book	-0.006	-0.013	-0.005	-0.041***	0.011	0.006	-0.080***
	(0.3566)	(0.2026)	(0.5671)	(0.0082)	(0.1225)	(0.1023)	(0.0000)
R&D intensity	-0.181	-0.145	-0.028	-0.321	0.070		
	(0.2500)	(0.5216)	(0.8886)	(0.2333)	(0.7092)		
Tangibility	-0.067	-0.142	-0.022	0.039	0.081	0.151*	-0.255
	(0.4995)	(0.3152)	(0.8628)	(0.6513)	(0.2773)	(0.0891)	(0.1281)
Industry competition	0.147***	0.198***	0.100	0.040	0.275***	0.057	0.245***
	(0.0003)	(0.0002)	(0.1481)	(0.4181)	(0.0001)	(0.3581)	(0.0000)

Relationship characteristics							
Relationship length	0.002	0.001	0.003	0.000	-0.000	0.001	0.004
	(0.3782)	(0.7563)	(0.3819)	(0.8808)	(0.9971)	(0.5987)	(0.2197)
Sales dependence	0.003			-0.065	0.047	-0.029	0.007
	(0.9292)			(0.3193)	(0.4094)	(0.5082)	(0.9018)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	NO	NO	YES	YES
Cluster by customer	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.373	0.292	0.406	0.454	0.295	0.433	0.328
No. of observations	4,050	1,972	1,994	1,877	2,274	2,059	1,971
Panel B. Suppliers with the Largest Publicly Traded Customer							
Customer characteristics							
Book leverage	0.197***	0.252**	0.159**	0.216***	0.133	0.256***	-0.026
	(0.0078)	(0.0221)	(0.0450)	(0.0054)	(0.2611)	(0.0001)	(0.8356)
Firm size	0.013*	0.021*	0.004	0.007	0.020**	0.015	0.018
	(0.0989)	(0.0972)	(0.6565)	(0.5843)	(0.0389)	(0.1653)	(0.1229)
Profitability	0.143	0.436*	0.006	0.208	-0.080	0.127	-0.181
	(0.4055)	(0.0981)	(0.9787)	(0.3307)	(0.7550)	(0.5228)	(0.5457)
Market to book	0.012*	0.019*	0.002	0.020***	0.015	0.010	0.015
	(0.0953)	(0.0703)	(0.8753)	(0.0072)	(0.2256)	(0.2460)	(0.1571)
R&D intensity	-0.007	0.165	-0.202	-0.254	0.434	-0.060	0.972
	(0.9816)	(0.7165)	(0.6204)	(0.4303)	(0.2824)	(0.8090)	(0.1483)
Tangibility	-0.064	-0.048	-0.058	-0.087	-0.042	-0.073	0.009
	(0.4217)	(0.6709)	(0.5412)	(0.2897)	(0.6469)	(0.4684)	(0.9408)
Supplier characteristics							
CEO total compensation	0.014	-0.024	0.038**	0.001	0.014	0.027**	0.029
	(0.2889)	(0.1762)	(0.0435)	(0.9325)	(0.4633)	(0.0436)	(0.1842)
CEO option compensation ratio	-0.001	0.020	-0.056	0.048	-0.073	0.021	-0.051
	(0.9846)	(0.8299)	(0.4690)	(0.6170)	(0.3105)	(0.7650)	(0.5730)
CEO stock compensation ratio	-0.021	-0.054	-0.082	0.135	-0.134*	0.034	-0.071
	(0.6774)	(0.4859)	(0.2412)	(0.1526)	(0.0869)	(0.6256)	(0.3780)
CEO cash compensation ratio	-0.032	-0.121	-0.024	-0.047	-0.067	0.052	-0.091
	(0.5661)	(0.1501)	(0.7845)	(0.5995)	(0.3940)	(0.4756)	(0.2592)
Firm size	0.069***	0.102***	0.052***	0.069***	0.085***	0.062***	0.054**
	(0.0000)	(0.0000)	(0.0005)	(0.0000)	(0.0000)	(0.0000)	(0.0468)
Book leverage	0.391***	0.413***	0.391***	0.341***	0.446***	0.226***	0.652***
	(0.0000)	(0.0000)	(0.0000)	(0.0003)	(0.0000)	(0.0000)	(0.0000)
Cash holding	-0.502***	-0.386***	-0.551***	-0.469***	-0.610***	-0.356***	-0.564***
	(0.0000)	(0.0023)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0026)
Profitability	0.462***	0.469***	0.429**	0.698***	0.225	0.306***	0.482
	(0.0000)	(0.0067)	(0.0151)	(0.0018)	(0.2074)	(0.0044)	(0.1162)
Market to book	-0.010	-0.008	-0.013	-0.037**	0.012	0.003	-0.059***
	(0.1825)	(0.4340)	(0.1043)	(0.0452)	(0.2559)	(0.5733)	(0.0036)
R&D intensity	-0.080	0.042	-0.160	-0.200	0.035		
	(0.7065)	(0.9019)	(0.5494)	(0.5603)	(0.8926)		
Tangibility	-0.069	-0.011	-0.080	-0.021	0.061	0.099	-0.158
	(0.5717)	(0.9427)	(0.5720)	(0.8570)	(0.5757)	(0.3921)	(0.4582)
Industry competition	0.191***	0.228***	0.148*	0.128	0.217***	0.120*	0.296***
	(0.0010)	(0.0025)	(0.0802)	(0.1026)	(0.0049)	(0.0967)	(0.0000)
Relationship characteristics							
Relationship length	0.003	0.006*	-0.001	0.005	-0.000	0.004	0.006
	(0.2757)	(0.0732)	(0.8934)	(0.1142)	(0.9148)	(0.1811)	(0.2171)
Sales dependence	0.046			-0.013	0.070	-0.033	0.078
	(0.2017)			(0.7798)	(0.2706)	(0.4232)	(0.2406)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	NO	NO	YES	YES
Cluster by customer	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.331	0.247	0.380	0.400	0.254	0.424	0.269
No. of observations	2,559	1,236	1,267	1,140	1,474	1,295	1,249

Table V: Logit Regression of Non-hedging Suppliers' Future Hedging Decision after New Relationship Establishment

The sample consists of 520 supplier-year observations covered in Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases from 1999 to 2005.To be included in the sample, the supplier is required to establish the new trading relationship with a public traded major customer in a given year and does not hedge prior to relationship establishment. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The dependent variable is an indicator that takes the value of one if the non-hedging suppliers hedge for interest rate risk during the first three years of the new major customer relationship establishment and zero otherwise. Suppliers are divided into two subgroups according to the sample median of the supplier's sales dependence on its major customers (columns (2) and (3)), whether the supplier operates in a durable goods industry (columns (4) and (5)), and the sample median of the supplier's R&D intensity (columns (6) and (7)). The coefficients reported are estimates of the average marginal effect on the probability. Industries are classified according to the first two digits of the SIC. The Appendix provides a detailed description of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customer. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample	Dependence on Customer		Durable Goods Industry		R&D Intensity	
		High	Low	Yes	No	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Customer characteristics							
Book leverage	0.214***	0.400***	0.025	0.302**	0.201	0.185**	0.173
	(0.0070)	(0.0004)	(0.7730)	(0.0120)	(0.1029)	(0.0248)	(0.1519)
Firm size	0.006	-0.000	0.011	-0.013**	0.021	-0.019***	0.015
	(0.4686)	(0.9873)	(0.3947)	(0.0427)	(0.1510)	(0.0059)	(0.1641)
Profitability	-0.037	-0.065	-0.206	0.264	-0.140	0.017	-0.027
	(0.8338)	(0.8499)	(0.3225)	(0.1028)	(0.6368)	(0.9435)	(0.9207)
Market to book	0.001	0.030	-0.014	-0.020	0.012	0.001	0.002
	(0.9258)	(0.1500)	(0.7645)	(0.3072)	(0.3517)	(0.9416)	(0.9507)
R&D intensity	-0.029	0.627	-0.286	0.301	-0.114	0.143	-0.499
	(0.8975)	(0.2434)	(0.3263)	(0.5564)	(0.8021)	(0.2370)	(0.4201)
Tangibility	0.114*	0.102	0.128	-0.144	0.287**	0.247*	0.077
	(0.0980)	(0.4297)	(0.1068)	(0.1397)	(0.0118)	(0.0587)	(0.4855)
Supplier characteristics							
CEO total compensation	-0.014	0.009	-0.012	-0.044**	-0.005	0.004	-0.024
	(0.3029)	(0.7655)	(0.5127)	(0.0279)	(0.8741)	(0.8801)	(0.2120)
CEO option compensation ratio	0.049	0.012	0.079	-0.252**	0.234*	0.083	0.136
	(0.4554)	(0.9116)	(0.4405)	(0.0440)	(0.0670)	(0.7621)	(0.1607)
CEO stock compensation ratio	0.047	-0.024	0.066	0.296***	0.144	0.133	-0.024
	(0.6608)	(0.8403)	(0.7896)	(0.0045)	(0.3804)	(0.6746)	(0.8451)
CEO cash compensation ratio	-0.042	-0.014	-0.037	-0.355***	0.124	0.034	-0.048
	(0.4954)	(0.9206)	(0.6578)	(0.0065)	(0.4499)	(0.9102)	(0.5978)
Firm size	0.042***	0.070***	0.033***	0.104***	0.040***	0.037***	0.060**
	(0.0003)	(0.0012)	(0.0004)	(0.0006)	(0.0013)	(0.0089)	(0.0166)
Book leverage	0.150***	0.166***	0.049	0.143**	0.142	0.095*	0.213**
	(0.0036)	(0.0051)	(0.4902)	(0.0193)	(0.1285)	(0.0813)	(0.0135)
Cash holding	-0.231***	-0.430***	-0.017	0.183	-0.592***	0.072	-0.521***
	(0.0058)	(0.0015)	(0.7932)	(0.3752)	(0.0004)	(0.4084)	(0.0000)
Profitability	0.288***	0.321***	0.214	-0.039	0.394*	0.241**	0.414**
	(0.0036)	(0.0034)	(0.3324)	(0.7782)	(0.0555)	(0.0371)	(0.0429)
Market to book	0.007	0.017**	-0.062**	-0.010	0.022***	0.007	-0.017
	(0.2957)	(0.0326)	(0.0464)	(0.5215)	(0.0041)	(0.1087)	(0.5404)
R&D intensity	0.158	0.311	-0.120	-0.365	0.228		
	(0.4409)	(0.1464)	(0.6644)	(0.3940)	(0.2850)		
Tangibility	-0.123*	-0.114	-0.063	0.174	-0.270***	0.466***	-0.239***
	(0.0544)	(0.2709)	(0.4134)	(0.2118)	(0.0058)	(0.0059)	(0.0095)
Industry competition	0.133**	0.137	0.115*	0.281***	0.036	0.330*	0.127
	(0.0415)	(0.1640)	(0.0851)	(0.0000)	(0.6377)	(0.0867)	(0.1363)
Relationship characteristics							

Sales dependence	-0.035 (0.7607)			0.129 (0.6276)	-0.118 (0.5871)	-0.139 (0.6566)	-0.043 (0.8197)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	NO	NO	NO	NO	NO	NO	NO
Cluster by customer	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.2587	0.227	0.472	0.570	0.304	0.361	0.302
No. of observations	520	260	260	218	277	260	260

Table VI: The Effect of Supplier Hedging on Supply Chain Stability

The sample consists of 851 supplier-customer pairs, including 477 suppliers and 318 customers, covered in the Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases from 1999 to 2007. To be included in the sample, each supplier-customer relationship should be newly established between 1999 and 2007. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. In columns (1) through (3), we use COX models to estimate the duration of the supplier-customer relationship at the time when the relationship is newly established. In columns (4) through (6), the dependent variable is an indicator that takes the value of one if the change in the supplier's sales dependence on the customer one year after relationship establishment is higher than the sample median and zero otherwise. For this logit analysis, we require that the relationship continue to exist in the year after relationship establishment. Suppliers are divided into two subgroups according to the sample median of customer leverage. The coefficients reported are estimates of the average marginal effect on the probability. Industries are classified according to the first two digits of the SIC. The Appendix provides a detailed description of the variables. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customer. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Cox Model			**Logit Model Relationship Expansion Dummy**		
	Full sample	Customer leverage		Full sample	Customer leverage	
		High	Low		High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier interest rate hedging (indicator)	-0.438**	-0.581**	-0.046	0.130**	0.169**	0.020
	(0.0232)	(0.0465)	(0.8711)	(0.0325)	(0.0186)	(0.8349)
Customer characteristics						
Book leverage	-0.216			-0.150		
	(0.5725)			(0.2402)		
Firm size	-0.067	-0.147**	0.000	0.025*	0.040**	0.003
	(0.1213)	(0.0166)	(0.9975)	(0.0631)	(0.0357)	(0.8425)
Profitability	-0.319	-1.583	0.131	-0.453	-0.920	-0.257
	(0.6007)	(0.1651)	(0.8619)	(0.2233)	(0.3214)	(0.4925)
Market to book	-0.020	0.012	-0.004	-0.003	0.070	-0.015
	(0.5278)	(0.9062)	(0.9225)	(0.8225)	(0.1081)	(0.3429)
R&D intensity	2.276***	3.991*	3.258***	-0.182	-0.713	-0.204
	(0.0037)	(0.0579)	(0.0003)	(0.6788)	(0.5219)	(0.6609)
Tangibility	0.149	0.712	0.843*	-0.101	-0.276	-0.094
	(0.6984)	(0.2057)	(0.0864)	(0.3938)	(0.1981)	(0.5522)
Supplier characteristics						
CEO total compensation	-0.011	-0.001	-0.120	0.062**	0.160***	-0.011
	(0.8617)	(0.9933)	(0.1162)	(0.0263)	(0.0012)	(0.7828)
CEO option compensation ratio	-0.099	0.512	-0.837*	-0.159	-0.106	-0.214
	(0.7953)	(0.3727)	(0.0821)	(0.2677)	(0.5572)	(0.3953)
CEO stock compensation ratio	0.950**	1.851***	0.297	0.033	0.092	0.085
	(0.0452)	(0.0085)	(0.6314)	(0.8529)	(0.7609)	(0.7445)
CEO cash compensation ratio	0.294	0.591	-0.349	0.066	0.388	-0.182
	(0.4289)	(0.3969)	(0.4496)	(0.6730)	(0.1391)	(0.4559)
Firm size	-0.091	-0.199*	0.015	-0.034	-0.053*	-0.003
	(0.1270)	(0.0519)	(0.8520)	(0.1094)	(0.0571)	(0.9230)
Book leverage	0.146	0.095	-0.492	-0.269***	-0.289	-0.384***
	(0.6293)	(0.8760)	(0.1058)	(0.0064)	(0.1718)	(0.0012)
Cash holding	0.811**	0.031	1.280***	0.162	0.313	0.116
	(0.0258)	(0.9567)	(0.0093)	(0.1376)	(0.1453)	(0.4586)
Profitability	-1.456***	-0.911	-1.654***	-0.299	0.343	-0.598***
	(0.0006)	(0.1647)	(0.0032)	(0.1022)	(0.2037)	(0.0025)
Market to book	-0.015	0.038	-0.047	-0.023**	-0.060**	-0.010
	(0.5684)	(0.2829)	(0.2372)	(0.0246)	(0.0129)	(0.3546)
R&D intensity	-0.141	0.144	-0.507	0.284	0.324	0.294
	(0.8233)	(0.8731)	(0.5502)	(0.1678)	(0.2228)	(0.3403)
Tangibility	-1.008	-3.890	-0.056	0.478	1.143*	0.125
	(0.3734)	(0.1155)	(0.9658)	(0.1285)	(0.0568)	(0.7622)
Industry competition	0.216	0.099	0.219	0.239*	0.200	0.070

	(0.6102)	(0.8537)	(0.7910)	(0.0914)	(0.2110)	(0.7826)
Relationship characteristics						
Sales dependence	-2.466** (0.0179)	-0.899 (0.4164)	-4.962*** (0.0002)			
Year fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES
Cluster by customer	YES	YES	YES	YES	YES	YES
Pseudo *R*-squared	-	-	-	0.0944	0.1899	0.1414
No. of observations	851	429	422	620	297	304

Table VII: Cumulative Abnormal Returns (-1, 1) for Suppliers around Bond Offer Announcements by Customers and Announcements of Customer Rating Downgrades by Rating Agencies

In Panel A, the sample consists of 168 bond offer announcements by the largest public customers, reported in Thomson Financial SDC New Issues database from 1999 to 2008.In Panel B, the sample consists of 202 announcements of the largest public customers' rating downgrades by rating agencies, obtained from the Mergent Fixed Investment Securities Database (FISD) from 1999 to 2008. To be included in the sample, suppliers must be covered in the Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer database field, customer name, to identify whether suppliers have corporate customers. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. When the supplier has multiple customers, the customer purchasing the largest amount of raw materials and intermediate products in a given year is identified as the largest customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The abnormal returns are calculated using a market model. We obtain our estimates of the market model by using one year (255 trading days) of return data, beginning 301 days before and ending 46 days before the announcement date. We use as the market portfolio the CRSP equally weighted index. We aggregate the daily abnormal returns to obtain the cumulative abnormal return (CAR) from one day before the announcement date to one day after the announcement date. The numbers in the test-of-difference columns are p-values. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. CARs (-1, 1) for Suppliers around Bond Offer announcements by the Largest Customers

	Full sample		Suppliers that use interest rate hedging (A)		Suppliers that do not use interest rate hedging (B)		Test of difference	
	N =577		N = 212		N = 365		(A - B)	
Event windows	Mean	Median	Mean	Median	Mean	Median	*t*-test	Wilcoxon *Z*-test
CAR (-1,+1)	-0.0014	-0.0015	0.0059**	0.0024	-0.0057**	-0.0039***	0.0029***	0.0011***

Panel B. CARs (-1, 1) for Suppliers during the Announcements of the Largest Customer s' Credit Downgrades by Rating Agencies

	Full sample		Suppliers that use interest rate hedging (A)		Suppliers that do not use interest rate hedging (B)		Test of difference	
	N =415		N = 160		N = 255		(A - B)	
Event windows	Mean	Median	Mean	Median	Mean	Median	*t*-test	Wilcoxon *Z*-test
CAR (-1,+1)	-0.0043*	-0.0000	0.0051	0.00440	-0.0102**	-0.0056***	0.0025***	0.0029***

Table VIII: OLS Regression of Cumulative Abnormal Returns (-1, 1) for Suppliers around Bond Offer Announcements by Customers and Announcements of Customer Rating Downgrades by Rating Agencies

In the first four columns, the sample consists of 168 bond offer announcements by the largest public customers, reported in Thomson Financial SDC New Issues database from 1999 to 2008. In the last four columns, the sample consists of 202 announcements of the largest public customers' rating downgrades by rating agencies, obtained from the Mergent Fixed Investment Securities Database (FISD) from 1999 to 2008. To be included in the sample, suppliers must be covered in the Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases. Firms in the financial industry (primary SIC codes 6000-6999) are excluded. We use the Compustat Segment Customer database field, customer name, to identify whether suppliers have corporate customers. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). If a firm is not covered by the Compustat Segment Customer file, it is assumed to have no major customer. When the supplier has multiple customers, the customer purchasing the largest amount of raw materials and intermediate products in a given year is identified as the largest customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The abnormal returns are calculated using a market model. We obtain our estimates of the market model by using one year (255 trading days) of return data, beginning 301 days before and ending 46 days before the announcement date. We use as the market portfolio the CRSP equally weighted index. We aggregate daily abnormal returns to obtain the cumulative abnormal return (CAR) from one day before the announcement date to one day after the announcement date and use it as the dependent variable. Industries are classified according to the first two digits of the SIC. The Appendix provides a detailed description of the variables. P-values are in parentheses. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customer. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Bond Offerings				**Bond Rating Downgrades**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Supplier interest rate hedging (indicator): A	0.011**	0.010	0.005	0.005	0.013**	-0.002	0.007	-0.001
	(0.0368)	(0.1706)	(0.3527)	(0.3261)	(0.0385)	(0.8263)	(0.2201)	(0.8570)
High dependence (indicator): B		-0.003				-0.015*		
		(0.5580)				(0.0764)		
Durable goods industry (indicator): C			-0.006*				-0.022***	
			(0.0912)				(0.0052)	
High R&D intensity (indicator): D				-0.001				-0.012
				(0.8384)				(0.1485)
A* B		0.002				0.029*		
		(0.7438)				(0.0581)		
A* C			0.018***				0.024**	
			(0.0037)				(0.0472)	
A* D				0.014**				0.039**
				(0.0435)				(0.0206)
Offerings/ rating changes characteristics								
Private placement 144a (indicator)	-0.004	-0.004	-0.003	-0.004				
	(0.2339)	(0.2446)	(0.3847)	(0.2866)				
Bond issuance's S&P rating above investment grade (indicator)	0.001	0.001	0.002	0.001				
	(0.8875)	(0.8995)	(0.7602)	(0.8983)				
Bond offering relative size	-0.048	-0.047	-0.077	-0.055				
	(0.5561)	(0.5615)	(0.2212)	(0.5123)				
Credit rating downgrade					-0.000	-0.000	0.000	0.000

					(0.9619)	(0.9656)	(0.9089)	(0.8904)
Rating shift from above investment grade to below investment grade (indicator)					-0.011	-0.009	-0.004	-0.011*
					(0.1137)	(0.4553)	(0.4946)	(0.0891)
S&P long term credit rating					-0.003*	-0.003	-0.001	-0.003*
					(0.0750)	(0.2310)	(0.4122)	(0.0612)
Relationship characteristics								
Relationship length	-0.001	-0.001	-0.001	-0.001	-0.002	-0.002	-0.001	-0.002*
	(0.2912)	(0.3341)	(0.2375)	(0.2993)	(0.1457)	(0.1170)	(0.1891)	(0.0796)
Sales dependence	-0.002		-0.003	-0.005	-0.004		-0.001	-0.015
	(0.8139)		(0.7227)	(0.5824)	(0.8388)		(0.9739)	(0.3990)
Customer characteristics								
Market capitalization	0.001	0.001	-0.002	0.000	-0.000	-0.000	-0.002	0.001
	(0.6915)	(0.6577)	(0.4827)	(0.8815)	(0.9040)	(0.9046)	(0.4645)	(0.8224)
Book leverage	0.003	0.003	0.001	0.004	0.055*	0.046	0.034	0.054**
	(0.9006)	(0.9119)	(0.9686)	(0.8920)	(0.0637)	(0.1100)	(0.1876)	(0.0482)
Market to book	0.010**	0.010**	0.009**	0.011**	0.004	0.002	-0.000	0.005
	(0.0157)	(0.0152)	(0.0385)	(0.0117)	(0.6453)	(0.8444)	(0.9708)	(0.5866)
Profitability	-0.045	-0.048	-0.058	-0.048	-0.084*	-0.078	0.015	-0.091**
	(0.4890)	(0.4454)	(0.3385)	(0.4720)	(0.0506)	(0.1955)	(0.7555)	(0.0431)
Supplier characteristics								
Past stock return	-0.011***	-0.011***	-0.009***	-0.011***	0.009	0.007	0.006	0.008
	(0.0001)	(0.0001)	(0.0018)	(0.0002)	(0.3457)	(0.4478)	(0.5076)	(0.3513)
Stock return volatility	-0.012	-0.013	-0.008	0.004	0.011	0.020	-0.006	0.013
	(0.7741)	(0.7308)	(0.8316)	(0.9125)	(0.7409)	(0.7026)	(0.8507)	(0.7092)
Market capitalization	-0.001	-0.001	-0.001	-0.001	0.001	0.001	0.002	-0.000
	(0.6946)	(0.6284)	(0.6500)	(0.6383)	(0.6668)	(0.7135)	(0.2765)	(0.8965)
Book leverage	0.009	0.009	0.013	0.012	-0.008	-0.017	-0.004	-0.022
	(0.3088)	(0.2736)	(0.1111)	(0.1662)	(0.7111)	(0.4606)	(0.8402)	(0.3348)
Cash holdings	0.001	0.001	0.004	0.003	0.008	0.009	0.002	-0.004
	(0.8845)	(0.9303)	(0.5690)	(0.6604)	(0.8269)	(0.7110)	(0.9355)	(0.8834)
Market to book	-0.005***	-0.005***	-0.005***	-0.004**	-0.001	-0.002	-0.002	-0.001
	(0.0048)	(0.0059)	(0.0035)	(0.0218)	(0.4103)	(0.2324)	(0.2330)	(0.4155)
Profitability	0.015	0.016	0.009	-0.002	-0.067**	-0.068**	-0.041*	-0.079**
	(0.3548)	(0.3114)	(0.6095)	(0.9165)	(0.0272)	(0.0477)	(0.0778)	(0.0106)
Tangibility	-0.005	-0.005	-0.003	-0.003	-0.009	-0.015	-0.004	-0.004
	(0.7211)	(0.7543)	(0.6904)	(0.8254)	(0.8143)	(0.6739)	(0.7984)	(0.9245)
R&D intensity	0.062*	0.063*	0.062**		0.019	0.024	0.037	
	(0.0680)	(0.0665)	(0.0460)		(0.5364)	(0.4907)	(0.3092)	
CEO total compensation	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.9403)	(0.9383)	(0.7273)	(0.9314)	(0.8762)	(0.9873)	(0.6962)	(0.8851)
CEO option compensation ratio	-0.004	-0.004	-0.007	-0.007	-0.026	-0.028	-0.033**	-0.032
	(0.6335)	(0.6733)	(0.4691)	(0.4158)	(0.1855)	(0.2258)	(0.0223)	(0.1278)
CEO stock compensation ratio	0.007	0.007	0.003	0.010	0.001	-0.005	-0.005	0.002

	(0.5177)	(0.5291)	(0.7445)	(0.3342)	(0.9502)	(0.7711)	(0.6499)	(0.9136)
CEO cash compensation ratio	0.000	0.000	-0.001	0.003	-0.002	-0.007	-0.009	-0.005
	(0.9761)	(0.9745)	(0.9473)	(0.7115)	(0.8932)	(0.6297)	(0.2045)	(0.7328)
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	NO	YES	YES	YES	NO	YES
Cluster by customer	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.161	0.161	0.129	0.158	0.157	0.169	0.104	0.178
No. of observations	577	577	577	577	415	415	415	415

Table IX: Supplier Hedging and the Comovement of Yield Spread Changes with the Customer

The sample consists of 112 supplier-customer pairs (5,238 supplier-customer bond pairs) from 1999 to 2008. To be included in the sample, suppliers must be covered in the Compustat Segment Customer, CRSP, Compustat, and ExecuComp databases. Firms in the financial industry (primary SIC codes 6000-6999) are also excluded. We use the Compustat Segment Customer file to identify whether a firm discloses its major customers. To determine if the major customer is a privately held or publicly traded firm, we manually match the customer names to the universe of firms in Compustat by closely following the approach in Fee et al. (2006). When the supplier has multiple customers, the customer purchasing the largest amount of raw materials and intermediate products in a given year is identified as the largest customer. We obtain each firm's information on the usage of interest rate derivatives by extensively searching its annual report on Form 10-K filed electronically in the SEC's Electronic Data Gathering and Retrieval (EDGAR) database. If the firm's annual report on Form 10-K makes no reference to the use of interest rate derivatives, we treat the firm in that year as a non-hedging firm. The dependent variables in columns (1) through (3) are monthly changes in suppliers' bond yields. Bond yield spreads are the option-adjusted yield spreads reported in the Bank of America Merrill Lynch US Corporate and High Yield Master Bond Index Database. The option-adjusted yield spread measures the amount by which a risk-free spot curve must be raised or lowered so that the resulting discounted cash flows equal the market price of the bond. The dependent variable in column (4) is yearly changes in suppliers' bond yields, which are calculated by aggregating monthly changes. *P*-values are in parentheses. We estimate *p*-values using robust standard errors to adjust for heteroskedasticity (White (1980)) and cluster errors by customer-supplier bond pairs. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Monthly change of supplier's bond yield (1)	Monthly change of supplier's bond yield (2)	Monthly change of supplier's bond yield (3)	Yearly change of supplier's bond yield (4)
Change of customer's bond yield: A	0.322***	0.555***	0.315***	0.392***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Supplier interest rate hedging (indicator): B	-0.015***	-0.026***	-0.032***	-0.309***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
A*B	-0.068***	-0.158***	-0.062***	-0.107**
	(0.0030)	(0.0000)	(0.0064)	(0.0305)
Change of credit spread	0.942***		0.713***	1.628***
	(0.0000)		(0.0000)	(0.0000)
Change of term spread	0.146***		0.143***	-0.288***
	(0.0000)		(0.0000)	(0.0000)
Market excess return	-1.760***		-1.774***	1.164***
	(0.0000)		(0.0000)	(0.0000)
SMB	-0.769***		-0.771***	-3.806***
	(0.0000)		(0.0000)	(0.0000)
HML	-0.276***		-0.287***	-0.957***
	(0.0000)		(0.0000)	(0.0000)
Customer characteristics				
Firm size		0.009***	0.009***	-0.016
		(0.0006)	(0.0002)	(0.4622)
Book leverage		0.012	0.058***	1.110***
		(0.5652)	(0.0033)	(0.0000)
Profitability		0.260***	0.270***	2.419***
		(0.0000)	(0.0000)	(0.0000)
Market to book		0.019***	0.022***	0.215***
		(0.0000)	(0.0000)	(0.0000)
R&D intensity		0.761***	0.589***	5.112***
		(0.0000)	(0.0000)	(0.0003)
Tangibility		-0.095***	-0.134***	-1.313***
		(0.0000)	(0.0000)	(0.0000)
Supplier characteristics				
CEO total compensation		0.036***	0.040***	0.195***
		(0.0000)	(0.0000)	(0.0000)
CEO option compensation		0.001	0.005	0.073
		(0.8774)	(0.4353)	(0.2484)
CEO stock compensation		-0.008	-0.013	-0.593***
		(0.3479)	(0.1217)	(0.0000)
CEO cash compensation		0.071***	0.087***	0.320***
		(0.0000)	(0.0000)	(0.0024)
Firm size		-0.012***	-0.013***	-0.123***
		(0.0000)	(0.0000)	(0.0000)
Book leverage		0.063***	0.074***	0.252*

		(0.0001)	(0.0000)	(0.0699)
Cash holding		0.400***	0.428***	1.086***
		(0.0000)	(0.0000)	(0.0000)
Profitability		-0.387***	-0.443***	-2.444***
		(0.0000)	(0.0000)	(0.0000)
Market to book		0.007***	0.009***	0.057**
		(0.0043)	(0.0016)	(0.0296)
R&D intensity		-0.879***	-0.930***	-5.006***
		(0.0000)	(0.0000)	(0.0000)
Tangibility		0.194***	0.208***	1.242***
		(0.0000)	(0.0000)	(0.0000)
Industry competition		0.000	0.007	0.033
		(0.9499)	(0.3200)	(0.6569)
Relationship characteristics				
Relationship length		0.000	0.000	-0.000
		(0.8521)	(0.6155)	(0.9186)
Sales dependence		0.003	0.004	-0.296***
		(0.5946)	(0.5044)	(0.0000)
Observations	109,066	109,066	109,066	12,436
R-squared	0.266	0.175	0.273	0.501
Year fixed effects	YES	YES	YES	NO
Cluster by bond pairs	YES	YES	YES	YES

Table X: Robustness Checks

This table provides robustness checks to results in Tables III and IV. For the sake of brevity, the table reports only the results for key variables of interest. In column (1), we control for the CEO's risk taking incentives by including the pay-performance sensitivity (delta) and the sensitivity of CEO wealth to stock volatility (vega). In column (2), we control for the amounts of trade credits of the customer and the supplier. In column (3), we control for customer industry fixed effects (first digit of SIC codes**)** and customer industry competition as measured by Herfindahl-Hirschman Index. In column (4), we control for the customer's use of derivatives to hedge interest rate risk. In rows (1), (4), and (7), the key explanatory variables of interest are the indicator for firms that have a high-leverage public customer, customer book leverage, customer book leverage, respectively. In rows (2), (5), and (8), we replace these key explanatory variables of interest with the KMV distance-to-default measure based on the Merton (1977) model (Crosbie and Bohn (2001)). In rows (3), (6), and (9), we replace the key explanatory variables of interest with the CHZ distress measure (Campbell, Hilscher, and Szilagyi (2008)). *P*-values are in parentheses. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table	Regression Specification	Variable of Interest	Control for CEO Delta and Vega	Control for trade credit ratio of customer and supplier	Control for customer industry fixed effects and customer industry competition	Control for customer interest rate hedging
			(1)	(2)	(3)	(4)
(1) Table III	3	Firms have a high-leverage public customer (indicator)	0.0874***	0.0889***	0.0865***	0.0844***
			(0.0027)	(0.0018)	(0.0039)	(0.0028)
(2) Table III	3	Firms have a public customer with a high-KMV distance to default measure(indicator)	0.0727***	0.0878***	0.0575***	0.0824***
			(0.0021)	(0.0036)	(0.0082)	(0.0095)
(3) Table III	3	Firms have a public customer with a high-CHZ distress measure (indicator)	0.0808***	0.0935***	0.0587***	0.0889***
			(0.0006)	(0.0006)	(0.0057)	(0.0056)
(4) Table IV Panel A	1	Customer book leverage	0.1547***	0.1623***	0.1917***	0.1708***
			(0.0013)	(0.0012)	(0.0011)	(0.0010)
(5) Table IV Panel A	1	Customer KMV distance to default measure	0.1045**	0.1077**	0.1075**	0.1141**
			(0.0344)	(0.0362)	(0.0298)	(0.0304)
(6) Table IV Panel A	1	Customer CHZ distress measure	0.0178 **	0.0189***	0.0201***	0.0196***
			(0.0121)	(0.0062)	(0.0053)	(0.0061)
(7) Table IV Panel B	1	Customer book leverage	0.1822**	0.1940***	0.2175***	0.2136***
			(0.0152)	(0.0101)	(0.0032)	(0.0041)
(8) Table IV Panel B	1	Customer KMV distance to default measure	0.2052**	0.2051***	0.2105**	0.2142**
			(0.0242)	(0.0226)	(0.0211)	(0.0183)
(9) Table IV Panel B	1	Customer CHZ distress measure	0.0451***	0.0452***	0.0463***	0.0475***
			(0.0001)	(0.0001)	(0.0001)	(0.0001)

Appendix: Variable Definitions

This appendix provides a detailed description of the construction of all the variables used in the tables.

Variable	Definition
Book leverage	Long-term debt plus debt in current liabilities divided by total assets.
Bond issuance's S&P rating above investment grade (indicator)	Equal to one if a bond offering's S&P rating is above investment grade (BBB+).
Bond offering relative size	Bond offering's principle divided by issuer's market capitalization.
Cash holdings	Cash plus short-term investments divided by total assets.
CEO total compensation	Natural log of the sum of cash salary, cash bonus, stock granted and Black-Scholes value of options granted to CEO.
CEO option compensation ratio	Black-Scholes value of options granted to CEO divided by total compensation of CEO.
CEO stock compensation ratio	Value of stock granted to CEO divided by total compensation of CEO.
CEO cash compensation ratio	Value of cash salary and cash bonus divided by total compensation of CEO
Change in credit spread	The monthly change in credit spread, which is defined as the difference between the yields of average Moody's BAA corporate bond and AAA corporate bond.
Change in term spread	The monthly change in term spread, which is defined as the difference between the yields of 10-year treasury bonds and 1-year treasury bonds.
Credit rating downgrade	The absolute magnitude of the rating downgrade, where categorical bond ratings are converted into a cardinal variable measured on a 23-point scale (1 for rating AAA, 23 for rating D)
Durable industry (indicator)	Equals to one if a firm's two digit SIC code is between 34 and 39 and zero otherwise.
Firm size	Natural log of total assets.
High R&D intensity (indicator)	Equals to one if a firm's R&D intensity is above the sample median and zero otherwise.
Firm have a public customer (indicator)	Equals to one if the firm has at least one major publicly listed corporate customer and zero otherwise.
Firm have a low leverage public customer (indicator)	Equals to one if the firm has at least one major publicly listed corporate customer whose book leverage is below the sample median and zero otherwise.
Firm have a high leverage public customer (indicator)	Equals to one if the firm has at least one major publicly listed corporate customer whose book leverage is above the sample median and zero otherwise.
High dependence (indicator)	Equals to one if the supplier sales dependence to the customer is higher than the sample median and zero otherwise.
Industry competition	Herfindahl-Hirschman Index for the four-digit SIC code industry.
Interest rate hedging (indicator)	Equals to one if a firm engages in interest rate hedging in a given year and zero otherwise.
Market capitalization	Natural log of market value (price per share times shares outstanding).

Market to book	Market value of equity plus the book value of debt divided by total assets
Monthly change of bond yield	First difference of monthly public bond yields. Bond yield spreads are obtained as the option-adjusted yield spread reported in the Bank of America Merrill Lynch US Corporate and High Yield Master Bond Index Database.
Past stock return	Buy-and-hold stock return for one year prior to the announcement date.
Private placement 144a (indicator)	Equals to one if the bond is a privately placed under the regulation 144a and zero otherwise.
Profitability	Operating income before depreciation divided by total assets.
R&D intensity	R&D expenditures divided by total assets. This variable is set to be zero if R&D expenditure is missing.
Rating shift from above investment grade to below investment grade (indicator)	Equal to one if the bond's credit rating is above the investment grade before credit rating downgrade and is below the investment grade after credit rating downgrade.
Sales dependence	Supplier's sales to customer divided by supplier's total asset.
Supplier-customer Relationship length	Number of years the customer-supplier relationship has lasted.
Supplier sales to customer	Natural log of sales to the major customer during the year.
Stock return volatility	Standard deviation of daily stock returns for one year prior to the announcement date.
S&P long term credit rating	Issuer's long term S&P credit rating, where categorical bond ratings are converted into a cardinal variable measured on a 23-point scale (1 for rating AAA, 23 for rating D)
Tangibility	Net property, plant, and equipment divided by total assets.

Essay Three: Local Housing Market and Stock Liquidity

Abstract

Essay three studies whether the change in the local housing market condition has significant impacts on stock liquidity of local firms. We find that stock liquidity of local firms significantly improve when the local housing price growth is high, even after controlling for extensive state economic related factors. This result is robust to alternative measures of stock liquidity and the estimation of Two Stages Least Square regression. The increase in the stock liquidity of local firms is only observed for firms with high retail concentration (i.e., small size, low stock price, low institutional ownership or low analyst coverage). Further, when the residential property price growth is high, the R^2 of local stocks with high retail concentration would significantly increase, indicating that less firm-specific information is incorporated into the stock price under strong housing market conditions. We also find that firms located in the state with higher housing price growth pay lower underwriting fees if they conduct seasoned equity offerings. The effect of lower cost of equity financing is also more pronounced for firms with high retail concentration. To the extent that rising home values strengthen households' financial conditions, lower their leverage and encourage them to participate more in the equity market, especially, to trade more frequently in the local stocks due to their local bias, the liquidity of local stocks will improve as the local housing market is booming.

Keywords: Local housing market, stock liquidity, local bias, noise trading

JEL Classification: G11, G12, R31.

I. Introduction

According to Iacoviello (2011), the aggregate market value of residential assets for all the households in the U.S. was 25.4 trillion dollars at the end of 2008, which nearly accounts for one half of total household net worth. For a median household, housing wealth accounts for almost two thirds of his total wealth.[1] Since residential house is a widely held and highly levered asset which composes the largest proportion of a household's asset portfolio, household's equity investment decisions would be substantially affected by the housing market conditions. Furthermore, since individual investors have the tendency to invest in local stocks, the change in households' investment behavior caused by booming or busting in local housing markets would potentially yield significant effects on the local stocks' liquidity.

Faig and Shum (2002), investigating data from the 1995 Survey of Consumer Finances, find that households who are saving to invest in their own homes have significantly safer financial portfolios, and further show that the relative housing value (value of house over the net total worth) has a positive impact on the households' cash holdings. Cocco (2005), constructing a model of optimal portfolio and consumption decisions of household, finds that the relative housing value crowds out stockholdings, which is stronger for younger and poorer investors who have limited financial wealth to invest in stocks. Bostic, Gabriel, and Painter (2009) analyze the data in the Survey of Consumer Finance and the Survey of Consumer Expenditure, and find that households' consumption increase with the value of their homes.

However, due to the limitation of survey data, existing studies mainly focus on the cross sectional difference among households' portfolio choices under different housing conditions, while neglecting the impacts from booming or busting of the housing market. It is worth noting that the housing market in the United States experienced rapid growth from 1997 to 2007, but the housing price growth rate varies across different states. For example, the housing prices in the west coast and east coast areas nearly doubled within a few years. While, housing prices in some other states, such as Texas, were almost flat. The heterogeneity of the housing price growth rate across different states

[1] http://www.federalreserve.gov/pubs/ifdp/2011/1027/ifdp1027.htm.

suggests that price appreciation of local housing market would have distinct impacts on local residents' investment decisions.

The local bias literatures argue that the tendency to invest in local stocks is more pronounced for individual investors than for institutional investors. Loughran and Schultz (2004) provide evidence that retail trading is concentrated in local stocks, by showing that trading volume of west coast companies is lower than that of east coast firms in the morning, which can be explained by the fact that investors in the west, who trade west coast stocks, are still in bed or on their way to work at that time. Using data from a large U.S. discount brokerage, Ivković and Weisbenner (2005) find that retail investors exhibit a strong preference for local investments. But the reason why local bias exists is still under debate. One argument is that local retail investors have superior information of local firms. Ivković and Weisbenner (2005) show that local investments of individual investors outperform their non-local investments, which suggests that local individual investors exploit their information advantage. But, with the same data, Seasholes and Zhu (2010) fail to find that portfolios of local stocks significantly outperform portfolios of remote stocks, after adjusting for the contemporaneous correlation in the cross-section of stock returns. Their results cast doubts on the information superiority hypothesis and support the familiarity hypothesis, which argues that investors over-weight local stocks simply because they are familiar with them. Grinblatt and Keloharju (2001) also provide supporting evidence for the familiarity hypothesis by showing that Finnish investors are more likely to trade stocks of same-language and same-culture firms.

Further, if escalated housing price induces retail investors' speculative behaviors (Case and Shiller (1988))[2] and their intensive trading activities on the stock market are more tilted towards local stocks due to the familiarity, then the local investors are more likely to act as noise traders, and thus potentially provide liquidity for the local stocks. As studied by the Glosten and Milgrom (1985), an increased proportion of noise trading decreases the market maker's order processing cost and thus increases stock liquidity. Admati and Pfleiderer (1988) also predict that noise trading increases stock liquidity even if informed trading is endogenized.

[2] Case and Shiller (1988) argue that during the housing boom period, the local households' trading behaviours in the housing market are less likely to have rational and economic basis.

Predictions from these theoretical models are verified in the later empirical studies. Greene and Smart (1999) use the "Investment Dartboard" column in The Wall Street Journal as a natural experiment to evaluate the impacts of the change in noise trading on the change in stock liquidity. They find that bid-ask spread decreases and trading volume increases after the stock is recommended by financial analysts in that column. Moreover, through an experimental study, Bloomfield, O'Hara, and Saar (2009) show that the noise traders indeed provide stock liquidity by increasing market volume and depth, and reducing bid-ask spreads and the temporary price impact of trades, but their noise trading also diminishes the ability of market prices to adjust to new information. Ding and Hou (2013), using the search volume index (SVI) from Google Trends to capture the retail investors' active attention, show that the stock liquidity significantly improve after it attracts more attention from retail investors.

In summary, if households' trading activities are important for local stocks, then the change in households' investment behavior caused by the change in housing market conditions would yield significant impacts on the local stocks' liquidity. There are existing two competing views in explaining the relationship between local housing market and local stock liquidity, namely, wealth effect hypothesis and substitution effect hypothesis.

The wealth effect hypothesis suggests that firms located in the state with higher growth of housing price experience an increase in stock liquidity. When the housing market is booming, local residents put more money in the stock market, not only because they feel wealthier, but also because the liquidity of the housing asset is improved and the degree of risk aversion is reduced. Faig and Shum (2002), and Cocco (2005) show that the relative housing value (value of house over the net total worth) reduces during a booming housing market, which stimulates more investment in the stock market.

Further, since local retail investors' have the tendency to invest in geographic proximate stocks (Loughran and Schultz (2004), Ivković and Weisbenner (2005) and Seasholes and Zhu (2010)) and during the booming of local housing market the increased noise trading reduce the market maker's order processing cost, the higher growth of housing price has a great potential to increase the

liquidity of local stocks through households' portfolio reallocation and trading behaviors. In addition, the improvement in stock liquidity due to booming local housing market should be particularly evident for stocks with a high retail concentration (e.g., stocks with small size, low price, low institutional ownership or low analyst coverage). Although local retail investors' trading may help to improve stock liquidity, less amount of new information would be incorporated into the stock price through their noise trading activities (Bloomfield, O'Hara, and Saar (2009)). Thus, the wealth effect hypothesis also predicts that the growth of housing price yields a positive effect on the price synchronicity (R^2)[3], and this effect would be more pronounced for stocks with a high retail concentration.

The substitution effect hypothesis predicts that firms located in the state with higher growth of housing price experience a decrease in stock liquidity. Since the residential property is also a potential investment instrument, its higher return could possibly attract local households to liquidate part of their equity holdings and invest more into the real estate market. Therefore, the stock liquidity of firms located in the area with escalating housing price decreases, which would be particularly evident for stocks with a high retail concentration (e.g., stocks with small size, low price, low institutional ownership or low analyst coverage).

Using a large sample from 1992-2008 and the housing price information across different states,[4] we find that the growth of local housing price is associated with a statistically and economically significant increase in stock liquidity for local firms: one standard deviation increase (0.065) in the growth rate of housing price is associated with a 0.014 increase in stock liquidity. Moreover, such effect is only observed for stocks with a high retail concentration, such as firms with smaller size, lower price, lower institutional ownership or lower analyst coverage. These results are consistent with the wealth effect hypothesis and suggest that higher growth of housing price stimulates local households to participate more in the local stock market, providing liquidity to local stocks.

[3] Morck et al. (2000), Durnev et al. (2001), and Shen (2008) propose that lower R^2 reflects more firm-specific information in the stock price.
[4] The housing price index across different states is available at http://www.fhfa.gov/Default.aspx?Page=87.

To address the potential endogeneity issue, we perform a variety of robustness tests. First, it is possible that omitted state level economic factors affect both the growth of housing price and local stock liquidity, resulting in a spurious correlation between these two. To alleviate this concern, we control for extensive macroeconomic factors, such as growth rate of local economics, the growth rate of household income, the state GDP level, the state population, and the average stock performance of local firms.[5] We find that our results are robust to including these additional variables. Second, to control for the possibility that omitted unobservable state characteristics affect both housing market and local stock liquidity, we include state fixed effects in the regressions and find the same results. Finally, we explicitly address the potential endogeneity problems using two-stage least squares (2SLS) approach, in which we employ the lag-one period crime rate as the instrumental variable. We find that our results do not change. Overall, series of robustness checks show that our key results are robust to controlling for potential endogeneity biases.

Further analysis shows that for stock with smaller firm size, lower stock price, lower institutional ownership or lower analyst coverage, the growth of housing price is significantly related with an increase in the stock price synchronicity (R^2). This is consistent with the argument by Bloomfield, O'Hara, and Saar (2009) that less firm-specific information is reflected in the stock price if the level of noise trading by individual investors is high.

Finally, to test whether the local firms can benefit from the improvement in stock liquidity caused by house value appreciation, we examine the relationship between the growth of housing price and local firms' underwriting fees for seasoned equity offerings. We find lower underwriting fees for local firms if they conduct seasoned equity offerings as the local housing market is booming. This effect of lower cost of equity financing is also more pronounced for small firms, firms with lower stock price, lower institutional ownership or lower analyst coverage.

Our paper contributes to existing literature in several ways. First, to the best of our knowledge, our study is the first to examine how local housing market conditions affect the stock liquidity of local

[5] In the robust check, we use an alternative measure (the abnormal growth of housing price), which is the residual from the OLS model that regress the growth of housing price on the growth of local economic, local population, and local household income at state level with year fixed effects.

firms. Loughran and Schultz (2005) study how geographical locations affect stock liquidity and show that stocks located in urban areas are more liquid. Our study focuses on the time-series variation of local stock liquidity, and finds that a significant positive association between local housing market condition and stock liquidity indeed exists.

Second, our paper contributes to the local bias literature, which facilitates our understanding of the household's stock trading behavior during the housing bubble period. We find that when the local housing market is hot, local households are more likely to behave as noise traders and their trading activities convey less information.

Third, we extend the literature on the positive association between stock liquidity and firm value. We document lower external financing cost for firms located in an area with escalated housing price. Specifically, we find a negative relationship between the growth rate of housing price and the underwriting fees for the seasoned equity offering by local firms, consistent with the view that improvement in stock liquidity reduces the direct cost of external equity financing (Butler, Grullon, and Weston (2005)).

The rest of the paper is organized as follows. In Section II, we describe the data and sample characteristics. Section III investigates the impact of housing market on stock liquidity of local firms. Section IV studies the impact of housing market on price synchronicity of local stocks. In Section IV, we investigate the effect of housing price appreciation on local firms' probability to do SEO and the SEO underwriting fees. Section V discusses the relation between local housing market and firm's information environment. Section VI presents the results from robustness tests. Section VII summarizes and concludes the paper.

II. Data and Summary Statistics

II.1 Sample

Our initial sample includes all firms covered in CRSP and Compustat database from 1990 to 2008.[6] We restrict our sample to those firms whose stock return and financial data are available in CRSP and Compustat, respectively. We also exclude firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC codes 4900-4999) from the sample.

We obtain state-level variables from the US Census Bureau, Bureau of Economic Analysis, Federal Housing Finance Agency and Federal Bureau of Investigation, such as state housing price index, state economic index, state real GDP, state population, median household income, home vacancy rate, and crime rate. Our main interested variable, the housing price index obtained from Federal Housing Finance Agency, is a seasonal adjusted index, which is equal to 100 at the beginning of 1990 for every state.[7] The state economic index (coincident index) obtained from Federal Reserve Bank combines four state-level indicators: nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index.[8]

Firm's headquarter location is from Compustat, institutional ownership comes from Thomson CDA/Spectrum (13F) and the number of analyst coverage is from Institutional Brokers Estimate System (I/B/E/S). Our final sample consists of 8,255 firms (60,053 firm-year observations).

II.2 Variable Definitions

We use the Amihud (2002) illiquidity measure as our main dependent variable. The Amihud illiquidity measure averages over each day in a year. It is calculated as following:

[6] To mitigate the impact of financial crisis in 2008, observations after 2008 are not included in our sample.
[7] The data is available at http://www.fhfa.gov/Default.aspx?Page=87.
[8] The data is available at http://www.philadelphiafed.org/research-and-data/regional-economy/indexes/coincident/.

Amihud-illiquidity measure= $\frac{1}{D_t}\sum\left(\sqrt{\frac{1000000*|\text{daily return}|}{|\text{daily dollar volume}|}}\right)$, where D_t is the number of days in year t.

The second illiquidity measure is the Roll's (1984) measure of effective trading costs, estimated as the square root of the negative of the auto-covariance of daily log returns, and set to zero when the sample auto-covariance is positive.

Since Hasbrouck (2009) develops a practical approach to estimating effective costs of trading using only daily data (the estimates are Bayesian and constructed using a Gibbs procedure), our third illiquidity measure is the estimate of the coefficient *c* in the following market-adjusted model: $\Delta P_{i,t} = c_i \Delta q_{i,t} + \beta_i r_{m,t} + u_{i,t}$, where P_i is the log the price and q_i is a trade direction taking +1 or -1 for buys and sells, R_m is the market return, u_i is the residual.[9]

Our main interested variable is the housing price growth, which equals to price $index_t$ / price $index_{t-1}$ minus one. Price $index_t$ and price $index_{t-1}$ are the housing price index at time t and at time t-1, respectively.

II.3 Summary Statistics

Panel A (B) of Table I reports the sample distribution of 60,053 firm-year observations according to year (state). From Table I, we find that significant variation exists in the growth rate of housing price not only across different years but also across different states. The average annual growth rate of housing price is 4.28% from 1991 to 2007, which is lowest in 2007 (-9.26%) and highest in 2004 (12.51%). From Table I panel B, the state of Utah has the highest average housing price growth (7.52%), following by Oregon (7.30%), Montana (6.84%), Washington (6.60%), and Colorado (6.51%). The state of Ohio has the lowest average housing price growth (3.07%).[10] More importantly, from 1991-2007, the housing price in States of Oregon, Utah, and Montana have

[9] We thank Joel Hasbrouck for making the data available on his website (http://pages.stern.nyu.edu/~jhasbrou/Research/GibbsCurrent/gibbsCurrentIndex.html).
[10] The statistics in Table I are based on firm-year observations, not state-year observations.

increased by more than 300%, however the housing price in States of Ohio, Michigan, and Indiana have only increased by around 160%.

Table II presents firm and state characteristics for our sample firms. If a firm locates in the state with an annual housing price growth rate higher than the sample median (4.28%), we treat the firm in that year as a firm located in hot state, and otherwise we treat it as a firm located in cold state. Several observations are noteworthy. First, compared to firms located in cold state, firms located in hot state have significant improvement in stock liquidity. Second, firms in hot state have lower past stock return and changes in market capitalization, but higher concurrent stock return. Third, changes in market to book ratio and tangibility are both lower for firms in hot state. Finally, firms in hot state enjoy better local economic conditions, as measured by higher economic growth, higher income growth, larger gross domestic product (GPD) and better local stock market performance.

III. Impact of Local Housing Market on Stock Liquidity

III.1 Impact of Housing Price on Stock Liquidity

Before directly going to the relation between the housing price growth and local stock liquidity, we need to obtain some fundamental supports for the argument that local housing market conditions indeed affect local households' demand for local stocks. However, to the best of our knowledge, the only available dataset on individual investors' stock trading in U.S. is coming from a large discount brokerage house (Odean (1998), Odean (1999), Barber and Odean (2000), Ivkovic and Weisbenner (2005), and Barber et al. (2009)). Moreover, the sample period of the dataset is from 1991 to 1996, which does not coincide with the recent housing bubble period. Here, we provide two limited evidences (untabulated) to support our argument.

Firstly, to the extent that local households are more likely to receive higher dividend income if they invest more in the equity market, we use the state level personal dividend, interest and rent income as a proxy for the stock market participation. We find that rising housing price is positively correlated with the personal dividend, interest and rent income. Secondly, following Da, Engelberg,

and Gao (2011), we hand collect the Google Search Volume Index for S&P 1500 firms from 2004 to 2008. More importantly, we additionally collect the information on "Regional interest" and construct a measure to proxy for local attention. The firm's local attention is equal to the regional interest from the firm's headquarter state divided by sum of regional interests from every states. We use this variable as a proxy for the local investors' demand for local stocks and find that rising housing price is also positively related with firms' local attention.

To investigate how the local housing market affects the local stock liquidity, we estimate an OLS regression of the change in stock liquidity on the growth rate of local housing price. Our findings are reported in Table III. The dependent variables are the change in Amihud-illiquidity (column (1) to (3)), the change in Roll-illiquidity (column (4) to (6)) and the change in C-illiquidity (column (7) to (9)) from year t to year t+1. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable.

From column (1) to column (9), the coefficient estimates on the growth rate of housing price are all negative and statistically significant at the 1% level, which suggest that the increase in housing price can indeed improve local stock liquidity. The coefficient estimate on the growth rate of housing price is -0.216 in column (3), which means one standard deviation (0.0635) increase in the growth rate of housing price is associated with 0.0141 raise in the stock liquidity. Such improvement in stock liquidity is economically large and significant, given that the 0.0141 increase in stock liquidity accounts for 38.1% of the average change in Amihud-illiquidity measure. Among other state level variables, we find that the coefficient estimates on population and state stock market performance are negative and significant, while those on growth of economic index and state real GDP level are positive and significant. Overall, these results support our wealth effect hypothesis that higher housing price appreciation reduces relative housing value (Cocco (2005)), and makes local households feel wealthier and less financial constrained and hence participate more in the stock market.

III.2 Correcting Endogeneity Bias: Instrumental Variables Approach

Although we extensively control for state economic variables to mitigate the concern that the growth of housing price is just a proxy of local economic condition, our study is still subject to potential endogeneity issues, such as omitted variable bias and reverse causality. For example, it is possible that omitted unobservable state factors affect both the local housing price and local stock liquidity, resulting in a spurious correlation between the two. In addition, if the liquidity of local stocks is high, households can easily sell their stock holdings without incurring high trading costs and subsequently invest more money into the housing market, therefore we are able to observe a positive correlation between local stock liquidity and housing price.

We attempt to address these issues by estimating 2SLS models with the lag one year state crime rate as the instrumental variable. Haurin and Brasington (1996) suggest that there is a close negative association between crime rate and housing price, since high crime rate reduces the demand for housing. Thus, we expect the lag one year crime rate has a negative impact on the housing price. However, there is no economic link between the crime rate and stock liquidity, thus lag one year crime rate also satisfies the exclusion condition.

In the first stage, we estimate an OLS regression of the growth in housing price on lag one year crime rate and the same set of control variables included in the Table III regressions. In the second stage, we estimate the OLS regression of change in stock liquidity using the instrumented growth of housing price and the control variables used in the first-stage regression as explanatory variables.

We report the results in Table IV. Column (1) presents the result from the first stage OLS regression. Consistent with our prediction, the coefficient estimates on crime rate is negative and significant at the 1% level. The value of the Anderson Canon. Corr. LR statistic is 110.58, which is significant at the 1% level, suggesting that our instrumental variable is relevant in explaining the variation in housing price appreciation. Columns (2) to (4) show the coefficient estimates from the second-stage regressions, with change in Amihud-illiquidity, change in Roll-illiquidity and change in C-illiquidity as the dependent variables, respectively. In all these three regressions, we find that the

coefficient estimates on the instrumented housing price growth remain negative and statistically significant. These results confirm that local housing price appreciation improves local stock liquidity, mitigating potential endogeneity concerns that our main results are driven by omitted unobservable state characteristics or reverse causality.

III.3 Analysis on Firm with Small Size, Low Stock Price, Low Institutional Ownership or Low Analyst Coverage

If local households feel wealthier when housing price increases, in turn participate in the local stock market more actively and lower the market makers' order processing costs, then this effect should be particularly pronounced when individual investors play more important roles on the stock market. Kumar and Lee (2006) show that small-cap stocks, lower-priced stocks and stocks with lower institutional ownership are more likely to have a higher retail concentration. Therefore, we set up four indicators to capture firms traded heavily by retail investors: a small firm indicator which equals one if the firm's market capitalization is below the sample median and zero otherwise, a low stock price indicator which equals one if the stock price is below the sample median and zero otherwise, a low institutional ownership indicator which equals one if the firm's institutional ownership is below the sample median and zero otherwise, and a low analyst coverage indicator which equals one if the firm's analyst coverage is below the sample median and zero otherwise. We are interested in the interaction terms of these indicators and housing price growth. The results are shown in Table V, using change in Amihud-illiquidity, change in Roll-illiquidity and change in C-illiquidity as the dependent variables in columns (1) to (4), columns (5) to (8), and columns (9) to (12), respectively.

In column (1), the coefficient estimate on housing price growth itself is positive and significant, that on the interaction term of small size indicator and housing price growth is negative and significant at the 1% level, suggesting that the positive impact of housing price appreciation on stock liquidity is only observed for small firms. Similarly, from columns (2) to (4), the coefficient estimates on the interaction terms of low stock price indicator and housing price growth, low institutional ownership indicator and housing price growth, and low analyst coverage indicator and

housing price growth are all negative and significant at the 1% level. The results show that the impact of housing price on stock liquidity can only be observed when the retail concentration is high. The analyses using other illiquidity measures (Roll-illiquidity and C-illiquidity) in columns (5) to (12) echo the findings in columns (1) to (4).

All these results in Table V further strongly support our wealth effect hypothesis that housing price appreciation promotes local retail investor's participation in the stock market and further enhance the local stock liquidity.

IV. Impact of Local Housing Market on Price Synchronicity

In an experimental study, Bloomfield, O'Hara, and Saar (2009) show that noise trading enhances stock liquidity, however, it also compromises the ability of market prices to adjust to new information. If households' noise trading on the local stocks is the main channel through which housing price growth enhances stock liquidity, then we expect less firm-specific information to be incorporated into stock price during the booming of local housing market. Further, this effect should be stronger when retail concentration of the stock is high.

Morck et al. (2000), Durnev et al. (2001), and Shen (2008) propose that higher price synchronicity (R^2) reflects less firm-specific information incorporated in the stock price. Therefore, in Table VI we use the change in R^2 as the dependent variable[11]. We also include retail concentration indicators (small size indicator, low stock price indicator, low institutional ownership indicators and low analyst coverage indicator), and the interaction terms between these indicators and the growth of housing price.

In column (1), the coefficient estimate on housing price growth is negative but insignificant, which indicates that on average the change in local housing price does not affect the information efficiency of local stock price. However, in column (2), the coefficient estimate on the interaction term of small size indicator and housing price growth is positive and significant at the 1% level,

[11] We regress daily stock return on market return and industry return, and estimate the R^2 for every stock in a given year.

suggesting that housing price appreciation would increase the price synchronicity (R^2) for small firms, and less firm-specific information is incorporated into stock price of small firms. Similarly, column (3) to (5) show that housing price appreciation has a positive impact on R^2 when the firm has lower stock price, lower institutional ownership or lower analyst coverage.

These results in Table VI are largely consistent with our prediction that due to higher growth of housing price, more local retail investors participate in the local stock market, providing liquidity to local stocks but incorporate less firm-specific information into stock price.

V. Impact of Local Housing Market on SEO Probability and SEO Underwriting Fees

Since the costs faced by the investment banking are similar as those of market makers, such as dealers who facilitate the intermediation process, it would be interesting to test whether local housing market would affect the cost associated with the underwriting process. Butler, Grullon, and Weston (2005) find that the stock liquidity is a key determinant of SEO underwriting fees, they argue that firms with higher stock liquidity attract higher investor demand and thus the more liquid the stock is, the easier it is for the investment bank to place the new issue and reduce these intermediation costs. In the previous sections, we find that appreciated property value induces households to participate more in the local stock market, leading to an increase in the stock liquidity. In this section, we further predict that SEO firms located in the state with higher housing price growth need less support from the underwriters, and thus are charged lower underwriting fees by the investment banks.

We obtain the information on seasoned equity offerings from Thomson's SDC New Issues database for the 1992-2008 periods. We keep the equity issuance with the largest offering proceeds if a firm has multiple seasoned equity offerings in a given year. The results are reported in Table VII. The dependent variable in column (1) is a SEO indicator, which equals one if the firm engages in a seasoned equity offering next year and zero otherwise. The dependent variable from column (2) to column (6) is the SEO underwriting fees.[12] We apply Probit model in column (1) and OLS regressions from column (2) to column (6). As in the previous table, retail concentration indicators (small size

[12] We exclude the SEO deals with missing underwriting fees in the models from column (2) to column (6).

indicator, low stock price indicator, low institutional ownership indicators and low analyst coverage indicator), and the interaction terms between these indicators and the growth of housing price are also included.

In column (1), the coefficient estimate on the growth of housing price is positive but insignificant, which indicates that housing price growth is not associated with the likelihood of local firms conducting seasoned equity offerings. One of the potential explanations is that rising housing price would not bring better investment opportunities for local firms. In column (2), the coefficient estimate on the growth of housing price is negative and significant at the 5% level, confirming our prediction that investment banks charge lower underwriting fees when the local housing market is hot. From column (3) to column (6), we focus on the interaction terms of housing price growth and retail concentration indicators. We find that the negative impact of hot housing market on underwriting fees are particularly evident when the SEO firm is a small firm, a firm with low stock price or low institutional ownership.

These results provide further support to our argument that rising residential property price has a positive impact on stock liquidity, facilitating the underwriting process, and thus benefits the local firms by lowering the direct cost of external equity financing.

VI. Impact of Local Housing Market on Analyst Coverage and Financial Reporting Quality

One potential alternative explanation of our finding could be that hot housing market attracts the attention from financial analysts and public media, further, the increased analyst coverage and improved information disclosure of local firms enhance their stock liquidity[13.] In this section, we investigate whether the change in analyst coverage and the firm's financial reporting quality in a hot housing market drive our results.

[13] Roulstone (2003) find that the number of analyst following has a positive association with stock liquidity. Bhattacharya, Desai, and Venkataraman (2012) show that improving earnings quality contributes to a better information environment for market participants and further increases stock liquidity.

We obtain the number of analyst coverage from Institutional Brokers Estimate System (I/B/E/S). Following Jones (1991) and Dechow, Sloan, and Sweeney (1995), we remove components of accruals that are beyond the control of the CEO when we estimate discretionary accruals. As in Jones (1991), we estimate nondiscretionary accruals as the fitted value from a regression of total accruals on lagged firm size, the change in firm sales, and gross property plant and equipment scaled by total firm assets for the sample firms in the same 2-digit SIC code industry group in a year. As suggested by Bergstresser and Philippon (2006), the absolute discretionary accrual is calculated as the absolute value of the estimated residual from the previous regressions.[14]

We present the results in Table VIII. The dependent variables are change in analyst coverage in column (1) to column (5), and change in absolute discretionary accruals in column (6) to column (10). Our interested variables are housing price growth and its interactions with retail concentration indicators.

In column (1), the coefficient estimate on the growth of housing price is positive but insignificant, which means on average housing price growth is not associated with increase in analyst coverage. In columns (2) through (5), we find that rising property price is negatively related with the change in analyst coverage if the firm is a small firm, a low-priced firm, a firm with low institutional ownership or with low analyst coverage.

Again, in column (6), the coefficient estimate on the growth of housing price is positive but insignificant, indicating that on average housing price growth is not associated with better financial reporting quality. In columns (7) through (10), we do not find any significant results on the interaction terms.

Overall, we find little evidence that the improvement in stock liquidity is due to more analyst coverage or better financial report quality in a hot housing market.

[14] Bergstresser and Philippon (2006) consider that earnings management involves the transfer of earnings from one period to another. The absolute measure of accruals measures the total amount of earnings transfer without being sensitive to the precise timing of when earnings are increased or decreased.

VII. Robustness Tests

To check the robustness of our key results, we conduct several additional tests. Below, we briefly summarize the results of these untabulated tests.

First, our results are robust to using an alternative measure of housing price growth. The alternative measure is the abnormal housing price growth, which is the residual from the OLS model, regressing housing price growth on state economic growth, state population, state household income, and year indicators.

Second, to examine whether our results are robust to controlling for additional firm characteristics and state characteristics, we further include in the analyses recent 3-year accumulative state economic growth rate, the percentage of elderly people (above 60) in the state, lag one year stock liquidity and total institutional ownership. Our results remain the same.

Third, if the omitted state economic factor has positive impact on firm's future performance and thus we observe the increase in stock liquidity, we should also find an improvement in profitability and an increase in institutional ownership. However, we do not find significant results on change in ROA and institutional ownership.

Fourth, we also conduct sensitivity tests by excluding the sample firms located nearby the financial centers (specifically, we exclude firms located in state of New York, California and Illinois). We get similar results.

Fifth, to the extent that local households are more likely to enjoy higher dividend income if they invest more in the equity market, we use personal dividend, interest and rent income (obtained from Bureau of Economic Analysis) as a proxy for the stock market participation. We find that rising housing price is positively correlated with the personal dividend income, even after controlling for local economic conditions, the average dividend payout ratio of local firms and the growth rate of housing rents.

Sixth, following Da, Engelberg, and Gao (2011), I hand collect the Google Search Volume Index for S&P 1500 firms from 2004 to 2008. More importantly, I also collect the information on

"Regional interest". For example, the ticker for K2 Inc is "KTO". I use "KTO" as the input in the Google Trend website, and Google Trend not only provides the search volume index but also the index for regional interest. I download this interesting variable, and construct a variable to proxy for local attention. The firm's local attention is equal to the regional interest from the firm's headquarter state divided by sum of regional interest from every states. We use this variable as a proxy for the local investors' demand. Consistent with the main argument, we find that rising housing price is also positively related with firms' local attention.

Seventh, if we decompose our sample into two sub-periods, pre-1999 period and post-1999 period, our results are mainly driven by the latter period, which coincides with the recent housing bubble[15]. This is consistent with our wealth effect hypothesis that households' stock investment behaviors are strongly stimulated when home prices are soaring.

Eighth, it is also possible that the high housing price growth affects the stock liquidity of the local firm through other channels. For example, during the housing boom period the collateral value of the firm's fixed asset increases, the local firm's borrowing capacity and firm's performance would be improved, and thus we observe an increase of stock liquidity. In order to alleviate such concern, we directly test this alternative explanation, by using the change in financial leverage of the firm as the dependent variable, and I find that the growth of local housing price does not significantly affect firms' financing decision. Secondly, I decompose my sample into two groups, based on the sample median of the firm's fixed asset ratio (net fixed asset / total assets), and interacts with the growth of housing price. If the improvement in stock liquidity is coming from the increase in collateral value, we should observe that this effect would be stronger for firms' with more fixed assets. I find that the coefficient of the interaction term is significant positive, which suggests that the improvement in stock liquidity mainly comes from firms with lower fixed assets ratio.

Ninth, we try other alternative measures of stock liquidity. Our results are robust to the bid-ask spread calculated from CRSP data (Chung and Zhang (2013)), and the turn-over version Amihud-

[15] Edward Pinto, a mortgage-industry consultant who was the chief credit officer at Fannie Mae in the late 1980s, argued that "Most agree that the housing bubble started in 1997". The article is available at: http://online.wsj.com/article/SB10001424052748703298004574459763052141456.html#mod=todays_us_opinion.

illiquidity measure (Brennan, Huh, and Subrahmanyam (2013)). In addition, we also add the yearly average dollar trading volume as an additional control variable in the regressions. The impacts of growth of housing price on Amihud-liquidity still exist.

VIII. Summary and Conclusion

In this paper, we investigate the relationship between local housing market and stock liquidity. We use the state-level housing price growth rate as our main interested variable. We find that firms located in the state with higher growth in housing price experience significant improvement in their stock liquidity. This result is only observed as retail concentration increases, that is, when the firm size is smaller, when the stock price is lower, when the firm has lower institutional ownership, or when the firm is covered by fewer analysts. These results are robust to different measures of stock liquidity, inclusion of extensive state economic variables, and estimation of the 2SLS model.

Second, for firm with smaller size, lower stock price, lower institutional ownership or less analyst coverage, the rising home price is associated with an increase in stock price synchronicity (R^2). This finding is consistent with Case and Shiller (1988) in which they show that an increase in housing prices stimulates speculative behaviors by homeowners, and also in line with Bloomfield, O'Hara, and Saar (2009) who argue that the noise traders indeed increase stock liquidity, but diminish the ability of stock prices to respond to new information.

Finally, we document a negative relationship between the rising housing price and the underwriting fees in the seasoned equity offerings conducted by local firms, supporting the view that increases in stock liquidity reduce the direct cost of external equity financing. Collectively, our results add to the understanding on how geographical locations affect stock liquidity, and the relationship between housing market and stock market.

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Table I: Sample Distribution by Year and State

The sample consists of 60,053 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Panel A and B present the distribution of sample firms by year and state, respectively.

Panel A. Distribution of Firms by Year

Year	Number of Firms	Average growth of housing price	Highest growth of housing price	Lowest growth of housing price
1991	3,234	1.40%	10.59%	-5.22%
1992	3,365	0.72%	11.58%	-7.55%
1993	3,577	2.98%	17.87%	-5.06%
1994	3,880	2.37%	14.58%	-3.49%
1995	4,072	2.83%	11.27%	-6.67%
1996	4,178	2.48%	8.89%	-3.55%
1997	4,308	4.09%	8.67%	-4.61%
1998	4,104	6.23%	9.86%	1.97%
1999	3,848	7.78%	12.88%	0.98%
2000	3,667	8.32%	15.92%	1.98%
2001	3,612	7.10%	16.18%	0.25%
2002	3,342	9.15%	20.86%	-0.05%
2003	3,193	9.90%	22.65%	1.14%
2004	3,019	12.51%	30.82%	1.10%
2005	2,975	10.07%	28.18%	-0.98%
2006	2,863	0.83%	17.87%	-6.18%
2007	2,816	-9.26%	4.11%	-26.54%
Total	60,053	4.28%	30.82%	-26.54%

Panel B. Distribution of Firms by State

State Code	Number of Firms	Average growth of housing price	Highest growth of housing price	Lowest growth of housing price
AK	29	5.15%	11.14%	-2.68%
AL	336	4.08%	9.28%	-1.28%
AR	307	3.97%	7.16%	-1.21%
AZ	947	6.39%	28.18%	-19.72%
CA	10,877	5.58%	25.15%	-25.11%
CO	1,775	6.51%	13.75%	-6.71%
CT	1,473	4.12%	12.95%	-6.28%
DE	179	4.27%	15.33%	-3.07%
FL	2,930	5.17%	22.67%	-20.07%
GA	1,758	3.83%	7.09%	-5.35%
HI	106	5.23%	24.49%	-6.78%
IA	259	4.56%	7.03%	-0.07%
ID	133	6.13%	19.32%	0.31%
IL	2,565	3.99%	7.88%	-7.62%
IN	629	3.13%	6.20%	-2.43%

KS	385	4.29%	6.97%	1.13%
KY	332	3.94%	6.60%	-1.11%
LA	353	4.86%	12.90%	-0.26%
MA	3,540	5.75%	14.88%	-7.21%
MD	944	4.62%	20.00%	-8.51%
ME	56	3.93%	13.66%	-7.55%
MI	1,241	3.75%	8.91%	-15.15%
MN	2,282	5.47%	11.88%	-9.58%
MO	957	4.06%	6.37%	-5.72%
MS	130	3.89%	9.76%	-1.77%
MT	45	6.84%	12.38%	1.28%
NC	1,144	3.77%	7.11%	-1.68%
ND	22	4.72%	11.35%	1.80%
NE	224	4.50%	8.60%	-1.33%
NH	274	5.17%	15.92%	-9.20%
NM	69	5.30%	13.69%	0.83%
NV	589	4.62%	30.82%	-26.54%
NY	5,166	3.89%	12.20%	-3.32%
OH	2,199	3.07%	6.16%	-9.00%
OK	511	4.04%	6.08%	0.61%
OR	679	7.30%	19.26%	-4.07%
PA	2,684	3.84%	10.63%	-0.67%
RI	213	4.96%	20.86%	-10.64%
SC	301	3.94%	8.22%	-2.35%
SD	63	5.01%	8.23%	2.40%
TN	961	4.29%	8.67%	-3.89%
TX	6,157	3.74%	6.55%	1.04%
UT	517	7.52%	17.87%	-0.05%
VA	1,475	5.21%	19.72%	-7.87%
VT	82	4.67%	15.40%	-3.55%
WA	1,137	6.60%	18.81%	-3.45%
WI	951	5.08%	8.31%	-2.10%
WV	55	4.68%	11.93%	-0.30%
WY	12	5.52%	11.74%	2.08%
Total	60,053	4.28%	30.82%	-26.54%

Table II: Firm and State Characteristics

The sample consists of 60,053 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. If a firm locates in the state with an annual housing price growth rate higher than sample median, we treat the firm in that year as a firm located in the hot state, and otherwise we treat the firm as a firm located in the cold state. All firm characteristics are measured as of the fiscal year-end. The Appendix provides a detailed description of the construction of the variables. The numbers in the test-of-difference columns are *t*-values or *z*-values. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Firms Located in the Hot State (N=29,954): A		Firms Located in the Cold State (N=30,099): B		Test of Difference (A-B)	
	Mean	Median	Mean	Median	*t*-test	Wilcoxon test
Firm Characteristics						
Δ Amihud-illiquidity×100	3.462	-0.196	3.890	-0.128	-0.868	-2.352**
Δ Roll-illiquidity×100	0.024	0.000	0.131	0.000	-10.938***	-9.503***
Δ C-illiquidity×100	-0.022	-0.025	-0.014	0.000	-1.098	-6.520***
Past stock return	0.161	0.019	0.187	0.066	-4.391***	-12.422***
Current stock return	0.141	0.014	0.103	0.007	6.426***	3.057***
Δ Market capitalization	0.032	0.044	0.086	0.083	-10.398***	-10.165***
Δ Book leverage×100	0.634	0.000	0.521	0.000	1.353	2.800***
Δ Probability×100	-0.689	-0.082	-0.638	-0.042	-0.466	-0.355
Δ Market to book×100	-13.049	-2.631	-6.602	-0.078	-5.582***	-6.310***
Δ Cash holding×100	-0.952	-0.117	-0.992	-0.113	0.454	1.085
Δ R&D intensity×100	0.221	0.000	0.247	0.000	-0.589	-0.540
Δ Tangibility×100	-0.049	-0.173	0.097	-0.085	-3.028***	-3.418***
State Characteristics						
Δ Economic Index	0.033	0.038	0.025	0.031	41.419***	47.437***
Δ Household Income	0.012	0.011	0.002	0.006	29.030***	23.677***
Population (million)	14.344	8.913	14.459	12.185	-1.703*	-11.006***
GDP (billion U.S dollars)	584.442	319.725	498.020	389.704	23.358***	-1.431
State stock market return	0.166	0.084	0.186	0.156	-8.820***	-28.018***

Table III: OLS Regression of Change in Liquidity on Change in Firm Characteristics

The sample consists of 60,053 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The dependent variable from column (1) to column (3) is the change in Amihud-illiquidity. The dependent variable from column (4) to column (6) is the change in Roll's measure of effective trading cost. The dependent variable from column (7) to column (9) is the change in C estimate of illiquidity. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Δ Amihud-illiquidity			Δ Roll-illiquidity			Δ C-illiquidity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Housing price	-0.126***	-0.215***	-0.216***	-0.002***	-0.004***	-0.003***	-0.002***	-0.003***	-0.003***
	(0.0065)	(0.0003)	(0.0001)	(0.0021)	(0.0003)	(0.0011)	(0.0006)	(0.0001)	(0.0000)
State characteristics									
Δ Economic Index		0.647***	0.473**		0.008*	0.002		0.007**	0.003
		(0.0083)	(0.0337)		(0.0696)	(0.5581)		(0.0303)	(0.3329)
Δ Household Income		0.061	0.012		0.001	0.000		0.001	0.001
		(0.3310)	(0.8425)		(0.3762)	(0.7210)		(0.1781)	(0.4525)
Ln (Population)		-0.301**	0.002		-0.012***	-0.007***		-0.005***	-0.001
		(0.0127)	(0.9849)		(0.0000)	(0.0002)		(0.0005)	(0.3400)
Ln (GDP)		0.218**	-0.054		0.009***	0.004***		0.006***	0.002**
		(0.0147)	(0.5053)		(0.0000)	(0.0045)		(0.0000)	(0.0406)
State stock market return		-0.168***	-0.023		-0.002***	-0.000		-0.002***	0.000
		(0.0000)	(0.1634)		(0.0000)	(0.1850)		(0.0000)	(0.7681)
Firm characteristics									
Past stock return			-0.017**			0.000			0.000*
			(0.0150)			(0.5561)			(0.0728)
Current stock return			-0.280***			-0.004***			-0.004***
			(0.0000)			(0.0000)			(0.0000)
Δ Market capitalization			-0.222***			-0.002***			-0.003***
			(0.0000)			(0.0000)			(0.0000)
Δ Book leverage			0.076***			0.001			0.001**
			(0.0048)			(0.1199)			(0.0100)
Δ Profitability			-0.240***			-0.004***			-0.004***
			(0.0000)			(0.0000)			(0.0000)
Δ Market to book			0.022***			-0.000			0.000
			(0.0000)			(0.5434)			(0.2863)
Δ Cash holding			0.049*			0.000			-0.000
			(0.0569)			(0.7597)			(0.7114)
Δ R&D intensity			-0.455***			-0.006***			-0.006***

			(0.0000)			(0.0000)			(0.0000)
Δ Tangibility			0.148***			0.002**			0.002***
			(0.0049)			(0.0495)			(0.0047)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
State fixed effects	NO	YES	YES	NO	YES	YES	NO	YES	YES
R-squared	0.0635	0.0662	0.212	0.0502	0.0519	0.129	0.0380	0.0401	0.176
Number of observations	60,053	60,053	59,315	60,049	60,049	59,312	56,316	56,316	55,635

Table IV: 2SLS Regression of Change in Liquidity on Change in Firm Characteristics

The sample consists of 59,316 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The crime rate is from the Federal Bureau of Investigation. The dependent variable in column (1) is the change in housing price. The dependent variable in column (2) is the change in Amihud-illiquidity. The dependent variable in column (3) is the change in Roll's measure of effective trading cost. The dependent variable in column (4) is the change in C estimate of illiquidity. Column (2) to (4) shows the results from second-stage regressions on instrument for change in housing price. Change in housing price is instrumented with fitted values from a first-stage OLS regression on the state crime rate. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Δ Housing price First-stage	Δ Amihud-illiquidity	Δ Roll-illiquidity	Δ C-illiquidity
	(1)	(2)	(3)	(4)
Crime rate	-0.000***			
	(0.0000)			
Instrumented Δ housing price		-3.272***	-0.068***	-0.023*
		(0.0008)	(0.0001)	(0.0535)
State characteristics				
Δ Economic Index	1.588***	5.485***	0.110***	0.036*
	(0.0000)	(0.0004)	(0.0001)	(0.0684)
Δ Household Income	0.106***	0.338***	0.007***	0.004**
	(0.0000)	(0.0050)	(0.0017)	(0.0233)
Ln (Population)	-0.019***	-0.085***	-0.002***	-0.001**
	(0.0000)	(0.0018)	(0.0000)	(0.0284)
Ln (GDP)	0.022***	0.091***	0.002***	0.001**
	(0.0000)	(0.0013)	(0.0000)	(0.0267)
State stock market return	0.012***	0.018	0.000	0.000
	(0.0000)	(0.3891)	(0.5504)	(0.2684)
Firm characteristics				
Past stock return	0.000	-0.017**	0.000	0.000
	(0.8629)	(0.0120)	(0.6358)	(0.3568)
Current stock return	0.000	-0.287***	-0.005***	-0.004***
	(0.1249)	(0.0000)	(0.0000)	(0.0000)
Δ Market capitalization	-0.001**	-0.232***	-0.002***	-0.003***
	(0.0428)	(0.0000)	(0.0000)	(0.0000)
Δ Book leverage	0.001	0.094***	0.001**	0.001***
	(0.4601)	(0.0006)	(0.0395)	(0.0018)
Δ Profitability	-0.001	-0.249***	-0.005***	-0.004***
	(0.6661)	(0.0000)	(0.0000)	(0.0000)
Δ Market to book	0.000	0.023***	-0.000	0.000*
	(0.4759)	(0.0000)	(0.7959)	(0.0594)
Δ Cash holding	-0.001	0.035	-0.000	0.000
	(0.6591)	(0.1861)	(0.9486)	(0.7509)
Δ R&D intensity	-0.016***	-0.503***	-0.007***	-0.006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Tangibility	0.002	0.149***	0.002**	0.002***
	(0.3957)	(0.0053)	(0.0474)	(0.0014)
Year fixed effects	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES
R-squared	0.630	0.210	0.127	0.176
Number of observations	59,316	59,315	59,312	55,601

Table V: Analysis on Firms with Small Size, Low Stock Price, Low Institutional Ownership and Low Analyst Coverage

The sample consists of 59,317 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The dependent variable from column (1) to column (4) is the change in Amihud-illiquidity. The dependent variable from column (5) to column (8) is the change in Roll's measure of effective trading cost. The dependent variable from column (9) to column (12) is the change in C estimate of illiquidity. The small size indicator is equal to one if the firm's market capitalization is below the sample median and zero otherwise. The low stock price indicator is equal to one if the firm's stock price is below the sample median and zero otherwise. The low institutional ownership indicator is equal to one if the firm's institutional ownership is below the sample median and zero otherwise. The low analyst coverage indicator is equal to one if the firm's analyst coverage is below the sample median and zero otherwise. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Δ Amihud-illiquidity				Δ Roll-illiquidity				Δ C-illiquidity			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δ Housing price: A	0.240***	0.199***	0.092*	0.242***	0.002**	0.005***	-0.000	0.004***	-0.000	0.000	0.000	0.001
	(0.0000)	(0.0001)	(0.0904)	(0.0000)	(0.0194)	(0.0000)	(0.9541)	(0.0005)	(0.6681)	(0.8798)	(0.9546)	(0.2461)
Small size (indicator): B	0.081***				0.000***				-0.000***			
	(0.0000)				(0.0004)				(0.0001)			
Low stock price (indicator): C		0.040***				0.001***				-0.000***		
		(0.0000)				(0.0000)				(0.0000)		
Low institutional ownership (indicator): D			0.055***				-0.000				0.000**	
			(0.0000)				(0.5108)				(0.0223)	
Low analyst coverage (indicator): E				0.083***				0.001***				0.000
				(0.0000)				(0.0000)				(0.1018)
A * B	-1.137***				-0.014***				-0.006***			
	(0.0000)				(0.0000)				(0.0000)			
A * C		-0.773***				-0.015***				-0.005***		
		(0.0000)				(0.0000)				(0.0000)		
A * D			-0.906***				-0.010***				-0.008***	
			(0.0000)				(0.0000)				(0.0000)	
A * E				-1.116***				-0.017***				-0.008***
				(0.0000)				(0.0000)				(0.0000)
State characteristics												
Δ Economic Index	0.699***	0.463**	0.758***	0.698***	0.005	0.002	0.006	0.006	0.004	0.002	0.005*	0.004
	(0.0015)	(0.0364)	(0.0007)	(0.0015)	(0.2237)	(0.5953)	(0.1613)	(0.1702)	(0.1950)	(0.4642)	(0.0574)	(0.1460)
Δ Household Income	0.027	0.016	0.030	0.026	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.6416)	(0.7857)	(0.6103)	(0.6493)	(0.6214)	(0.6757)	(0.6187)	(0.6005)	(0.4158)	(0.4632)	(0.3615)	(0.3960)
Ln (Population)	0.015	0.023	0.019	0.032	-0.007***	-0.007***	-0.007***	-0.007***	-0.001	-0.001	-0.001	-0.001
	(0.8883)	(0.8276)	(0.8571)	(0.7683)	(0.0003)	(0.0004)	(0.0005)	(0.0005)	(0.3561)	(0.3341)	(0.4259)	(0.4166)
Ln (GDP)	-0.088	-0.082	-0.102	-0.093	0.004**	0.004**	0.003**	0.004**	0.002*	0.002*	0.002	0.002*
	(0.2713)	(0.3044)	(0.2055)	(0.2484)	(0.0120)	(0.0132)	(0.0176)	(0.0153)	(0.0716)	(0.0633)	(0.1135)	(0.0852)
State stock market return	-0.026	-0.026	-0.022	-0.024	-0.001	-0.001	-0.000	-0.000	0.000	0.000	0.000	0.000

	(0.1232)	(0.1228)	(0.1990)	(0.1516)	(0.1670)	(0.1444)	(0.2030)	(0.1786)	(0.7559)	(0.8408)	(0.7090)	(0.7503)
Firm characteristics												
Past stock return	-0.017**	-0.016**	-0.017**	-0.017**	0.000	0.000	0.000	0.000	0.000*	0.000*	0.000*	0.000*
	(0.0146)	(0.0172)	(0.0148)	(0.0160)	(0.6085)	(0.5335)	(0.5735)	(0.5615)	(0.0819)	(0.0938)	(0.0705)	(0.0790)
Current stock return	-0.280***	-0.279***	-0.280***	-0.280***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
∆ Market capitalization	-0.218***	-0.222***	-0.222***	-0.219***	-0.002***	-0.002***	-0.002***	-0.002***	-0.003***	-0.003***	-0.003***	-0.003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
∆ Book leverage	0.078***	0.077***	0.076***	0.079***	0.001	0.001	0.001	0.001	0.001**	0.001**	0.001***	0.001**
	(0.0035)	(0.0043)	(0.0048)	(0.0032)	(0.1167)	(0.1126)	(0.1103)	(0.1067)	(0.0108)	(0.0100)	(0.0091)	(0.0109)
∆ Profitability	-0.241***	-0.240***	-0.240***	-0.240***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
∆ Market to book	0.021***	0.022***	0.022***	0.021***	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000	0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.6781)	(0.5167)	(0.5913)	(0.5219)	(0.1294)	(0.1150)	(0.2617)	(0.1781)
∆ Cash holding	0.050*	0.049*	0.051**	0.050*	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.0503)	(0.0558)	(0.0468)	(0.0505)	(0.7312)	(0.7545)	(0.7704)	(0.7250)	(0.7316)	(0.7405)	(0.7211)	(0.7544)
∆ R&D intensity	-0.448***	-0.452***	-0.454***	-0.443***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
∆ Tangibility	0.148***	0.145***	0.145***	0.150***	0.002*	0.002*	0.002*	0.002*	0.002***	0.002***	0.002***	0.002***
	(0.0049)	(0.0058)	(0.0058)	(0.0044)	(0.0566)	(0.0566)	(0.0585)	(0.0506)	(0.0063)	(0.0077)	(0.0056)	(0.0062)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.215	0.213	0.213	0.215	0.130	0.131	0.130	0.131	0.177	0.177	0.177	0.177
Number of observations	59,317	59,317	59,317	59,317	59,312	59,312	59,312	59,312	55,635	55,635	55,635	55,635

Table VI: OLS Regression of Change in R^2 on Change in Firm Characteristics

The sample consists of 59,311 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The dependent variable is the change in R^2. The small size indicator is equal to one if the firm's market capitalization is below the sample median and zero otherwise. The low stock price indicator is equal to one if the firm's stock price is below the sample median and zero otherwise. The low institutional ownership indicator is equal to one if the firm's institutional ownership is below the sample median and zero otherwise. The low analyst coverage indicator is equal to one if the firm's analyst coverage is below the sample median and zero otherwise. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Δ Housing price: A	-0.010	-0.065***	-0.072***	-0.041***	-0.058***
	(0.2993)	(0.0000)	(0.0000)	(0.0002)	(0.0000)
Small size (indicator): B		-0.015***			
		(0.0000)			
Low stock price (indicator): C			-0.012***		
			(0.0000)		
Low institutional ownership (indicator): D				-0.010***	
				(0.0000)	
Low analyst coverage (indicator): E					-0.012***
					(0.0000)
A * B		0.136***			
		(0.0000)			
A * C			0.116***		
			(0.0000)		
A * D				0.090***	
				(0.0000)	
A * E					0.117***
					(0.0000)
State characteristics					
Δ Economic Index	-0.062*	-0.091***	-0.066**	-0.088***	-0.087***
	(0.0626)	(0.0054)	(0.0441)	(0.0077)	(0.0074)
Δ Household Income	-0.012	-0.014	-0.013	-0.014	-0.013
	(0.2017)	(0.1350)	(0.1670)	(0.1395)	(0.1458)
Ln (Population)	0.005	0.003	0.000	0.005	0.002
	(0.7480)	(0.8246)	(0.9842)	(0.7495)	(0.8884)
Ln (GDP)	-0.033***	-0.029***	-0.029***	-0.029***	-0.029***
	(0.0026)	(0.0064)	(0.0076)	(0.0077)	(0.0067)
State stock market return	0.041***	0.041***	0.041***	0.041***	0.041***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Firm characteristics					
Past stock return	0.007***	0.007***	0.006***	0.007***	0.007***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Current stock return	0.017***	0.017***	0.017***	0.017***	0.017***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Market capitalization	0.008***	0.006***	0.006***	0.008***	0.007***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Book leverage	0.012***	0.012***	0.012***	0.012***	0.012***
	(0.0006)	(0.0010)	(0.0008)	(0.0005)	(0.0012)
Δ Profitability	-0.003	-0.003	-0.002	-0.003	-0.003
	(0.3301)	(0.4265)	(0.4954)	(0.3628)	(0.3393)
Δ Market to book	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Cash holding	0.001	0.001	0.001	0.001	0.001
	(0.7375)	(0.7532)	(0.7080)	(0.8275)	(0.7339)
Δ R&D intensity	-0.021**	-0.021**	-0.021**	-0.020**	-0.022***
	(0.0129)	(0.0119)	(0.0125)	(0.0167)	(0.0077)
Δ Tangibility	-0.011*	-0.012*	-0.012*	-0.011*	-0.012*
	(0.0860)	(0.0691)	(0.0688)	(0.0853)	(0.0650)

Year fixed effects	YES	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES	YES
R-squared	0.207	0.211	0.210	0.208	0.210
Number of observations	59,311	59,311	59,311	59,311	59,311

Table VII: Analysis on SEO Probability and SEO Underwriting Fees

In column, there are 59,395 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. From column (2) to column (6), there are 1,975 SEO deals. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The dependent variable in column (1) is an indicator which is equal to one if the firm engages in seasoned equity offering next year and zero otherwise. The dependent variable from column (2) to column (6) is the SEO underwriting fees. The small size indicator is equal to one if the firm's market capitalization is below the sample median and zero otherwise. The low stock price indicator is equal to one if the firm's stock price is below the sample median and zero otherwise. The low institutional ownership indicator is equal to one if the firm's institutional ownership is below the sample median and zero otherwise. The low analyst coverage indicator is equal to one if the firm's analyst coverage is below the sample median and zero otherwise. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	SEO indicator	Underwriting fees				
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Housing price: A	0.005	-0.388**	-0.088	-0.137	-0.167	-0.205
	(0.8030)	(0.0286)	(0.6415)	(0.4762)	(0.3736)	(0.2679)
Small size (indicator): B			0.056***			
			(0.0074)			
Low stock price (indicator): C				0.041**		
				(0.0141)		
Low institutional ownership (indicator): D					0.053***	
					(0.0057)	
Low analyst coverage (indicator): E						0.040**
						(0.0192)
A * B			-0.667**			
			(0.0118)			
A * C				-0.437*		
				(0.0897)		
A * D					-0.511*	
					(0.0648)	
A * E						-0.368
						(0.1230)
State characteristics						
Δ Economic Index	0.051	1.061**	1.148**	1.074**	1.139**	1.068**
	(0.4613)	(0.0280)	(0.0165)	(0.0264)	(0.0179)	(0.0256)
Δ Household Income	0.021	-0.224*	-0.239*	-0.228*	-0.218*	-0.222*
	(0.2677)	(0.0697)	(0.0518)	(0.0640)	(0.0770)	(0.0719)
Ln (Population)	0.050	-0.181	-0.196	-0.189	-0.210	-0.176
	(0.2224)	(0.5183)	(0.4859)	(0.5077)	(0.4386)	(0.5324)
Ln (GDP)	-0.026	-0.072	-0.054	-0.053	-0.093	-0.074
	(0.3665)	(0.7204)	(0.7880)	(0.7923)	(0.6376)	(0.7104)
State stock market return	0.009*	0.003	0.007	-0.001	0.007	0.001
	(0.0927)	(0.9579)	(0.9029)	(0.9919)	(0.9027)	(0.9912)
Firm characteristics						
Past stock return	0.009***	0.009**	0.008*	0.010**	0.009**	0.009*
	(0.0000)	(0.0413)	(0.0667)	(0.0335)	(0.0437)	(0.0540)
Ln (Market capitalization)	0.006***	-0.143***	-0.137***	-0.139***	-0.140***	-0.137***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Book leverage	0.033***	-0.021	-0.021	-0.024	-0.020	-0.020
	(0.0000)	(0.3711)	(0.3639)	(0.3009)	(0.3839)	(0.3791)
Profitability	-0.002	-0.056	-0.058	-0.050	-0.051	-0.052
	(0.5203)	(0.2024)	(0.1865)	(0.2570)	(0.2378)	(0.2321)
Market to book	-0.000	0.013***	0.013***	0.013***	0.013***	0.013***
	(0.6127)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Cash holding	0.025***	0.024	0.022	0.023	0.030	0.027
	(0.0000)	(0.4801)	(0.5033)	(0.4935)	(0.3839)	(0.4316)
R&D intensity	0.016***	-0.083	-0.083	-0.078	-0.077	-0.078
	(0.0087)	(0.1571)	(0.1518)	(0.1790)	(0.1842)	(0.1792)
Tangibility	0.008	-0.011	-0.009	-0.010	-0.011	-0.006
	(0.1464)	(0.7385)	(0.7779)	(0.7638)	(0.7203)	(0.8620)

Year fixed effects	YES	YES	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES
R-squared/ Pseudo R^2	0.069	0.551	0.553	0.552	0.552	0.552
Number of observations	59,395	1,975	1,975	1,975	1,975	1,975

Table VIII: OLS Regression of Change in Analyst Coverage and Change in Discretionary Accruals on Change in Firm Characteristics

The sample consists of 59,316 firm-year observations covered in Compustat and CRSP databases from 1992 to 2008. Firms in the financial industries (primary SIC codes 6000-6999) and utility industries (primary SIC 4900-4999) are excluded. We obtain the housing price information from Federal Housing Finance Agency (http://www.fhfa.gov/Default.aspx?Page=87). Other state level information is obtained from US Census Bureau, Federal Reserve Bank, and U.S. Bureau of Economic Analysis. The dependent variable from column (1) to column (5) is the change in analyst coverage. The dependent variable from column (6) to column (10) is the change in absolute discretionary accruals. The small size indicator is equal to one if the firm's market capitalization is below the sample median and zero otherwise. The low stock price indicator is equal to one if the firm's stock price is below the sample median and zero otherwise. The low institutional ownership indicator is equal to one if the firm's institutional ownership is below the sample median and zero otherwise. The low analyst coverage indicator is equal to one if the firm's analyst coverage is below the sample median and zero otherwise. All independent variables are measured as of the fiscal year-end and are lagged by one period with respect to the dependent variable. The Appendix provides a detailed description of the construction of the variables. We estimate p-values using robust standard errors to adjust for heteroskedasticity (White 1980) and cluster the errors by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Δ Analyst coverage					Δ Absolute discretionary accruals				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δ Housing price: A	0.325	0.795***	0.882***	0.794***	0.830***	0.007	0.010	0.009	0.013*	0.009
	(0.1844)	(0.0096)	(0.0072)	(0.0054)	(0.0073)	(0.3826)	(0.2200)	(0.2811)	(0.0937)	(0.2305)
Small size (indicator): B		-0.041*					0.002**			
		(0.0520)					(0.0158)			
Low stock price (indicator): C			-0.122***					-0.000		
			(0.0000)					(0.9268)		
Low institutional ownership (indicator): D				0.379***					0.004***	
				(0.0000)					(0.0002)	
Low analyst coverage (indicator): E					-0.383***					0.001
					(0.0000)					(0.1103)
A * B		-1.203***					-0.007			
		(0.0000)					(0.4855)			
A * C			-1.028***					-0.004		
			(0.0004)					(0.6482)		
A * D				-1.308***					-0.019	
				(0.0000)					(0.1310)	
A * E					-1.325***					-0.007
					(0.0000)					(0.5165)
State characteristics										
Δ Economic Index	0.947	1.141	0.781	1.203	0.971	-0.035	-0.033	-0.035	-0.030	-0.033
	(0.2369)	(0.1530)	(0.3285)	(0.1318)	(0.2215)	(0.2893)	(0.3211)	(0.2845)	(0.3647)	(0.3169)
Δ Household Income	-0.396*	-0.383*	-0.400*	-0.365	-0.390*	0.023*	0.023*	0.023*	0.023*	0.023*
	(0.0803)	(0.0909)	(0.0776)	(0.1070)	(0.0825)	(0.0560)	(0.0549)	(0.0560)	(0.0524)	(0.0549)
Ln (Population)	0.263	0.275	0.248	0.179	0.318	0.020	0.020	0.020	0.019	0.020
	(0.5419)	(0.5237)	(0.5659)	(0.6774)	(0.4643)	(0.1832)	(0.1834)	(0.1824)	(0.2007)	(0.1809)
Ln (GDP)	-0.454	-0.504	-0.498	-0.446	-0.582*	-0.014	-0.014	-0.014	-0.014	-0.014
	(0.1535)	(0.1135)	(0.1180)	(0.1607)	(0.0683)	(0.2303)	(0.2301)	(0.2248)	(0.2246)	(0.2281)
State stock market return	0.019	0.019	0.013	0.022	0.024	0.003	0.003	0.003	0.003	0.003

	(0.7768)	(0.7830)	(0.8495)	(0.7462)	(0.7293)	(0.3976)	(0.4060)	(0.4015)	(0.3914)	(0.4000)
Firm characteristics										
Past stock return	0.134***	0.131***	0.128***	0.135***	0.126***	0.000	0.000	0.000	0.000	0.000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.9409)	(0.9242)	(0.9458)	(0.9315)	(0.9338)
Current stock return	0.329***	0.335***	0.336***	0.322***	0.326***	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Market capitalization	0.636***	0.620***	0.596***	0.644***	0.592***	-0.023***	-0.022***	-0.023***	-0.023***	-0.023***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Book leverage	0.131	0.129	0.130	0.121	0.098	-0.064***	-0.064***	-0.064***	-0.064***	-0.064***
	(0.1530)	(0.1605)	(0.1575)	(0.1871)	(0.2833)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Profitability	-0.198***	-0.190***	-0.170**	-0.213***	-0.180***	-0.019***	-0.019***	-0.019***	-0.019***	-0.019***
	(0.0042)	(0.0061)	(0.0140)	(0.0021)	(0.0088)	(0.0021)	(0.0019)	(0.0022)	(0.0019)	(0.0021)
Δ Market to book	-0.045***	-0.042***	-0.040***	-0.046***	-0.032***	0.012***	0.012***	0.012***	0.012***	0.012***
	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0018)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Cash holding	-0.273***	-0.270***	-0.268***	-0.256***	-0.253***	0.001	0.001	0.001	0.001	0.001
	(0.0047)	(0.0052)	(0.0054)	(0.0079)	(0.0081)	(0.8759)	(0.8768)	(0.8752)	(0.8583)	(0.8783)
Δ R&D intensity	0.155	0.178	0.173	0.098	0.147	0.069***	0.069***	0.069***	0.069***	0.069***
	(0.3827)	(0.3167)	(0.3307)	(0.5817)	(0.4069)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Δ Tangibility	0.129	0.116	0.096	0.147	0.053	0.038***	0.038***	0.038***	0.038***	0.038***
	(0.4310)	(0.4795)	(0.5574)	(0.3715)	(0.7476)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Exchange fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.059	0.060	0.060	0.063	0.068	0.041	0.041	0.041	0.041	0.041
Number of Observations	59,316	59,316	59,316	59,316	59,316	54,704	54,704	54,704	54,704	54,704

Appendix: Variable Definitions

This appendix provides a detailed description of the construction of all the variables used in the tables.

Variable	Definition
Absolute discretionary accrual	We use a version of the Jones (1991) model of accruals, which estimates nondiscretionary accruals as the fitted value from a regression of total accruals on lagged firm size, the change in firm sales, and gross property plant and equipment scaled by total firm assets for the sample firms in the same 2-digit SIC code industry group in a given year. The absolute discretionary accrual is the absolute value of the estimate residual from the previous regression (winsorized at the 1st and 99th percentiles).
Amihud-illiquidity	The yearly average of the square root of 1000000 times absolute daily stock return divided by dollar trading volume (winsorized at the 1st and 99th percentiles).
Analyst coverage	The number of analysts who provide EPS estimate for the firm in the year.
Book leverage	Long-term debt plus debt in current liabilities divided by total assets (winsorized at the 1st and 99th percentiles).
Cash holding	Cash plus short-term investments divided by total assets (winsorized at the 1st and 99th percentiles).
C-illiquidity	The estimate of the coefficient in the market-adjusted model and the coefficient estimates are obtained using the Gibbs sampler (winsorized at the 1st and 99th percentiles). We obtain the C estimate from (http://pages.stern.nyu.edu/~jhasbrou/).
Current stock return	Buy-and-hold stock return for current one year (winsorized at the 1st and 99th percentiles).
Ln (GDP)	Natural log of total nominal GDP of the state in the year.
Ln (Population)	Natural log of total population of the state in the year.
Ln (Market capitalization)	Natural log of total shares outstanding times stock price at the fiscal year end.
Market to book	Market value of equity plus the book value of debt divided by total assets (winsorized at the 1st and 99th percentiles).
Past stock return	Buy-and-hold stock return for past one year (winsorized at the 1st and 99th percentiles).
Profitability	Operating income before depreciation divided by total assets (winsorized at the 1st and 99th percentiles).
R^2	The R^2 estimated from the regression of daily stock return on market return and industry return in the year.
Roll-illiquidity	Roll's (1984) measure of effective trading costs, estimated as the square root of the negative of the auto-covariance of daily log returns, which is set to zero when the sample auto-covariance is positive.
R&D intensity	R&D expenditures divided by total assets. This variable is set to be zero if R&D expenditure is missing (winsorized at the 1st and 99th percentiles).
SEO indicator	Equal to one if the firm engages in seasoned equity offering in the next year.
State stock market return	Equally weighted past one year stock return for all firm located in the same state (winsorized at the 1st and 99th percentiles).
Tangibility	Net property, plant, and equipment divided by total assets (winsorized at the 1st and 99th percentiles).
Underwriting fees	The percentage of total SEO proceeds charged by the SEO underwriters.

Δ Absolute discretionary accruals	The change in absolute discretionary accruals (winsorized at the 1st and 99th percentiles).
Δ Analyst coverage	The change in analyst coverage number (winsorized at the 1st and 99th percentiles).
Δ Amihud-illiquidity	The change in the Amihud-illiquidity measure (winsorized at the 1st and 99th percentiles).
Δ Book leverage	The change in book leverage (winsorized at the 1st and 99th percentiles).
Δ Cash holding	The change in cash holding (winsorized at the 1st and 99th percentiles).
Δ C-illiquidity	The change in the C-illiquidity measure (winsorized at the 1st and 99th percentiles).
Δ Economic Index	The growth of state economic (current state economic index divided by lag one period economic index minus one) (winsorized at the 1st and 99th percentiles).
Δ Housing price	The growth of state housing price (current state housing price index divided by lag one period housing price index minus one) (winsorized at the 1st and 99th percentiles).
Δ Household Income	The growth of median household income (current state median household income divided by lag one period household income minus one) (winsorized at the 1st and 99th percentiles).
Δ Market capitalization	The change in the Natural log of market capitalization (winsorized at the 1st and 99th percentiles).
Δ Market to book	The change in the market to book ratio (winsorized at the 1st and 99th percentiles).
Δ Profitability	The change in profitability (winsorized at the 1st and 99th percentiles).
Δ R^2	The change in R^2 (winsorized at the 1st and 99th percentiles).
Δ Roll-illiquidity	The change in Roll-illiquidity (winsorized at the 1st and 99th percentiles).
Δ R&D intensity	The change in R&D intensity (winsorized at the 1st and 99th percentiles).
Δ Tangibility	The change in tangibility (winsorized at the 1st and 99th percentiles).