



ST. JOHN'S
UNIVERSITY

THE PETER J. TOBIN
COLLEGE OF BUSINESS

Review of Business

*A Cross-Country Study of Interbank Loans:
The Effects of Regulations, Market Structure,
and Institutions* 1

Liuling Liu, Mingsheng Li, Haizhi Wang, and Jianrong Wang

Audit Firm Mergers and Low Balling 41

Wenjun Liu and June Cao

Female CFOs and Stock Price Crash Risk 63

Iftekhar Hasan, Trung Nguyen, and Jong Chool Park

Review of *Business*

Editor

Yun Zhu

St. John's University, United States

Advisory Board

Iftekhar Hasan

Fordham University, Bank of Finland, and University of Sydney, United States

Kose John

New York University, United States

Steven Ongena

University of Zurich, Swiss Finance Institute, KU Leuven, and Center for Economic and Policy Research (CEPR), Switzerland

Raghavendra Rau

University of Cambridge, United Kingdom

David Reeb

National University of Singapore, Singapore

Editorial Board

Turanay Caner

North Carolina State University, United States

Santiago Carbó-Valverde

CUNEF, Spain

Sandeep Dahiya

Georgetown University, United States

Sudip Datta

Wayne State University, United States

Co-Pierre Georg

University of Cape Town, South Africa

Xian Gu

Durham University, United Kingdom

Omrane Guedhami

University of South Carolina, United States

Roman Horváth

Charles University, Czech Republic

Patrick Flanagan

St. John's University, United States

Suk-Joong Kim

University of Sydney, Australia

Anzhela Knyazeva

Security Exchange Commission, United States

Chih-Yung Lin

National Chiao Tung University, Taiwan

Kristina Minnick

Bentley University, United States

Jerry Parwada

UNSW Sydney, Australia

Maurizio Pompella

University of Siena, Italy

Steven W. Pottier

University of Georgia, United States

Alon Raviv

Bar Ilan, Israel

Victoria Shoaf

St. John's University, United States

Akhtar Siddique

Office of the Comptroller of the Currency, United States

Benjamin Tabak

FGV, Brazil

Tuomas Takalo

Bank of Finland, Finland

Hongfei Tang

Seton Hall University, United States

Amine Tarazi

University of Limoges, France

Krupa Viswanathan

Temple University, United States

Wolf Wagner

Rotterdam School of Management and CEPR, The Netherlands

Noriyoshi Yanase

Keio University, Japan

Gaiyan Zhang

University of Missouri–Columbia, United States

Hao Zhang

Rochester Institute of Technology, United States

FROM THE EDITOR

We are delighted to publish the January 2023 issue of *Review of Business*, with three academic papers that explore issues in banking, corporate finance, and accounting.

The lead article, “A Cross-Country Study of Interbank Loans: The Effects of Regulations, Market Structure, and Institutions,” by Liu, Li, Wang, and Wang, examines factors that determine the financial contracts between banks. The authors use a sample of 1,854 syndicated loans issued to 530 commercial banks from 1995 to 2009 in 42 countries and find that the pricing of bank-to-bank loans is significantly influenced by bank regulations, market structure, institutional qualities, and their relative differences in borrower and lead lender countries. The results further demonstrate that prudential bank regulations are effective in reducing banks’ funding costs, especially when the banking industry is highly concentrated or the country has a weak institutional system. In addition, the paper also reveals consistent evidence for the non-price components of contracts, such as the loan maturity and syndicate structures.

In the second article, “Audit Firm Mergers and Low Balling,” Liu and Cao explore audit firm mergers from 2005 to 2013 in China. The paper examines the impact of audit firm mergers on audit fee discounts in the initial year. Their results show that low balling exists in China’s audit market, and audit firm mergers can curtail low balling. The empirical analysis suggests that audit firms rarely apply the low-balling strategy to state-owned enterprises (SOEs) and the impact of audit firm mergers on low balling only exists in non-SOEs. Moreover, the restraining effect over low balling lies in mergers between large audit firms and small ones, but not so in mergers between small audit firms. This paper contributes to the study of mergers of audit firms and advances the understanding of the recent strategy of regulators attempting to push audit firms to become bigger and stronger.

Hasan, Nguyen, and Park contribute their joint work, titled “Female CFOs and Stock Price Crash Risk,” as the third article of this issue. Their work taps into the role of gender heterogeneity in corporate decision making. Specifically, it investigates whether and how CFO gender is associated with firm-specific stock price crash risk. Using a sample of U.S. firms from 1993 to 2015, the authors find that female CFOs are significantly and negatively related to future crash risk, and the negative relation between female CFOs and future crash risk remains significant after controlling for accounting conservatism, CFO equity incentives, and female CEOs. The authors also use propensity score analysis to show both statistically and economically stronger effects of female CFOs on future crash risk, mitigating the concerns of endogeneity. In addition, with textual analysis, the paper shows that female CFOs are likely to better disclose the potential risk faced by the company than male CFOs. Collectively, the paper provides consistent evidence that female CFOs are more risk averse, leading to withholding less bad news, a better disclosure

for potential risk borne by the company, and thus are less likely to experience future stock price crashes.

We sincerely hope that scholars and professionals will find this issue of *Review of Business* constructive and enlightening. We will continue to publish high-quality scholarly articles that answer the most imminent questions in the business fields.

Yun Zhu, Editor

A Cross-Country Study of Interbank Loans: The Effects of Regulations, Market Structure, and Institutions

Liuling Liu

Mingsheng Li

Haizhi Wang

Jianrong Wang

Abstract

Motivation: Long-term bank-to-bank loans have become an increasingly important type of funding for banks. However, the literature does not examine whether and how banks' funding costs vary with cross-country factors.

Premise: In this paper we examine the factors that determine the financial contracts between banks.

Approach: Using a sample of 1,854 syndicated loans issued to 530 commercial banks from 1995 to 2009 in 42 countries, we conduct both country-level and borrower-level fixed effect estimations. To further ameliorate the endogeneity concern, we estimate our models using instrumental variable analysis and a difference-in-difference analysis.

Results: We find that the pricing of bank-to-bank loans is significantly influenced by bank regulations, market structure, institutional qualities, and their relative differences in borrower and lead lender countries. The results further demonstrate that prudential bank regulations are effective in reducing banks' funding costs, especially when the borrowers are relatively risky or when the banking industry is highly concentrated, or the country has weak institutional system.

Consistency: Consistent with this journal's purpose, this basic research on how banks manage the cost of funding and engage with global factors has important implications to the policy makers.

Keywords: bank borrowers, bank regulations, banks' funding costs, financial contracts

JEL Classification Codes: G21, G28, F34, F65

Liuling Liu, PhD, Bowling Green State University, liulinl@bgsu.edu

Mingsheng Li, PhD, Bowling Green State University, mli@bgsu.edu

Haizhi Wang, PhD, Illinois Institute of Technology, hwang23@stuart.iit.edu

Jianrong Wang, PhD, East China Normal University, jrwang@aebs.ecnu.edu.cn

INTRODUCTION

Finance-growth literature has demonstrated the importance of well-functioning banking systems for economic growth (e.g., King and Levine 1993). As the predominant credit providers in all countries, banks' abilities to obtain financing significantly impact the finance and investment policies of firms and the growth of economies (Lemmon and Roberts 2010).¹ Therefore, understanding the sources and costs of banks' funding is essential for the suppliers and users of capital, as well as the economy as a whole.

Work on this topic has focused, almost exclusively, on the use of deposits and certain forms of wholesale funding, such as interbank loans and subordinated debt (e.g., Flannery and Sorescu 1996; Berlin and Mester 1999; Furfine 2001; Corvoisier and Gropp 2002; Freixas and Holthausen 2005; Goyal 2005; Cocco, Gomes, and Martins 2009; Demirgüç-Kunt and Huizinga 2010; Chen and Hasan 2011). However, as is the case for nonfinancial corporations, banks also borrow extensively in the traditional bank loan market (we refer to such loan activities as *bank-to-bank loans*). Statistics compiled by LPC's DealScan show that over the 1995 to 2009 time period, the banking industry obtained, on average, around 15 percent of the total number of loans (or 10 percent of the total dollar value of loans) issued in the global bank loan market. Furthermore, from 1995 until the recent subprime financial crisis, banks' borrowing in the global loan market increased by 120 percent in terms of the total number of loans and by 80 percent in terms of the dollar value of the loans.²

The use of bank-to-bank loans as a source of financing by banks is pervasive and as evidenced by the above statistics is growing in importance (see Figure 1).³ Nevertheless, there is no empirical evidence on the pricing and, more generally, the contract features of these loans. This paper draws attention to this largely ignored funding source of banks. Specifically, controlling for individual borrower and loan characteristics, as well as national financial and economic development, we assess how bank regulations, banking market structure, institutional qualities, and their relative differences in borrower and lender countries affect the pricing and other features of these bank-to-bank loan contracts.

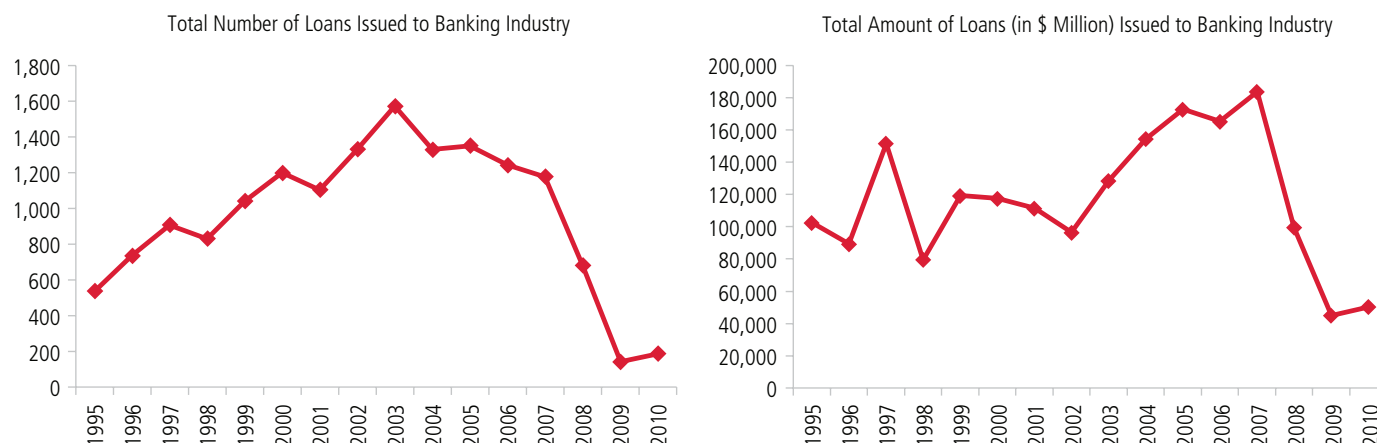
The bank-to-bank loans in our study clearly differentiate themselves from other wholesale funding sources. For instance, unlike interbank loans that are mostly generated by short-term liquidity needs, bank-to-bank loans in our study provide long-term funding, with a mean maturity of 29 months. Additionally, unlike other long-term funding sources such as subordinated debt, bank-to-bank loans are borrowing and lending between banks. Therefore, bank-to-bank loans can be viewed as a unique funding source that combines the features of subordinated debt and interbank loans. Given banks' increasing reliance on this type

¹When banks face difficulties in acquiring financing, they become more conservative by cutting back on lending and by charging borrowers higher rates, which in turn affects the finance and investment policies of firms (Lemmon and Roberts 2010).

²In 2007, this growth came to a halt as the emerging financial crisis in the United States deteriorated the lending environment in the global loan market. Beginning in 2008, the bank-to-bank loan market experienced a decline of more than 70 percent from its peak. Giannetti and Laeven (2012) document a similar degree of decline in the global syndicated loan market during the subprime crisis.

³We also look into the significance of this particular funding source in bank's balance sheet, we find that the median size of bank-to-bank loans is around 40 percent of bank equity and 4.4 percent of banks assets in our final sample.

FIGURE 1. The Time Series Trend of Banks' Borrowing in the Global Syndicated Loan Market in Terms of Both the Total Number and the Total Amount (in \$ Million) of Loan Facilities



of funding and its unique features, we believe that understanding the pricing of these loans and therefore the costs of funding, along with determinants of the contract features, are important.

The existing empirical literature on banks' funding costs focuses mostly on how market conditions, bank risk, or relationship lending in an individual country affect retail deposit rates (Berlin and Mester 1999; Corvoisier and Gropp 2002), the interbank interest rate (Furfine 2001; Cocco, Gomes, and Martins 2009), or subordinated debt yields (Goyal 2005). Francis et al. (2019) finds that taking senior bank loans is an effective market discipline and risk control mechanism for borrowing banks. As such, the literature does not examine whether and how banks' funding cost varies with cross-country factors. Our paper adds to the literature in this aspect.

Our research is also motivated by policy considerations. Banking systems can be fragile. To prevent bank panics, banking industries are heavily regulated. With this comes a large body of research devoted to understanding the costs and benefits of banking regulations. This includes studies focused on understanding how regulatory restrictions impact banking sector performance and stability (Barth, Caprio, and Levine 2004, 2006, 2008), bank net interest margin and overhead costs (Demirgüç-Kunt, Laeven, and Levine 2004), and risk-taking behavior of individual banks (Laeven and Levine 2009; Ongena, Alexander, and Udell 2013). In a pair of recent studies, Houston, Lin, and Ma (2012) examine how cross-country differences in bank regulations impact the flow of bank capital across borders, while Hao, Nandy, and Roberts (2012) investigate the impact of bank regulations on nonfinancial firms' cost of bank loans. Our study, however, is the first that examines how bank regulations influence individual banks' cost of funding. It is also unique in that it examines whether banks value those country-specific regulations. This is an important consideration. Although multi-lateral international organizations such as the Bank for International Settlements, International Monetary Fund, and the World Bank have developed extensive best practices recommendations, whether commercial banks value these recommendations is an open issue. In our research setting, we can infer banks'

attitudes toward those best practices based on the variation in interest rates they charge their peers, and thus provide an important insight for policy makers.

Lastly, our study extends the understanding of the pricing and contract features of bank loans. Although bank loan studies have drawn a great deal of attention over the past decade, the literature has been limited to corporate borrowers (e.g., Strahan 1999; Qian and Strahan 2007; Bharath, Sunder, and Sunder 2008; Bae and Goyal 2009; Chava, Livdan, and Purnanandam 2009; Bharath et al. 2011; Hao, Nandy, and Roberts 2012). Another important class of borrowers—banks—has largely been ignored. The uniqueness of banks implies that the contract features of loans to banks can be very different from that of loans to nonbanks.⁴ To further illustrate the potentially important insights that our study provides, we provide several reasons why the two types of loan contracts can be very different, although this is not the focus of our empirical study. Banks are significantly more opaque than nonfinancial firms due to off-balance-sheet transactions, among other factors. In the corporate loan market (i.e., bank-to-nonfinancial firm loans), an opaque borrower is more difficult to monitor and more likely to default. Therefore, lenders impose more stringent provisions on them. However, in the bank-to-bank loan market, peer monitoring and mutual trust could overcome opacity since both the borrowers and lenders are in the same special industry. Therefore, lenders may only need limited governance mechanisms such as covenants, collateral, or performance pricing provisions when designing bank-to-bank loan contracts. Moreover, the bank-to-bank loan market can be viewed as a long-term interdependent network among banks. For both borrowers and lenders, involvement in such a network is likely to lead to a strategic decision to insure against possible inter-temporal liquidity shocks in the future (Bhattacharya and Gale 1987). Therefore, both parties might be willing to pay to join the network. In other words, bank borrowers might be willing to pay additional rent or lenders might be willing to charge a discounted price. In sum, these special features of the banking industry suggest that it is likely not appropriate to use extant knowledge about corporate loans to make generalizations about bank-to-bank loans.

Due to the unique characteristics of the banking industry, we contend that the documented determinants for corporate loan contracts could have a different or no effect on the bank-to-bank loans, moreover, certain banking industry-specific features may play a core role in shaping the loan contracts obtained by banks. For instance, Hao, Nandy, and Roberts (2012) investigate how the bank regulation regarding banking-commerce integration (i.e., our financial conglomerate regulation) affects the cost of corporate loans. Although we both study the same regulation factor, opposite effects are observed on the two types of loan contracts. This is because in our study this particular regulation impacts the bank-to-bank loan contracts through a direct influence on bank borrowers' default risk, while in Hao, Nandy, and Roberts (2012) its effect on the cost of corporate loans is through its influence on lenders' information producing

⁴That banks are different and special is not debatable. Numerous papers have established that this is in fact the case (see, for example, James 1987, and Gande and Saunders 2012). Many studies on the special role of banks are surveyed in Gorton and Winton (2003). In an unreported table, we compare loans to banks and loans to nonfinancial corporates. Compared with corporate loans, bank-to-bank loans, on average, have significantly smaller loan size, shorter maturity, lower spreads and fees, and are much less likely to have the traditional monitoring mechanisms such as covenants, collateral, and performance pricing provisions.

ability. Therefore, exploring the cross-country determinants of the pricing and the contract features of the bank-to-bank loans is needed and will significantly enhance our understanding of bank loans in general.

Using a sample of 1,854 loans borrowed by 530 commercial banks from 42 countries over the 1995 to 2009 period, we examine how the basic pricing term (the interest rate), one non-price term (loan maturity), and three syndicate structure variables (the number of lenders, the number of foreign lenders, and the fraction of foreign lenders in the syndicate) vary with banking regulations, industry environment, and other country-level variables, such as institutional qualities (as measured by information sharing, property rights, and creditor rights) and a country's financial and economic development. In our tests, we also control for individual bank borrower and loan characteristics that are likely to affect the cost of bank loans through variations in credit risk or loan demand. However, the main focus of our paper is the effect of country-level factors and, in particular, bank regulations.

We draw several broad conclusions from our findings. First, we find that bank regulations, banking market structure, and institutional qualities all significantly impact banks' borrowing costs. Specifically, we find that commercial banks from countries with regulations that favor traditional banking (or restrict financial conglomerates) and transparent accounting disclosure pay significantly lower loan spreads. The results are consistent with the view that prudential bank regulations reduce the necessity of rigorous monitoring by lenders. Lenders pass on the savings from these monitoring costs to bank borrowers through reduced borrowing costs. Regarding banking market structure, we find that monopoly market power is rewarded when banks borrow in the loan market. That is, loans to banks in highly concentrated banking industries have, on average, significantly lower loan spreads.⁵ Additionally, the results also suggest that banks operating in a banking sector with a high foreign presence have lower borrowing costs. Consistent with Qian and Strahan (2007) and Bae and Goyal (2009), the institutional quality related to information sharing, creditor rights, and property rights in the borrower's country is negatively and significantly associated with loan spreads.

An important fact that should be noted regarding the above results is that lenders may offer loans to their ownership-connected bank borrowers for various reasons that go against economic theory. Therefore, the effect of the country-level factors that we identified above may not be as important. To be specific, since both parties in the bank-to-bank loans are from the banking industry, it is highly likely that a borrower is, in fact, a branch or subsidiary of a certain lender in their bank loan syndicate (or vice-versa). It is also likely that the same shareholder owns both the borrower and lender. In those cases, the bank loan market may simply become a platform for internal capital transfer, where pricing formation has no relation to the contractual environment or borrower risk. To address this concern, we identify ownership-connected loans of any form in our sample and re-estimate all the models without those connected loans. The results remain unaffected.

⁵We also check for a nonlinear relationship between concentration and loan spreads by breaking concentration into quintiles. The results indicate that the negative effect of concentration is significant for all quintiles.

To further examine the robustness of our results, we re-run our main model specifications by trying different thresholds to assign bank regulation values, taking shorter time periods, and randomly dropping different sample countries. Our results remain robust to various time periods and various country inclusions. While we consistently find that bank regulations and other country factors significantly impact the cost of bank-to-bank loans, there is always the possibility of omitted variable bias or reverse causality. Though these endogeneity issues are difficult to eliminate completely, we take a variety of steps to alleviate these concerns. First, we use both country-level and borrower-level fixed effect estimations to account for the unobserved time-invariant factors that could influence bank-to-bank loans. Although most of our key country factors have limited within-country time variations over our sample period, we still observe that the coefficient estimates for the bank regulations are of consistent sign and remain statistically significant. To further ameliorate the endogeneity concern, we estimate our models using instrumental variable analysis. Lastly, we adopt the event of joining the European Union (EU) as a natural experiment and conduct a difference-in-difference analysis to examine the effect of regulation changes on banks' cost of loan financing. Our main findings are upheld.

Second, looking beyond just the various regulations, banking market structure, and institutional qualities of the borrower country, we also consider lenders' perspectives by examining whether the gaps (or differences) in the country-specific determinants between borrower and lead lender countries influence the cost of bank-to-bank loans. Our results strongly indicate that the bank regulation gaps, banking market structure gaps, and institutional quality gaps also matter for the cost of bank-to-bank loans. Importantly, the signs of the coefficients are generally consistent with our base-model results, suggesting that if the circumstances in the lender's country are weaker than those in the borrower's country, the lender places additional value on (i.e., gives a price discount for) several features: regulations encouraging traditional banking and transparent accounting disclosure, a banking sector with concentrated and high foreign presence structure, and a country with strong institutional qualities. Additionally, we control for the culture distance when we estimate the Gap model. We find that lenders charge significantly higher loan spreads when the borrower is culturally distant, which is consistent with the first-order pricing effect of home bias.

To gain further insights into the economic impact of regulation we conduct several additional tests to explore how banking-market structure and institutional qualities influence the degree to which regulation affects the cost of bank-to-bank loans. We find that regulations that encourage traditional banking and transparency reduce banks' borrowing costs more in a highly monopolized banking industry. However, we do not observe a significant influence of foreign presence on such regulation effects. In addition, our results suggest that a country's bank regulations and its institutional development are substitutes for each other when determining the cost of banks' loan financing. Specially, marginal improvements in bank regulations produce greater reductions in loan costs for bank borrowers from weak institutional systems than for those from well-developed institutional systems.

Finally, we turn to the non-price provisions and syndicate structure of bank-to-bank loans. Unlike loans to nonfinancial firms, bank-to-bank loans

rarely have covenants, collateral, or performance pricing provisions. Therefore, in our estimations, we focus on one particular non-price debt contract feature: loan maturity. We find that loans in countries that favor traditional banking and transparency, as well as in countries that have a more concentrated banking sector structure, have longer maturities. With regard to the syndicate structure, we focus on the overall syndicate size and foreign involvement in the syndicate. We find that more restrictive financial conglomerate regulation and accounting disclosure regulation are associated with smaller syndicate size and lower foreign involvement in the syndicate. Our results support the finding of Houston, Lin, and Ma (2012), who show that banks tend to move funds away from markets with more restrictive regulations (regulatory arbitrage).⁶ In addition, we find that a greater number of lenders (especially foreign lenders) are attracted to syndicates when the borrowers are in concentrated markets or markets with a high presence of foreign banking institutions.

This paper makes several contributions to the banking literature. First, it is closely related to the literature on banks' funding strategies (e.g., Flannery and Sorescu 1996; Berlin and Mester 1999; Furfine 2001; Corvoisier and Gropp 2002; Freixas and Holthausen 2005; Goyal 2005; Cocco, Gomes, and Martins 2009; Demirgüç-Kunt and Huizinga 2010; Chen and Hasan 2011). These studies focus on traditional funding sources for banks. In contrast, our paper shows that a major source of funding for banks is the syndicate loan market. Thus, our research on the determinants of bank-to-bank loans adds to the extant understanding of the cost of banks' various funding sources. Second, our study is also related to a large body of literature that studies the cost of bank loan financing, especially those studies that examine the effect of country-specific factors (Qian and Strahan 2007; Bae and Goyal 2009; Hao, Nandy, and Roberts 2012).⁷ Our paper adds to this literature by providing evidence on a specific type of loan—bank-to-bank loans in a multi-country setting—which to the best of our knowledge has not been examined previously. Finally, the unique features of the banking industry suggest the necessity of investigating bank-to-bank loans separately. Along with other studies (e.g., James 1987; Gande and Saunders 2012; survey in Gorton and Winton 2003), our study provides further empirical evidence that banks are unique.

The rest of the paper proceeds as follows. The next section reviews the literature and develops the hypotheses. The background and sample selection section describes our data and sample construction procedure. The empirical results section presents our methodology, major results, and robustness tests. The conclusion rounds out the paper.

⁶However, Houston, Lin, and Ma (2012) did not provide results related to pricing information. Our paper suggests that once banks decide to lend in those markets with restrictive regulations, they value the governance role of prudential regulations and pass along the saved monitoring costs to borrowers.

⁷Among those studies on bank loan contracts, the closest to our study is Hao, Nandy, and Roberts (2012), who investigate how regulation regarding banking-commerce integration affects the cost of corporate loans. Although we also study this regulation factor, its effect on the bank-to-bank loan contracts is through a direct influence on bank borrowers' default risk, while in Hao, Nandy, and Roberts (2012) the regulation impacts the cost of corporate loans through its influence on lenders' information producing ability.

DETERMINANTS OF THE COST OF BANK-TO-BANK LOANS: BANK REGULATIONS, BANKING MARKET STRUCTURE, INSTITUTIONAL QUALITIES, AND OTHER COUNTRY FACTORS

In this section we define our measures of bank regulations, banking market structure, institutional qualities, and other country factors. We review the various components of the above factors and discuss their potential effects on banks' loan financing.

Bank Regulations

Measuring Bank Regulations

We obtain bank regulation information from three World Bank surveys conducted by Barth, Caprio, and Levine (2004, 2006, 2008). The first survey was conducted in 1998 and covered 117 countries. The second survey was conducted in 152 countries in 2003. The third survey was updated in 2007 and characterizes the regulatory status of 142 countries. The three surveys provide a comprehensive picture of various aspects of banking regulations across countries. We focus on the sample period of 1995 to 2009. Specifically, our regulatory variables for the period 1995 to 1999 use the values from the first survey. The regulatory variables for the period 2000 to 2003 use the values from the second survey. The regulatory variables for the period 2004 to 2009 use the values from the third survey. The two regulations we focus on are *Financial Conglomerates Restriction* (i.e., restriction on the banking-commerce link) and *Financial Statement Transparency* (i.e., restriction on bank accounting disclosure).

To be specific, the index of *Financial Conglomerates Restriction* measures the extent to which banks may own and control nonfinancial firms, the extent to which nonfinancial firms may own and control banks, and the extent to which nonbank financial firms may own and control banks. For each question above, the value equals 1 if unrestricted, 2 if permitted, 3 if restricted, and 4 if prohibited. Higher value of the index indicates that the country's banking regulation favors traditional banking over financial conglomerates.

We use *Financial Statement Transparency* to measure the degree to which banks face regulatory restrictions on their accounting disclosure. This index is constructed based on the following five conditions: (1) whether the income statement includes accrued or unpaid interest or principal on non-performing loans; (2) whether banks are required to produce consolidated financial statements, including non-bank financial affiliates or subsidiaries; (3) whether the off-balance sheet items are disclosed to the public; (4) whether banks' directors are legally liable for misleading or erroneous information; and (5) whether the penalties have been enforced. The indicator potentially ranges from 0 to 5, where higher values indicate greater restrictions on accounting disclosure (i.e., more transparent financial statements).

Bank Regulations and the Cost of Bank-to-Bank Loans

The extent to which banking and commerce should be permitted to mix is a subject of a long-lasting public policy debate. The most cited potential risks

of allowing banking-commerce integration are conflicts of interest, expansion of the safety net, and too complicated to discipline. Conflicts of interest may arise when a bank refuses to lend to the affiliates' competitors or grant credit preferentially to its commercial affiliates. In either case, the bank's income is reduced. Expansion of the safety net may arise when the parent organization shifts a bank affiliate's fund to its nonbank affiliates (e.g., it requires the bank to buy assets at inflated prices from the commercial affiliates or injects capital to the affiliates through cheap loans). As a result, the parent can shift potential losses to its bank affiliate, ultimately threatening the safety and soundness of the bank. In addition, allowing the mixing of banking and commerce may lead to financial conglomerates whose structures are too complicated to supervise (Laeven and Levine 2007). Prudential regulation that separates banks from commerce, thus serving as a national governance mechanism, should protect banks' safety and lower their credit risk as borrowers. Accordingly, lenders should incur fewer monitoring needs and costs when they lend to banks in countries that restrict mixing banking and commerce. If this is the case, restrictive financial conglomerates regulation should lower banks' cost of borrowing.

In contrast, the most cited potential benefits of permitting a banking-commerce mix are operational efficiencies (including economies of scale and economies of scope), informational efficiencies, and diversification benefits. When banks lend to corporate borrowers, the close link between banking and commerce reduces information asymmetry and enhances banks' abilities to monitor and enforce contracts. In line with this view, banks in countries that encourage mixing banking and commerce may have better lending portfolios, which could translate into lower default rates and lower interest rates when they raise capital from the loan market.

While there are potential conflicting effects of restricting financial conglomerates, there appears to be a universal belief that transparent bank-accounting disclosure benefits the banking sector, and more generally, the economy. Accurate accounting disclosure reduces the information asymmetry in the loan market (Bharath, Sunder, and Sunder 2008). Regulation that forces accurate accounting disclosure improves bank performance (Cole, Moshirian, and Wu 2008) and promotes the stability of banking sector (Barth, Caprio, and Levine 2004). Therefore, we expect that banks from countries that favor transparent bank-accounting disclosure pay significantly lower borrowing costs.

Banking Market Structure

Measuring Banking Market Structure

In addition to bank regulations, we also investigate how cross-country variations in the structure of the banking sector impact banks' own borrowing. We focus on two aspects: *Banking Concentration* and *Foreign Presence*.

We measure *Banking Concentration* as the fraction of bank assets held by the three largest commercial banks in the country. It is computed using the BankScope database. Based on the information from Barth, Caprio, and Levine (2004, 2006, 2008), we construct a measure, *Foreign Presence*, to control for the ownership composition of the banking industry. It equals 1 if 50 percent or

more of the share of banking system assets are held in foreign-owned banks, 0 otherwise.⁸

Banking Market Structure and the Cost of Bank-to-Bank Loans

The impact of banking concentration on the cost of banks' loan financing is an empirical issue. The *concentration-stability view* (Allen and Gale 2004) suggests that banks in more concentrated markets use their market power to extract rents from customers while paying significantly lower rates on their retail deposits, which in turn boosts bank profit and provides a "buffer" against adverse shocks. Additionally, banks in concentrated banking environments frequently receive "too-big-to-fail" subsidies from government safety-net policies designed to prevent banks from failure. Taken together, this would suggest that higher banking concentration should increase market power and lower credit risk of bank borrowers, which would result in lower cost of banks' loan financing. However, the *concentration-fragility view* (Boyd and De Nicolo 2005) links concentrated banking systems with increased fragility of the financial system. This view suggests that "too-big-to-fail" subsidies in concentrated banking sectors induce banks to take on greater risk, which increases the fragility of the whole financial system. If lenders believe the benefits of banking concentration outweighs the costs, higher banking concentration should lead to lower cost of banks' loan financing.

Financial globalization since the 1990s has brought one dramatic change to the banking industry around the world—a significant increase in the share of bank assets held by foreign banks. There is an ongoing debate regarding the benefits and costs of this, the emerging evidence supports a positive view and suggests that the presence of foreign banks enhances the efficiency of host country's banking system (e.g., Claessens, Demirgüç-Kunt, and Huizinga 2001). If this is the case, we expect that loans made to a banking sector with a higher fraction of foreign bank presence should have lower costs.

Institutional Qualities

Previous studies suggest that country-level institutional variables—such as information-sharing registries, creditor rights, and legal enforcement—are important determinants of financial development and corporate loan contracting. We are interested in their impacts on the bank-to-bank loans.

Information Sharing

There are two types of information-sharing mechanisms: public registries and private bureaus.⁹ Both collect and distribute data about the creditworthiness of

⁸Given that the coverage of BankScope increases over the sample period, the change in coverage might drive the change in concentration measure. To mitigate such biases, we use an alternative measure of concentration in an unreported test by averaging the annual concentration value over the sample period 1995 to 2009, and the results remain robust. In addition, our results remain unaffected after using other measures of concentration, such as the fraction of bank deposits held by the three largest commercial banks or the Herfindahl-Hirschman Index (HHI) of bank assets (or deposits) in a given country.

⁹The major difference between the two is that a public registry is owned by a public authority (usually the central bank or banking supervisory authority), while a private bureau is owned by private commercial firms or nonprofit organizations.

borrowers to lending institutions. Therefore, the existence of information-sharing mechanisms should reduce the monitoring costs of lenders. We obtain data from Djankov, McLiesh, and Shleifer (2007) and the World Bank “Doing Business” dataset. Djankov, McLiesh, and Shleifer (2007) collect information on private and public credit institutions in 129 countries between 1978 and 2003, and the World Bank “Doing Business” dataset updates information annually since then. In our empirical model, we create a dummy variable, *Information Sharing*, that equals 1 if the borrowing country has an information-sharing agency (either a public registry or private bureau) at the time of loan origination, and 0 otherwise.

Creditor Rights

The strength of creditor rights determines the power that lenders have in reorganization and liquidation procedures, which is an important consideration in bank loan contracting (Qian and Strahan 2007). We obtain the creditor rights index, *Creditor Rights*, from Djankov, McLiesh, and Shleifer (2007). The index consists of four components: (1) whether there are restrictions when a debtor files for reorganization (e.g., creditor consent); (2) whether there is no automatic stay or asset freeze, thereby allowing secured creditors to seize their collateral after the petition for reorganization is approved; (3) whether secured creditors are paid first compared with other creditors (e.g., the government or employees) in the liquidation of a bankrupt firm; and (4) whether the management does not stay in control of the business during the reorganization. *Creditor Rights* is the aggregated score, ranging from 0 to 4, with a higher value indicating stronger creditor rights. Djankov, McLiesh, and Shleifer (2007) provide the index between 1978 and 2003. We extend the values of 2003 for the years 2004 to 2009.

Property Rights

The extent to which creditor rights are enforced is also important for loan contracting. Poor legal enforcement, which lowers recovery rates and increases the time spent in repossessing collateral in the event of default, reduces lenders’ incentives to monitor and hurts their abilities to re-contract (Bae and Goyal 2009). To control for judicial efficiency, we use the property rights index, *Property Rights*, from the Index of Economic Freedom compiled by the Heritage Foundation/Wall Street Journal. A higher value indicates a better contract enforcement environment.

Other Country Factors

In our multivariate analysis, we also control for the following variables reflecting the stability of the banking sector and the financial and economic development of the borrowing country.

Explicit Deposit Insurance

The explicit deposit insurance scheme is universally adopted as a means to prevent banking crisis and promote financial stability. Our measure of deposit insurance is based on the World Bank’s “Comprehensive Deposit Insurance around the World” dataset, compiled by Demirgüç-Kunt, Laeven, and Levine (2008). Based on various country sources and surveys to officials of deposit insurance

institutions and central banks, this database documents detailed information on the deposit insurance scheme across 190 countries between 1934 and 2003. The information in Barth, Caprio, and Levine (2008) is then considered to identify the countries that have adopted a deposit insurance scheme between 2004 and 2009. We construct a dummy variable, *Explicit Deposit Insurance*, which equals 1 if the borrowing country has explicit deposit insurance scheme at the time of loan origination, and 0 otherwise.

Banking Crisis

Our information on banking crisis is obtained from the dataset compiled by Laeven and Valencia (2010). We construct a dummy, *Banking Crisis*, which takes on the value of 1 if the borrowing country is experiencing a banking crisis at the time of loan origination, 0 otherwise.

Sovereign Debt Ratings

We control for the overall country risk by including Standard and Poor's ratings on the long-term sovereign bonds for borrowing countries, which we convert to numerical scores. A lower value indicates a worse rating. We assign a value of 0 for countries without a sovereign debt rating and also construct an indicator for those missing rating observations. The log transformation of the sovereign ratings is used in our regression analyses.

Economic Development

Regulations, banking structure and stability, and institutional qualities of a country are often correlated with its economic development (La Porta et al. 1998). To control for the difference in country economic development, we include gross domestic product (GDP) growth, the natural log of GDP per capital, and the natural log of inflation, obtained from the World Development Indicators (WDI) database.

BACKGROUND AND SAMPLE SELECTION

Background of Bank-to-Bank Loans

Because our study is the first international study to investigate the determinants of the cost of banks' loan financing, an overview of the bank-to-bank loan market would provide some useful background knowledge. As such, we collect global bank loan data from the Loan Pricing Corporation's (LPC) DealScan database, which contains detailed information on individual loan facilities (such as loan spreads, maturity, collateral, covenants, performance pricing, loan types, loan purposes, and lender information).¹⁰

Figure 1 plots the time series trend of banks' borrowing in the global syndicated loan market in terms of both the total number and the total amount (in \$ million) of loan facilities. The plots show that banks' loan borrowing displays an overall increasing trend before the recent subprime crisis, with a 120 percent increase in the total number of loan issuances and an 80 percent increase in the total amount of loan issuances. During 2007, this growth slowed down as the

¹⁰Strahan (1999) provides a good description of the LPC DealScan database.

emerging financial crisis in the United States deteriorated the lending environment in the global loan market. A sharp decline of more than 70 percent from its peak is then observed since 2008, along with the collapse of the global bank loan market documented in Giannetti and Laeven (2012).

Table 1 provides evidence of the bank-to-bank loan flows in the global market. Panel A presents how bank borrowers in each region allocate their loan issuance across different regions. The three largest borrowing regions for bank-to-bank loans are Asia-Pacific, Europe, and North America, which represent 47.4 percent, 25.5 percent, and 12.6 percent of the total amount of global bank-to-bank loans, respectively. Panel A also reveals that banks located in Asia-Pacific, Europe, and North America mainly borrow from the regions in which they operate, as indicated by the fractions over 50 percent in panel A. Additionally, banks from outside the three regions, including the Middle East, Africa, and Latin America, usually borrow from Europe. Although not included, these statistics are similar to those of nonfinancial borrowers.

Panel B provides evidence on how the providers of bank-to-bank loans in each region allocate their lending portfolios across different regions. Generally speaking, the most prominent lending regions for the bank-to-bank loans are Asia-Pacific, Europe, and North America. Specifically, among the loans lent to the global banking industry, 46 percent are from Europe, 33 percent are from Asia-Pacific, and 18 percent are from North America. It appears that lenders allocate a significant percentage of their loan portfolios to their home region,

TABLE 1. The Bank-to-Bank Loan Flows Across Regions

This table shows the bank-to-bank loan flows in the global market. Data are compiled based on loans reported in DealScan during 1995 through 2009. Panel A presents how bank borrowers in each region allocate their loan issuance across different regions (i.e., where bank borrowers borrow from). Panel B shows how the lenders of bank-to-bank loans in each region allocate their lending portfolios across different regions (i.e., who the lenders lend to).

Panel A: Percentage of Syndicated Loan Volume Issued by Bank Borrowers in Each Region								
	Lender Region							
Borrower Region	North America	Asia-Pacific	Europe	Middle East	Africa	Latin America	Total	Global Weight
North America	61.4	13.9	24.5	0.1	0.0	0.1	100.0	12.6
Asia-Pacific	10.7	54.4	33.1	1.6	0.1	0.1	100.0	47.4
Europe	11.4	12.1	74.4	1.8	0.3	0.0	100.0	25.5
Middle East	18.3	12.2	57.0	10.9	1.6	0.0	100.0	9.6
Africa	13.9	19.7	60.3	1.2	5.0	0.0	100.0	3.6
Latin America	20.9	22.5	47.8	4.7	0.0	4.1	100.0	1.3
Panel B: Portfolio Allocation of Lenders in Each Bank Borrower Region								
	Borrower Region							
Lender Region	North America	Asia-Pacific	Europe	Middle East	Africa	Latin America	Total	Global Weight
North America	42.5	27.8	15.9	9.6	2.7	1.5	100.0	18.2
Asia-Pacific	5.3	78.6	9.4	3.6	2.1	0.9	100.0	32.8
Europe	6.7	34.1	41.2	11.9	4.7	1.4	100.0	46.0
Middle East	0.7	32.4	18.8	43.7	1.8	2.6	100.0	2.4
Africa	0.5	8.2	18.6	34.1	38.6	0.0	100.0	0.5
Latin America	8.4	30.8	6.7	0.0	0.0	54.1	100.0	0.1

displaying substantial home bias. For example, lenders from North America channel 42.5 percent, 27.8 percent, and 15.9 percent of their lending volume to borrowers located in North America, Asia-Pacific, and Europe, respectively.

Sample Selection Procedures

We begin by including all loan tranches borrowed by commercial banks in the DealScan database from 1995 to 2009. We screen the sample by excluding loan transactions that have missing interest rate, maturities, and loan sizes.¹¹ In order to ensure comparability in terms of currency and pricing benchmark, following Bae and Goyal (2008) we include only loans in U.S. dollars that are priced as spreads over the London Interbank Offered Rate (LIBOR). The above screening process leaves us with a sample of 2,920 loan facilities. Our analysis is conducted at the loan tranche level since the contract terms and the identity of the lenders can differ across facilities within a deal. The results are similar if we aggregate individual facilities into a deal-level based on the weighted average loan amount.

We then carefully match the name of commercial bank borrowers to Fitch-IBCA Ltd's BankScope by a combination of algorithmic matching and manual checking.¹² BankScope provides a good source of balance sheet and income statement information for both public and private banks across a wide range of countries. To ensure the accounting information is publicly available at the time of a loan origination, the borrowers' financials are measured at the year prior to the loan initiation.

Finally, countries are dropped if any of the key bank regulations, banking market structure, institutional qualities, and macroeconomic factors are not available. Additionally, countries are only included if they have at least 5 observations. The above procedures leave us with a sample of 1,854 loan facilities borrowed by 530 commercial banks in 42 countries from 1995 to 2009.

Summary Statistics

Panel A of Table 2 presents summary statistics regarding our key variables used in the regressions. In order to mitigate the impact of outliers or mis-recorded data, all variables are winsorized at the 0.5 percent and 99.5 percent level. In our sample, the average loan spread is 104.5 basis points (and median is 60 basis points), which is significantly smaller than the spread paid by nonfinancial companies.¹³ The mean loan size is \$188 million (median is \$100 million) with a maturity of 29 months (median is 18 months). Interestingly, the traditional monitoring mechanisms that commonly exist in the corporate loan contracts rarely exist in long-term bank-to-bank loans. For example, on average, the number of covenants is 0.09, the likelihood of having loan pricing tied to borrower perfor-

¹¹76 percent of the facilities do not have information on interest rate.

¹²The matching between DealScan and BankScope is based on bank name and a series of identification information such as country, state, city, zip code, fax number, website, etc.

¹³In Hao, Nandy, and Roberts (2012), the average loan spread for a sample of 12,468 loans to the nonfinancial borrowers in 30 countries is 149.13 (median is 125). In Bae and Goyal (2009), the median loan spread for a sample of 17,791 loans to the nonfinancial firms in 38 countries is 82.5 basis points.

TABLE 2. Summary Statistics

This table presents the summary statistics for our final sample. In panel A, we report number of observations (N), mean, median, standard deviation (SD), and percentiles at 1 percent (P1) and 99 percent (P99) of the key variables. In panel B, we compare the loan characteristics and borrower characteristics between foreign loans and domestic loans. We use the relatively more conservative measure of foreign loan (i.e., all lenders in the syndicate are foreign) to conduct the comparison. The detailed definitions are presented in the Appendix. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

Panel A						
Variable	N	Mean	Median	SD	P1	P99
Loan Characteristics						
Loan Amount (\$mil)	1854	187.93	100.00	285.77	8.00	1800.00
Loan Maturity (Months)	1854	28.76	18.00	20.96	6.00	84.00
All-in-Spread Drawn (AISD) (Basis Points)	1854	104.50	60.00	106.87	8.00	450.00
Log (Spread)	1854	4.18	4.09	0.98	2.08	6.11
All-in-Spread Undrawn (AISU) (Basis Points)	214	17.73	11.25	30.70	4.00	150.00
Commitment Fee (Basis Points)	167	21.14	12.50	37.36	0.00	300.00
Upfront Fee (Basis Points)	323	41.91	30.00	37.18	2.50	150.00
Annual Fee (Basis Points)	80	13.09	10.00	9.33	2.50	60.00
Collateral (Dummy)	1854	0.21	0.00	0.41	0.00	1.00
Covenant Intensity	1854	0.09	0.00	0.58	0.00	3.00
Performance Pricing (Dummy)	1854	0.03	0.00	0.18	0.00	1.00
# Lenders	1854	14.40	12.00	11.66	1.00	56.00
# Foreign Lenders	1854	13.42	11.00	11.65	0.00	56.00
Percentage of Foreign Lenders	1854	0.87	1.00	0.27	0.00	1.00
Foreign Loan	1854	0.60	1.00	0.49	0.00	1.00
Foreign Lead Loan	1854	0.78	1.00	0.41	0.00	1.00
Foreign Lead Presence	1852	0.90	1.00	0.31	0.00	1.00
Relationship Lending (Dummy)	1854	0.54	1.00	0.50	0.00	1.00
Syndicate Partner Loan (Dummy)	1854	0.39	0.00	0.49	0.00	1.00
Ownership-Connected Loan	1854	0.26	0.00	0.44	0.00	1.00
Bank Borrower Characteristics						
Bank Asset (\$mil)	1854	13,911.14	3,147.25	26,791.93	145.80	142,628.00
Investment Ratio	1854	0.43	0.41	0.20	0.01	0.97
ROE	1854	0.15	0.13	0.20	-0.20	0.57
CAR	1854	0.12	0.10	0.10	0.01	0.67
Deposit Ratio	1854	0.63	0.68	0.22	0.00	0.91
Log (Z-score)	1854	3.12	3.21	1.11	0.00	5.46
NPL_L	1854	0.04	0.02	0.05	0.00	0.31
State-Owned Bank	1854	0.15	0.00	0.35	0.00	1.00
Investment Grade	1854	0.19	0.00	0.39	0.00	1.00
Key Country Factors						
Financial Conglomerates Restriction	1854	4.43	4.00	0.98	2.00	6.00
Financial Statement Transparency	1854	4.64	5.00	1.04	3.00	6.00
Banking Concentration	1854	0.52	0.50	0.23	0.16	1.00
Foreign Presence	1854	0.12	0.00	0.33	0.00	1.00
Information Sharing	1854	0.79	1.00	0.41	0.00	1.00

continued

TABLE 2. Summary Statistics (continued)

Panel A									
Variable	N	Mean		Median	SD		P1		P99
Key Country Factors									
Creditor Rights	1854	1.98		2.00	0.88		0.00		4.00
Property Rights	1854	5.86		5.00	2.29		2.00		9.00
Explicit Deposit Insurance	1854	0.87		1.00	0.34		0.00		1.00
Banking Crisis	1854	0.10		0.00	0.30		0.00		1.00
Log (Sovereign Rating)	1854	1.18		1.10	0.47		0.00		1.79
GDP Growth	1854	5.21		4.74	3.18		0.44		13.50
Log (Inflation)	1854	1.76		1.83	1.03		−0.76		4.44
Log (GDP per Capital)	1854	9.12		9.05	1.13		6.64		11.04
Panel B									
	Foreign Loans (A)				Domestic Loans (B)				Mean Differences
Variable	N	Mean	Median	SD	N	Mean	Median	SD	(A−B)
Loan Characteristics									
Loan Amount (\$mil)	1113	176.5711	100	233.7417	741	205.0012	100	349.1584	−28.8168
Loan Maturity (Months)	1113	27.5876	12	20.4680	741	30.5196	24	21.5652	−2.8892
All-in-Spread Drawn (AISD) (Basis Points)	1113	106.6819	60	111.4080	741	101.2277	65	99.6402	5.5174
All-in-Spread Undrawn (AISU) (Basis Points)	71	24.6320	12	49.4650	143	14.3000	11	13.1000	10.3320
Commitment Fee (Basis Points)	83	25.9383	12	50.0983	84	16.3952	12.5	16.3183	9.5430
Upfront Fee (Basis Points)	206	42.2075	30	35.2691	117	41.3989	30	40.4754	0.8085
Annual Fee (Basis Points)	6	20.1667	8	22.6973	74	12.5135	10	7.3763	7.6532
Collateral (Dummy)	1113	0.2120	0	0.4089	741	0.2159	0	0.4117	−0.0062
Covenant Intensity	1113	0.0009	0	0.0300	741	0.2334	0	0.9009	−0.2313
Performance Pricing (Dummy)	1113	0.0207	0	0.1423	741	0.0553	0	0.2288	−0.0344
Relationship Lending (Dummy)	1113	0.5849	1	0.4930	741	0.4791	0	0.4999	0.1050***
Syndicate Partner Loan (Dummy)	1113	0.4483	0	0.4975	741	0.3036	0	0.4601	0.1452***
Ownership-Connected Loan	1113	0.2327	0	0.4227	741	0.3090	0	0.4624	−0.0769**
# Lenders	1113	14.2731	12	11.8636	741	14.5951	13	11.3563	−0.3591
Bank Borrower Characteristics									
Bank Asset (\$mil)	1113	14568.94	3326.178	26389.7	741	12923.11	2928.1	27373.23	1418.148
Investment Ratio	1113	0.4514	0.4322	0.1932	741	0.4005	0.3729	0.2165	0.0503***
ROE	1113	0.1528	0.1441	0.1207	741	0.1413	0.1189	0.2750	0.0112
Capital Ratio	1113	0.1173	0.0969	0.0892	741	0.1296	0.0950	0.1212	−0.0123
Deposit Ratio	1113	0.6511	0.7017	0.2126	741	0.5904	0.6455	0.2367	0.0598***
Log (Z-score)	1113	2.9791	3.0512	1.0843	741	3.3198	3.4518	1.1276	−0.3411***
NPL_L	1113	0.0429	0.0230	0.0561	741	0.0333	0.0141	0.0516	0.0095**
State-Owned Bank	1113	0.1590	0	0.3658	741	0.1282	0	0.3345	0.0309
Investment Grade	1113	0.1518	0	0.3590	741	0.2388	0	0.4266	−0.0854**

mance is 0.03, and there is only a 21 percent chance that the loans are likely to be secured.

The mean of the syndicate size is 14 (median is 12). Foreign lenders play an important role in the syndicates. In our final sample, *Foreign Loan* (where all lenders in the syndicate are foreign) represents 60 percent of the sample. The alternative measure of foreign loans, *Foreign Lead Loan* (where all lead lenders in the syndicate are foreign) represents 78 percent of the sample. Noticeably, in our sample, relationship borrowing is an important phenomenon, where more than half of the loans are repeatedly borrowed from the same lead banks, and 39 percent of the loans are from a previous syndicate partner. In addition, the summary statistics indicate that 26 percent of the loans are borrowed by commercial banks that have ownership connections with at least one of their syndicate lenders.

With regard to bank borrower characteristics, we find that borrowers are mainly commercial banks with mean (median) book value assets of \$13 billion (median is \$3 billion).¹⁴ On average, the sample bank borrowers have investment to asset ratio of 0.43, return on equity of 0.15, and capital ratio of 0.12. The mean deposit ratio is 0.63, the mean non-performing loans to loan ratio is 0.04, and the mean log Z-score is 3.12. In our sample, 15 percent of the borrowers are state-owned banks. Additionally, the table shows great variation in terms of the bank regulations, banking market structure, and other country-level variables.

Because a large fraction of loans have foreign bank involvement in the bank-to-bank loan syndicate, we compare the loan characteristics and borrower characteristics between foreign and domestic loans in panel B of Table 2. We use the relatively more conservative measure of foreign loan (all lenders in the syndicate are foreign) to conduct the comparison. The univariate comparison indicates that there are not significant differences between foreign and domestic loans in terms of loan maturity, loan size, interest rate, and fees. However, foreign loans have 11 percent higher likelihood of being relationship-lending loans and 15 percent higher likelihood of being syndicate-partnership loans than domestic loans. Borrowers of foreign loans are 7 percent less likely to have ownership connection with the lenders. Regarding borrower characteristics, we find that borrowers of foreign loans are more diversified (have higher investment ratio) and riskier (lower Z-score, higher non-performing loan ratio, less likelihood of having investment grade rating).

EMPIRICAL RESULTS

Pricing of Loan Facilities

We first test how country level bank regulations, banking market structure, institutional qualities, and other country-level factors affect the loan spreads of bank-to-bank loans. We estimate the following specification:

$$\text{Log (Spread)} = f(\text{Bank Regulations, Banking Market Structure, Institutional Qualities, Other Country Factors, Bank Borrower Characteristics, Loan Characteristics}) \quad (1)$$

¹⁴We compare the average asset sizes of borrowers and syndicate lenders and find that bank lenders are significantly larger than bank borrowers in bank-to-bank loans.

where the dependent variable is the natural log of loan spread, measured as the number of basis points over LIBOR.

We use *Financial Conglomerates Restriction* to measure regulation on the banking-commerce link and *Financial Statement Transparency* to measure the effectiveness of bank accounting disclosure restriction. Banking market structure includes *Bank Concentration* and *Foreign Presence*. We control for institutional qualities of the borrower country using *Information Sharing*, *Creditor Rights*, and *Property Rights*. *Explicit Deposit Insurance* and *Banking Crisis* are used to control for the degree of banking stability. In addition, we control for the overall country risk by including the log transformation of the Standard and Poor's sovereign rating. To control for the differences in country economic development, we include the GDP growth, log of inflation, and the natural log of GDP per capital in our estimations.

To identify the country-level determinants of the cost of bank-to-bank loans, it is important to control for bank borrower risk characteristics and loan characteristics. Consequently, all regressions include *Bank Size*, *Investment Ratio*, *ROE*, *Capital Ratio*, *Deposit Ratio*, and *Bank Risk* measures (i.e., *Log (Z-score)*, *NPL_L*, and *Investment Grade*), as well as the *State-Owned Bank* indicator. *Bank Size* is measured by the natural log of the book value of total asset of the bank borrower. *Investment Ratio* is the ratio of non-loan asset to the book value of total asset and measures a bank's asset diversification. *ROE* is the return on equity, which measures the profitability of a bank borrower. *Capital Ratio* equals total equity divided by total asset and measures the capital adequacy of a borrower. *Deposit Ratio* is the ratio of all short-term and long-term deposit funding to total asset. *Z-score* equals the return on asset plus the capital-asset ratio divided by the standard deviation of asset returns and measures a bank's distance from insolvency (Roy 1952). A higher Z-score implies a lower probability of insolvency and a greater financial stability. In our estimations, Z-score is calculated using information over the previous 5-year window before each loan origination year. Because the Z-score is highly skewed, we use the natural logarithm of the Z-score as the risk measure (following Laeven and Levine 2009). We also control for the ratio of non-performing loan to total loan, *NPL_L*, to capture the asset quality of a borrower. Additionally, we create a dummy variable *Investment Grade*, which equals 1 if the bank borrower has an S&P senior debt rating equal to or higher than BBB, and 0 otherwise. *State-Owned Bank* equals 1 if the bank borrower is government owned, 0 otherwise.

Equation (1) also includes non-price loan terms that may correlate with pricing in the loan contract. *Log (Maturity)* is the natural log of maturity in months. *Log (Loan Size)* is the natural log of the loan facility amount in millions of dollars. *Collateral* is a dummy that equals 1 if the loan is secured by collateral. Because a large proportion of loans (around 73 percent) are missing collateral information, we add a dummy, *Missing Collateral*, to indicate this. The other control variables include dummy variables for loan origination year, loan purpose, and loan type.

The existence of information asymmetry (both adverse selection and moral hazard problems) affects lenders' lending decisions and the effectiveness of governance mechanisms imposed in loan contracts. These informational frictions can be reduced if there are strong past relationships between lenders and bor-

rowers (Bharath et al. 2011). Accordingly, following Bharath et al. (2011), we construct a dummy variable, *Relationship Lending* that equals 1 if there is prior lending by the same lead banks over the previous 5-year window, and 0 otherwise. In addition, because our borrowers are commercial banks that are usually syndicate lenders, it is likely that a certain fraction of the loans in our sample is made between previous syndicate partners. That is, in the cases of bank-to-bank loans, some borrowers obtain loans from lenders with whom they previously served in the same syndicate (regardless of lending to nonfinancial or financial firms). We classify those cases as *Syndicate Partner Loan*. We expect that previous cooperation could also reduce the information asymmetry problem faced by lenders and hence lower the cost of bank-to-bank loans.

Untabulated summary statistics indicate that the syndicate structure of bank-to-bank loans is highly globalized, with over 60 percent of bank-to-bank loans being entirely from foreign lenders. However, the effects of foreign lending on loan spread are not as clear. On the one hand, foreign lenders could increase spreads to compensate for the additional information asymmetry they face due to geographic or cultural distance (Esty 2006). On the other hand, foreign lenders are more likely to engage in relationship loans, which could reduce the information frictions and lower the interest rate. Another possibility is that foreign lenders could strategically give price discounts in order to expand their business in those, possibly, new markets.¹⁵ To control for the effect of foreign lending on the cost of bank-to-bank loans, we include a dummy, *Foreign Loan*, which equals 1 if all the lenders (and lenders' parents) in the syndicate are from different countries than the borrower (and borrower's parent) in our regressions. For robustness, we also construct another indicator of foreign loan, *Foreign Lead Loan*, which equals 1 if all the lead lenders (and their parents) are from different countries than the borrower (and borrower's parent), and 0 otherwise.¹⁶ The detailed description of the variables is provided in the Appendix.

In our sample, more than half of the borrowers have multiple loans in the same year. Treating each loan independently could lead to biased standard errors and, as a result, faulty inference because the same borrower characteristics could be the driving force behind the origination of each of those loans. To address this issue we use robust *t*-statistics that adjust for heteroscedasticity and borrower-level clustering.¹⁷

The regression results are presented in Table 3. First, consider the bank regulation variables. The results suggest that more stringent bank regulations in the borrower country are associated with lower loan costs for banks. These effects are both statistically significant and economically important. Holding other things constant, a one-standard-deviation increase in the restrictions on financial

¹⁵Understanding the pricing impact of foreign lending on the bank-to-bank loans is not the focus of this study. There are many other possible factors that affect the pricing strategy of foreign lenders in the bank-to-bank loans, but we leave this to future studies.

¹⁶We took the most conservative measure to identify foreign loan because we believe one of the key incentive of including any domestic lenders in the syndicate is to enhance the familiarity and reduce information asymmetry between syndicate lenders and borrowers. Therefore, loans with domestic lender presence should be somehow similar to loans purely made by domestic lenders.

¹⁷Similarly, loans in a given country can also not be treated as independent observations if there are unobservable common country factors. Adjusting the standard errors for heteroscedasticity and clustering within a country renders our results unaffected.

TABLE 3. The Effect of Bank Regulations, Banking Market Structure, and Institutional Qualities on Loan Spread

This table presents the OLS regression results on the effect of bank regulations, banking environment, institutional qualities, and other country-level factors on loan spread. The dependent variable is *Log (Spread)*. We use *Financial Conglomerates Restriction* to measure regulation on banking-commerce link, and we use *Financial Statement Transparency* to measure the effectiveness of bank accounting disclosure restriction. Banking market structure includes *Bank Concentration* and *Foreign Presence*. We control for institutional qualities of the borrower country using *Information Sharing*, *Creditor Rights*, and *Property Rights*. *Explicit Deposit Insurance* and *Banking Crisis* are used to control for the degree of banking stability. We control for the overall country risk by including the log transformation of the Standard and Poor's sovereign rating. To control for the difference in country economic development, we include the *GDP Growth*, *Log (Inflation)*, and *Log (GDP per Capital)*. In the regressions, we control for bank borrower characteristics, measured as *Bank Size*, *Investment Ratio*, *ROE*, *Capital Ratio*, *Deposit Ratio*, *Bank Risk* (i.e., *Log (Z-score)*, *NPL_L*, and *Investment Grade*), and *State-Owned Bank* indicator. The regressions also include non-price loan terms such as *Log (Loan Maturity)*, *Log (Loan Size)*, *Collateral*, and *Missing Collateral* indicator. In addition, we control for the relationship effect, as measured by *Relationship Lending* and *Syndicate Partner Loan*, and foreign loan effect (measured as *Foreign Loan*) in our models. We include but do not report coefficients on year indicators, indicators on loan type, and loan purpose. The estimations from columns 1 through 6 are based on the full sample. In columns 7 and 8, we split the sample by whether it is an ownership-connected loan or not, and re-run our base model. The detailed definitions of the control variables are reported in the Appendix. In all of the regressions we report robust *t*-statistics that adjust for heteroscedasticity and borrower-level clustering. The table reports coefficients, with *t*-statistics in brackets. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

	Full Sample						Exclude Ownership-Connected Loans	Only Ownership-Connected Loans
Variables	(1) Log (Spread)	(2) Log (Spread)	(3) Log (Spread)	(4) Log (Spread)	(5) Log (Spread)	(6) Log (Spread)	(7) Log (Spread)	(8) Log (Spread)
Financial Conglomerates Restriction		-0.0648**				-0.0786***	-0.0680**	-0.1288***
		[-2.4108]				[-2.9461]	[-2.2772]	[-2.6613]
Financial Statement Transparency			-0.1054***			-0.0972***	-0.0978***	-0.0210
			[-3.5368]			[-3.4180]	[-2.9708]	[-0.4113]
Banking Concentration				-0.3658***		-0.4317***	-0.3282**	-0.9269***
				[-2.9119]		[-3.5177]	[-2.3663]	[-4.1591]
Foreign Presence					-0.2796***	-0.2395***	-0.1821*	-0.3235***
					[-3.5626]	[-3.1494]	[-1.9190]	[-2.9040]
Information Sharing	-0.3967***	-0.3877***	-0.3900***	-0.4210***	-0.4014***	-0.4123***	-0.3836***	-0.4957***
	[-5.1383]	[-5.0289]	[-4.9868]	[-5.4944]	[-5.2130]	[-5.3633]	[-4.6573]	[-3.2983]
Creditor Rights	-0.0685**	-0.0875***	-0.0447	-0.0750***	-0.0545**	-0.0655**	-0.0382	-0.1753***
	[-2.3799]	[-2.9491]	[-1.4807]	[-2.6539]	[-2.0008]	[-2.2129]	[-1.2088]	[-3.2178]
Property Rights	-0.1093***	-0.1068***	-0.0881***	-0.1022***	-0.1076***	-0.0770***	-0.0774***	-0.0704**
	[-6.0710]	[-5.9985]	[-4.9772]	[-5.4541]	[-5.9042]	[-4.3496]	[-4.1060]	[-2.1112]
Explicit Deposit Insurance	-0.2177***	-0.1927***	-0.2958***	-0.2679***	-0.1771***	-0.2841***	-0.2375***	-0.3817***
	[-3.4035]	[-3.0786]	[-4.7111]	[-3.9810]	[-2.7830]	[-4.5516]	[-3.2568]	[-2.9851]
Banking Crisis	0.1010	0.1026	0.0672	0.1189	0.0799	0.0747	0.0593	0.0605
	[1.3321]	[1.3749]	[0.8555]	[1.5672]	[1.0593]	[0.9741]	[0.6423]	[0.3732]
Bank Size	-0.0931***	-0.0872***	-0.0921***	-0.1101***	-0.0923***	-0.1044***	-0.0863***	-0.1371***
	[-3.3796]	[-3.2102]	[-3.3876]	[-3.8955]	[-3.5690]	[-4.0078]	[-2.8606]	[-3.4281]
Investment Ratio	0.3838***	0.3112**	0.3884***	0.4090***	0.4241***	0.3642***	0.3484**	0.7115***
	[3.1723]	[2.5430]	[3.1710]	[3.3436]	[3.4693]	[2.9043]	[2.5470]	[3.2578]
ROE	0.0899*	0.0973*	0.0911*	0.1122*	0.0759	0.1143**	0.0653	0.3695
	[1.6906]	[1.8374]	[1.7415]	[1.9212]	[1.4653]	[2.0033]	[1.2823]	[0.9956]

continued

TABLE 3. The Effect of Bank Regulations, Banking Market Structure, and Institutional Qualities on Loan Spread (*continued*)

	Full Sample						Exclude Ownership- Connected Loans	Only Ownership- Connected Loans
Variables	(1) Log (Spread)	(2) Log (Spread)	(3) Log (Spread)	(4) Log (Spread)	(5) Log (Spread)	(6) Log (Spread)	(7) Log (Spread)	(8) Log (Spread)
Capital Ratio	−0.3191 [−1.2256]	−0.2770 [−1.0939]	−0.2687 [−0.9988]	−0.3526 [−1.3665]	−0.2802 [−1.1049]	−0.2278 [−0.9028]	−0.1409 [−0.4954]	−0.5795 [−1.0848]
Deposit Ratio	0.0010 [0.0081]	0.0437 [0.3556]	0.0386 [0.2984]	0.0377 [0.3072]	−0.0033 [−0.0268]	0.1271 [1.0064]	0.1878 [1.1720]	−0.0355 [−0.2146]
Log (Z-score)	−0.0264 [−1.1847]	−0.0199 [−0.8920]	−0.0157 [−0.6937]	−0.0276 [−1.2443]	−0.0341 [−1.6200]	−0.0165 [−0.7777]	−0.0226 [−0.8863]	0.0039 [0.0993]
NPL_L	0.0220 [0.0514]	−0.0623 [−0.1419]	0.0364 [0.0904]	0.0562 [0.1275]	0.1194 [0.2890]	0.0568 [0.1358]	0.1687 [0.3944]	−0.6779 [−0.8412]
State Owned Bank	−0.2574*** [−3.3825]	−0.2531*** [−3.4045]	−0.2584*** [−3.4300]	−0.2463*** [−3.2557]	−0.2578*** [−3.4719]	−0.2405*** [−3.3648]	−0.3201*** [−3.7136]	−0.0293 [−0.2942]
Investment Grade	−0.1357* [−1.7330]	−0.1223 [−1.5836]	−0.0992 [−1.2560]	−0.1509** [−1.9792]	−0.0907 [−1.2268]	−0.0651 [−0.8908]	−0.1286 [−1.5712]	0.0379 [0.3326]
Log (Loan Size)	−0.1655*** [−6.0893]	−0.1724*** [−6.3255]	−0.1620*** [−6.0298]	−0.1625*** [−6.0380]	−0.1752*** [−6.9146]	−0.1753*** [−6.8954]	−0.1976*** [−7.0959]	−0.1489*** [−3.7480]
Log (Loan Maturity)	−0.2226*** [−5.1542]	−0.2147*** [−5.0367]	−0.2091*** [−4.8474]	−0.2053*** [−4.6059]	−0.2205*** [−5.4500]	−0.1781*** [−4.3585]	−0.2123*** [−4.6485]	0.0566 [0.7783]
Collateral	0.1157* [1.7178]	0.1244* [1.8295]	0.1392** [2.0209]	0.1271* [1.8967]	0.1121* [1.6760]	0.1584** [2.2772]	0.1869*** [2.7222]	0.2573 [1.5686]
Missing Collateral	−0.2028*** [−2.9667]	−0.1906*** [−2.7454]	−0.1574** [−2.2903]	−0.1490** [−2.2076]	−0.1706** [−2.4929]	−0.0550 [−0.7845]	−0.0294 [−0.4141]	0.0393 [0.3325]
Relationship Lending	−0.0482 [−1.2640]	−0.0453 [−1.2045]	−0.0584 [−1.5157]	−0.0442 [−1.1733]	−0.0446 [−1.2144]	−0.0465 [−1.2777]	−0.0458 [−1.0878]	−0.0533 [−0.8102]
Syndicate Partner Loan	−0.1310** [−2.2620]	−0.1384** [−2.4059]	−0.1379** [−2.4142]	−0.1121* [−1.9380]	−0.1433*** [−2.5880]	−0.1347** [−2.4957]	−0.1111* [−1.8026]	−0.1318* [−1.6645]
Foreign Loan	−0.2116*** [−5.2018]	−0.2225*** [−5.4931]	−0.2131*** [−5.1710]	−0.1826*** [−4.5660]	−0.2123*** [−5.2489]	−0.1926*** [−4.8486]	−0.2020*** [−4.4790]	−0.1166 [−1.4930]
Log (Sovereign Rating)	−0.1650* [−1.6528]	−0.1382 [−1.4127]	−0.2341** [−2.3443]	−0.1978* [−1.9471]	−0.1778* [−1.8016]	−0.2459** [−2.4900]	−0.1622 [−1.3859]	−0.5068*** [−2.9247]
GDP Growth	−0.0040 [−0.4671]	−0.0014 [−0.1681]	−0.0058 [−0.7218]	0.0009 [0.1054]	−0.0042 [−0.4861]	0.0031 [0.4066]	0.0014 [0.1697]	0.0076 [0.4220]
Log (Inflation)	0.1316*** [4.9220]	0.1319*** [5.0385]	0.0991*** [3.7193]	0.1235*** [4.5746]	0.1254*** [4.7212]	0.0871*** [3.2627]	0.0754** [2.5327]	0.0575 [0.9430]
Log (GDP per Capital)	0.0927** [1.9705]	0.0683 [1.4917]	0.0863* [1.8854]	0.1088** [2.3901]	0.0928* [1.9466]	0.0764* [1.7549]	0.0156 [0.2522]	0.1558*** [2.8619]
Loan Type	Y	Y	Y	Y	Y	Y	Y	Y
Loan Purpose	Y	Y	Y	Y	Y	Y	Y	Y
Year Effect	Y	Y	Y	Y	Y	Y	Y	Y
Constant	9.5552*** [15.9949]	10.0386*** [15.8128]	9.9946*** [16.8309]	9.6912*** [16.4191]	9.5102*** [15.7892]	10.6689*** [16.9410]	7.7617*** [11.8941]	7.9127*** [8.5698]
Observations	1,854	1,854	1,854	1,854	1,854	1,854	1,366	488
Adjusted R-squared	0.6577	0.6603	0.6632	0.6617	0.6647	0.6767	0.6775	0.6852

conglomerates (an increase of about 1 for the index value) lowers the interest rate by around 8 basis points ($= 0.0786 \times 104.5 \times 0.98$). This result suggests that banks, when lending to their industry peers, value the prudential regulation that differentiates them from commercial businesses. To the extent that the restrictions reduce the risk that commercial affiliates misuse bank funds and jeopardize financial safety and soundness, the need for monitoring decreases. The decrease in monitoring costs is passed along to bank borrowers in the form of lower interest rates. With regards to the accounting disclosure regulation, we find that loan spreads decline as this regulation becomes more restrictive. To be specific, holding all else constant, the estimate indicates that loan spread decreases by around 11 basis points ($= 0.0972 \times 104.5 \times 1.04$) for every one standard deviation (about 1 for the index value) increase in the index of bank accounting regulation. The result is consistent with the view that lending to countries with high disclosure standards reduces the information asymmetry that lenders must face.

Next, consider banking market structure. Our results show that both banking concentration and foreign presence are important determinants of cost of bank-to-bank loans. Looking more closely, we find that a higher level of banking concentration in the borrower country reduces banks' cost of borrowing. Holding other things constant, a one standard deviation increase in banking concentration is associated with 10 percent (or 10 basis points) lower loan spread, on average. This result supports the view that in a more concentrated banking system, the monopoly market power and possible government bailout that bank borrowers have can lower their risks of financial distress (i.e., reduced default risk), and lenders therefore respond by reducing the prices of loans. With regard to foreign presence, we find that banks in a foreign bank dominated banking industry pays, on average, 25 basis points lower on loans from the syndicated market than they would have otherwise. This is consistent with the argument that a banking system with a high fraction of foreign banks tends to be more efficient, and hence borrowers are less likely to default on their loans.

In addition to bank regulations and banking market structure, we test how loan pricing reflects other country-level variables such as institutional qualities, banking stability, and financial development. Consistent with recent studies (Qian and Strahan 2007; Bae and Goyal 2009), we find that bank-to-bank loans carry lower spreads when borrowers are from countries characterized by stronger information-sharing mechanisms, creditor rights, and legal enforcement. We also find that banks' cost of borrowing is higher in countries that do not adopt an explicit deposit insurance scheme and in countries that are experiencing a banking crisis at the time of loan origination. As expected, higher country risk (i.e., lower sovereign rating or higher national inflation) is associated with higher loan spreads. The positive relationship between GDP per capital and loan spread is likely driven by loan demand, as higher economic growth implies higher demand for loans from both the nonfinancial and financial sectors.

Turning to borrower characteristics, we find that large or focused banks (banks with lower investment ratios) have lower loan spreads, all else being equal. Safer banks (banks with a higher Z-score, a lower non-performing loan ratio, or with an investment grade rating) obtain loans with lower spreads. With government providing a guarantee, lenders respond to the reduced default risk by charging lower loan spreads to those state-owned bank borrowers. We find

that higher profitability is associated with higher loan spreads. This seemingly puzzling result presumably occurs because of the positive relationship between banks' risk and return.

The loan spread regressions also include loan characteristics as control variables. The negative (and significant) coefficients for maturity and loan size and the positive (and significant) coefficient for collateral are consistent with the notion that longer-maturity loans, larger loans, and loans without collateral are associated with better quality borrowers.¹⁸ We find that in the bank-to-bank loan market, previous syndicate partnership appears to be a more important type of relationship in reducing banks' borrowing costs compared with repeated borrowing from the same lead banks. Interestingly, we find that foreign loans have significantly lower spreads.¹⁹ Although finding reasons for foreign lenders' pricing discount is beyond the scope of this paper, the statistics in Panel B of Table 2 suggest that one possibility could be that foreign banks are more likely to lend to borrowers with a repeated borrowing or syndicate cooperating relationship. The relationship effect seems to overcome the unfamiliarity when lenders make loans to foreign peers.

Concerns on Ownership-Connected Loans

A concern regarding the results is that some borrowers could be branches or subsidiaries of certain lenders in their bank loan syndicate, or vice-versa. It's also likely that the same shareholder owns both the borrower and lender. In those cases, the syndicated loan market may simply become a platform for internal capital transfer. Therefore, the effect of the country-level factors we just identified may not be as important. To identify those ownership-connected loans, we first obtain the shareholder information of the borrowers and lenders at the year of loan origination. We use BankScope's annual shareholder data from the years 2001, 2003, 2005, and 2007 (based on the CD versions).²⁰ To create the time series ownership data, we fill in the years 1994 through 2001 with the ownership value at 2001. We fill the years 2002 through 2003 with the ownership value at 2003. We fill the years 2004 through 2005 with the ownership value at 2005. And we fill the years 2006 through 2009 with the ownership value at 2007. We then match the names of borrowers' shareholders with the names of lenders, and we match the names of lenders' shareholders with the names of borrowers, and we even match the shareholders of borrowers with that of lenders. A dummy variable, *Ownership-Connected Loans*, is constructed to indicate whether a loan is made among ownership related parties. In our sample, we identify that 26 percent of the loans are borrowed by commercial banks that have ownership connections with at least one of their syndicate lenders. In columns 7 and 8 of Table 3, we split the sample by whether it is an ownership-connected loan and re-run our base model. Our results remain quantitatively consistent in both subsamples. In fact, we do find

¹⁸The effects of non-price terms on the loan spread in our estimations are consistent with previous studies; see, for instance, Berger and Udell (1990), Strahan (1999), and Bharath et al. (2011).

¹⁹Bae and Goyal (2009) also find that loans with greater foreign participation are associated with lower spreads.

²⁰Even though we also have the 1999 BankScope CD, we did not use that year's ownership information since most of the data is not as accurate as the data from subsequent years.

that the negative effects that financial conglomerates restriction, banking concentration, and foreign presence have on the loan spread seem strongest among the subsample of only ownership-connected loans, suggesting that a host country's regulation and banking market structure are important considerations even when parents inject capital into their branches or subsidiaries.

Robustness Tests

We check the robustness of our results by re-estimating our main specification (Equation 1) in different ways. First, in unreported estimations, we tried different thresholds to assign values for the bank regulations and found the results quite robust. In addition, we also tried a shorter sample period before the sub-prime crisis (i.e., 1995 through 2007) and found consistent results. In another unreported exercise, we randomly drop different sample countries, and our results remain largely unaffected. All results are available upon request.

Fixed Effect Analysis

While we consistently find that bank regulations, banking market structure, institutional qualities, and other country factors significantly impact the cost of bank-to-bank loans, it is possible that our findings are driven by some unobserved time-invariant country or borrower characteristics. Ideally, fixed effects estimations would take control of this concern. However, our key country factors have limited within-country time variations over our sample period. Therefore, including either borrower-level or country-level fixed effects would absorb most of the explanatory power of these slowly within-country changing variables, rendering it impossible to identify their effects on the cost of bank-to-bank loans. Although we do not apply the fixed effects models to our baseline estimation, we check the robustness of our findings by including the country fixed effects in columns 1 and 2 of Table 4 and the borrower fixed effects in columns 3 and 4 of Table 4. We observe that the fixed effects indeed absorb most of the explanatory power of bank regulation and banking market structure variables. It is reassuring, however, that the coefficient estimates on the bank regulations and banking concentration are a consistent sign and remain statistically significant. Less robustness is observed for the effect of foreign presence and institutional qualities.

Instrumental Variable Analysis

So far, we have shown that our results are robust to various specification tests. However, there still exists the possibility that potential endogeneity could bias our results. We are particularly concerned with the endogeneity of bank regulations and its effect on our findings.²¹ For instance, it is possible that omitted variables that correlated with both bank regulations and banks' cost of borrowing could bias the results toward our baseline findings. While including fixed effects alleviates the concern of omitted variables that remain constant over time, it cannot fully solve the issue if the omitted variables are time-varying. In addition, there is a potential reverse causality problem whereby the regulatory

²¹It is very likely that regulators may consider banks' costs of funding when they design or change policy. However, banks' funding costs are less likely to affect banking structure or institution qualities. Therefore, we focus on addressing the endogeneity of bank regulations.

TABLE 4. Fixed Effect Analysis

We check for robustness of our results by re-estimating our main specification using fixed effect models. We include the country fixed effect in columns 1 and 2 and borrower fixed effect in columns 3 and 4. Estimations are conducted for the full sample in columns 1 and 3, and subsample of non-ownership-connected loans in columns 2 and 4. The dependent variable is *Log (Spread)*. In all the models, we include the same set of control variables as the baseline model. The detailed definitions of the control variables are reported in the Appendix. The table reports coefficients, with *t*-statistics in brackets. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

	Country Fixed		Borrower Fixed	
	Full Sample	Exclude Ownership-Connected Loans	Full Sample	Exclude Ownership-Connected Loans
	(1)	(2)	(3)	(4)
Variables	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction	−0.0775*	−0.1117**	−0.0757	−0.0841
	[−1.8113]	[−2.4504]	[−1.3394]	[−1.2757]
Financial Statement Transparency	−0.0554	−0.0853**	−0.0952**	−0.1082***
	[−1.6307]	[−2.5306]	[−2.1267]	[−2.7300]
Banking Concentration	−0.2841*	−0.1840	−0.2573	−0.0450
	[−1.7669]	[−0.9835]	[−1.1757]	[−0.1456]
Foreign Presence	−0.0041	−0.0149	−0.1596	−0.1335
	[−0.0423]	[−0.1399]	[−1.1698]	[−0.9239]
Information Sharing	−0.0895	−0.0689	−0.1026	−0.0905
	[−1.4051]	[−1.0705]	[−1.4875]	[−1.3453]
Creditor Rights	0.0657	0.0496	−0.0378	−0.0294
	[0.8618]	[0.5903]	[−0.2364]	[−0.1784]
Property Rights	0.0206	0.0312	0.0187	0.0173
	[1.2108]	[1.4415]	[0.8916]	[0.6167]
Other Control Variables	Y	Y	Y	Y
Loan Type	Y	Y	Y	Y
Loan Purpose	Y	Y	Y	Y
Borrower Country Effect	Y	Y	N	N
Borrower Effect	N	N	Y	Y
Year Effect	Y	Y	Y	Y
Constant	16.2471***	14.5101***	16.0306***	14.4573***
	[16.9538]	[13.1924]	[13.1166]	[9.4611]
Observations	1,854	1,366	1,854	1,366
Adjusted R-squared	0.8190	0.8221	0.8941	0.8982

environment in a given country may respond to changes in banks' cost of financing. In this section, we address the endogeneity concerns using two-stage least squares (2SLS) analysis.

We use two instruments for our two endogenous regulation variables. Specifically, as instruments, we include the absolute value of a country's latitude (*Latitude*) and the fraction of years that the country has been independent since 1776 (*Independence*), following the studies of Barth, Caprio, and Levine (2004, 2006). The use of Latitude takes into consideration the fact that European countries colonized much of the world. The ways in which European countries governed their

colonies shaped the institutions and regulations of these colonies once they became independent countries (Beck, Demirgüç-Kunt, and Levine 2003). For instance, in tropical climates, Europeans tended to form extractive regimes wherein small elites ruled the area. Those elites established powerful administrative structures to protect themselves and developed policies to facilitate the extraction of natural resources. However, in temperate climates, democratic policies were more likely to be established due to a greater number of European settlers. We include *Independent* because the literature suggests that countries with a longer history of independence have more opportunities to adopt regulations that are more conducive to economic growth (Easterly and Levine 1997). These two instruments are likely to affect bank regulations, while per se are unlikely to exert a direct and first-order effect on the cost of banks' borrowing. Therefore, we use them as instrumental variables in our analysis. The empirical results are presented in Table 5.

Table 5 shows that our empirical results are robust to endogeneity concerns. The coefficients of regulation variables remain negative and significant. The results strongly confirm our findings that prudential bank regulations reduce banks' cost of borrowing. Coefficients of other country factors yield qualitatively similar results. Noticeably, the coefficients estimated from the instrumental variable analysis are somewhat larger than the ordinary least squares (OLS) counterpart, thus suggesting that any potential endogeneity problem only biases the magnitude of the coefficients downwards. We also provide evidence of the appropriateness of the instruments. We perform an *F*-test of the excluded exogenous variables in the first-stage regression. The *p*-values of the *F*-tests are reported in the penultimate row of Table 5. We reject the null hypothesis that the instruments do not explain cross-sectional differences in bank regulations at the 1 percent level.

Difference-in-Difference Analysis

Our alternative identification strategy is the use of a natural experiment that generates a source of exogenous variations in bank regulations. We first identify the countries that have changed bank regulations during our sample period based on the information from Barth, Caprio, and Levine (2004, 2006, 2008). However, we are aware of the fact that most of the regulation changes that occurred were responding to the country's characteristics or status. That is, those regulation changes are endogenous. To identify the exogenous banking reforms, we need to identify those changes that are due to outside pressures or requirements. We searched central bank annual reports and newspapers of our sample countries for the reasons underlying the regulation changes. Based on the results of our search, we narrowed our focus to the countries that joined the European Union (EU) during our sample period. In order to join the EU, the candidate countries have to meet certain political, regulatory, institutional, and economic stability requirements. Thus, the regulation changes in these member states should be largely induced by external pressures from the EU. Therefore, we contend that joining the EU is a source of exogenous variations in bank regulations that should affect a bank's subsequent cost of borrowing only through its effect on the regulation changes.²²

²²In addition, we stress here that endogeneity is less of a concern in this setting since an individual bank does not have the luxury of deciding whether to enter into EU membership or not.

TABLE 5. Instrumental Variable Analysis

We check for robustness of our results using a two-stage least squares (2SLS) analysis. As instruments, we include the absolute value of a country's latitude (i.e., *Latitude*) and the fraction of years that the country has been independent since 1776 (i.e., *Independence*). Estimations are conducted for the full sample in column 1, and subsample of non-ownership-connected loans in column 2. The dependent variable is *Log (Spread)*. In all the models, we include the same set of control variables as the baseline model. The detailed definitions of the control variables are reported in the Appendix. The table reports coefficients, with *t*-statistics in brackets. *, **, *** Statistical significance at $p < 0.1$, 0.05, 0.01, respectively.

	Full Sample	Exclude Ownership-Connected Loans
	(1)	(2)
Variables	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction	-0.9087** [-2.5331]	-0.5840*** [-2.9178]
Financial Statement Transparency	-0.3265* [-1.8092]	-0.2359* [-1.6852]
Banking Concentration	-0.8397*** [-2.8470]	-0.5278** [-2.4112]
Foreign Presence	-0.3550** [-2.4892]	-0.2519** [-2.0588]
Information Sharing	-0.3534*** [-2.8537]	-0.3740*** [-3.7859]
Creditor Rights	-0.4065*** [-4.0369]	-0.2711*** [-4.1849]
Property Rights	-0.1217** [-2.0687]	-0.1304*** [-3.1139]
Other Control Variables	Y	Y
Loan Type	Y	Y
Loan Purpose	Y	Y
Year Effect	Y	Y
Constant	9.5020*** [5.4011]	11.6555*** [8.1886]
Observations	1,854	1,366
First-Stage <i>F</i> -test (<i>p</i> -value)	0.000	0.000
Adjusted R-squared	0.1375	0.4444

In our sample, there are six countries that joined the EU in 2004 and experienced changes in at least one of the two bank regulations after joining.²³ The countries are Czech Republic, Estonia, Hungary, Latvia, Lithuania, and Slovenia.²⁴ Regarding the regulation on banking-commercial integration, we find that Czech Republic, Hungary, and Slovenia relaxed their restrictions, while Latvia and Lithuania toughened their restrictions after joining the EU. Regarding financial transparency regulations, we find that Czech Republic and Estonia became less restrictive, while Hungary and Lithuania became more restrictive after be-

²³Bulgaria and Romania joined the EU in 2007, which is also within our sample period. However, we do not exactly know whether those countries altered regulations to join the EU since the World Bank's last survey we use on bank regulations was updated in 2007.

²⁴Among the six countries, Czech Republic, Hungary, Latvia, Lithuania, and Slovenia altered regulations on financial conglomerates, and Czech Republic, Estonia, Hungary, and Lithuania altered financial transparency regulations.

coming EU members. Following Rajan and Zingales (1998), for each regulation type we split the sample into positive and negative regulation change groups.

For the treatment group, we obtain loans that are made to the banking industries of the above countries five years before and after the event year 2004.²⁵ We then construct a control group of loans that are matched to the treatment group on all important observable characteristics, but whose borrower country did not change bank regulations after the event year. Our matching procedure relies on a nearest neighbor matching of propensity scores, originally developed by Rosenbaum and Rubin (1983) and also adopted by recent studies such as Lemmon and Roberts (2010). We first run a probit regression of a dummy variable that equals 1 if a particular loan belongs to our treatment group (and 0 otherwise) on a comprehensive list of observable factors, including banking market structure (*Bank Concentration* and *Foreign Presence*), institutional qualities (*Information Sharing*, *Creditor Rights*, and *Property Rights*), degree of banking stability (*Explicit Deposit Insurance* and *Banking Crisis*), overall country risk (*Standard and Poor's Sovereign Rating*), and country economic development (*GDP Growth*, *Log [Inflation]*, and *Log [GDP per Capital]*). In addition, we control for borrower size, loan size, and loan maturity. Finally, the matched loan is initiated in the same year as the treatment loan. After obtaining a closely matched sample of control loans, we use a difference-in-differences approach to ensure that the results are not driven by cross-sectional heterogeneity between the treatment and control loans or by the common time trends that affect both groups of loans.

Table 6 reports the results from the difference-in-differences analysis using the matched sample. Panel A (B) contains results for the positive (negative) regulation change group. Columns 1 and 2 show the average difference between the post- and pre-shock periods for the treatment and control loans, respectively. The results show that after 2004, both treatment and control groups experienced an increase in loan spread. However, our focus is column 3, which indicates the difference between the treatment and control groups, adjusting for the different group and time period variances. Panel A of Table 6 demonstrates that for countries that favor more traditional banking and transparent accounting disclosure after joining the EU, the difference-in-difference estimates for the loan spread are negative and statistically significant. These results show that an exogenous increase of bank regulation restriction results in lower average loan spread for the treatment loans compared to the control loans in the following years. Panel B of Table 6 shows that the negative changes in financial conglomerates restriction do not result in a significant difference in loan spreads between the treatment and control groups. However, the negative changes in financial transparency regulation lead to a positive and significant difference in loan spreads between the two groups that is due to the statistically dramatic increase in loan spread for the treatment loans, but an insignificant increase in loan spread for the control loans surrounding the event.

²⁵Choosing a ten-year window (from year -5 to year +5) reflects a trade-off between relevance and accuracy. Choosing too wide a window may induce too much noise irrelevant to the events, and thus reduce the power of our test. Choosing a window that is too narrow may also limit our ability to identify enough loans before and after the 2004 event year. The ten-year window allows us to find at least one loan before and after each country joining the EU without reducing the power of our test by too much.

TABLE 6. Difference-in-Difference Analysis

This table reports the results of the difference-in-difference test on how an exogenous shock to bank regulations (i.e., joining the European Union) affects the loan spreads of bank-to-bank loans. For the treatment group, we obtain loans that are issued to the banking industries of six countries that joined the EU in 2004, such as Czech Republic, Estonia, Hungary, Latvia, Lithuania, and Slovenia. We kept loans five years before and after the event year 2004. We then construct a control group of loans that are matched to the treatment group on all important observable characteristics but whose country of borrowers do not change bank regulations after the event year. Our matching procedure relies on a nearest neighbor matching of propensity scores. We first run a probit regression of a dummy variable that equals 1 if a particular loan belongs to our treatment group (and 0 otherwise) on a comprehensive list of observable factors, including banking market structure (*Bank Concentration* and *Foreign Presence*), institutional qualities (*Information Sharing*, *Creditor Rights*, and *Property Rights*), degree of banking stability (*Explicit Deposit Insurance* and *Banking Crisis*), overall country risk (*Standard and Poor's Sovereign Rating*) and country economic development (*GDP Growth*, *Log of Inflation*, and *Log of GDP per Capital*). In addition, we control for bank borrower size, loan size, and loan maturity. We also ensure that the matched loan is initiated at the same year as the treatment loan. Panel A is for the positive regulation change group, and Panel B is for the negative regulation change group. Column 1 and Column 2 show the average difference between the post-shock period and pre-shock period for the treatment and control loans, respectively. Column 3 indicates the difference between the treatment and control groups, adjusting for the different group and time period variances. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

Panel A: Positive Regulation Change Group			
	(1)	(2)	(3)
	Mean Treatment Difference (After – Before)	Mean Control Difference (After – Before)	Mean Difference-in-Difference (Treat – Control)
Financial Conglomerates Restriction	7.21	13.75	–6.54*
<i>t</i> -statistics	[0.64]	[1.87]	[–2.05]
Financial Statement Transparency	11.38	28.54**	–17.16**
<i>t</i> -statistics	[0.63]	[2.36]	[–2.73]
Panel B: Negative Regulation Change Group			
	Mean Treatment Difference (After – Before)	Mean Control Difference (After – Before)	Mean Difference-in-Difference (Treat – Control)
Financial Conglomerate Restriction	7.21	9.71	–2.5
<i>t</i> -statistics	[0.53]	[1.34]	[–0.89]
Financial Statement Transparency	38.75**	26.98	11.77**
<i>t</i> -statistics	[2.33]	[0.80]	[2.37]

Distances of Bank Regulations, Banking Market Structure, and Institutional Qualities between the Borrowing and Lending Country

In this subsection, we explore the specific connections between the borrowing and lending country. In particular, we investigate—from the lender's perspective—whether gaps (or distances) in bank regulation, banking market structure, and other country factors between borrower and lead lender countries influence the cost of bank-to-bank loans. We estimate the following regression:

$$\begin{aligned} \text{Log (Spread)} = f & (\text{Bank Regulations Gap, Banking Market Structure Gap,} \\ & \text{Institutional Qualities and Other Country Factor Gap,} \\ & \text{Culture Distance, Bank Borrower Characteristics, Loan} \\ & \text{Characteristics, Other Control Variables}) \end{aligned} \quad (2)$$

In the Gap model, we consider each individual lead lender-loan as the basic observation. The Gap measures are calculated as the absolute difference between the levels of country factors in the borrower country and those in the lead lender country. The value of Gap measures go from negative to positive. If the lead lender is from the same country as the borrower, the Gap measures are

equal to zero. A large positive regulatory gap indicates more restrictive bank regulations in the borrower country relative to those in the lead lender country, and a negative gap means the regulatory restrictions are more stringent in the lead lender country than in the borrower country. To be specific, a high value of *Financial Conglomerates Restriction Gap* suggests that borrower country has a much higher restriction on the mixing of banking and commerce than the lender country. A large *Financial Statement Transparency Gap* suggests that the borrower country has a much higher standard of accounting disclosure than the lender country. A positive value of *Banking Concentration Gap* indicates that the borrower country has a more concentrated banking sector than the lender country. Similarly, a positive value for *Foreign Presence Gap* indicates that the borrower country is dominated by foreign banks more than the lender country is.

We control for the institutional quality gaps, explicit deposit insurance gap, banking crisis gap, and other macroeconomic factors gap in our estimation. In addition, a combined measure of *Culture Distance* is also included to control for potential cultural differences between the borrower and lender countries. This measure involves two components: *Language Distance* and *Colonizer Distance*. *Language Distance* and *Colonizer Distance* are both measured as dummies, which equal 0 if the borrower and lead lender countries share a common official language or have had a common colonizer after 1945, and equal 1 otherwise. The *Culture Distance* sums up these two components. A larger value indicates a larger culture distance. Unlike the borrowers' country-level factors, our Gap measures have enough within-country time variations. Therefore, in our regressions of Table 7 we include the lenders' country-level fixed effect.

In columns 1 and 2 of Table 7, we conduct our Gap model in the full sample and a sample that excludes ownership-connected loans. In columns 3 and 4, we conduct the estimations in the subsamples of purely foreign loans and foreign loans without ownership-connected ones. Our findings provide strong evidence that the distances in bank regulations, banking market structure, and institutional qualities between the borrower and lead lender countries also significantly impact the cost of bank-to-bank loans. Moreover, the directions of the coefficients are highly consistent with our previous results in Table 3. Specifically, we find that lead lenders charge significantly lower loan spreads when they lend to markets where banking-commerce and accounting-disclosure regulations are more stringent than in their own countries. In terms of banking market structure, the results suggest that lenders from a country with less of a foreign presence or a less concentrated banking industry offer dramatically lower interest rates to bank borrowers from countries with a high foreign presence or a highly concentrated banking industry. Regarding institutional qualities, we find that lenders in countries with poorly developed institutional systems charge significantly lower loan spreads when lending to countries with well-developed information-sharing systems, property rights, and creditor rights. We also find that a large pricing discount is given if the borrower country has an explicit deposit insurance scheme while the lender country does not.

In addition, the observed results provide some evidence supporting the theory of *Home Bias*. The Home Bias theory suggests that the concern of famil-

TABLE 7. Distances of Bank Regulations, Banking Market Structure and Institutional Qualities between the Borrowing and Lending Country

In this table, we examine, from the perspective of lenders, whether gaps (or differences) in bank regulation, banking market structure, and other country factors between borrower and lead lender countries influence the cost of bank-to-bank loans. In the Gap model, we consider each individual lead lender-loan as the basic observation. The Gap measures are calculated as the absolute difference between the levels of country factors in the borrower country and those in the lead lender country. The value of Gap measures ranges from negative to positive. If the lead lender is from the same country as the borrower, the Gap measures are equal to zero. A large positive regulatory gap indicates more restrictive bank regulations in the borrower country relative to those in the lead lender country, and a negative gap means the regulatory restrictions are more stringent in the lead lender country than in the borrower country. We include *Culture Distance* to control for potential cultural differences between the borrower and lender countries. This measure involves two components: *Language Distance* and *Colonizer Distance*. A larger value indicates a larger culture distance. Unlike the borrowers' country-level factors, our Gap measures have enough within-country time variations. Therefore, in the Gap regressions, we include the lenders' country-level fixed effect. In all the models, we include the same set of control variables as the baseline model. The detailed definitions of the control variables are reported in the Appendix. The table reports coefficients, with *t*-statistics in brackets. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

Variables	Both Foreign and Domestic Loans		Only Foreign Loans	
	Full Sample	Exclude Ownership-Connected Loans	Full Sample	Exclude Ownership-Connected Loans
	(1)	(2)	(3)	(4)
	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction Gap	-0.1459*** [-7.1348]	-0.1502*** [-6.4694]	-0.1894*** [-8.2241]	-0.1669*** [-6.9912]
Financial Statement Transparency Gap	-0.1382*** [-6.1257]	-0.1173*** [-4.8149]	-0.1315*** [-4.9556]	-0.0997*** [-3.7250]
Banking Concentration Gap	-0.1755* [-1.7303]	-0.4614*** [-3.7852]	-0.4307*** [-3.6241]	-0.6469*** [-4.7029]
Foreign Presence Gap	-0.1668*** [-3.4159]	-0.1123* [-1.7641]	-0.0954* [-1.6975]	-0.0325 [-0.4716]
Information Sharing Gap	-0.4470*** [-7.4477]	-0.4331*** [-6.4796]	-0.4299*** [-6.5138]	-0.3973*** [-5.5257]
Creditor Rights Gap	-0.0361 [-1.2861]	-0.0540* [-1.6895]	-0.0722** [-2.0225]	-0.0704* [-1.8846]
Property Rights Gap	-0.0824*** [-5.0588]	-0.1020*** [-5.5635]	-0.1184*** [-5.9636]	-0.1536*** [-7.4355]
Culture Difference	0.1971*** [4.9103]	0.1070** [2.4533]	0.2430*** [6.0440]	0.1599*** [3.4114]
Other Control Variables	Y	Y	Y	Y
Loan Type	Y	Y	Y	Y
Loan Purpose	Y	Y	Y	Y
Year Effect	Y	Y	Y	Y
Lender Country Effect	Y	Y	Y	Y
Constant	6.2578*** [12.1897]	5.8380*** [13.4782]	4.9716*** [9.2706]	6.2129*** [12.0161]
Observations	8,493	5,356	5,726	3,517
Adjusted R-squared	0.7775	0.7714	0.8058	0.7985

ilarity causes lenders to limit their credit exposure in foreign countries, which implies that unfamiliarity would push up interest rates charged by lenders due to information frictions (Karolyi and Stulz 2002). In the global bank-to-bank loans context, our paper provides direct empirical evidence that lenders charge

significantly higher loan spreads when the borrower is culturally distant, which is consistent with the first-order pricing effect of Home Bias.

Bank Regulations: Does Banking Market Structure and Institutional Qualities Matter?

Next, to gain additional insights into the determinants of the spread in bank-to-bank loans, we investigate whether the level of banking market structure and the institutional qualities influence the extent to which regulation impacts the cost of bank-to-bank loans. In carrying out our analysis, we seek answers to the following question: Would bank regulations still matter if these countries had strong institutional qualities and a well-functioning market structure?

For every regulated industry—in particular, the banking industry—market structure and regulation are usually interrelated. Therefore, the effectiveness of bank regulations cannot be isolated, especially from the banking structure in that country. Panel A of Table 8 includes the interaction terms between the bank regulations and the *High Concentration* indicator (which equals 1 if the concentration value is higher than the median, 0 otherwise) to examine the joint effects of bank regulations and banking market structure. The full sample results are presented in columns 1 through 3, and the subsample that excludes ownership-connected loans is in columns 4 through 6. All the coefficients of the interaction terms are negative and statistically significant. The results consistently show that having more restrictive bank regulations in a highly concentrated banking environment results in additional reductions in loan spread. Next, bank regulations interacted with the *Foreign Presence* dummy in all estimations, and results are reported in Panel B of Table 8. Similarly, columns 1 through 3 contain full sample results and columns 4 through 6 the subsample without ownership-connected loans. Note however, that the results do not show that the impact of bank regulation on banks' borrowing costs varies significantly with the level of foreign presence in the borrower's banking industry.

In Table 9, we examine the effect of institutional qualities. We combine the three individual institutional quality indicators (i.e., information sharing, property rights, and creditor rights) to obtain an aggregate measure of the overall institutional quality for each country. A country with a below-median institutional quality score is viewed as a country with poorer institutions. Using the interaction of the bank regulation variables with a dummy, *Low Institutional Quality*, as our variable of interest, the results suggest that bank regulations and country institutions are substitutes in determining the cost of banks' loan financing. Specifically, for both the full sample and the non-ownership-connected loan subsample, the coefficients of the interaction terms are statistically significant at the 1 percent level and consistently show that the marginal improvements in bank regulations produce greater reductions in the cost of loans for banks from weak institutional systems than those from well-developed institutional systems.

Non-Price Terms and Syndicate Structure

In this subsection, we examine the effects of bank regulation, banking market structure, and other country factors on the non-price provisions and syndicate

TABLE 8. Bank Regulation and Banking Market Structure

In this table, we investigate whether the level of banking market structure influences the degree of regulation effect on the cost of bank-to-bank loans. The dependent variable is *Log (Spread)*. Panel A includes the interaction terms between the bank regulations and the *High Concentration* indicator (equals 1 if the concentration value is higher than the median, 0 otherwise). Panel B includes the interaction terms between the bank regulations and the *Foreign Presence* dummy. Columns 1 through 3 are for the full sample, and columns 4 through 6 are for the subsample without ownership-connected loans. In all the models, we include the same set of control variables as the baseline model. *, **, *** Statistical significance at $p < 0.1$, 0.05, 0.01, respectively.

Panel A: Bank Regulation and Banking Concentration						
	Full Sample			Exclude Ownership-Connected Loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction × High Banking Concentration	−0.1508***		−0.1546***	−0.2002***		−0.2187***
	[−2.9846]		[−3.0700]	[−3.2693]		[−3.6255]
Financial Statement Transparency × High Banking Concentration		−0.0768*	−0.0827*		−0.1433***	−0.1625***
		[−1.7219]	[−1.8183]		[−3.1939]	[−3.4993]

Panel B: Bank Regulation and Foreign Presence						
	Full Sample			Exclude Ownership-Connected Loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction × High Foreign Presence	−0.0393		−0.0428	−0.0197		−0.0015
	[−0.5644]		[−0.6073]	[−0.2114]		[−0.0166]
Financial Statement Transparency × High Foreign Presence		−0.0165	−0.0252		0.0712	0.0708
		[−0.1494]	[−0.2320]		[0.6005]	[0.5976]

structure of bank-to-bank loans. Bank loan contracts contain both price and non-price provisions that cannot be split and traded separately. These non-price terms help to mitigate banks' risk exposures and enhance their monitoring ability during the life of each loan. However, unlike loan contracts to nonfinancial firms, bank-to-bank loans rarely have covenants, collateral, or performance pricing provisions. Therefore, we focus on one particular non-price debt contract feature: loan maturity. Syndicate structure has also been shown to be a reliable mechanism for banks to manage the riskiness of the loans. With regard to the structure of lending syndicate, we focus on the overall syndicate size and foreign involvement in the syndicate.

Results are presented in Table 10. Column 1 (full sample) and column 2 (subsample of non-ownership-connected loans) present the results for loan maturity. They show that loans in countries that favor traditional banking and transparency have longer maturities. The coefficient on the *Financial Conglomerates Restriction* in the full sample estimation indicates that, holding other things constant, a one standard deviation increase in financial conglomerates restriction increases the loan maturity by about 1.8 months ($= 0.0623 \times 28.76 \times 0.98$). The results also show that loan maturity increases by about 2.2 months ($= 0.0736 \times 28.76 \times 1.04$) for every one standard deviation increase in the index

TABLE 9. Bank Regulation and Institutional Quality

In this table, we investigate whether the level of institutional qualities influences the degree of regulation effect on the cost of bank-to-bank loans. The dependent variable is *Log (Spread)*. We combine the three individual institutional quality indicators (i.e., information sharing, property rights, and creditor rights) to obtain an aggregate measure of the overall institutional quality for each country. A country with a below-median institutional quality score is viewed as a country with poorer institutions. We interact our bank regulation variables with a dummy, *Low Institutional Quality*. The estimations are conducted for the full sample in columns 1 through 3, and for the subsample that excludes ownership-connected loans in columns 4 through 6. In all the models, we include the same set of control variables as the baseline model. *, **, *** Statistical significance at $p < 0.1, 0.05, 0.01$, respectively.

	Full Sample			Exclude Ownership-Connected Loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)	Log (Spread)
Financial Conglomerates Restriction × Low Institutional Quality	−0.1702*** [−3.5904]		−0.1622*** [−3.3622]	−0.1601*** [−2.7642]		−0.1574*** [−2.7474]
Financial Statement Transparency × Low Institutional Quality		−0.2357*** [−4.1941]	−0.2297*** [−3.9819]		−0.2515*** [−4.1257]	−0.2498*** [−4.0472]

of bank accounting regulations. With regard to banking market structure, we find that bank concentration is positively associated with loan maturity. The coefficients are statistically and economically significant in both the full sample and subsample estimations. Taking the results in the full sample regression, for example, and holding other things constant, a one standard deviation increase in banking concentration, on average, is associated with a 10 percent (or 2.9 months) longer loan maturity. However, the impact of foreign presence on the bank-to-bank loan maturity is insignificant.

Turning to the syndicate structure, we use three measures of syndicate structure in our estimations. These are the total number of lenders (columns 3 and 4), the total number of foreign lenders (columns 5 and 6), and the fraction of foreign lenders (columns 7 and 8). We find a negative and significant association between bank regulations and syndicate size. To the extent that loan risk is negatively related to syndicate size, this would suggest that an increase in bank regulations would indicate riskier loans. However, there is also a negative relation between the number of foreign lenders in the syndicate and the percentage of foreign lenders, suggesting that the reduction of syndicate size is largely driven by the foreign involvement and not because these loans are riskier. These results are consistent with the view of regulatory arbitrage that banks tend to move funds away from markets with more regulations (Houston, Lin, and Ma 2012). Note, however, that once they decide to provide loans to those markets with restrictive bank regulations, they value the governance role of prudential regulations and pass along the savings in monitoring cost to the borrowers. Noticeably, our relationship measures, such as *Relationship Lending* and *Syndicate Partnership Loan*, are both significantly and positively associated with the overall syndicate size and the number and fraction of foreign lenders in the syndicate. In addition, we find that higher banking concentration is associated with larger syndicate size and greater foreign involvement, which further supports the view that market power and government guarantee are valued when banks borrow. In terms of foreign presence, we find that a greater number of lenders, especially foreign lenders, are attracted to the syndicate when the borrowers are in a foreign-dominated banking industry.

TABLE 10. Non-Price Term and Syndicate Structure

This table presents the regression results on the effect of bank regulations, banking market structure, and other country-level factors on the non-price term and syndicate structure of bank-to-bank loans. Column 1 (for full sample) and column 2 (for subsample of non-ownership-connected loan) present our OLS estimations on the Log (Loan Maturity). We also test three syndicate structure variables: total number of lenders (in columns 3 and 4), total number of foreign lenders (in columns 5 and 6), and the fraction of foreign lenders (in columns 7 and 8). We use Poisson estimations for columns 3 and 6, and OLS estimations for columns 7 and 8. The detailed definitions of the control variables are reported in the Appendix. The table reports coefficients, with *t*-statistics in parentheses. *, **, *** Statistical significance at $p < 0.1$, 0.05, 0.01, respectively.

Variables	Log (Loan Maturity)		# Lenders		# Foreign Lenders		Percent Foreign Lenders	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial Conglomerates Restriction	0.0623** [2.3632]	0.0689** [2.3886]	−0.0528*** [−2.7368]	−0.0706*** [−2.8081]	−0.0911*** [−4.2006]	−0.0935*** [−3.3755]	−0.0473*** [−5.9579]	−0.0439*** [−4.8763]
Financial Statement Transparency	0.0736*** [3.1153]	0.0864*** [3.3716]	−0.0522** [−2.3821]	−0.0664*** [−2.7230]	−0.0702*** [−2.9812]	−0.0731*** [−2.8108]	−0.0173** [−2.2717]	−0.0113 [−1.3108]
Banking Concentration	0.4368*** [4.8953]	0.3388*** [3.2321]	0.3306*** [3.2679]	0.4855*** [4.0638]	0.4661*** [4.0422]	0.6060*** [4.6553]	0.4511*** [12.7152]	0.4637*** [11.2733]
Foreign Presence	−0.0077 [−0.1119]	0.0194 [0.2234]	0.0847* [1.7347]	0.1050* [1.7514]	0.1481*** [2.8101]	0.1789*** [2.8117]	0.0831*** [4.0675]	0.0821*** [3.2395]
Information Sharing	0.0911* [1.9103]	0.0487 [1.0192]	0.0086 [0.1668]	0.0410 [0.6771]	−0.0227 [−0.4184]	0.0236 [0.3640]	−0.0208 [−1.2894]	−0.0193 [−1.0753]
Creditor Rights	−0.0270 [−1.1314]	−0.0288 [−1.1468]	0.0395* [1.8579]	0.0237 [0.9760]	0.0594** [2.4237]	0.0380 [1.3498]	0.0462*** [5.3889]	0.0383*** [4.0441]
Property Rights	−0.0457*** [−3.0034]	−0.0424*** [−2.6608]	−0.0119 [−0.8532]	−0.0297* [−1.8142]	−0.0113 [−0.7663]	−0.0331* [−1.8725]	−0.0155*** [−3.1016]	−0.0217*** [−3.7445]
Other Control Variables	Y	Y	Y	Y	Y	Y	Y	Y
Loan Type	Y	Y	Y	Y	Y	Y	Y	Y
Loan Purpose	Y	Y	Y	Y	Y	Y	Y	Y
Year Effect	Y	Y	Y	Y	Y	Y	Y	Y
Constant	1.2445*** [2.8015]	0.4694 [1.0748]	0.0057 [0.0139]	−1.3180*** [−2.6099]	−0.3216 [−0.4780]	−2.3523*** [−4.1206]	1.1689*** [7.1485]	0.8126*** [4.8159]
Observations	1,854	1,366	1,854	1,366	1,854	1,366	1,854	1,366
Adjusted R-squared/Log Pseudo Likelihood	0.5194	0.5286	−7613.5198	−5429.9618	−7821.2756	−5584.438	0.5974	0.5908

CONCLUSION

Over the past decade, the use of bank loans as a source of financing by banks is pervasive and growing in importance. This paper examines the factors that determine the cost of this particular funding source. Using a sample of 1,854 syndicated loans borrowed by 530 commercial banks from 1995 to 2009 in 42 countries, this paper reveals that the cost of loans is significantly influenced by bank regulations, market structure, institutional development, and their relative differences between borrower and lead lender countries.²⁶

²⁶We recognize that there is a limitation in our sample since it ends in 2009. However, we expect that the post-crisis data may not affect our results much. In unreported estimations, we tried a shorter sample period before the subprime crisis (i.e., 1995–2007) and found consistent results. In another unreported exercise, we randomly drop different sample countries, and our results remain largely unaffected. All results are available upon request.

Specifically, we find that banks from countries with more restrictive regulations have significantly lower costs of bank loan financing. The results are consistent with the view that prudential bank regulations are effective governance mechanisms that reduce monitoring costs for lenders, who then pass the savings on to borrowers. Keeping in line with this argument, we provide empirical evidence that restrictive bank regulations reduce banks' borrowing costs more for loans that need intensive monitoring, such as loans with short maturities and loans with stringent covenants.

Regarding banking market structure, we find that lenders reward the monopoly market power of bank borrowers by giving larger price discounts to a more concentrated banking industry. We also find that a banking sector with a high foreign presence is viewed as more efficient; therefore, banks from such banking environments pay lower cost of borrowing. Consistent with the findings on the corporate loans (Qian and Strahan 2007; Bae and Goyal, 2009), we find that better institutional qualities negatively and significantly impact the cost of banks' borrowing. We further investigate whether the degree of the regulation effect varies across different levels of banking market structure and institutional qualities. The results show that restrictive regulations reduce banks' borrowing costs more in highly concentrated banking industries or in countries with weak institutional systems.

Our results are robust with different sample periods, random country inclusions, and the exclusion of ownership-connected loans. In order to address the endogeneity concerns of bank regulations, we adopt the fixed effect models, instrumental variable analysis, and the difference-in-difference analysis, and the results are upheld.

In sum, several points are worth repeating. First, our study draws attention to a largely ignored funding source of banks—long-term funding by other banks—and also adds to our knowledge on the cost of various banks' funding sources. Second, our paper furthers extant understandings of debt contracts by expanding the range of borrowers from nonfinancial corporations to the traditional lenders, commercial banks. Third, our study adds to the literature on the costs and benefits of bank regulations and certain market structure. In particular, we provide evidence on their role in affecting banks' cost of funding.

References

- Allen, F. and D. Gale. 2000. *Comparing Financial Systems*. Cambridge, MA: MIT Press.
- Bae, K. and V. Goyal. 2009. "Creditor Rights, Enforcement and Bank Loans." *Journal of Finance* 64, 823–60.
- Barclay, M. and C. Smith. 1995. "The Maturity Structure of Corporate Debt." *Journal of Finance* 50, 609–31.
- Barth, J., G. Caprio, and R. Levine. 2004. "Bank Regulation and Supervision: What Works Best?" *Journal of Financial Intermediation* 13, 205–48.
- Barth, J., G. Caprio, and R. Levine. 2006. *Rethinking Bank Regulation: Till Angels Govern*. New York, NY: Cambridge University Press.
- Barth, J., G. Caprio, and R. Levine. 2008. "Bank Regulations Are Changing: For Better or Worse?" *Comparative Economic Studies* 50, 537–63.
- Beck, T., A. Demirgüç-Kunt, and R. Levine. 2003. "Law, Endowments, and Finance." *Journal of Financial Economics* 70, 137–77.

- Berger, A. and G. Udell. 1990. "Collateral, Loan Quality, and Bank Risk." *Journal of Monetary Economics* 25, 21–42.
- Berlin, M. and L. Mester. 1999. "Deposits and Relationship Lending." *Review of Financial Studies* 12, 579–607.
- Bharath, S., S. Dahiya, A. Saunders, and A. Srinivasan. 2011. "Lending Relationships and Loan Contract Terms." *Review of Financial Studies* 24, 1141–203.
- Bharath, S., J. Sunder, and S. Sunder. 2008. "Accounting Quality and Debt Contracting." *Accounting Review* 23, 1–28.
- Bhattacharya, S., and D. Gale. 1987. "Preference Shocks, Liquidity, and Central Bank Policy." In *New Approaches to Monetary Economics*, edited by W. Barnett, and K. Singleton, New York, NY: Cambridge University Press, 69–88.
- Boyd, J. and G. De Nicrolo. 2005. "The Theory of Bank Risk-Taking and Competition Revisited." *Journal of Finance* 55, 679–713.
- Bradley, M. and M. Roberts. 2004. "The Structure and Pricing of Corporate Debt Covenants." [Working paper.]
- Carey, M. and G. Nini. 2007. "Is the Corporate Loan Market Globally Integrated? A Pricing Puzzle." *Journal of Finance* 62, 2969–3007.
- Chava, S., D. Livdan, and A. Purnanandam. 2009. "Do Shareholder Rights Affect the Cost of Bank Loans?" *Review of Financial Studies* 22, 2973–3004.
- Chen, Y. and I. Hasan. 2011. "Subordinated Debt, Market Discipline, and Bank Risk." *Journal of Money, Credit and Banking* 43, 1043–172.
- Claessens, S., A. Demirgüç-Kunt, and H. Huizinga. 2001. "How Does Foreign Entry Affect the Domestic Banking Market?" *Journal of Banking and Finance* 25, 891–911.
- Cocco, J., F. Gomes, and N. Martins. 2009. "Lending Relationships in the Interbank Market." *Journal of Financial Intermediation* 18, 24–48.
- Cole, R., F. Moshirian, and L. Wu. 2008. "Bank Stock Returns and Economic Growth." *Journal of Banking and Finance* 32, 995–1007.
- Corvoisier, S. and R. Gropp. 2002. "Bank Concentration and Retail Interest Rates." *Journal of Banking and Finance* 26, 2155–289.
- Demirgüç-Kunt, A. and H. Huizinga. 2010. "Bank Activity and Funding Strategies: The Impact on Risk and Returns." *Journal of Financial Economics* 98, 626–50.
- Demirgüç-Kunt, A., E. Kane, and L. Laeven. 2008. "Determinants of Deposit-Insurance Adoption and Design." *Journal of Financial Intermediation* 17, 407–38.
- Demirgüç-Kunt, A., L. Laeven, and R. Levine. 2004. "Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation." *Journal of Money, Credit, and Banking* 36, 593–622.
- Djankov, S., C. McLiesh, and A. Shleifer. 2007. "Private Credit in 129 Countries." *Journal of Financial Economics* 84, 299–329.
- Easterly, W. and R. Levine. 1997. "Africa's Growth Tragedy: Policies and Ethnic Divisions." *Quarterly Journal of Economics* 112, 1203–150.
- Esty, B. 2006. "When Do Foreign Banks Finance Domestic Investment? New Evidence on the Importance of Legal and Financial Systems." [Working paper.]
- Flannery, M. and S. Sorescu. 1996. "Evidence of Bank Market Discipline in Subordinated Debenture Yields: 1983–1991." *The Journal of Finance* 51, 1347–177.
- Francis, B., I. Hasan, L. Liu, and H. Wang. 2019. "Senior Debt and Market Discipline: Evidence from Bank-to-Bank Loans." *Journal of Banking & Finance* 98, 170–82.
- Freixas, X. and C. Holthausen. 2005. "Interbank Market Integration under Asymmetric Information." *Review of Financial Studies* 18, 458–90.
- Furfine, C. 2001. "Banks as Monitors of Other Banks: Evidence from the Overnight Federal Funds Market." *Journal of Business* 74, 33–57.
- Gande, A. and A. Saunders. 2012. "Are Banks Still Special When There Is a Secondary Market for Loans?" *Journal of Finance* 67, 1649–184.
- Giannetti, M. and L. Laeven. 2012. "The Flight Home Effect: Evidence from the Syndicated Loan Market During Financial Crises." *Journal of Financial Economics* 104, 23–43.

- Gorton, G. and A. Winton. 2003. "Financial Intermediation." In *Handbook of the Economics of Finance*, edited by G. Constantinides, M. Harris, and R. Stulz. North-Holland: Elsevier Science, 431–552.
- Goyal, V. 2005. "Market Discipline of Bank Risk: Evidence from Subordinated Debt Contracts." *Journal of Financial Intermediation* 14, 318–50.
- Hao, L., D. Nandy, and G. Roberts. 2012. "The Effect of Bank Regulation and Lender Location on Loan Spreads." *Journal of Financial and Quantitative Analysis* 47, 1247–178.
- Hauswald, R. and R. Marquez. 2006. "Competition and Strategic Information Acquisition in Credit Markets." *Review of Financial Studies* 19, 967–1000.
- Houston, J., C. Lin, and Y. Ma. 2012. "Regulatory Arbitrage and International Bank Flows." *Journal of Finance* 67, 1845–195.
- James, C. 1987. "Some Evidence on the Uniqueness of Bank Loans." *Journal of Financial Economics* 19, 217–35.
- Karolyi, G. and R. Stulz. 2002. "Are Financial Assets Priced Locally or Globally?" In *Handbook of the Economics of Finance*, edited by G. Constantinides, M. Harris, and R. Stulz. North-Holland: Elsevier.
- King, R. and R. Levine. 1993. "Finance and Growth: Schumpeter Might Be Right." *Quarterly Journal of Economics* 108, 717–37.
- La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. Vishny. 1998. "Law and Finance." *Journal of Political Economy* 106, 1113–155.
- Laeven, L. and R. Levine. 2007. "Is There a Diversification Discount in Financial Conglomerates?" *Journal of Financial Economics* 85, 331–67.
- Laeven, L. and R. Levine. 2009. "Bank Governance, Regulation, and Risk Taking." *Journal of Financial Economics* 93, 259–75.
- Laeven, L. and F. Valencia. 2010. "Resolution of Banking Crises: The Good, the Bad, and the Ugly." [Working paper.]
- Lemmon, M. and M. Roberts. 2010. "The Response of Corporate Financing and Investment to Changes in the Supply of Credit." *Journal of Financial and Quantitative Analysis* 45, 555–87.
- Mian, A. 2006. "Distance Constraints: The Limits of Foreign Lending in Poor Economies." *Journal of Finance* 61, 1465–505.
- Ongena, S., P. Alexander, and G. Udell. 2013. "'When the Cat's Away the Mice Will Play': Does Regulation at Home Affect Bank Risk-Taking Abroad?" *Journal of Financial Economics* 108, 727–50.
- Petersen, M. 2009. "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches." *Review of Financial Studies* 22, 435–80.
- Qian, J. and P. Strahan. 2007. "How Law and Institutions Shape Financial Contracts: The Case of Bank Loans." *The Journal of Finance* 62, 2803–234.
- Rajan, R. and A. Winton. 1995. "Covenants and Collateral as Incentives to Monitor." *Journal of Finance* 50, 1113–146.
- Rajan, R. and L. Zingales. 1998. "Financial Dependence and Growth." *American Economic Review* 88, 559–86.
- Rosenbaum, P. and D. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70, 41–55.
- Roy, A. 1952. "Safety First and the Holding of Assets." *Econometrica* 20, 431–49.
- Strahan, P. 1999. "Borrower Risk and the Price and Nonprice Terms of Bank Loans." Federal Reserve Bank of New York, Staff Paper No. 90.

Appendix

TABLE A.1. Variable Definitions and Data Sources

Variable	Definition	Original Sources
Financial Conglomerates Restrictions	It measures the extent to which banks may own and control nonfinancial firms, the extent to which nonfinancial firms may own and control banks, and the extent to which nonbank financial firms may own and control banks. For each question, the value equals 1 if unrestricted, 2 if permitted, 3 if restricted, and 4 if prohibited. Higher values indicate that the country's banking regulation favors traditional banking over financial conglomerates.	Barth, Caprio, and Levine (2004, 2006, 2008)
Financial Statement Transparency	It measures the degree to which banks face regulatory restrictions on their accounting disclosure. It is constructed based on the following five conditions: (1) whether the income statement includes accrued or unpaid interest or principal on non-performing loans; (2) whether banks are required to produce consolidated financial statements, including non-bank financial affiliates or subsidiaries; (3) whether the off-balance sheet items are disclosed to the public; (4) whether banks' directors are legally liable for misleading or erroneous information; and (5) whether the penalties have been enforced. The indicator potentially ranges from 0 to 5, where higher values indicate greater restrictions on accounting disclosure (i.e., more transparent financial statements).	Barth, Caprio, and Levine (2004, 2006, 2008)
Bank Concentration	It is measured as the fraction of bank assets held by the three largest commercial banks in the country.	BankScope
Foreign Presence	It equals 1 if 50 percent or more the share of banking system assets are held in foreign-owned banks and 0 otherwise.	Barth, Caprio, and Levine (2004, 2006, 2008)
Information Sharing	It equals 1 if the borrowing country has an information-sharing agency (either public registry or private bureau) at the time of loan origination and 0 otherwise.	Djankov, McLiesh, and Shleifer (2007), World Bank "Doing Business" database
Creditor Rights	It measures the power that lenders have in reorganization and liquidation procedures. The index consists of four components: (1) whether there are restrictions when a debtor files for reorganization (e.g., creditor consent); (2) whether there is no automatic stay or asset freeze, thereby allowing secured creditors to seize their collateral after the petition for reorganization is approved; (3) whether secured creditors are paid first compared with other creditors (e.g., the government or employees) in the liquidation of a bankrupt firm; and (4) whether the management does not stay in control of the business during the reorganization. <i>Creditor Rights</i> is the aggregated score, ranging from 0 to 4, with a higher value indicating stronger creditor rights. Djankov, McLiesh, and Shleifer (2007) provides the index between 1978 and 2003. We extend the values of 2003 for the years 2004 to 2009.	Djankov, McLiesh, and Shleifer (2007)
Property Rights	To control for judicial efficiency, we use the property rights index from the Index of Economic Freedom compiled by the Heritage Foundation/ <i>Wall Street Journal</i> since 1995. A higher value indicates a better contract enforcement environment.	Heritage Foundation/ <i>Wall Street Journal</i>
Explicit Deposit Insurance	It equals 1 if the borrowing country has explicit deposit insurance scheme at the time of loan origination and 0 otherwise.	World Bank's Comprehensive Deposit Insurance Around the World Dataset; Barth, Caprio, and Levine (2008)
Culture Distance	It measures potential cultural differences between the borrower and lead lender countries. This measure involves two components: <i>Language Distance</i> and <i>Colonizer Distance</i> . <i>Language Distance</i> and <i>Colonizer Distance</i> are both measured as dummies and equal 0 if the borrower and lead lender countries share a common official language or have had a common colonizer after 1945; they equal 1 otherwise. The <i>Culture Distance</i> sums up these two components. A larger value indicates a larger culture distance.	The CEPII http://www.cepii.fr/anglaisgraph/bdd/bdd.htm
Banking Crisis	It takes on the value of 1 if the borrowing country is experiencing a banking crisis at the time of loan origination and 0 otherwise.	Laeven and Valencia (2010)

continued

TABLE A.1. Variable Definitions and Data Sources (*continued*)

Variable	Definition	Original Sources
Sovereign Rating	We control for the overall country risk by including Standard and Poor's ratings on the long-term sovereign bonds for the borrowing country. We converted the rating to a numerical score. A lower value indicates a worse rating. We assign a value of 0 for countries without a sovereign debt rating and also construct an indicator for those missing rating observations. The log transformation of the sovereign ratings is used in the regression specifications.	Standard and Poor's ratings
Bank Size	The natural log of the book value of total asset of the bank borrower in millions of U.S. dollars.	BankScope
Investment Ratio	It is the ratio of non-loan asset to the book value of total asset and measures a bank's asset diversification.	BankScope
ROE	It is the ratio of return on equity, which measures the profitability of a bank borrower.	BankScope
Capital Ratio	It equals total equity divided by total asset and measures the capital adequacy of a borrower.	BankScope
Deposit Ratio	It equals the ratio of all short term and long term deposit funding to total asset.	BankScope
Log (Z-score)	Z-score equals the return on asset plus the capital-asset ratio divided by the standard deviation of asset returns and measures a bank's distance from insolvency (Roy 1952). A higher Z-score implies a lower probability of insolvency and a greater financial stability. In our estimations, Z-score is calculated in the previous 5-year window before each loan origination year. Since the Z-score is highly skewed, we use the natural logarithm of the Z-score as the risk measure (following Laeven and Levine 2009).	BankScope
NPL_L	It is the ratio of non-performing loan to total loan, to capture the asset quality of a borrower.	BankScope
State-Owned Bank	It equals 1 if the bank borrower is government-owned and 0 otherwise.	BankScope
Investment Grade	It equals 1 if the bank borrower has an S&P senior debt rating equal to or higher than BBB and 0 otherwise.	LPC's DealScan
All-in-Spread Drawn (AISD)	It is measured as the number of basis points over London Interbank Offered Rate (LIBOR), indicating the interest rate spread banks charge for each dollar drawn. To ensure appropriate comparability in currency and benchmark for pricing loans, we only include loans in U.S. dollars and the LIBOR benchmark. The benchmark information obtained from DealScan's "Base Rate and Margin."	LPC's DealScan
Loan Size	The loan facility amount in millions of U.S. dollars.	LPC's DealScan
Loan Maturity	It measures how long (in months) the facility will be active from signing date to expiration date.	LPC's DealScan
Collateral	A dummy that equals 1 if the loan is secured and 0 otherwise.	LPC's DealScan
Missing Collateral	A dummy that equals 1 if the information on collateral is missing and 0 otherwise.	LPC's DealScan
Performance Pricing	It is a dummy that equals 1 if there are any performance-pricing provisions in the loan contract; it equals 0 otherwise.	LPC's DealScan
Relationship Lending	It equals to 1 if there is prior lending by the same lead banks over the previous 5-year window and 0 otherwise.	LPC's DealScan
Syndicate Partner Loan	In the bank-to-bank loans, some borrowers obtain loans from lenders with whom they previously served in the same syndicate (regardless of lending to nonfinancial or financial firms). We classify those cases as <i>Syndicate Partner Loan</i> .	LPC's DealScan
Ownership-Connected Loans	It is constructed to indicate whether a loan is made among ownership related parties. The ownership connection includes the cases that some borrowers might be branches or subsidiaries of certain lenders in their bank loan syndicate, or vice-versa. It also includes the cases that same shareholder owns both the borrower and lender.	LPC's DealScan & BankScope
Foreign Loan	It is a dummy that equals 1 if all the lenders (and lenders' parents) in the syndicate are from different countries than the borrower (and borrower's parent) and 0 otherwise.	LPC's DealScan
Foreign Lead Loan	It is a dummy that equals 1 if all the lead lenders (and their parents) in the syndicate are from different countries than the borrower (and borrower's parent) and 0 otherwise.	LPC's DealScan
# Lenders	Number of lenders in the syndicate.	LPC's DealScan
# Foreign Lender	Number of foreign lenders in the syndicate.	LPC's DealScan
Percent of Foreign Lenders	The percentage of foreign lenders in the syndicate.	LPC's DealScan

Audit Firm Mergers and Low Balling

Wenjun Liu

June Cao

Abstract

Motivation: This paper investigates whether audit firm mergers affect audit fee discounts in the initial year. The numerous mergers of audit firms in China's capital market provide a quasi-natural experiment to investigate this issue.

Premise: The merger of audit firms can increase the firm size, thereby improving quasi-rents that are required by auditors. Therefore, we argue that the merger of audit firms will improve the auditor independence, thereby reducing the behavior of low balling.

Approach: We select samples from 43 cases of audit firm mergers that occurred between 2005 and 2013 in China and use ordinary least squares (OLS) regressions on 5,552 listed firm-years observations during the period from two years before to two years after the merger.

Results: We find audit firms would offer an initial fee discount to the clients, and the merging of audit firms can dramatically reduce the discounts on audit fees for new clients. We also show the treatment effect is more pronounced for non-state-owned enterprises (non-SOEs) and the merger between large audit firm and small ones.

Conclusion: The results suggest that low balling exists in China's audit market. The merger of audit firms can curtail low balling, but only exists in non-SOEs. Moreover, the restraining effect of audit firm mergers on the low balling lies in the merger between large audit firms and small ones.

Consistency: The findings in this paper can advance the understanding of the recent strategy raised by related regulators attempting to enhance audit quality.

Keywords: audit firm mergers, audit fees, low-balling, quasi-rent

JEL Classification Codes: M42, L11

INTRODUCTION

The low-balling behavior of audit firms has long been of great concern to regulators, such as the Securities and Exchange Commission (2000), fearing that the reduction of audit fees for new clients may affect audit independence and thus

Wenjun Liu, PhD, Fujian Agricultural and Forestry University, wjliu@fafu.edu.cn

June Cao, PhD, Curtin University, june.cao@curtin.edu.au

impair audit quality. Concerned regulatory authorities in China's capital market also attach great importance to the price-competition behavior of audit firms. For example, the Ministry of Finance of the People's Republic of China released the "Administrative Fees Management Measures for Audit Firms" document in 2011, which clearly states that all localities should curb the low-price negative competition of audit firms and standardize the audit fees. Yugui Chen, Secretary General of the Chinese Institute of Certified Public Accountants (CICPA), also believes that the audit fees of China's audit firms are low, and the problem of unfair competition in the industry is prominent.¹ Low balling is particularly outstanding in China's capital market due to the fragmented audit market structure, low market concentration, and fierce competition among audit firms to survive. Recently, to promote the industrialization and sound development of audit firms, concerned departments have pushed audit firms to become bigger and stronger and encouraged mergers among audit firms, as seen in "Guideline to Promote Audit Firms to Be Bigger and Stronger" issued by CICPA in 2007. Audit firm mergers have been raging in recent years. Although regulators have expressed great concern about whether the merger of audit firms can inhibit low-balling practices, the related literature is scarce.

Low balling has also caught academia's attention. DeAngelo (1981a) proposes that it is a pricing strategy adopted by audit firms in fierce market competition, expecting to earn quasi-rents from clients in the future. Additionally, the initial fee reductions are sunk costs and thus do not impair the audit independence. Current literature agrees on the existence of audit firm low balling but varies on its exact impact on audit quality. Earlier research suggests that low balling does not affect, and will even improve, audit quality (Deis and Giroux 1996; Gul, Fung, and Jaggi 2009). Recent studies, however, have come to the opposite conclusion (Stanley, Brandon, and McMillan 2015; Huang et al. 2015).

Despite the increasing number of studies arguing that this pricing practice may lead to a lessening of the audit quality, whether the merger of audit firms can indeed affect low-balling behavior is theoretically uncertain. A merger of audit firms can curb low balling in at least two aspects. First, the audit fee reductions on the initial engagement are not sunk costs in future periods. Those incumbent audit firms who expect to earn future quasi-rent from a particular client have increased incentives to acquiesce in the client's fraud, implying absence of auditor independence. Moreover, with the firm unfamiliar with new clients during the initial engagement, discounted audit fees restrain the audit budget and further increase the risk of audit failure. It is plausible that audit firm mergers will likely inhibit low balling, which is a threat, formally or substantially, to audit quality. Since the size of audit firms has increased after the merger, larger quasi-rents are required. Even if the low balling itself does not influence audit quality, the merger of the firms increases audit market concentration and reduces peer competition, strengthening audit firms' bargaining power over the initial discount reduction. However, the merger of audit firms may not be able to affect the low-balling practice for at least three reasons. First, the litigation risk in the Chinese audit market is relatively low, which will reduce the probability of the firms' quasi-rent loss caused by audit failure. Second, because China's

¹Quoted from Chen Yugui's speech at the Beijing CPA Institute's fee training class on February 23, 2016.

audit market is fiercely competitive and fragmented, the merger of audit firms has limited effect on enhancing market concentration and substantial bargaining power improvement. Third, the public firms care more about the audit fees than the quality, resulting in lack of market demand for high audit quality. Therefore, such mixed results call for empirical data to test whether the merger of audit firms can constrain low balling.

This paper examines the impact of audit firms' merger on the discounting of audit fees for new clients received during the period from two years before to two years after the merger, taking samples from 2005 through 2013, with the number of clients engaged without changing auditor before and after the merger as the control samples. We find that audit firms indeed charge lower audit fees for a newly accepted client, which indicates that the practice of low balling exists in the audit market. The discounts decline considerably after the merger of audit firms, and *ceteris paribus* the audit fees increase, which further reveals that the merger of audit firms can reduce low balling to a certain extent. We have removed the audit firms with defective mergers and re-examined the window period before and after the mergers, and our research conclusions remain unchanged.

In addition, compared with non-state-owned enterprises (non-SOEs), the autonomy of auditors in state-owned enterprises (SOEs) is relatively low. Because the State-owned Assets Supervision and Administration Commission of the State Council (SASAC) and the local government will intervene in the selection and appointment of state-owned enterprise auditors, for example, a unified audit bidding will be conducted for state-owned enterprises, and certain audit firms will be designated for state-owned enterprises to choose. Therefore, it is difficult for audit firms to undertake auditing services for state-owned enterprises through low prices. We further test by dividing the sample into two separate groups, SOEs and non-SOEs. The results show that low balling does not exist with SOEs, nor does the merger of audit firms affect the audit fees for new SOEs clients as it does to non-SOE clients. Specifically, only when the quasi-rents of the audit firms involved in the merger are sufficiently large will the merger increase the audit independence and thus inhibit the low-balling behavior of the audit firm. The merger of audit firms in China can be split into two types: mergers of large and small firms ("LS mergers"), and mergers of small ones ("SS mergers"). Compared to SS mergers, whose growth in size is limited, we posit that the LS mergers can increase the total quasi-rents and restrict low balling to a greater extent. By dividing the sample according to the two types, we find supportive evidence suggesting that the merger of large and small audit firms, rather than the one of small firms, can inhibit the low balling of audit firms.

Our paper contributes to the auditing research mainly in the following aspects:

1. Some prior literature studies on the audit fees in the initial engagement year, attempting to examine whether low balling exists in audit firms, as a large stream of research has supported, yet the perspective of studying low balling is still limited, either from the size of the firm (Ghosh and Lustgarten, 2006), the Sarbanes-Oxley Act (SOX) (Huang, Raghunandan, and Rama 2009; Desir, Casterella, and Kokina 2014), or the replacement of

signing auditors (Huang et al. 2015). Our study adds additional evidence to the growing literature on low balling;

2. This paper also contributes to the study of the merger of audit firms. Prior research on the merger of audit firms focuses on whether the merger of audit firms affects audit independence and audit quality (Chan and Wu 2011; Gong et al. 2016), audit fees (Li, Zhang, and Liu 2012; Gong et al. 2016) and audit efficiency (Gong et al. 2016), most of which pay particular attention to the clients who do not switch the incumbent audit firm before and after the merger. Few studies, however, document the impact of the firms' merger on their following pricing strategy for the new client. Therefore, to some extent, this paper can advance our current understanding of the merger of audit firms;
3. Furthermore, our study provides a credible support for regulatory authorities. In recent years, China's regulatory authorities have rolled out an array of policies aiming to supervise and direct the fees of audit firms by constraining the low balling resulting from excessive competition in audit market. Our findings indicate that the merger of firms plays a role in standardizing the pricing behavior in the audit market, hinting that the regulatory authorities should adhere to the very strategy to boost audit firms.

The remainder of the paper is organized as follows. Comprehensive Review recaps the related literature. The next section develops the hypotheses concerning the impact of audit firm mergers on low balling in audit market. Following that, Research Design describes the data and sample selection procedure and discusses the main and control variables. The next sections presents the empirical results, including robustness tests, followed by additional analysis, and conclusion.

COMPREHENSIVE REVIEW

The term *low balling* refers to a practice wherein audit firms offer a price which is lower than the audit costs to obtain the clients in the initial engagement year. However, given that the audit firm cannot be observed, academia generally uses the initial audit fee discounts for the new clients as a substitute (Huang et al. 2015). Ghosh and Lustgarten (2006) document that the initial audit fee discounts appear to be a common practice in the audit market, which seem to be more serious in highly competitive markets than the monopolistic market. By comparing the fee discounts on initial engagement before and after the introduction of SOX in U.S. capital market, Huang, Raghunandan, and Rama (2009) find that the Big 4 audit firms provided fee discounts in the first year of audit before SOX was introduced, and there were fee premiums after SOX, illustrating that the introduction of SOX has increased audit independence and pushed the audit firms to be more cautious in audit pricing. However, Desir, Casterella, and Kokina (2014) found that even after the introduction of SOX, both Big 4 and non-Big 4 firms are still providing fee discounts for the initial audit engagement, which in fact means that SOX does not constrain the low balling of audit firms. Highly concentrated as the audit market is in United States, the low balling still occurs, not to mention China's more competitive audit market. In line with our prediction, low balling is also found in China's audit market, as surveyed

by Huang et al. (2015), but he claims that no initial engagement fee discounts are granted by the audit firm if the clients simply switch to a new firm without changing the incumbent auditors.

The regulatory authority has expressed great concerns on the low balling of audit firms, for the fear that it may undermine the audit quality. Presumably, the fee discounts in the initial period can negatively affect the audit independence since they are set to obtain the clients and gain profits when the audit firms recoup the investment in the subsequent period. Moreover, considering that the firm is unfamiliar with the new client's business, and the reason that the client would switch to a new audit firm is that the former one did not acquiesce to the company's misreporting and underreporting, the firm's audit risk is higher. The audit fees below the normal level will limit the audit budget and increase potential possibility of audit failure. Both SEC (2000) and GAO suppose that the low balling is likely to impair audit independence. China's regulatory authorities have expressed the same concern because the Chinese audit market is more fragmented and competitive. Aiming to suppress excessive price competition in the audit market, the China Securities Regulatory Commission and the CICPA have paid specific attention to the audit fees and closely monitored the low balling issue of audit firms. The price departments across the country have also introduced the pricing standards of audit firms to prevent audit firms from competing at low prices.

Despite regulatory concerns, DeAngelo (1981a) argues that low balling audit firms is a market competition strategy to earn expected future quasi-rents since the clients are subject to transaction costs of switching auditors. She addresses that the discount for the initial year is essentially a sunk cost, thus low balling will not affect audit independence. Lee and Gu (1998) even propose that low balling raises the level of audit independence. Whether low balling audit firms affects the audit quality is still contentious in the empirical research. When investigating the government audit of the school districts in Texas, Deis and Giroux (1996) note that although there was a higher audit quality with audit fee discounts on the initial engagement, Gul, Fung, and Jaggi (2009) do not find a significant link between the low fees of audit firms in the short tenure and the accrual profits of clients. Yet recent studies suggest that low balling can lessen the audit quality. Ettredge, Fuerherm, and Li (2014) do not directly test the impact of low balling on audit quality, but the results indicate that the reduction in audit fees during the economic downturn will increase the probability of financial restatement of the company, implying that low balling may impair the audit quality. Stanley, Brandon, and McMillan (2015) provide direct evidence that low balling undermines the audit quality by discovering the positive correlation between audit firms' low balling behavior and the practice that clients use the discretionary accruals to meet the analyst's forecast, and the link is more obvious before SOX. Huang et al. (2015) suggest that in China's audit market, when a public firm has two new signing auditors in the initial year of audit engagement and simultaneously conducted an audit fee discount, the probability of the company being punished for audit problems is raised, drawing a conclusion that low balling can reduce the audit quality to some extent for the audit firms in China.

Cultivating audit market concentration may be a way to improve audit independence and curb low balling behavior. DeAngelo (1981b) believes that large audit firms have better audit independence due to the higher quasi-rents, and to

earn quasi-rents in the future, the audit firms will place more emphasis on their reputation, and thus the audit quality will be higher, the theory of which has directed the merger of audit firms promoted by concerned government departments. Existing literature uses the background of the firm's merger to study the impact of the merger of audit firms on audit quality, audit independence and audit fees. For example, Zeng and Zhang (2010) find that the merger of audit firms can improve the audit quality, while Li and Liu (2015) argue that the merger can reduce the audit quality horizontally and vertically. The reason behind the diametrically opposite research conclusions of the two studies above probably lies in the differences in the sample selection of the audit firm merger, the measure of audit quality, and the research design. Based on data of the merger of the audit firms in China's capital market, Chan and Wu (2011) state that the audit independence increases as the merger enriches the quasi-rents, and *ceteris paribus*, the auditors issue a higher probability of modified audit opinions after the merger. While according to their paper, the merger fails to affect the audit pricing, Li, Zhang, and Liu (2012), in contrast, propose that the audit fees have increased significantly following the merger after studying the influence of the merger on audit fees. Gong et al. (2016) demonstrate that the merger of audit firms improves audit efficiency, along with audit quality and audit fees. However, aforementioned literature rarely discusses whether the merger of audit firms can restrain low balling to explore the impact of the merger on the audit fee discounts for new clients' initial engagement.

HYPOTHESIS DEVELOPMENT

Chung and Kallapur (2003) construct the following model according to DeAngelo's (1981b) theoretical interpretation and analysis framework for auditors' quasi-rents:

$$V = QR_C + QR_O \quad (1)$$

Where

V is the value of an audit firm

QR_C is the present value of the future quasi-rent of a client C

QR_O is the present value of the future quasi-rent of other clients

The model is derived from DeAnglo (1981a), who suggests that the audit firm's charge for the initial year engagement is a sunk cost and does not affect the value of the firm and the auditor's behavior. As more and more studies find that the initial audit fee discounts reduce the audit quality, it is plausible that the discounts reduce the value of audit firms. In addition, research in the field of organizational behavior proposes that sunk costs should not be ignored, and actually affect behavior (Straw 1976; Arkes and Blumer 1985). Simon and Francis (1988) also believe that this sunk cost is a discount granted by the firm to strengthen its business relationship with clients. Therefore, we assume that the audit firm's fee discounts in the initial year affect the value of the firm and modify the initial model of Chung and Kallapur (2003) as follows:

$$V^A = AF_{C1}^A - AC_{C1}^A + QR_C^A + QR_O^A \quad (2)$$

AF_{C1}^A and AC_{C1}^A in model (2) refer to the audit fees and audit costs in the first year of the audit firm A 's client C , and QR_C^A is the present value of the

quasi-rent earned by the audit firm A following the first year from the client C. The definitions of other variables are the same as the model (1). Assume that the audit risk assessed by the audit firm in advance for client C is P , and the proportion of quasi-rent loss after the disclosure of material misstatement of client C is a . When the firm decides to undertake the audit business of client C, then audit fee the first year for client C must satisfy:

$$AF_{C1}^A - AC_{C1}^A + (1 - P\alpha) (QR_C^A + QR_O^A) > QR_O^A \quad (3)$$

Model (3) shows that the condition for the firm A to undertake the C client business is that the value of firm A after the project should exceed the value before. By simplifying the model (3), we can conclude that the firm A's initial year audit fee for client C must meet:

$$AF_{C1}^A > P\alpha QR_O^A - (1 - P\alpha) QR_C^A + AC_{C1}^A \quad (4)$$

And after the merger of the firm A and firm B, the audit fees charged by the new audit firm for the initial engagement are required to meet the following conditions:

$$AF_{C1}^{AB} - AC_{C1}^{AB} + (1 - P\alpha)(QR_C^{AB} + QR_O^A + QR_O^B) > QR_O^A + QR_O^B \quad (5)$$

In model (5), AF_{C1}^{AB} and AC_{C1}^{AB} are the audit fees and audit costs for the first year of the newly contracted client C after the merger of audit firms A and B, and QR_C^A is the present value of the quasi-rents earned from client C following the first year. Assume that the cost, technology, and auditor's ability of the audit firm A and B after the merger has not improved,² then AC_{C1}^{AB} is equal to AC_{C1}^A , QR_{C1}^{AB} is equal to QR_C^A ; QR_O^B is the present value of future quasi-rents of other clients of the original audit firm B. Simplifying the model (5), it can be concluded that the initial audit fees of the client C after the merger of the audit firm A and B are met:

$$AF_{C1}^{AB} > P\alpha QR_O^A + P\alpha QR_O^B - (1 - P\alpha) QR_C^A + AC_{C1}^{AB} \quad (6)$$

Comparing the model (4) with the model (6), the difference between the two is that $P\alpha QR_O^B$ is added to the left side of the model (6) inequality, and since $P\alpha QR_O^B$ is positive, we posit that the threshold for the initial audit fees for new clients after the merger of audit firms is higher than before the merger of audit firms, which makes sense because the merger raises the quasi-rents. Thus, we can further estimate that AF_{C1}^{AB} is likely to be greater than AF_{C1}^A , in other words, the audit fees for new clients are higher than they are before the merger. The audit fees increase insofar as the audit costs are held constant, suggesting that the merger of audit firms inhibits the low-balling practice. Moreover, the merger of firms promotes the concentration of the audit market, which enhances the bargaining power of the firms, and the increase in bargaining power will also suppress the low balling (Dye 1991).

Based on the above analysis, we develop our hypothesis 1 as follows.

²In order to control the impact of the improvement of the auditor's cost, technology, and audit capability on the audit fees after the merger of audit firms, we only compare the audit fees of new clients received during the period from two years before to two years after the merger.

Hypothesis 1: *The merger of audit firms can restrain the low-balling behavior of the audit market.*

However, it should be noted that the merger of the audit firms may not affect the low-balling practice. There are three reasons for this. First, weak protection for investors and the low risk of audit litigation in China's capital market result in the situation that audit risk of the firm, namely P in our model, is pretty low. Second, China's audit market lacks the demand for high-quality audits. It is often the case that the demand for audit by listed companies is only due to the mandatory requirements of the regulatory authorities, which indicates that the value of α is essentially low. Third, the audit market in China is too fragmented and the market competition is fierce so that several large firms can hardly monopolize the audit market. Indeed, most of the audit firms are small in size, which means that the value of QR_O^B is low. To summarize, the three aspects mentioned above suggest that the value of $P\alpha QR_O^B$, the threshold for the increase in audit fees after the merger of the firms, is likely to be rather low, and thus may not necessarily inhibit the discounts on new client audit fees. In this case, the research of our paper is necessary.

RESEARCH DESIGN

Data and Sample Selection

This paper selects client data before and after the merger to examine the impact of audit firms' merger on the low balling, taking samples from 43 cases of the audit firm merger that occurred between 2005 and 2013.³ Our sample screening criteria are as follows.

1. To control the impact of audit technology and ability improvement caused by the merger of audit firms on audit fees, we only select the public company clients obtained during the period from two years before to two years after the merger as research samples.
2. Given that some listed companies switch the audit firm only but retain the incumbent signing auditor, which is not a real change of audit firms, and as such a new client has no access to initial audit fee discounts as Huang (2015) documents, we eliminate those firms' data.
3. We exclude the firms whose clients are in the financial industry.
4. Observations with missing data for required variables are removed. The final sample is 5,552 public firms. We collect the merger case information of the audit firm comes from the website of the China Association of Investors and the manual sorting through Baidu search and obtain the financial data from the CSMAR database. Specifically, the standard errors of all the models in this paper are corrected for the firm-level clustering.

The merger among audit firms can enlarge the size of the firm. Table 1 shows the changes in the average size of the firms the year preceding the merger

³Of the 43 merger cases selected in this paper, all the audit firms involved in the merger have securities qualifications, for Chan and Wu (2011) find that the merger of audit firms without securities qualification, which can't increase the quasi-rents, thus does not affect audit independence.

TABLE 1. Changes in the Average Size of Audit Firms before and after the Merger

	The Year before the Merger	The Year after the Merger	Increased Percentage
Total assets of the clients (billion RMB)	202	364	80.19%
Total audit fees of the firms (million RMB)	22.5	37.6	67.11%
Number of clients	41	63	53.66%

and the year following the merger.⁴ We compare the changes in the size with three dimensions: total assets,⁵ total audit fees, and the number of public company clients audited by the firm. As illustrated in Table 1, the client's total assets on average increase by 80.19 percent, from 202 billion RMB before the merger to 364 billion RMB after the merger. And the client's audit fees on average increase by 67.11 percent, growing from 22.5 million RMB to 37.6 million RMB. As for the number of clients, it rises from 41 to 63 at a percentage of 53.66. Consistent with our assumption, the merger between audit firms is a crucial way to enlarge the size of the firm.

Empirical Model and Variable Definitions

Extant studies on the low-balling practice of the audit firm basically adopt the initial audit fee discounts for the new client as an alternative. Paralleling to the methodology of Huang et al. (2015), we construct the following model to test our hypothesis.

$$\begin{aligned}
 \text{LNFEET} = & \alpha_0 + \alpha_1 \text{INITIAL} + \alpha_2 \text{POST} + \alpha_3 \text{INITIAL} \times \text{POST} + \alpha_4 \text{RECTA} \\
 & + \alpha_5 \text{INVTA} + \alpha_6 \text{QUICK} + \alpha_7 \text{GROWTH} + \alpha_8 \text{LNSIZE} + \alpha_9 \text{LEV} + \alpha_{10} \text{ROA} \\
 & + \alpha_{11} \text{LOSS} + \alpha_{12} \text{OPINION} + \alpha_{13} \text{CI} + \alpha_{14} \text{INDSPE} + \alpha_{15} \text{STATE} \\
 & + \alpha_{16} \text{MKT} + \text{IND} + \text{YEAR} + \varepsilon
 \end{aligned} \tag{7}$$

In model (7), the dependent variable is the audit fee (LNFEET), measured as the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. Following prior literature, we control the complexity of the company's business, including the proportion of accounts receivable to total assets (RECTA) and the proportion of inventory to total assets (INVTA). The more complex the company's business is, the higher the auditor's investment and the audit fees will be. Thus, we speculate that the coefficients of RECTA and INVTA to be significantly positive.

We also control the company's audit risk, including the company's acid-test ratio (QUICK, quick assets divided by current liabilities), financial leverage (LEV, liabilities divided by total assets), firm's growth (GROWTH,

⁴In order to reflect the changes in the size of the audit firm before and after the merger more roundly, the sample we used for comparison is the company with no missing data in total assets, audit fees, and the company name in the CSMAR database.

⁵Considering that some public companies do not disclose the audit fees paid to the audit firms, we use the total assets of the company as a substitute indicator of its size.

growth rate of income), firm size (LNSEIZE, the natural logarithm of total assets), and company performance (ROA, net profit divided by total assets; LOSS, an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise). To our knowledge, the stronger the company's short-term liquidity and long-term liquidity are, the smaller the firm size, the better the company's performance and the lower the audit risk will be, which leads to lower audit fees. In this case, we assume that the QUICK coefficient is negative, the LEV, LNSIZE, and LOSS coefficient are significantly positive, and the ROA coefficient is significantly negative.

We control the auditors' opinions on the company (OPINION), which is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise and its coefficient is expected to be significantly negative. The auditor characteristics, which incorporate client importance (CI, the ratio of the client's total assets to the sum of all client assets of the audit firm) and auditor industry expertise (INDSPE, the auditor's industry market share), are also controlled. Generally, audit firms tend to have more audit input for important clients and auditors with industry expertise will have an audit premium, so the coefficients of both CI and INDSPE are expected to be significantly positive.

We further control the property right character of the company (STATE, an indicator variable equal to 1 if it's a SOE company, and 0 otherwise). Compared with non-SOE enterprises, SOE enterprises have stronger demand for high-quality audits because the competent departments of state-owned enterprises hope to supervise the management of SOE enterprises with high-quality audits, indicating that the coefficient of STATE should be significantly positive. Moreover, we control the market transition process of the company's location (MKT) (Fan, Wang, and Zhu 2011), whose coefficient is predicted to be significantly positive based on the inference that where there is more advanced market transition process, there is better corporate governance and more potential demand for high-quality audits, thus creating more incentives to purchase audit services. Finally, the industry (IND) and year fixed effects are included in all tests.

EMPIRICAL RESULTS

Descriptive Statistics of Main Variables

Table 2 presents the descriptive statistics for the main variables used in this paper. As can be seen in the table, the average audit fees (FEE) of the audit firms involved in the merger is 68,6877.9 RMB, with a median of 500,000 RMB. The average natural logarithm (LNFEET) of audit fees is approximately 13.2323 and the median is 13.1224. The value of INITIAL on average is 0.0893, indicating that 8.93 percent of the companies in the sample are new clients of the audit firms. The mean POST is 46.49 percent, suggesting that the number of clients after the audit firm's merger accounts for 46.49 percent of the total. The mean RECTA is 0.0263 and the median is 0.0107. The mean INVTA is 0.17 and the median is 0.1320. The GROWTH, on average, is 0.2295 and the median is 0.1347, implying that the sample firms are growing rapidly. The mean natural logarithm (LNSIZE) of the company's size is 21.6337, with a median of 21.5051.

TABLE 2. Descriptive Statistics

Variables	N	Mean	S.D.	25th	Median	75th
LNFEF	5,552	13.2323	0.5375	12.8992	13.1224	13.5278
INITIAL	5,552	0.0893	0.2853	0	0	0
POST	5,552	0.4649	0.4988	0	0	1
RECTA	5,552	0.0263	0.0452	0.0043	0.0107	0.0262
INVTA	5,552	0.1700	0.1551	0.0662	0.1320	0.2186
GROWTH	5,552	0.2295	0.6341	−0.0103	0.1347	0.2988
LNSIZE	5,552	21.6337	1.1783	20.8353	21.5051	22.3411
QUICK	5,552	1.5664	2.2764	0.5394	0.8809	1.5302
LEV	5,552	0.4912	0.2399	0.3188	0.4903	0.6495
ROA	5,552	0.0343	0.0661	0.0119	0.0346	0.0634
LOSS	5,552	0.1097	0.3125	0	0	0
OPINION	5,552	0.9391	0.2391	1	1	1
CI	5,552	0.0395	0.1103	0.0022	0.0078	0.0262
INDSPE	5,552	0.0481	0.0554	0.0121	0.0258	0.0658
STATE	5,552	0.5285	0.4992	0	1	1
MKT	5,552	8.5160	2.0438	7.18	8.78	10.42

Note: N is the number of observations. LNFEF is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSPE is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

The average acid-test ratio (Quick) is 1.5664 and the median is 0.8809.⁶ The average asset-liability ratio (LEV) is 0.4912, with a median of 0.4903, indicating that the company's debt level is moderate, and short-term and long-term liquidity is strong. The mean ROA is 0.0343, the median is 0.0346, and the mean value of LOSS is 0.1097, which both indicate that the sample company's performance is poor. The average value of OPINION is 0.9391, indicating that 93.91 percent of the companies in the sample are issued a standard and unqualified audit opinions. The mean CI is 0.0395, the median is 0.0078. The mean INDSPE is 0.0481, with a median of 0.0258, suggesting that the sample companies have a lower degree of industry specialization. The average value of STATE is 0.5285, which indicates that the proportion of state-owned enterprises in the selected sample is 52.85 percent. The average MKT is 8.5160, with a median of 8.78.

Univariate Analysis

We compare the audit fees of regular and new clients before and after the merger of audit firms, and the results of the *t*-test are shown in Table 3. It can

⁶The wide gap between the median and the mean of the acid-test ratio indicates that there is a skewed data distribution, akin to the statistical results of Li, Zhang, and Liu (2012). We try to winsorize the variable at the top and bottom 5 percent to limit the influence of distribution asymmetry on the conclusions of our study, and it was found that the results of the study remain qualitatively similar to those reported in Table 2.

TABLE 3. Comparison of Average Audit Fees of Clients before and after the Merger of Audit Firms

	Old Client	New Client	Difference
Before the merger	640,053.4 (2695)	542,920.3 (276)	97,133.14**
After the merger	751,748.9 (2361)	744,895.5 (220)	6,853.459
Difference	111,695.5***	201,975.2***	

Note: Sample size is shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively.

be seen from Table 3 that the average audit fees for the regular clients before the merger of the audit firms is 64,0053.4 RMB and increase by 11,1695.5 RMB to 75,1748.9 RMB after the merger, significant at the 1 percent level. The average audit fees for the new clients before the merger of the audit firms is 542920.3 RMB and increase by 201975.2 RMB to 744895.5 RMB after the merger, significant at the 1 percent level. Obviously, the amount of fees charged for new clients either before or after the merger is higher than that of regular clients. Judging from the gap between the regular and new clients' audit fees, the average audit fees for the regular clients before the merger of the audit firms is 97,133.14 RMB higher than the new clients' and is significant at the 5 percent level, which initially indicates that low balling exists before the merger of audit firms. After the merger, the average audit fees for regular clients exceed the new clients' by 6853.459 RMB, whereas the difference between the two is statistically insignificant, preliminarily revealing that there is no audit fee discounts for new clients after the merger of audit firms, and the phenomenon of low balling of the audit firms disappears.

Multivariate Analysis

Table 4 demonstrates the test results of regression analysis for Hypothesis 1. In column 1, the coefficient of INITIAL is negative and significant at the level of 5 percent, which, consistent with most studies at home and abroad, suggests that the audit firms would offer an initial fee discount for the clients, namely low balling. The coefficient of INITIAL is -0.0398 , which can be translated as the firm's general 3.98 percent reduction on fees to newly accepted clients. The coefficient of POST in column 2 is significantly positive at the 1 percent level, consistent with relevant research findings (Li, Zhang, and Liu 2012) that audit fees increase after the merger of audit firms. The coefficient of POST is 0.0521 , which indicates that the overall audit fees of the audit firms increased by 5.35 percent. As illustrated in column 3, INITIAL is still significantly negative at the 1 percent level, POST is significantly positive at the 1 percent level, and the $INITIAL \times POST$ coefficient is significantly positive at the 5 percent level, implying that the merger of audit firms can dramatically reduce the discounts on audit fees for new clients, and inhibit the low balling behavior of audit firms. Specifically, it shows that the merger increases the auditing quasi-rents and improves the audit independence, and further raises the pricing threshold when they obtain new clients. We find that the coefficient of $INITIAL \times POST$ is 0.0719 , which is a 7.45 percent reduction in the audit fee discounts for new clients after the merger of audit firms.

TABLE 4. Regression Results of the Impact of Audit Firm's Merger on Low Balling

Variables	(1)	(2)	(3)
INITIAL	−0.0398**		−0.0761***
	(−2.17)		(−3.17)
POST		0.0521***	0.0467***
		(3.93)	(3.46)
INITIAL × POST			0.0719**
			(2.12)
RECTA	1.0901***	1.0974***	1.1007***
	(6.54)	(6.58)	(6.60)
INVTA	−0.1244*	−0.1193*	−0.1195*
	(−1.82)	(−1.75)	(−1.75)
GROWTH	−0.0064	−0.0076	−0.0064
	(−0.70)	(−0.84)	(−0.71)
LNSIZE	0.3288***	0.3283***	0.3279***
	(31.35)	(31.32)	(31.33)
QUICK	−0.0153***	−0.0150***	−0.0149***
	(−3.72)	(−3.66)	(−3.61)
LEV	−0.0101	−0.0109	−0.0068
	(−0.20)	(−0.21)	(−0.13)
ROA	0.3026	0.3048	0.3069
	(1.61)	(1.63)	(1.64)
LOSS	0.0667**	0.0660**	0.0673**
	(2.32)	(2.30)	(2.35)
OPINION	−0.1414***	−0.1408***	−0.1417***
	(−4.04)	(−4.02)	(−4.05)
CI	−0.0160	−0.0079	−0.0081
	(−0.26)	(−0.13)	(−0.13)
INDSPE	0.6428***	0.6419***	0.6356***
	(3.47)	(3.47)	(3.43)
STATE	−0.0420**	−0.0423**	−0.0410**
	(−2.11)	(−2.13)	(−2.07)
MTK	0.0400***	0.0393***	0.0392***
	(8.50)	(8.36)	(8.36)
Constant	5.9400***	5.9497***	5.9667***
	(27.80)	(27.76)	(27.89)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	5,552	5,552	5,552
R-squared	0.535	0.536	0.537

Note: *T*-statistics based on standard errors clustered by firm are shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. The dependent variable is LNFEES, which is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSP is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

From the regression results of the control variables in Table 4, the coefficient of RECTA is significantly positive, indicating that the higher the proportion of receivables is, the higher the audit fees of audit firms will be. The coefficients of both LNSIZE and LOSS are significantly positive, indicating that if a company is large or unprofitable, then the audit fees will be higher. The coefficient of OPINION is significantly negative, showing that the audit firms charge a lower fee for companies that have been issued non-standard audit opinions. The INDSPE coefficient is positive and significant, suggesting that audit firms with industry expertise can increase audit fees. The coefficient of MTK is significantly positive, implying that the audit firm has higher audit fees for public companies in areas with advanced marketization process. The regression results of these control variables above are all consistent with expectations. But the following three variables are exceptions: INVTA, ROA, and STATE. The INVTA coefficient is negative, indicating that the greater the proportion of inventory in the company's assets are, the lower the audit fees will be. The ROA coefficient is significantly positive, indicating that the audit fees are higher for those companies with better performance. Despite the inconsistency with previous expectations, the results are comparable to the findings of Li, Zhang, and Liu (2012) and Huang et al. (2015). In addition, other control variables did not appear to be statistically significant.

Robustness Tests

Delete the Observations of the Defective Audit Firm Merger

In China's audit market, some audit firms have merged some other "unhealthy" audit firms, which refer to those with serious problems in terms of professional ethics, internal control, and implement quality. A typical case is the merger of Guofu Haohua with Pengcheng Audit Firm. While those primary merger firms show relatively high audit quality and independence, considering the audit firms with audit quality problems may have more serious low-balling behavior, it's plausible that the restraint on low balling found after the merger may be driven by the "ill" audit firms. We eliminate these "defective merger" observations from the sample and then re-examine the hypothesis of this paper and present the regression results in Table 5. It can be seen that the coefficient of INITIAL in column 1 is significantly negative at the level of 5 percent, the coefficient of POST in column 2 is significant at the level of 1 percent, and the coefficient of $INITIAL \times POST$ in column 3 is significantly at the 5 percent level. The results above remain qualitatively similar to the primary test, which mitigates the concern that the findings in our paper are driven by the "defective merger."

Change the Research Window Period

We posit that the merger of audit firms enlarges the firm's size and increases the quasi-rents. This, in turn, can improve audit independence and give the firm more bargaining power by promoting market concentration, leading to the constraint on low balling of audit firms. After the merger, the original firms may undergo business restructuring, integration, and complementary advantages. This is likely to improve the audit quality and curb discounts on audit fees rather than audit independence and bargaining power resulting from the increase of the firm

TABLE 5. Impact of the Audit Firms' Merger on Low Balling (Excluding the "Defective Merger" Sample)

Variables	(1)	(2)	(3)
INITIAL	−0.0442**		−0.0854***
	(−2.33)		(−3.41)
POST		0.0498***	0.0437***
		(3.54)	(3.04)
INITIAL × POST			0.0793**
			(2.28)
RECTA	1.0027***	1.0122***	1.0141***
	(5.95)	(6.01)	(6.02)
INVTA	−0.1341*	−0.1282*	−0.1296*
	(−1.88)	(−1.81)	(−1.82)
GROWTH	−0.0058	−0.0072	−0.0061
	(−0.58)	(−0.72)	(−0.61)
LNSIZE	0.3334***	0.3331***	0.3324***
	(30.47)	(30.44)	(30.45)
QUICK	−0.0140***	−0.0138***	−0.0136***
	(−3.08)	(−3.04)	(−2.99)
LEV	0.0041	0.0020	0.0086
	(0.07)	(0.04)	(0.16)
ROA	0.3063	0.3108	0.3160
	(1.55)	(1.57)	(1.60)
LOSS	0.0702**	0.0705**	0.0713**
	(2.35)	(2.36)	(2.39)
OPINION	−0.1313***	−0.1300***	−0.1314***
	(−3.59)	(−3.56)	(−3.60)
CI	0.0093	0.0165	0.0171
	(0.14)	(0.24)	(0.25)
INDSPE	0.6426***	0.6460***	0.6408***
	(3.37)	(3.40)	(3.37)
STATE	−0.0483**	−0.0481**	−0.0468**
	(−2.37)	(−2.36)	(−2.30)
MTK	0.0373***	0.0367***	0.0366***
	(7.58)	(7.46)	(7.46)
Constant	5.8595***	5.8621***	5.8871***
	(26.41)	(26.33)	(26.50)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	5,126	5,126	5,126
R-squared	0.539	0.540	0.541

Note: *T*-statistics based on standard errors clustered by firm are shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. The dependent variable is LNFEF, which is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSP is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

size. Therefore, we set the research window of the primary test to two years before the merger and two years after the merger. To further eliminate the quality improvement hypothesis, we set the research window period to two years before the merger of audit firms and one year after the merger, consistent with Chan and Wu (2011), as it is difficult for the original audit firms to complete the restructuring, integration, and complementary advantages of the business within such a period of time after the merger and so the impact of the merger is more likely to be only an expansion of scale rather than an improvement in audit quality. Table 6 shows the regression results of the study window period as two years before the merger and one year after the merger. The coefficient of INITIAL in the column 1 is negative and significant at the level of 5 percent. The coefficient of INITIAL \times POST in column 3 is significant at the 10 percent level. In addition, we also change the research period to (i) the year before and two years after the merger, (ii) the year before and the year after the merger, and then re-examine the impact of the merger on low balling. The results are shown in column 2 and column 3 of Table 6. We find no substantial changes in the conclusions. The above results reveal that it is the change of quasi-rents and the increase of market concentration rather than the improvement of audit quality after the merger that affect the low balling of audit firms, and the selection of the window period study exerts no influence on the research conclusions.

ADDITIONAL ANALYSIS

Impact of the Merger of Audit Firms on the Low Balling of Clients with Different Property Right Character

According to the nature of property rights, China's public companies can be divided into two groups as SOE enterprises and non-SOE enterprises, which vary greatly in hiring auditors. Compared with non-SOE enterprises, the recruiting and selecting of auditors of SOE enterprises are heavily restricted because the government intervenes in the selection to conduct closer supervision over SOE enterprises. Restrictions include a unified bidding for auditors of SOE enterprises, designation of several audit firms for state-owned enterprises to choose from, and even requiring the audit firms selected by SOE enterprises to implement mandatory rotations that cannot be dismissed at will. All of these will affect the audit demand of SOE enterprises. In contrast, non-SOE enterprises do not have the above restrictions and have access to a more market-oriented audit market. Thus, non-SOE enterprises possess a wider range of choices. Given the restriction on the auditor selection of SOE enterprises, it is difficult for audit firms to attract state-owned enterprises with low fees. Therefore, if the merger of audit firms can really inhibit the low balling, then this role is mainly reflected in non-SOE enterprises.

We divide the research sample into SOEs and non-SOEs according to the nature of the property rights, then carry out the regression and present the results in Table 7. Column 1 is the regression result of SOEs. As is shown in the table, the coefficient of neither INITIAL nor INITIAL \times POST is statistically insignificant, which indicates that the audit firm does not offer the audit fee discounts for the newly accepted SOEs before the merger, and the merger of audit firms has no effect on the audit fee discounts for new clients. Column 2

TABLE 6. Impact of Mergers of Audit Firms on Low Balling (–2 to 1 Year)

Variables	(1) 2 Years Pre-Merger and 1 Year Post-Merger	(2) 1 Year Pre-Merger and 2 Years Post-Merger	(3) 1 Year Pre-Merger and 1 Years Post-Merger
INITIAL	–0.0761*** (–3.16)	–0.0809*** (–2.77)	–0.0774*** (–2.62)
POST	0.0276 (1.58)	0.0372** (2.46)	0.0138 (0.75)
INITIAL × POST	0.0809* (1.85)	0.0690* (1.88)	0.0916* (1.94)
RECTA	1.0537*** (6.13)	1.3438*** (6.50)	1.2623*** (5.89)
INVTA	–0.1433** (–1.98)	–0.0730 (–1.02)	–0.0844 (–1.11)
GROWTH	–0.0115 (–1.16)	–0.0081 (–0.85)	–0.0198* (–1.73)
LNSIZE	0.3256*** (29.64)	0.3287*** (31.04)	0.3199*** (28.89)
QUICK	–0.0159*** (–3.80)	–0.0142*** (–3.29)	–0.0151*** (–3.28)
LEV	–0.0036 (–0.07)	–0.0197 (–0.38)	–0.0121 (–0.23)
ROA	0.2662 (1.31)	0.3146 (1.58)	0.2801 (1.30)
LOSS	0.0604* (1.90)	0.0722** (2.37)	0.0670* (1.96)
OPINION	–0.1300*** (–3.68)	–0.1425*** (–3.64)	–0.1212*** (–3.01)
CI	0.0103 (0.15)	–0.0444 (–0.70)	–0.0011 (–0.02)
INDSPE	0.7429*** (3.55)	0.5947*** (3.16)	0.5959*** (2.86)
STATE	–0.0330 (–1.59)	–0.0408** (–1.98)	–0.0290 (–1.35)
MTK	0.0390*** (7.77)	0.0393*** (8.30)	0.0374*** (7.53)
Constant	6.0111*** (27.13)	5.8926*** (26.79)	6.0772*** (27.09)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	4,262	4,580	3,126
R-squared	0.530	0.538	0.531

Note: T-statistics based on standard errors clustered by firm are shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. The dependent variable is LNFEET, which is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSP is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

TABLE 7. Regression of Property Rights Character, Audit Firm Merger, and Low Balling

Variables	(1) SOEs	(2) Non-SOEs
INITIAL	−0.0455 (−1.46)	−0.1287*** (−3.66)
POST	0.0362* (1.90)	0.0627*** (3.25)
INITIAL × POST	0.0315 (0.72)	0.1464*** (2.94)
RECTA	1.5670*** (5.58)	0.7364*** (3.98)
INVTA	−0.0856 (−0.86)	−0.1283 (−1.44)
GROWTH	−0.0032 (−0.21)	−0.0114 (−1.06)
LNSIZE	0.3501*** (24.05)	0.2975*** (20.54)
QUICK	−0.0252*** (−3.06)	−0.0115*** (−2.68)
LEV	−0.0952 (−1.09)	0.0821 (1.46)
ROA	0.3180 (1.14)	0.2336 (1.00)
LOSS	0.0734* (1.79)	0.0545 (1.52)
OPINION	−0.1707*** (−3.50)	−0.0824* (−1.77)
CI	−0.0187 (−0.23)	−0.0366 (−0.39)
INDSPE	0.6008** (2.54)	0.5089* (1.88)
TOTAL	0.0439*** (6.16)	0.0309*** (5.34)
Constant	5.6368*** (19.48)	6.3472*** (20.78)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	2,934	2,618
R-squared	0.563	0.494

Note: T-statistics based on standard errors clustered by firm are shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. The dependent variable is LNFEET, which is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm merges, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSP is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

demonstrates the regression result of non-SOEs. INITIAL is significantly negative at the 1 percent level, and the coefficient of $\text{INITIAL} \times \text{POST}$ is significantly positive at the level of 1 percent, which suggests that the low-balling behavior of audit firms aims at non-SOEs, and the merger of audit firms can constrain this low balling of non-SOEs.

Impact of the Type of Merger on the Low Balling

In the case of the audit firm's merger, sometimes the size of the audit firms involved in the merger doesn't match, and even has large differences. Depending on whether the audit firm involved in the merger includes the Top 10 audit firms in China,⁷ it can be divided into two groups: merger between the large firm and the small firm (LS mergers), and the merger between small firms (SS mergers).⁸ Although China's audit market has undergone many mergers of audit firms in recent years, the overall audit market is still fragmented. In a merger between small firms, the size of the firm is still not large enough, and therefore may not necessarily constrain the low balling of audit firms. As for mergers between the large firm and the small firm, they're more likely to curtail low balling given that the large firms attach greater importance to their reputation and audit failure will result in greater loss of quasi-rents. Based on the findings above that the impact of the merger on low balling is concentrated in non-SOEs, we exclude observations of SOEs enterprises for this part of test.⁹ The sample is split into two groups (in accordance with the previous statement) and tested respectively. The regression results are shown in column 1 and column 2 of Table 8. In column 1, the coefficient of INITIAL is significantly negative at the level of 1 percent, and the coefficient of $\text{INITIAL} \times \text{POST}$ is significantly positive at the 5 percent level, which indicates that the merger between the large firm and the small firm can suppress the low balling of the audit firms. In column 2, the INITIAL coefficient is significantly negative at the level of 1 percent, the coefficient of $\text{INITIAL} \times \text{POST}$ is positive but insignificant, which is consistent with our assumption that the merger between small firms doesn't affect the low balling of audit firms.

CONCLUSION

The structure of China's audit market is fragmented. To contract the business, the audit firms compete to suppress prices, which seriously affects the audit quality of public companies and the sound development of the capital market and has aroused great concern of regulatory authorities and investors. In recent years, promoted by the government's policy of becoming bigger and stronger, China's audit market has experienced a wave of merging audit firms. Based on this background, this paper studies the impact of the merger of audit firms on

⁷The Top 10 audit firms in China defined in this paper include the Big 4 audit firms.

⁸The merger cases of audit firms in this paper do not include the merger of the Top 10 audit firms. Due to the low ranking of Ernst & Young Dahua, we classify the merger of Ernst & Young Huaming and Dahua as the merger between the large firm and the small firm. In fact, our results are still robust after deleting this observation.

⁹We also test the SOE sample, showing that not only the merger of audit firms but also the type of merger has no significant impact on low balling for SOE clients.

TABLE 8. Impact of the Type of Merger on the Low Balling

Variables	(1) Large and Small	(2) Small and Small
INITIAL	−0.1458*** (−3.16)	−0.1355*** (−2.95)
POST	0.0928*** (3.93)	−0.0078 (−0.24)
INITIAL × POST	0.1545** (2.55)	0.1170 (1.34)
RECTA	1.0367*** (4.22)	0.5051* (1.90)
INVTA	−0.0915 (−0.87)	−0.1757 (−1.25)
GROWTH	−0.0112 (−0.81)	−0.0064 (−0.34)
LNSIZE	0.3189*** (17.98)	0.2530*** (10.40)
QUICK	−0.0124** (−2.49)	−0.0111 (−1.54)
LEV	−0.0011 (−0.02)	0.1836** (2.22)
ROA	0.3304 (1.13)	−0.0753 (−0.24)
LOSS	0.1121** (2.54)	−0.0684 (−1.30)
OPINION	−0.0983* (−1.80)	−0.0526 (−0.76)
CI	−0.1437 (−1.41)	0.1200 (0.89)
INDSPE	0.2234 (0.70)	2.6438*** (3.75)
STATE	0.0244*** (4.08)	0.0361*** (3.07)
MTK	6.0956*** (16.95)	7.0719*** (13.94)
Constant	−0.1458*** (−3.16)	−0.1355*** (−2.95)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	1,704	914
R-squared	0.508	0.503

Note: T-statistics based on standard errors clustered by firm are shown in parentheses. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively. The definition of large or small audit firms depends on whether the audit firm involved in the merger include the Top 10 audit firms in China. The dependent variable is LNFEF, which is the natural logarithm of the audit fees paid by the public company to the audit firm. INITIAL is an indicator variable equal to 1 if it's the first year for the client to hire the audit firm, and 0 otherwise. POST is an indicator variable equal to 1 if the client firm mergers, and 0 otherwise. RECTA, INVTA are the proportion of accounts receivable and inventory to total assets, respectively. GROWTH is growth rate of income. LNSIZE is the natural logarithm of total assets. QUICK is quick assets divided by current liabilities, LEV is total liabilities divided by total assets, ROA is net income divided by total assets and LOSS is an indicator variable equal to 1 if the firm reports a loss for the year, and 0 otherwise. OPINION is an indicator variable equal to 1 if the auditor issues an unmodified opinion, and 0 otherwise, CI is the ratio of the firm's total assets to the sum of all client assets of the audit firm and INDSPE is the auditor's industry market share. STATE is an indicator variable equal to 1 if it's a SOE company, and 0 otherwise. MKT is the marketization index where the firm is located.

auditors' low-balling behavior. Theoretically, the merging of firms can enlarge the size of the audit firm, thereby affecting the quasi-rents and improving the audit independence. Therefore, the merger may affect the audit firm's low balling. Using the cases of the audit firm merger from 2005 to 2013 as a research setting, we document that low balling does exist in China's audit market; that is, the fee discounts for the initial engagement offered by auditors, which, consistent with our hypothesis, can be significantly constrained by the merger of audit firms. Even after removing the "defective merger" sample and changing the research window period, the results remain robust. In addition, compared with non-SOEs, SOEs, due to the lack of autonomy in the recruiting of auditors, gain low resilience in selecting auditors. We find that audit firms do not implement the low pricing strategy to SOEs enterprises and offer no fee discounts for new SOE clients. The negative impact of the merger of audit firms on low balling is concentrated on non-SOEs. We also find that the merger between small firms cannot inhibit low balling because of the limited increase in the size of the audit firm. The merger of large audit firms and small audit firms, however, can significantly constrain low balling of the audit firms due to their greater emphasis on reputation and greater loss of quasi-rents.

This paper provides important enlightenment in following aspects. On one hand, the merger of audit firms should be regarded as a vital way to promote the concentration of audit market and improve audit independence. We suggest that concerned government departments adhere to encourage M&A between domestic audit firms, especially the merger of large firms with the small and medium-sized firms, to boost the growth of the audit firms. On the other hand, regulatory authorities should standardize the fee charged to new clients of audit firms, and further enhance guidance on audit engagement after the merger of small- and medium-sized firms and curtail the low-balling practice of audit firms.

References

- Arkes, H. R. and C. Blumer. 1985. "The Psychology of Sunk Cost." *Organizational Behavior and Human Decision Processes* 35, no. 1, 124–40.
- Chan, K. H. and D. Wu. 2011. "Aggregate Quasi Rents and Auditor Independence: Evidence from Audit Firm Mergers in China." *Contemporary Accounting Research* 28, no. 1, 175–213.
- Chung, H. and S. Kallapur. 2003. "Client Importance, Nonaudit Services, and Abnormal Accruals." *The Accounting Review* 78, no. 4, 931–55.
- DeAngelo, L. E. 1981a. "Auditor Independence, 'Low Balling', and Disclosure Regulation." *Journal of Accounting and Economics* 3, no. 2, 113–27.
- DeAngelo, L. E. 1981b. "Auditor Size and Audit Quality." *Journal of Accounting and Economics* 3, no. 3, 183–99.
- Deis, D. R. and G. Giroux. 1996. "The Effect of Auditor Changes on Audit Fees, Audit Hours, and Audit Quality." *Journal of Accounting and Public Policy* 15, no. 1, 55–76.
- Desir, R., J. R. Casterella, and J. Kokina. 2014. "A Reexamination of Audit Fees for Initial Audit Engagements in the Post-SOX Period." *Auditing: A Journal of Practice & Theory* 33, no. 2, 59–78.
- Dye, R. A. 1991. "Informationally Motivated Auditor Replacement." *Journal of Accounting and Economics* 14, no. 4, 347–74.
- Ettredge, M., E. E. Fuerherm, and C. Li. 2014. "Fee Pressure and Audit Quality." *Accounting, Organizations and Society* 39, no. 4, 247–63.

- Fan, G., X. L. Wang, and H. P. Zhu. 2011. *China Marketization Index: Report on the Relative Progress of Marketization in Various Regions in 2011*. Beijing: Economic Science Press.
- Ghosh, A. A. and S. Lustgarten. 2006. "Pricing of Initial Audit Engagements by Large and Small Audit Firms." *Contemporary Accounting Research* 23, no. 2, 333–68.
- Gong, Q., O. Z. Li, Y. Lin, and L. Wu. 2016. "On the Benefits of Audit Market Consolidation: Evidence from Merged Audit Firms." *The Accounting Review* 91, no. 2, 463–88.
- Gul, F. A., S. Y. K. Fung, and B. Jaggi. 2009. "Earnings Quality: Some Evidence on the Role of Auditor Tenure and Auditors' Industry Expertise." *Journal of Accounting and Economics* 47, no. 3, 265–87.
- Huang, H. W., K. Raghunandan, and D. Rama. 2009. "Audit Fees for Initial Audit Engagements before and after SOX." *Auditing: A Journal of Practice & Theory* 28, no. 1, 171–90.
- Huang, H. W., K. Raghunandan, T. C. Huang, and J. R. Chiou. 2015. "Fee Discounting and Audit Quality Following Audit Firm and Audit Partner Changes: Chinese Evidence." *The Accounting Review* 90, no. 4, 1517–46.
- Lee, C. W. J. and Z. Gu. 1998. "Low Balling, Legal Liability and Auditor Independence." *The Accounting Review* 73, no. 4, 533–55.
- Li, M. H. and X. Liu. 2015. "Impact of Audit Firm Merger on Audit Quality: Empirical Evidence from China's Capital Market." *Journal of Management Engineering* 1, 169–82. (In Chinese).
- Li, M. H., J. Zhang, and X. Liu. 2012. "Audit Firm Merger and Audit Pricing-Based on the Panel Data of the 10 Merger Cases in 2003–2009." *Accounting Research* 5, 86–94. (In Chinese).
- Simon, D. T. and J. R. Francis. 1988. "The Effects of Auditor Change on Audit Fees: Tests of Price Cutting and Price Recovery." *The Accounting Review* 73, no. 4, 255–69.
- Stanley, J. D., D. M. Brandon, and J. J. McMillan. 2015. "Does Lowballing Impair Audit Quality? Evidence from Client Accruals Surrounding Analyst Forecasts." *Journal of Accounting and Public Policy* 34, no. 6, 625–45.
- Staw, B. M. 1976. "Knee-Deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Course of Action." *Organizational Behavior and Human Performance* 16, no. 1, 27–44.
- Zeng, Y. and J. Zhang. 2010. "The Impact of Mergers of Accounting Firms on Audit Quality." *Audit Research* 5, 53–60. (In Chinese)

Female CFOs and Stock Price Crash Risk

Iftekhar Hasan

Trung Nguyen

Jong Chool Park

Abstract

Motivation: Extant literature suggests that female leaders tend to exhibit greater risk aversion in their decision-making process than male leaders. However, more empirical evidence is needed to shed light on the potential impact of executive genders on stock price crash.

Premise: This study explores whether female chief financial officers (CFOs) are less likely to withhold negative information from investors, which mitigates stock price crash risk.

Approach: To test the central prediction, we perform multivariate regression analyses on a sample of 14,846 firm-year observations over the 1994 through 2015 period. The sample has 1,108 unique firms, 286 unique female CFOs, and 3,377 unique male CFOs. We also employ the propensity score matching approach to address endogeneity, and the textual analysis to investigate the risk disclosure quality of the 10-K filings.

Results: Female CFOs are negatively associated with stock price crash risk. Firms with female CFOs tend to exhibit greater risk disclosure quality.

Conclusions: Female CFOs are less likely to hoard bad news and they exhibit a higher level of transparency, leading to lower future stock price crash risk.

Consistency: This research highlights the significance of the gender of CFOs in corporate financial reporting. The evidence also emphasizes the essential role of the CFOs, besides that of the CEOs, in corporate decision-making processes. Furthermore, this study suggests a useful implication to investors who want to incorporate crash risk in their portfolio and risk management decisions.

Keywords: female CFOs, stock price crash risk

JEL Classification Codes: G12, G17, G30, G34, M16, M41

INTRODUCTION

While female executives are severely underrepresented in large companies, there has been a steady advance of women in corporate leadership over the past decades. The percentage of female CFOs among the Fortune 500 firms at the end

Iftekhar Hasan, PhD, Fordham University, ihasan@fordham.edu

Trung Nguyen, PhD, Northern Kentucky University, nguyent21@nku.edu

Jong Chool Park, PhD, University of South Florida, parkj@usf.edu

of 2015 is 13.8 percent, more than double the 6.8 percent reported as of year-end 2006. Similarly, the percentage of women in the top five executives among S&P 500 firms are 14.2 percent. The advance of women in business leadership has been spread out among all sectors of the economy and within all industries. With this increase in female representation, recent studies investigate the impact of female executives on corporate financial decision making. In general, these studies provide evidence consistent with the notion that female executives are more risk averse than male executives. For example, Huang and Kisgen (2013) find that female executives give wider ranges for earnings estimates and are more likely to exercise stock options early. They also find that female executives are more cautious when making investments and financing decisions and thus less likely to make acquisitions and issue debt. Similarly, Faccio, Marchica, and Mura (2016) show female CEOs are likely to have lower leverage, less volatile earnings, and a higher chance of survival than male CEOs.

In this study, we extend the literature by examining the impact of female CFOs on firm-specific stock price crash or, more generally, negative return skewness (McNichols 1988). Stock price crashes are large negative outliers in the return distribution. Due to concerns about compensation and career prospects, managers have incentives to conceal negative information from outside investors (Ball 2009; Kothari, Shu, and Wysocki 2009). However, when the accumulated bad news reaches a certain tipping point, the large amount of negative information will suddenly be released to the market all at once, resulting in a stock price crash (Jin and Myers 2006; Hutton, Marcus, and Tehranian 2009).

The extant literature shows that female CFOs are likely to make more conservative financial reporting (Francis et al. 2015), are less likely to make both accrual and real earnings management (Barua et al. 2010; Peni and Vähämaa 2010, Duong and Evans 2016), and are less likely to employ riskier tax-avoidance measures (Francis, Philbrick, and Schipper 2014) or engage in potentially illegal tactics for profit. Drawing on this literature, we conjecture that due to risk averseness, female CFOs are less likely to withhold bad news from investors, mitigating the incidence of stock price crash risk.

We focus on CFO instead of CEO gender because CFOs take the main responsibility of managing corporate financial reporting policy. Previous literature provides strong evidence demonstrating that the CFO has more direct impact on financial reporting decisions than the CEO (e.g., Mian 2001; Geiger and North 2006; Chava and Purnanandam 2010; Jiang, Petroni, and Wang 2010; Ge, Matsumoto, and Zhang 2011; Liu, Wei, and Xie 2016). In addition, female representation is more pronounced in CFO positions than CEO positions. Although past studies find a number of factors affecting firm-specific crash risk,¹ most studies

¹Among the growing literature, CEO and CFO equity incentives (Kim, Li, and Zhang 2011a, 2011b), corporate tax avoidance (Kim, Li, and Zhang 2011a, 2011b), institutional investors (Callen and Fang 2013), religiosity (Callen and Fang 2015a), short interest (Callen and Fang 2015b), stock price synchronicity (An and Zhang 2013), corporate social responsibility (Kim et al. 2014), corporate governance (Andreou et al. 2016a), accounting conservatism (Kim and Zhang 2016), CEO overconfidence (Kim et al. 2016), proximity to the Securities and Exchange Commission (SEC) (Kubick and Lockhart 2016), employee welfare (Ben-Nasr and Ghoulma 2018), stock liquidity (Chang, Chen, and Zolotoy 2017), earnings smoothing (Chen, Kim, and Yao 2017; Khurana et al. 2017), divergence of cash flows and voting rights (Hong et al. 2017), earnings transparency (Hung and Qiao 2017), and social trust (Li et al. 2017) are associated with future stock price crash risk.

focus on firm-specific factors such as opaque financial reporting, accounting conservatism, tax avoidance, executive equity compensations, and corporate governance (Hutton, Marcus, and Tehranian 2009; Kim, Li, and Zhang 2011a, 2011b; Kim and Zhang 2016; Andreou et al. 2016). Yet, relatively few studies examine executives' individual characteristics as a determinant of future crash risk. Rather than focusing on firm-level characteristics, this study examines the influence of a primary CFO characteristic, gender, on future stock price crash risk.

Using a sample of U.S. firms from 1993 through 2015, we test whether female CFOs are significantly and negatively related to future crash risk. Following prior studies (Jin and Myers 2006; Hutton, Marcus, and Tehranian 2009), we measure firm-level stock price crash risk by the negative skewness of firm-specific daily returns (*NCSKEW*), and the down-to-up volatility of firm-specific daily returns (*DUVOL*). We find that for both measures of stock price crash risk, female CFOs are less likely to experience future stock price crashes. We also find that the negative relation between female CFOs and future crash risk remains significant after controlling for accounting conservatism, CFO equity incentives, and female CEOs. Our results are also robust to the endogeneity of the selection of female CFOs. The propensity score analysis shows both statistically and economically stronger effects of female CFOs on future crash risk. Finally, we show that female CFOs are likely to make a better disclosure about the potential risk faced by the company than male CFOs. Collectively, our evidence is consistent with the notion that female CFOs are more risk averse, leading to withholding less bad news, a better disclosure for potential risk borne by the company, and thus are less likely to experience future stock price crashes.

Our study adds to the growing literature on female executives and its economic consequences. Following the steady increase in the number of female executives, the effect of gender on corporate finance has attracted considerable attention among researchers. However, many studies have focused on CEOs, and yet only a few studies examine the effect of female CFOs. Furthermore, these studies primarily focus on the difference in decision making between male CFOs and female CFOs, not on the economic consequences of different decision making. In contrast to past studies, this study examines the stock market consequence of the gender effect by providing strong evidence that financial-reporting behaviors of female CFOs have a significant impact on future stock price crash risk. This study also contributes to crash risk literature by identifying a new factor that mitigates future stock price crash risk. By examining the influence of CFO gender on future stock price crash risk, results of our study provide useful implications to investors who want to incorporate crash risk in their portfolio and risk management decisions.

The next section provides a literature review and develops the main hypothesis. The Methodology section discusses the sample, variable measurements, and research design. The Findings presents empirical results and additional analysis, which is followed by the Conclusion.

LITERATURE REVIEW AND HYPOTHESIS

Whether men and women are systematically different in their responses to risk is an important economic question. If women are more sensitive to risk than men, this will be reflected in all aspects of their decision making. A large body of liter-

ature in psychology and economics documents gender differences in risk taking. The robust and consistent finding in this literature is that women are more risk averse than are men in the vast majority of environments and tasks.^{2, 3} For example, in a lab setting, Charness and Gneezy (2012) provide strong evidence that women make smaller investments in risky assets than do men, and so appear to be financially more risk averse. Jianakoplos and Bernasek (1998) investigate allocation of portfolio assets and find that women tend to hold less risky assets in their wealth portfolio than men. Furthermore, Bernasek and Shwiff (2001) also report that women allocate their pension more conservatively than men. In addition, Barber and Odean (2001) reveal that female online broker investors trade less frequently than their male counterparts and earn smaller negative excess returns. Using a sample of chartered financial analysts and certified financial planners, Olsen and Cox (2001) find that female professional investors are more concerned with downside risk than male investors. Similarly, Niessen and Ruenzi (2007) show that female fund managers are more risk averse than male fund managers in their investment decisions. Niederle and Vesterlund (2007) also provide evidence that female risk aversion plays a major role in explaining gender differences in willingness to compete.

Gender differences in ethical matters have also been extensively examined in the business ethics literature. In general, the literature finds that women consider harmonious relationships more seriously and are less likely to be unethical, whereas men pursue economic benefits more, chase a successful career, and are more inclined to engage in unethical business behaviors to achieve competitive success (Gilligan 1982; Betz et al. 1989; Butz and Lewis 1996; Mason and Mudrack 1996).

More recently, studies have begun to investigate whether the gender of corporate executives and directors affects corporate decision making. Faccio, Marchica, and Mura (2016) show that female CEOs are likely to have lower leverage, less volatile earnings, and a higher chance of survival than male CEOs. Levi et al. (2008) examine whether the gender of CEOs or corporate directors plays a role in the pricing and returns of mergers and acquisitions. They find that bidders with female CEOs pay much lower premiums than bidders with male CEOs. They also show that the presence of female directors on the board is inversely related to bid premiums. Chen et al. (2016) find that firms with higher percentages of female representation on boards are less likely to have internal control weaknesses. Similarly, Parker et al. (2017) find that the percentage of female directors on the audit committee increases the likelihood of reporting internal control weaknesses. Capozio and Mavisakalyan (2016) document that female representation on company boards is associated with a decreased probability of fraud. In addition, Huang et al. (2014) find that female CEOs and the percentage of females on the board are positively associated with audit fees, suggesting that female CEOs and directors demand higher audit quality to external auditors. Harjoto, Laksmana, and Lee (2015) provide similar evidence that compared to male CEOs, female CEOs are associated with significantly higher audit fees and shorter audit delays.

²Eckel and Grossman (2008) and Byrnes et al. (1999) provide excellent surveys of the economics literature and psychology literature on gender differences in risk aversion, respectively.

³Croson and Gneezy (2009) highlight three factors causing gender differences in risk preference. The first factor is the affective reaction to risk. The second factor is that men are more confident than women. Lastly, men tend to view risky situations as challenges, as opposed to threats, which leads to increased risk tolerance.

In this study, we focus on gender differences among CFOs (rather than CEOs) due to the significant influence of CFOs on corporate financing, investing, and financial reporting decisions. Jiang, Petroni, and Wang (2010) find that CFO equity incentives are more strongly related to earnings management than CEO equity incentives. Moreover, Chava and Purnanandam (2010) argue that CFOs are more influential in decisions requiring financial expertise, such as earnings smoothing.

Recent studies also provide evidence of gender differences among chief financial officers (CFOs) in corporate financial decision making. For instance, Huang and Kisgen (2013) find that female CFOs place wider bounds on earnings estimates and are more likely to exercise stock options early. They also find that female CFOs are more cautious when making investments and financing decisions and thus less likely to make acquisitions and issue debt. However, when female CFOs do make acquisitions, they exhibit higher announcement returns as compared to those made by male CFOs. Huang and Kisgen (2013) also find that female CFOs are less likely to issue debt and are more likely to reduce the leverage ratio than their male counterparts. These findings are consistent with the notion that female CFOs are more risk averse than male CFOs.

Barua, et al. (2010) and Peni and Vähämaa (2010) find that female CFOs are likely to report lower absolute discretionary accruals or higher income-decreasing discretionary accruals. Similarly, Francis et al. (2016) find that firms with female CFOs tend to make more conservative financial reporting. Specifically, they show a significant increase in the level of accounting conservatism after a female CFO has been hired to replace a male CFO. In a similar vein, Duong and Evans (2016) find that female CFOs engage substantially less in both accrual and real earnings management than their male counterparts. Finally, Francis, Philbrick, and Schipper (2014) find that female CFOs are less tempted to employ aggressive tax-avoidance measures than their male counterparts.

Stock price crashes are large negative outliers in the return distribution. Jin and Myers (2006) and Hutton, Marcus, and Tehranian (2009) argue that bad news hoarding is a main cause of future stock price crash risk. When managers withhold adverse private information from outside investors for an extended period, bad news accumulates and reaches a critical threshold, leading to stock price crash risk when it comes out all at once. Literature on CFO gender and financial reporting quality suggests that female CFOs are less likely to manipulate earnings and hide unfavorable private information, thereby withholding bad news from investors, than male CFOs. Therefore, we hypothesize that female CFOs lower the probability of bad news being stockpiled within a firm and thus reducing the likelihood of a stock price crash.

Hypothesis: *Female CFOs are associated with lower stock price crash risk than male CFOs.*

METHODOLOGY

The Sample

We begin the sample collection procedure by identifying 35,934 firm-year observations from the intersection of Execucomp and Compustat databases during

the period of 1993 to 2015. After identifying these observations, we follow prior studies and impose the following sample selection criteria:

1. Insufficient data for CFO variables
2. Insufficient data for firm-specific crash risk measures
3. Insufficient data for other related variables used in the main analysis
4. Fiscal year-end stock prices less than \$1.00 (Kim et al. 2011a, 2011b)
5. Firm-year observations with negative equity book value (Kim and Zhang 2014; Khurana, Pereira, and Zhang 2017)

Regarding the classification of CFO observations, we follow Kim et al. (2011b) and Jiang, Petroni, and Wang (2010) and apply the following criteria. For the post-2006 period, an executive with *CFOANN* item equal to “CFO” is categorized as the chief financial officer of the firm. Since such an item was not available in the pre-2006 period, we instead exploit the annual title of an executive, i.e., *TITLEANN*, to classify whether he or she is the firm’s chief financial officer. Specifically, we consider an executive the CFO of a company if his or her *TITLEANN* is any of the following: *CFO*, *chief financial officer*, *treasurer*, *controller*, *finance*, and *vp-finance*. Occasionally, multiple executives are identified as the potential CFOs of the same company without the explicit title of “CFO.” In such cases, we choose the executive with the highest total compensation (*TDC1*) during the fiscal year.

The final sample size comprises 14,846 firm-year observations. Through the entire sample, we have 1,108 unique firms, 286 unique female CFOs, and 3,377 unique male CFOs. Table 1 details our sample selection procedures.

Measures Firm-Specific Crash Risk

We employ the negative conditional skewness of future firm-specific weekly returns (*NCSKEW*) and down-to-up volatility (*DUVOL*) as our main crash risk measures, following Chen, Hong, and Stein (2001). Both measures are based on firm-specific weekly returns estimated as the residuals from the market model.

$$r_{j,t} = \alpha_j + \beta_{1,j} r_{m,t-2} + \beta_{2,j} r_{m,t-1} + \beta_{3,j} r_{m,t} + \beta_{4,j} r_{m,t+1} + \beta_{5,j} r_{m,t+2} + \varepsilon_{j,t} \quad (1)$$

Where

$r_{j,t}$ is the firm-specific weekly return for firm j during week t

$r_{m,t}$ is the CRSP value-weighted market return inclusive of dividends for week t

Two lead and lag terms are included in the model to allow for nonsynchronous trading that may occur over one or more weeks (Dimson 1979). We calculate *NCSKEW* for a given firm in a fiscal year by taking the negative of the third moment of firm-specific weekly returns, $W_{j,t}$, during the fiscal year and dividing it by the standard deviation of firm-specific weekly returns, raised to the third power. Specifically, for each firm j in year t , we obtain *NCSKEW* as follows:

$$NCSKEW_{jt} = -[n(n-1)^{3/2} \sum W_{jt}^3] / [(n-1)(n-2)(\sum W_{jt}^2)^{3/2}] \quad (2)$$

TABLE 1. Sample Distribution by Year

This table reports the distribution of 16,081 CFO-year observations by year from 1994 to 2015. Column 1 shows the distribution for the full sample while columns 2 and 3 show the distribution for the female and male samples, separately. The last column documents the annual ratio of female CFOs to male CFOs. See Appendix A for variable definitions.

Fiscal Year	Full Sample	Female CFO	Male CFO	Female/Male
	(1)	(2)	(3)	(4)
1994	237	2	235	0.009
1995	349	7	342	0.020
1996	391	7	384	0.018
1997	393	7	386	0.018
1998	419	10	409	0.024
1999	426	12	414	0.029
2000	466	17	449	0.038
2001	503	23	480	0.048
2002	579	33	546	0.060
2003	644	42	602	0.070
2004	731	56	675	0.083
2005	785	53	732	0.072
2006	850	61	789	0.077
2007	996	71	925	0.077
2008	1,077	87	990	0.088
2009	1,111	88	1,023	0.086
2010	1,142	85	1,057	0.080
2011	1,118	89	1,029	0.086
2012	1,047	87	960	0.091
2013	981	75	906	0.083
2014	949	89	860	0.103
2015	887	87	800	0.109
Total	16,081	1,088	14,993	0.073

Where the firm-specific weekly return for firm j in week t ($W_{j,t}$) is defined as $W_{j,t} = \ln(1 + \varepsilon_{j,t})$.

To calculate second measure of crash risk, $DUVOL$, we separate firm-specific weekly returns into down (up) weeks when firm-specific weekly returns are below (above) the annual average weekly return. We calculate $DUVOL$ as the log of the ratio of the standard deviation of firm-specific down weekly returns to the standard deviation of up weekly returns during the fiscal year where standard deviation of firm-specific weekly returns is calculated separately for each of down and up weeks.

$$DUVOL_{jt} = \log[(n_u - 1) \sum_{Down} W_{j,t}^2 / (n_d - 1) \sum_{Up} W_{j,t}^2], \quad (2)$$

Where n_u and n_d are the number of up and down weeks in year t , respectively. Both crash risk measures are all increasing in the direction of greater stock price crash risk.

Empirical Models

To investigate the gender effect of CFO on firm-specific future stock price crash risk, we estimate the following model:

$$\begin{aligned} \text{CRASH_RISK}_t = & \beta_0 + \beta_1 \text{Female CFO}_{t-1} + \beta_2 \text{Log of CFO Age}_{t-1} \\ & + \beta_3 \text{Log of CFO Tenure}_{t-1} + \beta_4 \text{NCSKEW}_{t-1} + \beta_5 \text{Stock Return}_{t-1} \\ & + \beta_6 \text{Stock Volatility}_{t-1} + \beta_7 \text{Dturnover}_{t-1} + \beta_8 \text{Size}_{t-1} + \beta_9 \text{Market-to-Book} \\ & \text{Ratio}_{t-1} + \beta_{10} \text{Leverage}_{t-1} + \beta_{11} \text{Return on Assets}_{t-1} + \beta_{12} \text{Accruals}_{t-1} \\ & + \text{Industry Fixed Effects} + \text{Year Fixed Effects} + \varepsilon_t \end{aligned} \quad (4)$$

Where the dependent variable, CRASH_RISK_t , is proxied by NCSKEW_t or DUVOL_t . Our primary independent variable is Female CFO_{t-1} . We impose a one-year lag between the dependent and independent variables to test whether *Female CFO* in year $t - 1$ can predict crash risk in year t . We control for two CFO characteristics that may potentially affect future stock price crash risk. By using CFO age ($\text{Log of CFO Age}_{t-1}$), we first control for CFO's potential financial incentives to hoard bad news earlier in their career (Andreou, Louca, and Petrou 2016). We thus expect that CFO age ($\text{Log of CFO Age}_{t-1}$) is inversely related to future stock-price crash risk. In addition to CFO age, we control for CFO firm-specific experience using CFO tenure ($\text{Log of CFO Tenure}_{t-1}$) (Hambrick and Fukutomi 1991). The lack of firm-specific knowledge and experience for short-tenured CFOs may create uncertainty about the ability of CFOs, which provides pressure on short-tenured CFOs to hide bad news (Simsek 2007). We thus expect that CFO tenure ($\text{Log of CFO Tenure}_{t-1}$) is inversely related to future stock-price crash risk. Following Henderson, Miller, and Hambrick (2006), we measure CFO tenure using the natural logarithm of the number of years in a CFO post with a particular company. We also control for several factors that affect future stock price crash risk in prior studies. We first control for the lag value of NCSKEW_{t-1} . Chen, Hong, and Stein (2001) find that past returns help to forecast crash risk. The predictive power of past returns can be explained by a bubble buildup as indicated by high past returns, followed by a large price drop when prices fall back to fundamentals. We thus control for past returns ($\text{Stock Return}_{t-1}$), calculated as the mean of firm-specific weekly returns over the fiscal year. The next control variable is stock volatility ($\text{Stock Volatility}_{t-1}$), calculated as the standard deviation of firm-specific weekly returns over the fiscal year, as more volatile stocks are likely to be more crash prone.

Chen, Hong, and Stein (2001) show that trading volume, a proxy for the intensity of differences of opinion among investors, is a predictor of stock price crash risk. We thus control for change in trading volume (Dturnover_{t-1}), calculated as the average monthly share turnover in year t minus the average monthly share turnover in $t - 1$. The predictive power of firm size has been documented in several studies (e.g., Harvey and Siddique 2000; Chen, Hong, and Stein 2001), hence we control for firm size (Size_{t-1}), calculated as the log value of the market value of equity. In addition, we control for the market-to-book ratio ($\text{Market-to-Book Ratio}_{t-1}$), as glamour stocks (those with a high market-to-book [MB]) are also predicted to have higher crash risk. In addition, we control for financial leverage (Leverage_{t-1}) calculated as total long-term debts divided by total assets, and profitability measured by return on assets ($\text{Return on Assets}_{t-1}$). Our

last control variable is abnormal accruals, a proxy for earnings management, as Hutton, Marcus, and Tehranian (2009) show that earnings management is positively related to future crash risk. We measure abnormal accruals as the residuals from the modified Jones model (Dechow, Sloan, and Sweeney 1995), estimated by each year and each two-digit SIC code industry. We use the negative value of absolute abnormal accruals (ABACC) in our regression analysis. Appendix A provides definitions of all variables used in our analysis. All of our regressions also include industry and year fixed effects.

FINDINGS

Descriptive Statistics

Table 2 reports the descriptive statistics for the study variables used in our primary analyses. Our sample statistics for crash risk are similar to those in the existing literature (Kim et al. 2011a, 2011b, 2014). Specifically, the means of *NCSKEW* and *DUVOL* are 0.016 and -0.007 , indicating that the mean firm-year has positive conditional skewness and greater volatility of weekly returns during positive return weeks when compared to the volatility during negative return weeks, respectively. The standard deviations of *NCSKEW* and *DUVOL* suggest a wide variation in these measures of crash risk in the sample. The sample statistics for *Female CFO*, *CFO Age*, and *CFO Tenure* are also similar to those in the existing literature. Specifically, only 7.5 percent of the full sample are firm-year observations with female CFO indicating the severe underrepresentation of women among CFOs that has been extensively documented in recent literature (see e.g., Adams et al. 2007; Wanzenried 2008). The underrepresentation

TABLE 2. Descriptive Statistics

This table presents descriptive statistics for two measures of stock price crash risk, as well as executive and firm level variables. The table reports means, standard deviations, 5th, 25th, 50th, 75th, and 95th percentiles of related variables. The final sample comprises 16,081 CFO-year observations spanning from 1994 to 2015. The main independent variable and other controls are lagged by one period. See Appendix A for variable definitions.

Variable	Mean	Standard Deviation	5%	25%	50%	75%	95%
<i>NCSKEW</i>	0.003	0.675	-1.048	-0.408	-0.029	0.375	1.171
<i>DUVOL</i>	-0.013	0.318	-0.527	-0.235	-0.022	0.203	0.526
<i>Female CFO</i>	0.068	0.251	0.000	0.000	0.000	0.000	1.000
<i>CFO Age</i>	3.899	0.130	3.664	3.807	3.912	3.989	4.094
<i>CFO Tenure</i>	1.449	0.558	0.693	1.099	1.386	1.792	2.398
<i>Stock Return</i>	-0.115	0.130	-0.358	-0.140	-0.074	-0.039	-0.016
<i>Stock Volatility</i>	0.043	0.022	0.018	0.028	0.039	0.053	0.085
<i>Dturnover</i>	0.002	0.076	-0.117	-0.027	0.001	0.030	0.121
<i>Size</i>	7.428	1.519	5.121	6.361	7.302	8.393	10.157
<i>Market-to-Book Ratio</i>	2.857	2.810	0.780	1.462	2.200	3.444	7.255
<i>Leverage</i>	0.182	0.160	0.000	0.027	0.166	0.288	0.470
<i>Return on Assets</i>	0.156	0.103	0.018	0.096	0.145	0.207	0.338
<i>Accruals</i>	-0.148	0.120	-0.395	-0.188	-0.114	-0.068	-0.031

of women may suggest the lack of qualified women over the sample period or the existence of discriminatory attitudes against women. Our statistics for other variables are also similar to the existing studies. The average change in monthly trading volume (as a percentage of shares outstanding) is 0.002. The average firm in our sample has a firm-specific weekly return of -10.9 percent, a market capitalization of \$1,712 million, a market-to-book ratio of 2.887, a weekly return volatility of 0.043, a leverage of 0.177, and a return on assets of 0.157. The average absolute value of abnormal accruals is 0.145.

The Effect of CFO Gender on Crash Risk

Table 3 reports results from regression analysis of the relation between *Female CFO* and future firm-specific crash risk after controlling for other potential determinants of crash risk. All standard errors are adjusted at the firm level (Petersen 2009) and are shown in parentheses. Consistent with our predictions, results suggest that *Female CFO* is negatively associated with one year-ahead crash risk estimated by *NCSKEW* and *DUVOL*. Column 1 indicates that *NCSKEW* is significantly and negatively associated with *Female CFO*. On average, *Female CFO* in year $t - 1$ is associated with a decrease of 0.037 in *NCSKEW* in year t . Column 3 indicates that *DUVOL* is significantly and negatively associated with *Female CFO*. On average, *Female CFO* in year $t - 1$ is associated with a decrease of 0.018 in *DUVOL* in year t . Thus, the effect of *Female CFO* on future crash risk is both statistically and economically significant. Columns 2 and 4 show that the negative relation between *Female CFO* and crash risk holds after controlling for *Log of CFO Age* and *Log of CFO Tenure*. Both statistical and economic significance of the effect of *Female CFO* on future crash risk increase after controlling for both CFO characteristics, indicating the robustness of the relation between female CFO and crash risk. The coefficients on the control variables are generally consistent with prior studies. Firms that have a higher past return, a larger firm size, a higher return volatility, and a higher return on assets are associated with higher future crash risk. Overall, results in Table 3 suggest that firms with female CFOs experience a lower future stock price crash risk. The results are consistent with the notion that female CFOs are less likely to hoard bad news, make higher quality risk disclosures, and exhibit a higher level of transparency, leading to lower future stock price crash risk.

Robustness Test: Controlling for Accounting Conservatism and CFO Equity Incentives

To mitigate concerns on omitted correlated variables, we add to the model *Accounting Conservatism* and *CFO Equity Incentives* that can potentially affect both female CFO and crash risk based on prior studies. Kim and Zhang (2016) find that the degree of accounting conservatism is significantly and negatively associated with future crash risk, consistent with the notion that accounting conservatism is associated with more timely disclosure of bad news, thereby reducing stock price crash risk. In addition, Francis, Philbrick, and Schipper (2014) show that female CFOs are more likely to make conservative accounting choices than male CFOs. We thus include two proxies of accounting conservatism, *Conservatism Skewness* and *Conservatism Score*, separately in the regression model.

TABLE 3. Effect of CFO Gender on Stock Price Crash Risk

This table presents the multivariate regressions of crash risk measures on female CFOs with different model specifications. The main independent variable and other controls are lagged by one period. The full sample comprises 16,081 CFO-year observations spanning from 1994 to 2015. The dependent variables are *NCSKEW* and *DUVOL*, respectively. Columns 1 and 3 show the direct effect of female CFOs on stock price crash risk measures controlling for firm characteristics. Columns 2 and 4 include log of CFO age and log of CFO tenure. All specifications are adjusted for year and industry fixed effects; the latter is defined using two-digit SIC codes. Standard errors are clustered at the firm level and shown in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively. See Appendix A for variable definitions.

Variable	<i>NCSKEW_t</i>		<i>DUVOL_t</i>	
	(1)	(2)	(3)	(4)
<i>Female CFO_{t-1}</i>	-0.055*** (0.018)	-0.061*** (0.018)	-0.025*** (0.008)	-0.029*** (0.008)
<i>CFO Age_{t-1}</i>		-0.127*** (0.044)		-0.068*** (0.021)
<i>CFO Tenure_{t-1}</i>		0.002 (0.011)		0.001 (0.005)
<i>NCSKEW_{t-1}</i>	0.013* (0.008)	0.013* (0.008)	0.005 (0.004)	0.005 (0.003)
<i>Stock Return_{t-1}</i>	0.689*** (0.122)	0.674*** (0.122)	0.306*** (0.058)	0.298*** (0.058)
<i>Stock Volatility_{t-1}</i>	4.029*** (0.926)	3.911*** (0.928)	1.778*** (0.435)	1.712*** (0.435)
<i>Dturnover_{t-1}</i>	0.258*** (0.064)	0.261*** (0.064)	0.124*** (0.030)	0.126*** (0.030)
<i>Size_{t-1}</i>	0.027*** (0.004)	0.028*** (0.004)	0.014*** (0.002)	0.015*** (0.002)
<i>Market-to-Book Ratio_{t-1}</i>	-0.004*** (0.002)	-0.004*** (0.002)	-0.002** (0.001)	-0.002** (0.001)
<i>Leverage_{t-1}</i>	-0.082** (0.037)	-0.085** (0.037)	-0.053*** (0.017)	-0.054*** (0.017)
<i>Return on Assets_{t-1}</i>	0.516*** (0.057)	0.512*** (0.057)	0.268*** (0.027)	0.266*** (0.027)
<i>Accruals_{t-1}</i>	0.042 (0.044)	0.046 (0.044)	0.013 (0.021)	0.015 (0.021)
<i>Intercept</i>	-0.341*** (0.085)	0.161 (0.191)	-0.187*** (0.047)	0.081 (0.095)
<i>Industry Fixed Effects</i>	Yes	Yes	Yes	Yes
<i>Year Fixed Effects</i>	Yes	Yes	Yes	Yes
<i>Adjusted R-Squared (%)</i>	2.23%	2.27%	2.94%	2.99%
<i>Observations (N)</i>	16,081	16,081	16,081	16,081

Conservatism Skewness is calculated as the difference between the skewness in operating cash flows (divided by total assets) and the skewness in net income (divided by total assets) over the previous three years (Givoly and Hayn 2000). *Conservatism Score* is the firm-level conservatism measure (*CSCORE*) developed by Khan and Watts (2009). For both conservatism measures, higher values

mean more conservative accounting. Table 4 reports results of this analysis. We find that the coefficients on *Female CFO* remain significantly negative for both *NCSKEW* and *DUVOL* in columns 1 and 2 and columns 5 and 6, respectively. The coefficients of both conservatism measures are not statistically significant, indicating that the effect of female CFO subsumes the effect of accounting conservatism.

In addition to accounting conservatism, we also control for the effect of CFO equity incentives. Kim et al. (2011b) report that CEO and CFO equity incentives are associated with firm-specific stock price crash risk. Specifically, they find that the incentives from CFOs' option holdings are significantly and positively related to future crash risk, suggesting that equity incentives induce CFOs to hide bad news and increase crash risk. Following Kim et al. (2011b), we add two measures of CFO equity incentives, *Option Incentive* and *Stock Incentive*, to the regression models. *Option Incentive* is the incentive ratio for CFO option holdings, which is measured as $\text{Option Sensitivity}/(\text{Option Sensitivity} + \text{SALARY} + \text{BONUS})$, where *Option Sensitivity* is the dollar change in the value of CFO option holdings resulting from a 1 percent increase in the firm's stock price. *Stock Incentive* is the incentive ratio for CFO stock holdings, which is measured similar to *Option Incentive*. Table 4 reports results of the additional analysis. Consistent with the findings of Kim et al. (2011b), the coefficient of *Option Incentive* is positive and significant while *CFO Stock Incentives* are not significant. The results suggest that options have a more powerful impact than stock awards on managers' incentives to engage in share price manipulation (Burns and Kedia 2006; Peng and Röell 2008). More importantly, for both *NC-SKEW* and *DUVOL*, the coefficients on *Female CFO* remain significantly negative after controlling for CFO equity incentives and accounting conservatism. In addition, both statistical and economic significance of the effect of *Female CFO* on future crash risk increase, indicating the robustness of the relation between female CFO and crash risk. Overall, our finding of a negative relation between female CFO and future stock price crash risk is robust to including *Accounting Conservatism* and *CFO Equity Incentives* to mitigate the concern on omitted correlated variables.

Robustness Test: Controlling for CEO Characteristics

Kim et al. (2011b) find that CFO equity incentives have a different effect on crash risk from CEO equity incentives because bad news hoarding requires financial expertise and CFOs are generally in direct charge of processing the firm's financial information and disseminating it to the stock market. Jiang, Petroni, and Wang (2010) find that CFO equity incentives are more strongly related to earnings management than CEO equity incentives. Moreover, Chava and Purnanandam (2010) argue that CFOs are more influential in decisions requiring financial expertise, such as earnings smoothing. Similarly, Peni and Vähämaa (2010) find that firms with female CFOs are less likely to engage in earnings management than male CFOs, while there is no significant difference in earnings management between firms with male and female CEOs. Thus, we expect CFO gender to have a different effect on crash risk from CEO gender, because bad news hoarding requires financial expertise and CFOs are responsible for processing financial information about the firm and disseminating it to the stock market.

TABLE 4. Controlling for Accounting Conservatism and CFO Equity Incentives

This table presents the multivariate regressions of crash risk measures on female CFOs with different model specifications. The main independent variable and other controls are lagged by one period. The full sample comprises 16,081 CFO-year observations spanning from 1994 to 2015. The first (last) four columns report the multivariate results for NCSKEW (DUVOL) as dependent variable. Models 1 and 5 show the direct effect of female CFOs on stock price crash risk measures controlling for firm characteristics. Models 2 and 6 include log of CFO age and log of CFO tenure. The other models also incorporate accounting conservatism and CFO equity incentives. All specifications are adjusted for year and industry fixed effects; the latter is defined using two-digit SIC codes. Standard errors are clustered at the firm level and shown in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively. See Appendix A for variable definitions.

Variable	NCSKEW _t				DUVOL _t			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female CFO _{t-1}	-0.069*** (0.018)	-0.062*** (0.018)	-0.071*** (0.019)	-0.065*** (0.019)	-0.032*** (0.009)	-0.028*** (0.009)	-0.034*** (0.009)	-0.030*** (0.009)
CFO Age _{t-1}	-0.120*** (0.045)	-0.128*** (0.044)	-0.138*** (0.049)	-0.144*** (0.048)	-0.063*** (0.022)	-0.068*** (0.021)	-0.069*** (0.023)	-0.074*** (0.023)
CFO Tenure _{t-1}	0.004 (0.011)	0.003 (0.011)	0.004 (0.012)	0.002 (0.012)	0.001 (0.005)	0.001 (0.005)	0.001 (0.005)	-0.001 (0.005)
Accounting Conservatism 1 _{t-1}	0.003 (0.003)		0.004 (0.004)		0.001 (0.001)		0.001 (0.002)	
Accounting Conservatism 2 _{t-1}		-0.071 (0.085)		-0.059 (0.094)		-0.022 (0.041)		-0.020 (0.045)
Option Incentive _{t-1}			0.044* (0.023)	0.048** (0.023)			0.023** (0.011)	0.025** (0.011)
Stock Incentive _{t-1}			-0.163* (0.099)	-0.167* (0.098)			-0.066 (0.046)	-0.065 (0.046)
NCSKEW _{t-1}	0.014* (0.008)	0.014* (0.008)	0.012 (0.008)	0.010 (0.008)	0.005 (0.004)	0.005 (0.004)	0.004 (0.004)	0.004 (0.004)
Stock Return _{t-1}	0.719*** (0.127)	0.686*** (0.130)	0.708*** (0.133)	0.693*** (0.136)	0.321*** (0.060)	0.302*** (0.061)	0.308*** (0.063)	0.298*** (0.064)
Stock Volatility _{t-1}	4.078*** (0.953)	4.115*** (0.964)	4.030*** (0.994)	4.210*** (1.008)	1.789*** (0.448)	1.790*** (0.452)	1.712*** (0.472)	1.785*** (0.477)
Dturnover _{t-1}	0.267*** (0.067)	0.247*** (0.066)	0.290*** (0.072)	0.275*** (0.071)	0.127*** (0.031)	0.122*** (0.031)	0.136*** (0.033)	0.134*** (0.033)
Size _{t-1}	0.028*** (0.004)	0.025*** (0.006)	0.022*** (0.006)	0.018** (0.007)	0.015*** (0.002)	0.014*** (0.003)	0.011*** (0.003)	0.010*** (0.004)
Market-to-Book Ratio _{t-1}	-0.005*** (0.002)	-0.005** (0.002)	-0.004** (0.002)	-0.005** (0.002)	-0.002** (0.001)	-0.002* (0.001)	-0.002** (0.001)	-0.002 (0.001)
Leverage _{t-1}	-0.092** (0.038)	-0.079* (0.042)	-0.074* (0.040)	-0.056 (0.044)	-0.056*** (0.018)	-0.054*** (0.020)	-0.050*** (0.019)	-0.045** (0.021)
Return on Assets _{t-1}	0.508*** (0.058)	0.504*** (0.058)	0.496*** (0.061)	0.495*** (0.061)	0.263*** (0.027)	0.259*** (0.027)	0.255*** (0.029)	0.251*** (0.029)
Accruals _{t-1}	0.033 (0.045)	0.058 (0.045)	0.036 (0.048)	0.059 (0.049)	0.010 (0.022)	0.020 (0.022)	0.013 (0.024)	0.022 (0.024)
Intercept	0.117 (0.198)	0.205 (0.199)	0.250 (0.212)	0.328 (0.213)	0.056 (0.098)	0.101 (0.098)	0.116 (0.104)	0.161 (0.104)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared (%)	2.19%	2.20%	2.14%	2.16%	2.88%	2.89%	2.80%	2.79%
Observations (N)	15,561	15,763	13,596	13,777	15,561	15,763	13,596	13,777

We investigate the potential effect of female CEO by adding four variables to capture CEO characteristics: *Log of CEO Age*, *Log of CEO Tenure*, *CEO Option Incentive*, and *CEO Stock Incentive*. Results in Table 5 suggest that the effect of female CFOs on crash risk is not mitigated by the effect of female CEO. The coefficients of *Female CFO* remain negative and significant whereas the coefficients of *Female CEO* are not significant. These results are consistent with prior studies which suggest that the CFO has more direct impact on financial reporting decisions than the CEO. We also conduct our analyses on subsamples formed by deleting observations where both the CEO and CFO are female, or the CEO is female. In both cases, *Female CFO* remains negative and statistically significant. Overall, our results suggest that CFO gender has a significant effect on crash risk while CEO gender is not related to crash risk.

Propensity Score Matching (PSM) Analysis

Our analysis so far suggests a negative relation between female CFO and one-year-ahead crash risk. However, the potential endogenous relation between female CFO and crash risk is a concern in our analysis. Endogeneity can arise due to unobservable heterogeneity when unobservable firm-specific factors affect both female CFO and crash risk. In addition, while the use of lagged *Female CFO* to predict future crash risk in our research design potentially mitigates the problem of simultaneity or reverse causality, the concern of simultaneity still remains. We thus perform the propensity score matching (PSM) analysis to mitigate these endogeneity concerns.

The propensity score matching firstly proposed by Rosenbaum and Rubin (1983) is a statistical matching technique conditioning on the covariates that predict the likelihood for receiving the treatment. It reduces the bias caused by the possibility that the difference between two groups of units may depend on the features that affect whether a unit received treatment instead of the effect of treatment *per se*. One of the implicit assumptions of the PSM approach is that the potential outcomes are independent of the treatment assignment conditional on the propensity score, which is strong and untestable. Nonetheless, the PSM approach is one of the most frequently used techniques to address endogeneity concerns according to the survey collected by Roberts and Whited (2012). Therefore, we use the PSM approach to control for the endogeneity of *Female CFO* because *Female CFO* is determined by mutual matching process. After retrieving the propensity scores for each CFO-year observation, we then implement one-to-one nearest neighbor matching with no replacement to ensure that each female CFO-year observation is paired with a male CFO-year observation in the same industry group based on two-digit SIC industry. That is, a control firm is matched with a treated firm in each year over the sample window if they are in the same two-digit SIC industry and have the closest propensity score in year t . Similar to the methodology of Huang and Kisgen (2013), we compute the propensity score for the selection of *Female CFO* in year t using the multivariate logistic regression model as follows:

$$\begin{aligned} \text{Female CFO}_{t-1} = & \gamma_0 + \gamma_1 \text{Gender Equality Index}_{t-1} + \gamma_2 \text{Size}_{t-1} \\ & + \gamma_3 \text{Market-to-Book Ratio}_{t-1} + \gamma_4 \text{Leverage}_{t-1} + \gamma_5 \text{Sales Growth}_{t-1} \\ & + \gamma_6 \text{PPE}_{t-1} + \text{Industry Fixed Effects} + \text{Year Fixed Effects} + \epsilon t \end{aligned} \quad (5)$$

TABLE 5. Controlling for CEO Characteristics

This table presents the multivariate regressions of crash risk measures on female CFOs controlling for CEO characteristics. In addition to the variable used before, the following regressions also include CEO gender, age, tenure, stock incentives, and option incentives. The main independent variable and other controls are lagged by one period. The dependent variables are the two crash risk measures, *NCSKEW*, and *DUVOL*, respectively. For both measures, the first model shows the direct effect of female CFOs on stock price crash risk measures controlling for CEO gender, age, and tenure. The next two models incorporate all control variables. All specifications are adjusted for year and industry fixed effects; the latter is defined using two digit SIC codes. Standard errors are clustered at the firm level and shown in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively. See Appendix A for variable definitions.

Variable	<i>NCSKEW_t</i>			<i>DUVOL_t</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Female CFO_{t-1}</i>	-0.070*** (0.019)	-0.080*** (0.022)	-0.074*** (0.022)	-0.032*** (0.009)	-0.036*** (0.010)	-0.032*** (0.010)
<i>Female CEO_{t-1}</i>	-0.010 (0.042)	0.018 (0.047)	0.022 (0.047)	-0.001 (0.019)	0.010 (0.021)	0.012 (0.021)
<i>CFO Age_{t-1}</i>	-0.111** (0.048)	-0.122** (0.057)	-0.133** (0.056)	-0.059*** (0.023)	-0.058** (0.027)	-0.066** (0.027)
<i>CFO Tenure_{t-1}</i>	0.001 (0.012)	0.005 (0.014)	0.003 (0.014)	-0.001 (0.006)	0.000 (0.007)	-0.001 (0.007)
<i>CEO Age_{t-1}</i>	-0.028 (0.055)	-0.005 (0.064)	-0.008 (0.063)	-0.019 (0.026)	-0.010 (0.030)	-0.009 (0.029)
<i>CEO Tenure_{t-1}</i>	-0.003 (0.008)	-0.005 (0.010)	-0.002 (0.009)	-0.001 (0.004)	-0.001 (0.004)	0.001 (0.004)
<i>Accounting Conservatism 1_{t-1}</i>		0.003 (0.004)			0.000 (0.002)	
<i>Accounting Conservatism 2_{t-1}</i>			-0.039 (0.106)			-0.004 (0.050)
<i>CFO Option Incentive_{t-1}</i>		0.032 (0.031)	0.033 (0.030)		0.017 (0.015)	0.017 (0.014)
<i>CFO Stock Incentive_{t-1}</i>		-0.114 (0.118)	-0.115 (0.117)		-0.041 (0.055)	-0.039 (0.055)
<i>CEO Option Incentive_{t-1}</i>		0.049 (0.030)	0.054* (0.030)		0.026* (0.014)	0.029** (0.014)
<i>CEO Stock Incentive_{t-1}</i>		-0.053 (0.045)	-0.046 (0.044)		-0.034 (0.021)	-0.032 (0.021)
<i>NCSKEW_{t-1}</i>	0.010 (0.008)	0.009 (0.010)	0.007 (0.010)	0.003 (0.004)	0.003 (0.004)	0.002 (0.004)
<i>Stock Return_{t-1}</i>	0.699*** (0.135)	0.749*** (0.156)	0.742*** (0.156)	0.310*** (0.064)	0.327*** (0.074)	0.323*** (0.074)
<i>Stock Volatility_{t-1}</i>	4.171*** (1.024)	4.679*** (1.164)	4.895*** (1.168)	1.823*** (0.481)	2.003*** (0.552)	2.098*** (0.552)
<i>Dturnover_{t-1}</i>	0.274*** (0.071)	0.305*** (0.082)	0.284*** (0.081)	0.137*** (0.033)	0.143*** (0.038)	0.137*** (0.038)
<i>Size_{t-1}</i>	0.028*** (0.005)	0.020*** (0.007)	0.017** (0.009)	0.015*** (0.002)	0.011*** (0.003)	0.010** (0.004)
<i>Market-to-Book Ratio_{t-1}</i>	-0.004** (0.002)	-0.004** (0.002)	-0.005** (0.002)	-0.001* (0.001)	-0.002* (0.001)	-0.001 (0.001)
<i>Leverage_{t-1}</i>	-0.116*** (0.041)	-0.136*** (0.046)	-0.118** (0.051)	-0.070*** (0.019)	-0.081*** (0.022)	-0.079*** (0.024)
<i>Return on Assets_{t-1}</i>	0.480*** (0.063)	0.452*** (0.072)	0.451*** (0.072)	0.249*** (0.029)	0.233*** (0.034)	0.230*** (0.034)
<i>Accruals_{t-1}</i>	0.072 (0.048)	0.075 (0.055)	0.097* (0.056)	0.026 (0.023)	0.029 (0.027)	0.038 (0.027)
<i>Intercept</i>	0.152 (0.288)	0.153 (0.334)	0.255 (0.332)	0.101 (0.140)	0.088 (0.162)	0.136 (0.159)
<i>Industry Fixed Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year Fixed Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adjusted R-Squared (%)</i>	2.21%	2.08%	2.13%	2.85%	2.68%	2.71%
<i>Observations (N)</i>	13,536	10,745	10,872	13,536	10,745	10,872

Where *Gender Equality Index* is the cross-state index of gender equality across the United States developed by Sugarman and Straus (1988). We incorporate firm characteristics as the determinants for *Female CFO*, including firm size (*SIZE*), market-to-book ratio (*Market-to-Book Ratio*), leverage (*Leverage*), sales growth (*Sales Growth*), and property, plant, and equipment (*PPE*). Detailed definitions of control variables are provided in Appendix A. In addition, we also control for the year- and industry-fixed effects in Equation (3). The matching procedure constructs a control group that is similar to the treated group in terms of the *likelihood* to have a female CFO, but a female CFO is only found in the treated group. Thus, the change of crash risk in the control group can be considered as the change of crash risk that would have been if the treated group had not received the treatment. Consequently, the difference between the change in crash risk for the treated group and that for the control group reflects the causal effect of female CFOs on future crash risk.

Table 6 shows the estimation results for the logistic regression. *Gender Equality Index* is positively associated with *Female CFO*, consistent with Huang and Kisgen (2013). The effect is statistically significant at the 1 percent level. In addition, firms with lower long-term debt leverage are more likely to choose a female CFO. The coefficient estimate is statistically significant at the 1 percent level. To confirm the validity of our PSM sample, we also perform the difference-in-mean test and report the means of the control variables for each group. According to Panel B of Table 3, there are no statistically significant differences among the controls between the treatment and control groups, which shows the validity of our PSM procedure.

The descriptive statistics of the PSM sample are qualitatively similar to those of the full sample. We find similar yet stronger results after controlling for potential endogeneity concerns using the PSM sample. Table 7 shows that the coefficient estimate of female CFO is consistently negative and statistically significant at 1 percent across all model specifications. *Female CFO* is negatively and significantly correlated with *NCSKEW* and *DUVOL* at 1 percent, which further lends support to our main hypotheses, suggesting that the negative relation between female CFOs and future crash risk holds after controlling for endogeneity based on the propensity score matching analysis. We also perform a two-stage Heckman selection model as an additional analysis to mitigate the endogeneity concerns. Although results are omitted for brevity, the effect of female CFOs on crash risk continues to be significant.

The Effect of CFO Gender on the Quality of Risk Disclosure

So far, our results suggest that female CFOs are less likely to hoard bad news and exhibit a higher level of transparency, leading to lower future stock price crash risk. These results are also consistent with findings that female CFOs are more sensitive to future risk and make timely dissemination of potential risks faced by the company to warn the stock market. In this section, we perform a textual analysis of 10-K disclosure of our sample firms and test whether female CFOs make a better disclosure regarding current and future risks of the company. Specifically, we measure the quality of firm-specific risk disclosure through the two-stage procedure. In the first stage, we perform principal component analysis (PCA) to derive the primary components of firm risk determinants comprising

TABLE 6. Propensity Score Matching (PSM) Regression of CFO Gender

This table reports the PSM's logistic regression of female CFO on gender equality index, firm size, firm market-to-book ratio, firm leverage, firm PPE, and firm sales growth. The model also includes year and industry fixed effects with firm clustered standard errors; industry fixed effects are defined using two digit SIC codes. The full sample comprises 16,081 CFO-year observations spanning from 1994 to 2015. Panel A shows the coefficient estimates and their significance in the logistic regressions. Panel B reports the difference-in-mean tests for these control variables between male and female CFO samples after PSM. Standard errors are reported in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively. See Appendix A for variable definitions.

Panel A: Propensity Score Matching Logistic Regression			
Variable		Female CFO _t	
Gender Equality Index _{t-1}		0.012**	
		(0.005)	
Size _{t-1}		0.039	
		(0.025)	
Market-to-Book Ratio _{t-1}		-0.006	
		(0.012)	
Leverage _{t-1}		-0.484**	
		(0.227)	
Sales Growth _{t-1}		-0.037	
		(0.096)	
PPE _{t-1}		-0.166	
		(0.241)	
Intercept		-2.855***	
		(0.319)	
Industry Fixed Effects		Yes	
Year Fixed Effects		Yes	
Pseudo R-Squared (%)		3.54%	
Observations (N)		15,662	
Panel B: Difference-in-Mean Tests for the PSM Control Variables			
Variable	Male CFO	Female CFO	Male – Female
Gender Equality Index _{t-1}	44.589	44.876	-0.286
	0.233	0.248	0.340
Size _{t-1}	7.591	7.654	-0.063
	0.046	0.048	0.067
Market-to-Book Ratio _{t-1}	2.837	2.896	-0.059
	0.083	0.087	0.121
Leverage _{t-1}	0.159	0.159	0.000
	0.005	0.004	0.007
Sales Growth _{t-1}	0.095	0.098	-0.002
	0.006	0.007	0.009
PPE _{t-1}	0.270	0.263	0.006
	0.007	0.007	0.010

TABLE 7. Effect of CFO Gender on Stock Price Crash Risk on the Propensity Score Matching (PSM) Sample

This table presents the multivariate regressions of crash risk measures on Female CFO. The main independent variable and other controls are lagged by one period. The PSM sample comprises 2,130 CFO-year observations. Panels A and B report the multivariate results for *NCSKEW* and *DUVOL*, respectively. In both panels, the first model shows the direct effect of female CFOs on stock price crash risk measures controlling for firm characteristics. Model 2 includes log of CFO age and log of CFO tenure. The next two models add the proxies of accounting conservatism. Models 5 and 6 incorporate all control variables including CFO equity incentives. All specifications are adjusted for year and industry fixed effects; the latter is defined using two-digit SIC codes. Standard errors are clustered at the firm level and shown in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively. See Appendix A for variable definitions.

Panel A: Effect of CFO Gender on NCSKEWt						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
<i>Female CFO_{t-1}</i>	-0.064** (0.026)	-0.070*** (0.027)	-0.076*** (0.027)	-0.069** (0.027)	-0.091*** (0.029)	-0.088*** (0.029)
<i>CFO Age_{t-1}</i>		-0.150 (0.133)	-0.142 (0.138)	-0.177 (0.136)	-0.234 (0.144)	-0.252* (0.142)
<i>CFO Tenure_{t-1}</i>		0.011 (0.029)	0.012 (0.030)	0.009 (0.029)	0.022 (0.032)	0.018 (0.032)
<i>Accounting Conservatism 1_{t-1}</i>			-0.014 (0.009)		-0.015 (0.009)	
<i>Accounting Conservatism 2_{t-1}</i>				-0.406* (0.225)		-0.485** (0.240)
<i>Option Incentive_{t-1}</i>					0.012 (0.057)	0.019 (0.056)
<i>Stock Incentive_{t-1}</i>					-0.132 (0.250)	-0.117 (0.245)
<i>NCSKEW_{t-1}</i>	0.024 (0.017)	0.024 (0.017)	0.027 (0.017)	0.023 (0.017)	0.028 (0.019)	0.025 (0.019)
<i>Stock Return_{t-1}</i>	0.719** (0.309)	0.690** (0.310)	0.662* (0.343)	0.670** (0.330)	0.819** (0.378)	0.805** (0.354)
<i>Stock Volatility_{t-1}</i>	4.662** (2.365)	4.428* (2.389)	4.317* (2.537)	4.770* (2.500)	5.519** (2.713)	6.001** (2.634)
<i>Dturnover_{t-1}</i>	0.063 (0.169)	0.070 (0.169)	0.054 (0.174)	0.036 (0.171)	-0.026 (0.187)	-0.013 (0.185)
<i>Size_{t-1}</i>	0.023** (0.011)	0.023** (0.011)	0.025** (0.012)	0.007 (0.017)	0.025* (0.014)	0.000 (0.020)
<i>Market-to-Book Ratio_{t-1}</i>	-0.003 (0.005)	-0.004 (0.005)	-0.007 (0.005)	-0.004 (0.007)	-0.006 (0.005)	-0.005 (0.008)
<i>Leverage_{t-1}</i>	-0.199* (0.106)	-0.203* (0.106)	-0.222** (0.109)	-0.197 (0.122)	-0.184 (0.117)	-0.133 (0.131)
<i>Return on Assets_{t-1}</i>	0.523*** (0.143)	0.524*** (0.142)	0.540*** (0.146)	0.499*** (0.151)	0.602*** (0.154)	0.575*** (0.158)
<i>Accruals_{t-1}</i>	0.146 (0.110)	0.143 (0.110)	0.065 (0.112)	0.194* (0.116)	0.108 (0.120)	0.240* (0.124)
<i>Intercept</i>	-0.236 (0.164)	0.345 (0.548)	0.343 (0.571)	0.641 (0.567)	0.702 (0.601)	1.036* (0.601)

(continued)

TABLE 7. Effect of CFO Gender on Stock Price Crash Risk on the Propensity Score Matching (PSM) Sample (*continued*)

Panel A: Effect of CFO Gender on NCSKEWt						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared (%)	2.39%	2.36%	2.32%	2.37%	2.63%	2.91%
Observations (N)	2,130	2,130	2,056	2,078	1,797	1,818

Panel B: Effect of CFO Gender on DUVOLT						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Female CFO _{t-1}	-0.027** (0.012)	-0.030** (0.013)	-0.032** (0.013)	-0.029** (0.013)	-0.041*** (0.014)	-0.039*** (0.014)
CFO Age _{t-1}		-0.067 (0.061)	-0.059 (0.064)	-0.081 (0.062)	-0.093 (0.067)	-0.108 (0.066)
CFO Tenure _{t-1}		0.002 (0.013)	0.002 (0.014)	0.001 (0.014)	0.005 (0.015)	0.003 (0.015)
Accounting Conservatism 1 _{t-1}			-0.006 (0.004)		-0.006 (0.004)	
Accounting Conservatism 2 _{t-1}				-0.209* (0.107)		-0.236** (0.114)
Option Incentive _{t-1}					0.010 (0.027)	0.014 (0.027)
Stock Incentive _{t-1}					-0.081 (0.130)	-0.069 (0.129)
NCSKEW _{t-1}	0.013 (0.008)	0.013 (0.008)	0.014* (0.008)	0.012 (0.008)	0.013 (0.009)	0.011 (0.009)
Stock Return _{t-1}	0.307** (0.153)	0.292* (0.153)	0.292* (0.171)	0.259 (0.162)	0.360* (0.190)	0.326* (0.177)
Stock Volatility _{t-1}	1.978* (1.132)	1.857 (1.139)	1.852 (1.219)	1.870 (1.188)	2.398* (1.321)	2.477* (1.275)
Dturnover _{t-1}	0.057 (0.081)	0.060 (0.081)	0.048 (0.083)	0.046 (0.083)	0.014 (0.090)	0.025 (0.090)
Size _{t-1}	0.014** (0.005)	0.014*** (0.005)	0.015*** (0.006)	0.005 (0.008)	0.015** (0.007)	0.003 (0.009)
Market-to-Book Ratio _{t-1}	-0.002 (0.002)	-0.002 (0.002)	-0.004 (0.002)	-0.002 (0.003)	-0.002 (0.002)	-0.002 (0.004)
Leverage _{t-1}	-0.121** (0.051)	-0.123** (0.051)	-0.130** (0.052)	-0.119** (0.058)	-0.120** (0.056)	-0.100 (0.063)
Return on Assets _{t-1}	0.284*** (0.070)	0.284*** (0.069)	0.286*** (0.072)	0.262*** (0.074)	0.300*** (0.076)	0.279*** (0.078)
Accruals _{t-1}	0.062 (0.057)	0.062 (0.057)	0.027 (0.058)	0.083 (0.059)	0.052 (0.063)	0.112* (0.064)
Intercept	-0.097 (0.077)	0.167 (0.249)	0.143 (0.260)	0.321 (0.259)	0.279 (0.274)	0.465* (0.276)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared (%)	2.62%	2.58%	2.49%	2.53%	2.97%	3.15%
Observations (N)	2,130	2,130	2,056	2,078	1,797	1,818

size, leverage and market-to-book ratio, cash flow volatility, the number of business segments, litigation risk, and Herfindahl-Hirschman Index (HHI) (Hill and Stone 1980; Francis et al. 1994; John et al. 2008; Faccio, Marchica, and Mura 2011; Campbell et al. 2014; Babenko, Boguth, and Tserlukevich 2016).⁴ Two principal components whose eigenvalues are greater than one are retained for the estimation of firm-level risk disclosure quality. In the second stage, we perform multivariate regressions in which we regress two risk disclosure measures on the two principal components to capture the actual risks faced by the company in addition to year and industry-fixed effects with standard errors clustered at the firm level. The two risk disclosure measures include the $\log(1 + RW_t)$, and the $\log(1 + RWTW_t)$, where RW_t is the number of risk-related words and $RWTW_t$ is the ratio of risk-related words to total words. We follow Kravet and Muslu (2013) to identify risk-related words in 10-Ks. We define the quality of risk disclosure as residuals from the regression, that is, the portion of risk disclosures that is not captured by firm-specific risk. For a given level of risk, higher quality risk disclosure would be associated with more risk-related words than lower quality risk disclosure.

Table 8 reports the results of regressions for two measures of the quality of risk disclosures using RW_t and $RWTW_t$. Consistent with our predictions, female CFOs have a significant and positive effect on firms' risk disclosure quality. For instance, in model 1, the risk words disclosure measure (RW) of firms led by female CFOs is 0.070 higher than that of firms led by male CFOs. The evidence is robust to both the full and PSM samples. In addition, the results are similar across both measures of risk disclosure quality and different model specifications. We also find that older firms and firms with smaller stock volatility, smaller size, lower leverage, higher return on assets, and smaller sales growth are associated with lower risk disclosure quality. In addition, firms incurring loss also have lower risk disclosure quality. Collectively, the results are consistent with the notion that female CFO are more risk averse, leading to a better disclosure for potential risk borne by the company and subsequently, a lower future stock price crash risk.

CONCLUSION

This paper investigates whether CFO gender is associated with firm-specific stock price crash risk. Using a sample of U.S. firms from 1993 through 2015, we find that female CFOs are significantly and negatively related to future crash risk. We also document that the negative relation between female CFOs and future crash risk remains statistically significant after controlling for accounting conservatism, CFO equity incentives, and female CEOs. Our results are also robust to the endogeneity of the selection of female CFOs. The propensity score analysis shows both statistically and economically stronger effects of female CFOs on future crash risk. Finally, we show that female CFOs are likely to make better disclosure about the potential risk faced by the company than male CFOs. This additional evidence is consistent with the notion that female CFO are more

⁴Cash flow volatility is the three-year standard deviation of firm cash flow measured by the ratio of income before extraordinary items plus depreciation to average total assets. Litigation risk is equal to 1 if a firm is in the biotechnology (SIC 2833–2836 and 8731–8734), computer (SIC 3570–3577 and 7370–7374), electronics (SIC 3600–3674), or retail (SIC 5200–5961) industries, and 0 otherwise.

TABLE 8. Effect of CFO Gender on the Quality of Risk Disclosure

This table presents the multivariate regressions of firm disclosure qualities on female CFOs and other control variables for both the full and PSM samples. The dependent variables are risk words disclosure (RW_t), and risk words to total words disclosure ($RWTW_t$), respectively. The main independent variable and other controls are lagged by one period. The full sample has 16,081 CFO-year observations and the PSM sample comprises 2,130 CFO-year observations, respectively. For both samples, the first two models do not control for CFO age and tenure while the last two models incorporate all of the control variables. All specifications are adjusted for year and industry fixed effects; the latter is defined using two-digit SIC codes. Standard errors are clustered at the firm level and shown in parentheses. ***, **, and * are used to denote significance at 1 percent, 5 percent, and 10 percent levels, respectively.

Variable	Full Sample				PSM Sample			
	RW_t	$RWTW_t$	RW_t	$RWTW_t$	RW_t	$RWTW_t$	RW_t	$RWTW_t$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Female CFO</i> _{<i>t-1</i>}	0.060** (0.025)	0.014** (0.006)	0.045* (0.025)	0.013** (0.006)	0.065** (0.027)	0.016** (0.007)	0.057** (0.027)	0.014** (0.007)
<i>CFO Age</i> _{<i>t-1</i>}			-0.191*** (0.056)	-0.016 (0.014)			-0.142 (0.117)	-0.044 (0.031)
<i>CFO Tenure</i> _{<i>t-1</i>}			-0.053*** (0.011)	-0.004 (0.003)			-0.020 (0.021)	-0.003 (0.005)
<i>Stock Return</i> _{<i>t-1</i>}	0.412*** (0.142)	0.057* (0.034)	0.381*** (0.142)	0.054 (0.034)	0.640** (0.312)	0.078 (0.077)	0.605* (0.313)	0.068 (0.077)
<i>Stock Volatility</i> _{<i>t-1</i>}	7.440*** (1.018)	1.042*** (0.243)	7.071*** (1.009)	1.012*** (0.243)	7.482*** (2.091)	1.397*** (0.517)	7.176*** (2.093)	1.314** (0.519)
<i>Age</i> _{<i>t-1</i>}	-0.003*** (0.001)	-0.001*** (0.000)	-0.003*** (0.001)	-0.001*** (0.000)	-0.001 (0.001)	0.000 (0.000)	-0.001 (0.001)	0.000 (0.000)
<i>Size</i> _{<i>t-1</i>}	0.128*** (0.007)	0.011*** (0.002)	0.129*** (0.007)	0.011*** (0.002)	0.085*** (0.012)	0.009*** (0.003)	0.086*** (0.012)	0.009*** (0.003)
<i>Leverage</i> _{<i>t-1</i>}	0.330*** (0.048)	0.032*** (0.011)	0.321*** (0.048)	0.031*** (0.011)	-0.066 (0.092)	0.019 (0.024)	-0.070 (0.092)	0.018 (0.024)
<i>Return on Assets</i> _{<i>t-1</i>}	-0.973*** (0.080)	-0.095*** (0.019)	-0.980*** (0.078)	-0.096*** (0.019)	-0.903*** (0.172)	-0.038 (0.040)	-0.904*** (0.170)	-0.039 (0.040)
<i>Loss</i> _{<i>t-1</i>}	0.055*** (0.015)	-0.007** (0.003)	0.051*** (0.015)	-0.007** (0.003)	0.077** (0.033)	0.011 (0.009)	0.075** (0.033)	0.011 (0.009)
<i>Sales Growth</i> _{<i>t-1</i>}	0.162*** (0.022)	0.019*** (0.005)	0.155*** (0.022)	0.019*** (0.005)	0.220*** (0.058)	0.037*** (0.013)	0.220*** (0.058)	0.036*** (0.013)
<i>Intercept</i>	-1.123*** (0.086)	-0.083** (0.037)	-0.272 (0.233)	-0.012 (0.067)	-0.749*** (0.179)	-0.112*** (0.042)	-0.157 (0.475)	0.068 (0.121)
<i>Industry Fixed Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Year Fixed Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adjusted R-Squared (%)</i>	12.46%	2.76%	13.14%	2.85%	6.11%	0.23%	6.28%	0.43%
<i>Observations (N)</i>	14,956	14,956	14,956	14,956	2,006	2,006	2,006	2,006

risk averse, leading to a better disclosure for potential risk borne by the company and subsequently, a lower future stock price crash risk. This study complements the existing literature on gender and corporate behavior. Our study supports extant evidence that female CFOs make higher quality financial reporting decisions compared to male counterparts. In addition, our results are consistent with the view that individual executive characteristics matter for managing stock price crash risk.

References

- Adams, Susan M., Atul Gupta, Dominique M. Haughton, and John D. Leeth. 2007. "Gender Differences in CEO Compensation: Evidence from the USA." *Women in Management Review* 22, no. 3, 208–24.
- An, Heng and Ting Zhang. 2013. "Stock Price Synchronicity, Crash Risk, and Institutional Investors." *Journal of Corporate Finance* 21, 1–15.
- Andreou, Panayiotis C., Christodoulos Louca, and Andreas P. Petrou. 2016. "CEO Age and Stock Price Crash Risk." *Review of Finance* 21, no. 3, 1287–325.
- Andreou, Panayiotis C., Constantinos Antoniou, Joanne Horton, and Christodoulos Louca. 2016. "Corporate Governance and Firm-specific Stock Price Crashes." *European Financial Management* 22, no. 5, 916–56.
- Babenko, Ilona, Oliver Boguth, and Yuri Tserlukevich. 2016. "Idiosyncratic Cash Flows and Systematic Risk." *The Journal of Finance* 71, no. 1, 425–56.
- Ball, Ray. 2009. "Market and Political/Regulatory Perspectives on the Recent Accounting Scandals." *Journal of Accounting Research* 47, no. 2, 277–323.
- Barber, Brad M. and Terrance Odean. 2001. "Boys Will Be Boys: Gender, Overconfidence, and Common Stock Investment." *The Quarterly Journal of Economics* 116, no. 1, 261–92.
- Barua, Abhijit, Lewis F. Davidson, Dasaratha V. Rama, and Sheela Thiruvadi. 2010. "CFO Gender and Accruals Quality." *Accounting Horizons* 24, no. 1, 25–39.
- Ben-Nasr, Hamdi and Hatem Ghouma. 2018. "Employee Welfare and Stock Price Crash Risk." *Journal of Corporate Finance* 48, 705–25.
- Bernasek, Alexandra and Stephanie Shwiff. 2001. "Gender, Risk, and Retirement." *Journal of Economic Issues* 35, no. 2, 345–56.
- Betz, Michael, Lenahan O'Connell, and Jon M. Shepard. 1989. "Gender Differences in Proclivity for Unethical Behavior." *Journal of Business Ethics* 8, no. 5, 321–4.
- Bodnaruk, Andriy, Tim Loughran, and Bill McDonald. 2015. "Using 10-K Text to Gauge Financial Constraints." *Journal of Financial and Quantitative Analysis* 50, no. 4, 623–46.
- Burns, Natasha and Simi Kedia. 2006. "The Impact of Performance-Based Compensation on Misreporting." *Journal of Financial Economics* 79, no. 1, 35–67.
- Butz, Clarence E. and Phillip V. Lewis. 1996. "Correlation of Gender-Related Values of Independence and Relationship and Leadership Orientation." *Journal of Business Ethics* 15, no. 11, 1141–9.
- Byrnes, James P., David C. Miller, and William D. Schafer. 1999. "Gender Differences in Risk Taking: A Meta-Analysis." *Psychological Bulletin* 125, no. 3, 367–83.
- Callen, Jeffrey L. and Xiaohua Fang. 2013. "Institutional Investor Stability and Crash Risk: Monitoring Versus Short-Termism?" *Journal of Banking & Finance* 37, no. 8, 3047–63.
- Callen, Jeffrey L. and Xiaohua Fang. 2015. "Religion and Stock Price Crash Risk." *Journal of Financial and Quantitative Analysis* 50, no. 1–2, 169–95.
- Callen, Jeffrey L. and Xiaohua Fang. 2015. "Short Interest and Stock Price Crash Risk." *Journal of Banking & Finance* 60, 181–94.
- Campbell, John L., Hsinchun Chen, Dan S. Dhaliwal, Hsin-min Lu, and Logan B. Steele. 2014. "The Information Content of Mandatory Risk Factor Disclosures in Corporate Filings." *Review of Accounting Studies* 19, no. 1, 396–455.
- Capezio, Alessandra and Astghik Mavisakalyan. 2016. "Women in the Boardroom and Fraud: Evidence from Australia." *Australian Journal of Management* 41, no. 4, 719–34.
- Chang, Xin, Yangyang Chen, and Leon Zolotoy. 2017. "Stock Liquidity and Stock Price Crash Risk." *Journal of Financial and Quantitative Analysis* 52, no. 4, 1605–37.
- Charness, Gary and Uri Gneezy. 2012. "Strong Evidence for Gender Differences in Risk Taking." *Journal of Economic Behavior & Organization* 83, no. 1, 50–8.
- Chava, Sudheer and Amiyatosh Purnanandam. 2010. "CEOs Versus CFOs: Incentives and Corporate Policies." *Journal of Financial Economics* 97, no. 2, 263–78.

- Chen, Changling, Jeong-Bon Kim, and Li Yao. 2017. "Earnings smoothing: Does It Exacerbate or Constrain Stock Price Crash Risk?" *Journal of Corporate Finance* 42, 36–54.
- Chen, Joseph, Harrison Hong, and Jeremy C. Stein. 2001. "Forecasting Crashes: Trading Volume, Past Returns, and Conditional Skewness in Stock Prices." *Journal of Financial Economics* 61, no. 3, 345–81.
- Chen, Yu, John Daniel Eshleman, and Jared S. Soileau. 2016. "Board Gender Diversity and Internal Control Weaknesses." *Advances in Accounting* 33, 11–9.
- Croson, Rachel and Uri Gneezy. 2009. "Gender Differences in Preferences." *Journal of Economic Literature* 47, no. 2, 448.
- Dechow, Patricia M., Richard G. Sloan, and Amy P. Sweeney. 1995. "Detecting Earnings Management." *Accounting Review*, 193–225.
- Dimson, Elroy. 1979. "Risk Measurement When Shares Are Subject to Infrequent Trading." *Journal of Financial Economics* 7, no. 2, 197–226.
- Duong, Lien and John Evans. 2016. "Gender Differences in Compensation and Earnings Management: Evidence from Australian CFOs." *Pacific-Basin Finance Journal* 40, 17–35.
- Eckel, Catherine C. and Philip J. Grossman. 2008. "Men, Women and Risk Aversion: Experimental Evidence." *Handbook of Experimental Economics Results* 1, 1061–73.
- Faccio, Mara, Maria-Teresa Marchica, and Roberto Mura. 2016. "CEO Gender, Corporate Risk-Taking, and the Efficiency of Capital Allocation." *Journal of Corporate Finance* 39, 193–209.
- Faccio, Mara, Maria-Teresa Marchica, and Roberto Mura. 2011. "Large Shareholder Diversification and Corporate Risk-Taking." *The Review of Financial Studies* 24, no. 11, 3601–41.
- Francis, Bill B., Iftekhar Hasan, Qiang Wu, and Meng Yan. 2014. "Are Female CFOs Less Tax Aggressive? Evidence from Tax Aggressiveness." *The Journal of the American Taxation Association* 36, no. 2, 171–202.
- Francis, Bill, Iftekhar Hasan, Jong Chool Park, and Qiang Wu. 2015. "Gender Differences in Financial Reporting Decision Making: Evidence from Accounting Conservatism." *Contemporary Accounting Research* 32, no. 3, 1285–318.
- Francis, Jennifer, Donna Philbrick, and Katherine Schipper. 1994. "Shareholder Litigation and Corporate Disclosures." *Journal of Accounting Research* 32, no. 2, 137–64.
- Ge, Weili, Dawn Matsumoto, and Jenny Li Zhang. 2011. "Do CFOs Have Style? An Empirical Investigation of the Effect of Individual CFOs on Accounting Practices." *Contemporary Accounting Research* 28, no. 4, 1141–79.
- Geiger, Marshall A. and David S. North. 2006. "Does Hiring a New CFO Change Things? An Investigation of Changes in Discretionary Accruals." *The Accounting Review* 81, no. 4, 781–809.
- Gilligan, Carol. 1982. *In a Different Voice*. Harvard University Press.
- Givoly, Dan and Carla Hayn. 2000. "The Changing Time-Series Properties of Earnings, Cash Flows and Accruals: Has Financial Reporting Become More Conservative?" *Journal of Accounting and Economics* 29, no. 3, 287–320.
- Hambrick, D. C. and G. D. S. Fukutomi. 1991. "The Seasons of a CEO's Tenure" *The Academy of Management Review* 16, 719–42.
- Harjoto, Maretno, Indrarini Laksmana, and Robert Lee. 2015. "Board Diversity and Corporate Social Responsibility." *Journal of Business Ethics* 132, no. 4, 641–60.
- Harvey, Campbell R. and Akhtar Siddique. 2000. "Conditional Skewness in Asset Pricing Tests." *The Journal of Finance* 55, no. 3, 1263–95.
- Henderson, A. D., D. Miller, and D. C. Hambrick. 2006. "How Quickly Do CEOs Become Obsolete? Industry Dynamism, CEO Tenure, and Company Performance." *Strategic Management Journal* 27, 447–60.
- Hill, Ned C. and Bernell K. Stone. 1980. "Accounting Betas, Systematic Operating Risk, and Financial Leverage: A Risk-Composition Approach to the Determinants of Systematic Risk." *Journal of Financial and Quantitative Analysis* 15, no. 3, 595–637.

- Hoberg, Gerard, Gordon Phillips, and Nagpurnanand Prabhala. 2014. "Product Market Threats, Payouts, and Financial Flexibility." *The Journal of Finance* 69, no. 1, 293–324.
- Hong, Hyun A., Jeong-Bon Kim, and Michael Welker. 2017. "Divergence of Cash Flow and Voting Rights, Opacity, and Stock Price Crash Risk: International Evidence." *Journal of Accounting Research* 55, no. 5, 1167–212.
- Huang, Jiekun and Darren J. Kisgen. 2013. "Gender and Corporate Finance: Are Male Executives Overconfident Relative to Female Executives?" *Journal of Financial Economics* 108, no. 3, 822–39.
- Huang, Ting-Chiao, Hua-Wei Huang, and Chih-Chen Lee. 2014. "Corporate Executive's Gender and Audit Fees." *Managerial Auditing Journal* 29, no. 6, 527–47.
- Hung, Shengmin and Zheng Qiao. 2017. "Shadows in the Sun: Crash Risk behind Earnings Transparency." *Journal of Banking & Finance* 83, 1–18.
- Hutton, Amy P., Alan J. Marcus, and Hassan Tehranian. 2009. "Opaque Financial Reports, R 2, and Crash Risk." *Journal of Financial Economics* 94, no. 1, 67–86.
- Jianakoplos, Nancy Ammon and Alexandra Bernasek. 1998. "Are Women More Risk Averse?" *Economic Inquiry* 36, no. 4, 620–30.
- Jiang, John Xuefeng, Kathy R. Petroni, and Isabel Yanyan Wang. 2010. "CFOs and CEOs: Who Have the Most Influence on Earnings Management?" *Journal of Financial Economics* 96, no. 3, 513–26.
- Jin, Li and Stewart C. Myers. 2006. "R2 around the World: New Theory and New Tests." *Journal of Financial Economics* 79, no. 2, 257–92.
- John, Kose, Lubomir Litov, and Bernard Yeung. 2008. "Corporate Governance and Risk-Taking." *The Journal of Finance* 63, no. 4, 1679–728.
- Khan, Mozaffar and Ross L. Watts. 2009. "Estimation and Empirical Properties of a Firm-Year Measure of Accounting Conservatism." *Journal of Accounting and Economics* 48, no. 2, 132–50.
- Khurana, Inder K., Raynolde Pereira, and Eliza Xia Zhang. 2017. "Is Real Earnings Smoothing Harmful? Evidence from Firm-Specific Stock Price Crash Risk." *Contemporary Accounting Research*.
- Kim, Jeong-Bon and Liandong Zhang. 2016. "Accounting Conservatism and Stock Price Crash Risk: Firm-Level Evidence." *Contemporary Accounting Research* 33, no. 1, 412–41.
- Kim, Jeong-Bon, Yinghua Li, and Liandong Zhang. 2011a. "Corporate Tax Avoidance and Stock Price Crash Risk: Firm-Level Analysis." *Journal of Financial Economics* 100, no. 3, 639–62.
- Kim, Jeong-Bon, Yinghua Li, and Liandong Zhang. 2011b. "CFOs versus CEOs: Equity Incentives and Crashes." *Journal of Financial Economics* 101, no. 3, 713–30.
- Kim, Jeong-Bon, Zheng Wang, and Liandong Zhang. 2016. "CEO Overconfidence and Stock Price Crash Risk." *Contemporary Accounting Research* 33, no. 4, 1720–49.
- Kim, Yongtae, Haidan Li, and Siqi Li. 2014. "Corporate Social Responsibility and Stock Price Crash Risk." *Journal of Banking & Finance* 43, 1–13.
- Kothari, Sabino P., Susan Shu, and Peter D. Wysocki. 2009. "Do Managers Withhold Bad News?" *Journal of Accounting Research* 47, no. 1, 241–76.
- Kravit, Todd and Volkan Muslu. 2013. "Textual Risk Disclosures and Investors' Risk Perceptions." *Review of Accounting Studies* 18, no. 4, 1088–122.
- Kubick, Thomas R. and G. Brandon Lockhart. 2016. "Proximity to the SEC and Stock Price Crash Risk." *Financial Management* 45, no. 2, 341–367.
- Levi, Maurice D., Kai Li, and Feng Zhang. 2008. "Mergers and Acquisitions: The Role of Gender." Unpublished working paper.
- Li, Xi. 2010. "The Impacts of Product Market Competition on the Quantity and Quality of Voluntary Disclosures." *Review of Accounting Studies* 15, no. 3, 663–711.
- Li, Xiaorong, Steven Shuye Wang, and Xue Wang. 2017. "Trust and Stock Price Crash Risk: Evidence from China." *Journal of Banking & Finance* 76, 74–91.
- Liu, Yu, Zuobao Wei, and Feixue Xie. 2016. "CFO Gender and Earnings Management: Evidence from China." *Review of Quantitative Finance and Accounting* 46, no. 4, 881–905.

- Loughran, Tim and Bill McDonald. 2011. "When Is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10-Ks." *The Journal of Finance* 66, no. 1, 35–65.
- Mason, E. Sharon and Peter E. Mudrack. 1996. "Gender and Ethical Orientation: A Test of Gender and Occupational Socialization Theories." *Journal of Business Ethics* 15, no. 6, 599–604.
- McNichols, Maureen. 1988. "A Comparison of the Skewness of Stock Return Distributions at Earnings and Non-Earnings Announcement Dates." *Journal of Accounting and Economics* 10, no. 3, 239–73.
- Mian, Shehzad. 2001. "On the Choice and Replacement of Chief Financial Officers." *Journal of Financial Economics* 60, no. 1, 143–75.
- Niederle, Muriel and Lise Vesterlund. 2007. "Do Women Shy Away from Competition? Do Men Compete Too Much?" *The Quarterly Journal of Economics* 122, no. 3, 1067–101.
- Niessen, Alexandra and Stefan Ruenzi. 2007. "Sex Matters: Gender Differences in a Professional Setting." No. 06–01. *CFR Working Paper*.
- Olsen, Robert A. and Constance M. Cox. 2001. "The Influence of Gender on the Perception and Response to Investment Risk: The Case of Professional Investors." *The Journal of Psychology and Financial Markets* 2, no. 1, 29–36.
- Parker, Robert James, et al. 2017. "Disclosing Material Weakness in Internal Controls: Does the Gender of Audit Committee Members Matter?" *Asia-Pacific Journal of Accounting & Economics* 24, no. 3–4, 407–20.
- Peng, Lin and Ailsa Röell. 2008. "Manipulation and Equity-Based Compensation." Unpublished working paper.
- Peni, Emilia and Sami Vähämaa. 2010. "Female Executives and Earnings Management." *Managerial Finance* 36, no. 7, 629–45.
- Petersen, Mitchell A. 2009. "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches." *The Review of Financial Studies* 22, no. 1, 435–80.
- Roberts, Michael R. and Toni M. Whited. 2012. "Endogeneity in Empirical Corporate Finance." Unpublished working paper.
- Rosenbaum, Paul R. and Donald B. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70, no. 1, 41–55.
- Simsek, Z. 2007. "CEO Tenure and Organizational Performance: An Intervening Model." *Strategic Management Journal* 28, 653–62.
- Sugarman, David B. and Murray A. Straus. 1988. "Indicators of Gender Equality for American States and Regions." *Social Indicators Research* 20, no. 3, 229–70.
- Wanzenried, Gabrielle. 2008. "How Feminine Is Corporate America? A Recent Overview." *Journal of Economic Inequality* 6, no. 2, 185–209.

Appendix A. Variable Definitions

Variables	Definition
Crash Risk Variables	
<i>NCSKEW</i>	Negative conditional skewness of firm-specific weekly returns over the fiscal-year period
<i>DUVOL</i>	Natural logarithm of the ratio of the standard deviation of down-week to that of up-week firm-specific weekly returns over the fiscal-year period
CFO Variables	
<i>Female CFO</i>	Indicator variable equal to 1 if a CFO is female and 0 otherwise
<i>CFO Age</i>	Natural logarithm of 1 plus the executive's age
<i>CFO Tenure</i>	Natural logarithm of 1 plus the number of years the executive has been in the CFO position according to the ExecuComp database
Control and Other Variables	
<i>Stock Return</i>	Average firm-specific weekly returns for the current fiscal-year period, multiplied by 100
<i>Stock Volatility</i>	Standard deviation of firm-specific weekly returns over the fiscal-year period
<i>Dturnover</i>	Average monthly share turnover over the current fiscal-year period minus that of the previous period, where monthly share turnover is the ratio of monthly trading volume to total number of shares outstanding during the month
<i>Size</i>	Natural logarithm of market value of equity
<i>Market-to-Book Ratio</i>	Ratio of market value of equity to book value of equity
<i>Leverage</i>	Long-term debts divided by total assets
<i>Return on Assets</i>	Operating income before depreciation divided by lagged total assets
<i>Accruals</i>	Absolute value of discretionary accruals multiplied by -1 (Hutton, Marcus, and Tehranian 2009), where discretionary accruals are estimated from the modified Jones model (Dechow, Sloan, and Sweeney 1995). A higher absolute value indicates better financial reporting quality.
<i>Sales Growth</i>	Change in firm sales over the fiscal year divided by the previous period's value
<i>PPE</i>	Property, plant, and equipment divided by total assets
<i>Accounting Conservatism 1</i>	Difference between the skewness in operating cash flows (divided by total assets) and the skewness in net income (divided by total assets) over the previous three years (Givoly and Hayn 2000). A higher value means more conservative accounting.
<i>Accounting Conservatism 2</i>	The firm-level conservatism measure in Khan and Watts (2009). A higher value means more conservative accounting. We closely follow the variable definition and the sample selection of Khan and Watts. The only difference is that we winsorize the top and bottom 1 percent of key regression variables whereas Khan and Watts delete them.
<i>Option Incentive</i>	Incentive ratio of CFO option holdings (Kim et al. 2011b)
<i>Stock Incentive</i>	Incentive ratio of CFO stock holdings (Kim et al. 2011b)
<i>Gender Equality Index</i>	Cross-state index of gender equality across the United States developed by Sugarman (1988)
<i>Risk Disclosure Quality</i>	Residuals from the regression of the natural logarithm of number of risk-related words in 10-K on the two principal components of firm risk determinants
<i>Total Disclosure Quality</i>	Residuals from the regression of the natural logarithm of 1 plus number of total words on the principal components of firm risk determinants
<i>Relative Risk Disclosure Quality</i>	Residuals from the regression of the natural logarithm of 1 plus the ratio of the number of risk words to the number of total words on the principal components of firm risk determinants
<i>Market Governance</i>	Product market fluidity index reported by Hoberg, Phillips, and Prabhala (2014). A higher (lower) value indicates stronger (weaker) market governance.

Appendix B. Parsing Sequence of 10-K Filings

We retrieve all 10-K (including 10-K405) filings for the companies presented in the sample using the master index file provided by the U.S. Securities and Exchange Commission (SEC). We do not consider subsequent amendments. According to previous studies, textual analysis only focuses on the textual contents of the filings (e.g., Bodnaruk, Loughran, and McDonald 2015). Therefore, for each filing in the sample, we apply the following parsing sequence⁵ using regular expressions to eliminate unnecessary components of the text and make the filings comparable across firms. The remaining textual contents in each filing are used to count the total number of risk-related words suggested Kravet and Muslu (2013) and the total number of words commonly used in financial reporting by Loughran and McDonald (2011).

1. All ASCII-Encoded segments including <TYPE> tags of GRAPHIC, ZIP, EXCEL, and PDF are removed. In particular, ASCII encoding allows the conversion of binary data files to plain ASCII-printable characters to ensure cross-platform conformity, which ultimately increases the size of the original file by orders of magnitude.
2. All eXtensible Business Reporting Language (XBRL) format characters between <XBRL...>...</XBRL> are deleted. Specifically, XBRL is a markup language and it provides semantic context for the information provided in the 10-K. The usage of XBRL steadily became more popular after 2005. See <http://xbrl.sec.gov> for more information regarding XBRL.
3. All <DIV>, <TR>, <TD>, and formatting HTML tags are deleted.
4. SEC header section is then removed from the text using the following HTML tags: </SEC-HEADER> or </IMS-HEADER>.
5. All remaining markup tags such as <...> are removed.
6. The remaining reserved HTML characters are re-encoded. According to previous work, it is necessary to re-encode reserved HTML characters. For example, “&” and “&” are converted to the “&” symbol, or “>” or “>” are re-encoded as “GT” (i.e., greater than).
7. Lastly, some common idiosyncratic anomalies are parsed out. For instance, underscore symbols (“_”) are deleted, or line feeds (i.e., “\n”) following hyphens (“-”) are deleted.

⁵For more information regarding the parsing sequence, see Loughran and McDonald (2011) and Bodnaruk, Loughran, and McDonald (2015). Instead of deleting all tables, we opt to keep all character components to retain potential information discussed in these tables.

Appendix C. List of Risk-Related Keywords Suggested by Kravet and Muslu (Appendix 1, Table 6, 2013)

may	dependences	fluctuated
could	depended	fluctuating
can	depends	fluctuation
cannot	depending	fluctuations
risk	dependently	uncertain
risks	expose	uncertainty
risked	exposes	uncertainties
risking	exposing	possible
risky	exposer	possibly
riskiness	exposed	vary
riskier	exposure	varies
riskiest	exposures	varying
affect	hedge	might
potential	hedges	likely
potentials	hedged	influence
potentially	hedging	influences
depend	fluctuate	influencing
dependent	fluctuates	susceptible
dependence		

Review of Business is published twice a year.
ISSN: 0034-6454

Review of Business is a peer-reviewed academic journal. The journal publishes original research articles in all academic fields of business, both theoretical and empirical, that will significantly contribute to the literature of business and allied disciplines. The journal advocates for research articles in imminent topics, such as sustainable development, technology-related business issues, and topics that enrich the interdisciplinary understanding of business.

The Peter J. Tobin College of Business
St. John's University
New York

www.stjohns.edu/ROB (for submissions, style guide, publishing agreement, and standards of integrity)

ROBJournal@stjohns.edu (for inquiries and communications)



ST. JOHN'S UNIVERSITY

THE PETER J. TOBIN
COLLEGE OF BUSINESS

The Peter J. Tobin College of Business
8000 Utopia Parkway
Queens, NY 11439
stjohns.edu

Non-Profit Org.
U.S. Postage
PAID
St. John's University
New York