Carnegie Mellon
Tepper
SCHOOL OF BUSINESS

DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY
INDUSTRIAL ADMINISTRATION
(BUSINESS TECHNOLOGIES)

Titled

"ESSAYS IN ACCOUNTING REGULATION AND EARNINGS MANAGEMENT"

Presented by
Yi Liang

Accepted by

Pierre Jinghong Liang **4/30/15**

Chair: Prof. Pierre Jinghong Liang **Date**

Approved by The Dean

Robert M. Dammon **4/30/15**

Dean Robert M. Dammon **Date**

CARNEGIE MELLON UNIVERSITY

ESSAYS IN ACCOUNTING REGULATION AND EARNINGS MANAGEMENT

A DISSERTATION

SUBMITTED TO THE TEPPER SCHOOL OF BUSINESS

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

FIELD OF INDUSTRIAL ADMINISTRATION

By

Yi Liang

2015

Dissertation Committee

Jonathan Glover

Guofang Huang

Pierre Jinghong Liang (Chair)

John O’Brien

ACKNOWLEDGEMENTS

I am greatly indebted to Pierre Liang for his guidance, patience and encouragement that immensely improve my dissertation and shape my way of academic thinking. I am grateful to my committee members, Jonathan Glover, Guofang Huang, and John O'Brien for their advice, insights, and time. I also thank Andrew Bird, Stephen Karolyi, and Thomas Ruchti for their help and feedback.

It is impossible for me to complete this dissertation without the active and inter-disciplinary research environment at Tepper School of Business. I thank the professors for their courses and research seminars which greatly inspired me and benefited my research. I appreciate the financial support from the William Larimer Mellon Fellowship. I am grateful to Lawrence Rapp for making the school home to Ph.D. students. My fellow Ph.D. students also help me improve and the helps from Chen Li, Nan Xiong, Gaoqing Zhang, and Ronghuo Zheng are especially appreciated.

The second chapter is based on my working paper previously presented at 2014 American Accounting Association Annual Meeting. The discussant, Monica Neamtiu, provided extremely helpful comments regarding various aspects of the paper. This chapter also benefits from discussion with seminar participants at Carnegie Mellon University and Singapore Management University.

The third chapter is based on my job market paper. Jing Li provided extraordinary helpful comments regarding the theoretical model. Jack Stecher and Dirk Simons provided extensive help regarding the preparation of presentation. This chapter also benefits from discussion with seminar participants at Carnegie Mellon University, Chinese University of Hong Kong, HEC Paris, and Temple University.

Finally, I want to express my deepest gratitude to my parents for their love, sacrifice, and support. I am also thankful to my wife Jing Gong for her support and for bringing so much happiness to my life.

CONTENTS

1. INTRODUCTION

Agency problem and its implications are a key area of research in accounting. Agency problems arise when agent interests are not fully aligned with principal interests so that the agents' decisions may not be ideal to the principals. For accounting research specifically, agency problems can occur in various corporate contracting situations such as between managers and shareholders (e.g., Antle and Eppen 1985), board of directors and shareholders (e.g., Adams and Ferreira 2007), and auditors and shareholders (e.g., Antle 1984).

The agency problems between different participants of the financial market also manifest a variety of different phenomena and consequences in business practices. For example, the agency problem between managers and shareholders can cause manager shirking (e.g., Holmstrom 1979), earnings management (e.g., Fischer and Verrecchia 2000), and empire building (e.g., Hope and Thomas 2008). The agency problem between board and shareholders can result in boards' decisions that are undesirable to the shareholders such as excessively high manager compensation (e.g., Ryan and Wiggins 2004), fewer CEO turnovers (e.g., Laux 2008), and inefficient auditor selection (e.g., DeFond and Zhang 2013).

In this dissertation, I focus on two phenomena where agency problems may have a significant impact: earnings management and board's selection of auditors, and empirically assess their economic impact.

Chapter 2 explores whether commercial banks manipulate loan origination activities for loan-transfer-based earnings management. Using a unique database that contains home mortgage origination information of all commercial banks in the United States, I find that banks increase the origination of the more liquid non-jumbo mortgages to meet earnings benchmarks such as zero earnings and prior-year earnings. To originate more non-jumbo mortgages, I find two strategies are used by the banks: (1) denying fewer applications and (2) attracting more borrowers to accept the approved applications. I also find that the manipulation is negative associated with future bank interest income and noninterest income, which suggests that the manipulation has negative long-term consequences.

Chapter 3 empirically evaluates the economic impact of mandatory auditor rotation, which is one of the most controversial regulations in the public accounting industry. This chapter focuses on the critical role played by firms' existing internal governance and investigates whether the agency conflicts from imperfect internal governance will potentially affect the impact of mandatory auditor rotation.

Because mandatory auditor rotation is not yet effective in the US, it is difficult or even impossible to conduct a before-after comparison using a reduced form approach. To address this issue, I deploy a structural approach. Specifically, I first develop an analytical model auditor-client matching, then estimate the model parameters, and finally conduct counterfactual analysis by simulating new auditor-client matches with the requirement of mandatory rotation.

My counterfactual analysis suggests that (1) the cost of a ten-year rotation policy to shareholders is 5.9 billion to 7.2 billion dollars; (2) a significant fraction of the reduction results from reduced board effectiveness in selecting desirable auditors and hence the policy is more costly to the shareholders of the firms with strong internal governance; (3) policies that improve firm internal governance can work better and increase shareholder value; and (4) mandatory rotation becomes even more costly and further increases the cost of reduced board effectiveness by approximately 4.0 percent when firm internal governance improves and the board interests become fully aligned with shareholder interests. These findings highlight the potential cost of mandatory audit firm rotation and that the proposed rotation may counteract other policies intended to improve internal corporate governance.

2. DO BANKS MANIPULATE LOAN ORIGINATION ACTIVITIES FOR LOAN-TRANSFER-BASED EARNINGS MANAGEMENT

2.1 Introduction

After witnessing the growth of the secondary loan market, both accounting researchers and practitioners extended efforts and made attempts to understand the nature and accounting processes of loan transfers in the market. Among these attempts, much attention has been paid to the activities and consequences related to loan-transfer-based earnings management (i.e., manage earnings by recognizing gains from loan transfers such as securitization and loan sale) because it is under scrutiny for contributing to the recent financial crisis (e.g., Kothari and Lester 2012). Prior loan-transfer-based earnings management literature has majorly focused on the manipulation of securitization transactions and the related gains recognition (e.g., Dechow and Shakespeare 2009). This study extends the literature by studying whether incentives to manage gains from loan transfers also lead to real activity manipulation in loan originations. Using a unique database that contains home mortgage origination information of all commercial banks in the United States, this study hypothesizes and provides evidence that banks manipulate their loan origination activities for loan-transfer-based earnings management to meet earnings benchmarks. It is also documented that the manipulation has long-term negative impact on bank interest income and noninterest income.

The US secondary loan market has been growing rapidly since the 1970s. According to the Federal Reserve, for example, less than 10 percent of the home mortgages were securitized in the early 1970s, while more than 50 percent of them are securitized in the recent two decade.[1] This growth has not only improved the liquidity of bank assets but also created more opportunities for banks to recognize gains from loan sale and securitization.[2] The gains recognition, however, has also led to concerns about loan-transfer-based earnings management, and these concerns became even greater during and after the recent financial crisis. Accounting researchers contributed to the debates by sharing their insights about securitization and its accounting process (e.g., Ryan 2008). Regulators also took actions to resolve the concerns. For example, the Financial Accounting Standards Board (FASB) introduced SFAS 166/167 to further regulate gains recognition in securitization transactions in 2009. However, although loan-transfer-based earnings management has attracted the attention of a wide range of audience, empirical research about its real effects is still limited.

To fill this gap, this paper provides evidence on the following two research questions.

(1) Do banks manipulate loan origination activities for loan-transfer-based earnings management to meet earnings benchmarks? If yes, how do the banks manipulate?

(2) Does the manipulation have long-term impact on bank performance?

To answer these questions, this study focuses on the most mature and the largest secondary loan market in the US, the secondary home mortgage market, and examines the difference in jumbo and non-jumbo mortgages origination activities. Compared to jumbo mortgages, non-jumbo mortgages are more liquid in the secondary market because Government-Sponsored Enterprises (GSEs), such as Fannie Mae and Freddie Mac, trade and securitize them. This

[1] The Federal Reserve Statistical Release Z.1 – Financial Accounts of the United States is available online with URL: http://www.federalreserve.gov/releases/z1/.

[2] An example of gains recognition from securitization is provided in Section 2.

additional liquidity makes non-jumbo mortgages less costly to transfer and thus more attractive for earnings management. Specifically, this study tests whether banks exploit this opportunity by originating more non-jumbo mortgages for the earnings management purpose.

To originate more non-jumbo mortgages, banks can deploy different strategies. First, banks may increase the supply of non-jumbo mortgage by denying fewer non-jumbo mortgage applications. Second, banks may also adopt various promotional strategies to stimulate the demand. Empirically, this study tests whether both strategies are deployed by examining the bank denial ratio and borrower acceptance ratio of the non-jumbo mortgage applications.

Furthermore, this study examines the impact of the manipulation on bank future performance. Following the seminal work by Stein (1989), although real earnings management increases current earnings, this increase is generated at the cost of future earnings. In particular, if banks manipulate mortgage origination activities for loan-transfer-based earnings management, banks may have to sacrifice future interest income because (1) more loans are transferred eventually, (2) the interest rate of non-jumbo mortgages are in general lower than that of jumbo mortgages, and (3) banks may ask for lower interest rates so that more non-jumbo mortgages can be originated. Moreover, banks may also have to sacrifice future noninterest income because (1) if a fraction of the current-period incremental originations are not from increase in total demand but from inter-temporal substitution and (2) banks may approve risky mortgages to increase origination but then suffer more mortgage defaults in the future especially during the years when housing prices decrease.

The main findings of this study are summarized as follows. First, it is documented that more non-jumbo mortgages are originated when banks just meet earnings benchmarks, which is consistent with the expectation that manipulation in mortgage origination activities is used by banks to manage earnings. Second, this study finds that, in order to originate more non-jumbo mortgages, banks are less likely to deny non-jumbo mortgage applications and the borrowers' acceptance rate of bank approved mortgage applications increases. Finally, this study documents that manipulating mortgage origination activities to meet earnings benchmarks is negatively associated with future interest income and noninterest income, which suggests that the manipulation has long-term costs.

The reminder of this chapter is organized as follows. Section 2 discusses the institutional background. Section 3 reviews related literature. Section 4 develops hypotheses. Section 5 describes data and sample. Section 6 discusses my research design and main results. Section 7 concludes.

2.2 Industry Background

The secondary home mortgage market is the place where financial institutions trade and securitize home mortgages. The market has been growing rapidly since 1970s and is the most mature and the largest loan securitization market in the US today. About 30 percent of commercial bank total assets consist of home mortgages and more than half of the home mortgages were securitized after origination in the recent two decades (Loutskina 2011). [3]

A unique feature of the secondary home mortgage market is that it is significantly affected by Government-Sponsored Enterprises (GSEs), such as Fannie Mae and Freddie Mac. The GSEs are created to help the low- and mid-income Americans to become home owners so that Federal laws, such as Emergency Home Finance Act, restrict GSEs to only purchase conforming

[3] A detailed discussion of accounting for mortgage banking is provided in Appendix 2A.

mortgages. To be conforming, the loan amount cannot exceed a certain threshold. The threshold is referred as the "jumbo/non-jumbo cutoff", which is announced by Fannie Mae at the beginning of each year. Any mortgage with loan amount greater than the threshold is classified as jumbo mortgage, and any mortgage with loan amount less than the threshold is classified as non-jumbo mortgage.

Bank managers control and optimize the mortgage portfolios to achieve business goals such as maximizing profits and meeting earnings benchmarks by taking the differences between jumbo and non-jumbo mortgages into consideration. On the one hand, as discussed above, because GSEs may only purchase non-jumbo mortgages, the secondary market liquidity of non-jumbo mortgages is higher than that of jumbo mortgages, which gives non-jumbo mortgages the competitive advantage in generating gains from loan transfers. On the other hand, jumbo mortgages have higher interest rates in general and are more likely to be held for a longer period by the banks, which yield higher interest income in the future.[4] Therefore, in terms of bank performance, the tradeoffs between originating non-jumbo mortgages and jumbo mortgages are majorly about the inter-temporal tradeoffs of earnings.

2.3 Literature Review

This paper is closely related to literature on real earnings management and bank earnings management.

Prior literature on real earnings management documents that managers manipulate various real activities to manage earnings including reducing R&D expenditure (e.g., Dechow and Sloan 1991, Bushee 1998), repurchasing stocks (e.g., Bens, Nagar, Skinner, and Wong 2003), and

[4] This situation, however, reverted in 2013 when GSEs increased the guarantee fee, which increased the opportunity cost of originating non-jumbo mortgages.

selling fixed assets (e.g., Herrmann, Inoue, and Thomas 2003). Perhaps one of the most important reasons for managers to manage earnings is to meet earnings benchmarks, such as zero earning, analyst forecasts, and earnings of the previous years (Burgstahler and Dichev 1997). One of the most important incentives for the managers to manage earnings to meet benchmarks is from compensation. Matsunaga and Park (2001) report that the bonus of CEOs drops significantly if earnings benchmarks are not met. Bartov, Givoly and Hayn (2002) find that the firms can enjoy higher stock returns if earnings benchmarks are met, and this is perhaps the reason why managers with higher equity-based compensation are more likely to report earnings that meet analyst forecasts as documented by Cheng and Warfield (2005). Besides the monetary incentives, Farrell and Whidbee (2003) report that boards take meeting earnings benchmarks into account when they make CEO turnover decisions.

Degeorge, Patel, and Zeckhauser (1999) theoretically prove that forward looking managers manage earnings to meet earnings benchmarks if there is compensation incentive and the managers' expected high future earnings. This finding suggests that meeting earnings benchmarks also conveys information about good future performance to the market. This prediction is also supported by a recent empirical study by Gunny (2010), which documents positive associations between firm future performance and various types of real activities manipulation.

The literature on bank earnings management provides evidence that banks engage in both accrual and real earnings management. Beatty, Chamberlain, and Magliolo (1995) use data in the late 1980's and find that banks use discretions over loan-related accruals and real transactions to manage both earnings and capital. In contrast, Ahmed, Takeda, and Thomas (1999) provide evidence that loan loss provisions are not used for managing earnings after 1990. Beatty, Ke, and

Petroni (2002) compare the earnings management by public banks with that by private banks, and their documentation suggest that public banks engage in earnings management to avoid small earnings declines more frequently.

Within the literature on bank earnings management, several studies focus on loan-transfer-based earnings management. Shakespeare (2004), Karaoglu (2005), and Dechow, Myers, and Shakespeare (2010) consistently find that recognizing gains on securitization is used by the managers to manage earnings. However, by focusing on the reported gains on securitization only, none of these studies documents any real transaction manipulation by the firms. Dechow and Shakespeare (2009), perhaps the most closely related research to this study, find that many securitization transactions occur within the last five days of the quarter so that managers can perform financial statement window-dressing to beat earnings benchmarks.

The research questions and designs of this study differ from the previous studies in the following ways. First, this study focuses on the loan origination activities rather than the loan transfer transactions and the gains recognitions. Second, this study further examines the impact of loan origination manipulations on bank future profitability. Third, more than 2,000 distinct banks, 65 million mortgage applications, and 5 trillion dollars are directly involved in the sample, which are much greater than those in most of the prior literature.

2.4 Hypotheses Development

As discussed above, mortgage transfers provide banks opportunities to recognize gains, which can be further used to manage earnings and accomplish goals such as meet earnings benchmarks. In order to recognize such gains, the gains need to be justifiable. For mortgage transfers, because the secondary home mortgage market is more mature, standard, and active than other secondary loan markets, exceptionally large gains from transactions of a few mortgages are hard to be justified (Ryan 2007). Therefore, banks need to have enough volumes of transferred mortgages to justify sizable gains.

This feature of secondary home mortgage market makes originating non-jumbo mortgages more attractive for loan-transfer-based earnings management to meet earnings benchmarks for the following two reasons. First, more non-jumbo mortgages yield more accessible opportunities to recognize gains from loan transfers because non-jumbo mortgages may be purchased by the GSEs.[5] Second, non-jumbo mortgages can also better satisfy the need of window-dressing because the high liquidity of non-jumbo mortgages makes it easier for the banks to transfer them within a short period. Hence, my first hypothesis is as follows.

H1: Other things being equal, banks originate more non-jumbo mortgages (than jumbo mortgages) to meet earnings benchmarks.

As a supplier in the mortgage origination market (i.e., the market consists of banks and borrowers), in order to originate more non-jumbo mortgages, the banks can either increase the supply or stimulate the demand. That is, the banks can increase the supply of the non-jumbo mortgages by simply approving more non-jumbo mortgage applications. Or, the banks can stimulate the demand of non-jumbo mortgages by attracting more non-jumbo mortgage

[5] As discussed in Section 2, Fannie Mae and Freddie Mac may not necessarily purchase all non-jumbo mortgages, especially when the mortgages are classified as non-conforming. Therefore, ideally, if conforming mortgages can be identified directly, the paper should use conforming rather than jumbo as the criterion to segment mortgages. This data limitation, however, works against the paper to find a significant difference between the originations of jumbo and non-jumbo mortgages when there is earnings management incentive.

borrowers to accept the approved applications by, for instance, reducing the interest rates.[6] Hence, my second hypothesis is as follows.

H2A: Other things being equal, banks deny fewer non-jumbo mortgage applications (than jumbo mortgage applications) to meet earnings benchmarks.

H2B: Other things being equal, non-jumbo mortgage borrowers are more likely to accept approved mortgage applications (than jumbo mortgage borrowers) when banks meet earnings benchmarks.

Although manipulating non-jumbo mortgage origination activities can increase current period earnings, it also has negative impact on bank future earnings. Specifically, bank future interest income may decrease because, to attract more borrowers to accept the approved applications, the banks may need to provide low-interest-rate offers to the borrowers. Moreover, when more mortgages are originated for transfer and are indeed transferred later, the bank interest income will reduce mechanically. Finally, because the interest rates of non-jumbo mortgages are lower than that of jumbo mortgages in general, allocating more resources to non-jumbo mortgages will also lead to low future interest income.

Furthermore, bank future noninterest income may also decrease because denying fewer non-jumbo mortgages applications could lead to more defaults in the future. In particular, by denying fewer non-jumbo mortgages, banks have to accept the marginal applications that they will not accept without earnings management incentives, and these applications are probably from borrowers of worse credit history and are hence more risky. Moreover, if not all of the current-

[6] Consistent with the definitions used by HMDA database, the term 'approve a mortgage' means the bank accepts the mortgage application and agrees to originate the mortgage, while the term 'accept a mortgage' means the borrower takes the offer after the mortgage application is approved by the bank.

period incremental originations are from increase in total demand but from inter-temporal substitution, the future mortgage origination volume will reduce and bank noninterest income will also reduce accordingly.

The predictions above are consistent with the opinion that real earnings management is costly (e.g. Stein 1989). However, from an information economics perspective, real earnings management may also be associated with good future performance. Specifically, managers may only manage earnings to meet earnings benchmarks when they expect good future performance (Degeorge et al. 1999) so that meeting earnings benchmarks may be viewed as signals for high future profitability (Bartov et al. 2002). Moreover, meeting earnings benchmarks can also avoid potential debt covenant violations, which can also positively affect future firm profitability (Bartov 1993).

Finally, combining the prior two theoretical predictions, there may be no association between manipulation and future profitability if conducting real earnings management is the banks' optimal choice. In other words, originating more non-jumbo mortgages could be optimal if the benefits from meeting the earnings benchmarks equal the costs of manipulation, thus the subsequent bank performance may be insignificantly different a peer bank.

Because different theories predict different associations between manipulation and future bank profitability, I write the hypothesis about the association in null form. Hence, my third hypothesis is as follows.

H3: Other things being equal, there is no association between loan origination manipulation to meet earnings benchmarks and future profitability.

2.5 Data and Sample Selection

The data for this empirical study are from three sources. First, the data on mortgage applications and originations are obtained from the Home Mortgage Disclosure Act (HMDA) database. Second, the bank financial statement data are obtained from the Reports of Condition and Income (known as Call Reports). Third, the data on jumbo mortgage thresholds of each year are obtained from the website of Fannie Mae. The sample starts from 1998 Q4 and ends at 2011 Q4.

The HMDA database provides detailed information about each mortgage application. The key variables that are used in this study include the ID of the bank that received the mortgage application, the year when the application was received, the loan amount, the action taken to the application (i.e., whether the mortgage is successfully originated or not), the applicant's gross annual income, and the location of the property.

The sample is created with the following steps, which are summarized in Table 1. First, any non-conventional mortgages (i.e., mortgages that are insured or guaranteed by Federal Housing Administration, Veterans Administration, Farm Service Agency, or Rural Housing Service) are dropped since the risks and returns of these mortgages are fundamentally different from those of conventional mortgages. Second, the records with missing loan amount, property state, and the action taken to the application are dropped. Third, the applications of which the property locations are in Alaska, Hawaii, Guam, or US Virgin Island are dropped, because jumbo mortgage thresholds are not applicable to the properties in those areas. Fourth, the records from HMDA sample are aggregated into bank-year observations. Since the interests are in the mortgage origination activities for jumbo/non-jumbo mortgages, the aggregation is separate for the two types of mortgages. Fifth, bank-years that have no jumbo mortgage application, no non-jumbo application, or fewer than 100 mortgage applications during the year are dropped. The purpose of this step is to ensure the home mortgage businesses of the banks are not too small so that earnings management with mortgage transfers is feasible to them. Sixth, the quarterly Call Report data are aggregated to bank-years and only observations with non-missing total assets and net income are retained in the sample. Finally, the HMDA data with Call Report data are merged by year and Call Report identification number (item RSSD9001 in the Call Report). After this process, 22,633 bank-year observations are left in the sample.

Table 2 reports the number of mortgage applications, the volume of mortgage originations, and the number of suspect banks (i.e., the bank-years just meet/beat earnings benchmarks) in each year. Until 2006, there was a significant increase in total number of applications, but the situation reversed afterwards. The origination volumes for both jumbo and non-jumbo mortgages also exhibit similar trends. These patterns are consistent with the timing of the boom and recession of the home mortgage market in the recent two decades. The total suspect bank-years consist of approximately 5.5 percent of the total observations, which is similar to those reported in the prior literature.

2.6 Research Design and Main Results

2.6.1 Variables and Summary Statistics

This study focuses on bank home mortgage origination activities for jumbo and non-jumbo mortgages. To measure the mortgage origination activities, the total jumbo (non-jumbo) mortgage origination volume is used, which is the summation of the loan amount of all originated jumbo (non-jumbo) mortgages for a bank-year combination (scaled by average total assets). Following Loutskina and Strahan (2009), the difference between non-jumbo and jumbo mortgages origination volumes is taken to difference out any unobserved factors that have same impact on the origination volumes of both types of mortgages. Finally, this difference is denoted as ΔVol.[7]

Following prior earnings management literature, I further decompose ΔVol into two components, a normal component ΔVol^N and an abnormal component ΔVol^A. Conceptually, ΔVol^N is the level of difference between non-jumbo and jumbo mortgages origination volumes without any manipulation. Thus, ΔVol^N should be related to bank fundamentals and mortgage market characteristics but not earnings management incentives. For example, bank book liquidity ratio may be negatively associated with ΔVol^N because banks may worry less about the illiquid jumbo mortgages when bank book liquidity is high. Similarly, the average household income may be negatively associated with ΔVol^N since richer families are more likely to apply for jumbo mortgages. ΔVol^N is estimated as the expected value from the following model developed by Loutskina and Strahan (2009).[8]

$$\begin{aligned}\Delta Vol = \beta_0 + \beta_1 bank\ size + \beta_2 liquidity\ ratio + \beta_3 capital\ ratio \\ + \beta_4 avg(home\ income) + \beta_5 avg(loan\ size) + \beta_6 fraction\ in\ MSA + \epsilon\end{aligned} \tag{1}$$

where:

$bank\ size$ is the logarithm of bank average total assets.

$liquidity\ ratio$ is the bank book liquidity ratio, which is calculated as the summation of hold-to-maturity securities and available-for-sale securities scaled by average total assets.

[7] Bank-specific and year-specific subscripts are not included for expositional simplicity. The subscripts will be added back in the following sections.

[8] I run a pooled regression to estimate the coefficients since all firms in my sample are commercial banks, which implies that they should have similar coefficients. A pooled regression ignores heterogeneity, but reduces the estimation error.

$capital\ ratio$ is bank capital ratio, which is calculated as the summation of tier-1 and tier-2 capital scaled by total risk weighted assets in year $t-1$.

$avg(home\ income)$ is the average of household income.

$avg(loan\ size)$ is the average of loan amount.

$fraction\ in\ MSA$ is the percentage of properties that locate in Metropolitan Statistical Area (MSA).

Finally, ΔVol^{A} is defined as the difference between ΔVol and ΔVol^{N}, which is estimated as the residual from the previous model and used to examine the long term impact of manipulation.

Panel A Table 3 reports sample statistics of key variables that are used in the analysis. The variable of primary interest is ΔVol. On average, ΔVol is positive, which means that banks originate more non-jumbo mortgage than jumbo mortgage. The sample statistics also suggest that ΔVol is right skewed, which suggests that some banks may focus almost entirely on originating non-jumbo mortgages. Panel B Table 3 shows the Pearson and Spearman correlations between the variables. For almost all the pairs reported in the panel, Pearson and Spearman correlations are of same sign and significance. However, there is one exception, which is the correlation between ΔVol and bank ROA. The Pearson correlation between these two variables is positive but Spearman correlation is negative. However, this may not be too surprising because, as will be discussed in Section 2.6.5, reverse causality may exist between these two variables.

2.6.2 Meeting Earnings Benchmarks and Mortgage Origination

To test whether banks originate more non-jumbo mortgages for loan-transfer-based earnings management to meet earnings benchmarks, a similar research design developed by

Roychowdhury (2006) is deployed. Specifically, the term "suspect" is used to indicate a bank-year observation if the bank just meets either zero earnings or prior-year earnings benchmarks in that particular year. Suspects that just meet the zero earnings benchmark are defined as bank-years with net income divided by average total assets within the interval [0, 0.005]. Similarly, suspects that just meet prior-year earnings are defined as bank-years with the ratio of current-year net income to the prior-year net income within the interval [1, 1.005]. To identify the difference in mortgage origination activities between normal bank-years and suspect bank-years, The following regression is conducted.[9]

$$\Delta Vol_{i,t} = \beta_0 + \beta_1 Suspect_{i,t} + \sum_m \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t} \quad (2)$$

where $Suspect_t$ is a dummy variable that equals one if the bank-year is classified as suspect and equals zero otherwise. Control variables include a dummy variable that equals one if the bank-year misses the earnings benchmarks, logarithm of bank average total assets, bank book liquidity ratio, bank capital ratio, average of household income, average of loan amount, percentage of properties that locates in MSA, Return on Assets (ROA), bank fixed effects, and year fixed effects.

According to hypothesis H1, suspects are expected to engage in more loan-transfer-based earnings management. Therefore, the coefficient of suspect, β_1, is expected to be positive and significant. Table 4 reports the estimation results. Specifically, Table 4 provides three versions of regression (2). The first two columns are for two different earnings benchmarks, zero earnings

[9] As discussed in the prior literature that adopts a similar research design (e.g., Roychowdhury 2006 and Zang 2012), the following reasons may reduce the power of the empirical test and work against me finding difference between suspects and non-suspects. First, some bank-years that just missed earnings benchmarks may also tried real earnings management but were not successful. Second, bank-years with high earnings may manage their earnings downwards to reserve so that the interval used to classify suspects may also contain some of these observations.

and prior–year earnings, respectively. The third column is a pooled regression, where the suspect dummy variable equals one as long as either of the earnings benchmarks is met. For all of the three versions, the coefficients of the suspect dummy variable are positive and significant at 1% level. The consistent positive coefficients support hypothesis H1. Moreover, the coefficients of the control variables are also consistent with the predictions and findings from prior literature that studies mortgage origination activities (e.g., Loutskina and Strahan 2009).

To show the robustness of the above results, a modified version of regression (2) as follows is used by adding seven additional dummy variables near the earnings benchmarks.

$$\begin{aligned}\Delta Vol_{i,t} = \beta_0 + \beta_1 Suspect_{i,t} &+ \beta_2 D_{[-0.02,-0.015),i,t} + \beta_3 D_{[-0.015,-0.01),i,t} \\ &+ \beta_4 D_{[-0.01,-0.005),i,t} + \beta_5 D_{[-0.005,0),i,t} + \beta_6 D_{(0.005,0.01],i,t} \\ &+ \beta_7 D_{(0.01,0.015],i,t} + \beta_8 D_{(0.015,0.02]i,t} + \sum_m \beta_{9,m} Control_{m,i,t} + \epsilon_{i,t}\end{aligned} \quad (2')$$

where $D_{[x,y)}$ equals one if earnings is within the interval $[x, y)$. Compared with regression (2), this modified specification has the advantage of identifying the variations of ΔVol from not only suspect bank-years but also bank-years that are near the earnings benchmarks.

Figure 1 reports the coefficients of the dummy variables estimated from regression (2'). Panel A plots the variation of ΔVol near zero earnings benchmark and Panel B plots the variation of ΔVol near prior-year earnings benchmarks.[10] For both panels, the peaks of ΔVol are at the suspect interval, which suggests that the suspects engage in the highest level of earnings management. For some of the intervals that are close to the earnings benchmarks, ΔVol is also higher, which suggests that banks sometimes may still miss earnings benchmarks or over-

[10] The coefficients are not statistically significant except those of suspect dummy for both earnings benchmarks and $D_{(0.005,0.01],i,t}$ for zero earnings benchmarks.

manage earnings when bank managers' information about unmanaged earnings is imperfect (Degeorge et al. 1999).

2.6.3 The Strategies to Manage Earnings

To study what strategies are used by the banks to manage earnings (i.e., deny fewer applications and/or attract more borrowers to accept approved applications), two new variables are first defined as follows: The volume difference between denied non-jumbo mortgage applications and denied jumbo mortgage applications, denoted as ΔVol_Deny, and the volume difference between not accepted or withdrawn non-jumbo mortgage applications and not accepted or withdrawn jumbo mortgage applications, denoted as $\Delta Vol\_NotAccepted$. Again, not accepted applications are applications that are approved by the banks but are not accepted by the borrowers. Hence, a greater $\Delta Vol\_NotAccepted$ means the offered non-jumbo mortgages are less attractive to borrowers. The following regressions are run to test how earnings management incentive affects the bank mortgage origination strategies.

$$\Delta Vol\_Deny_{i,t} = \beta_{1,0} + \beta_{1,1} Suspect_{i,t} + \sum_m \beta_{1,2,m} Control_{m,i,t} + \epsilon_{1,i,t} \tag{3.1}$$

$$\begin{aligned}\Delta Vol\_NotAccepted_{i,t} \\ = \beta_{2,0} + \beta_{2,1} Suspect_{i,t} + \beta_{2,2} \Delta Vol\_Deny_{i,t} + \sum_m \beta_{2,3,m} Control_{m,i,t} \\ + \epsilon_{2,i,t}\end{aligned} \tag{3.2}$$

According to hypothesis H2A and H2B, suspects are expected to deny fewer while attract more non-jumbo mortgages, thus both $\beta_{1,1}$ and $\beta_{2,1}$ are expected to be negative and significant. When banks approve the marginal applications that would not be approved without earnings management incentives, these applications are also likely to be denied by other banks. Thus, the acceptance rate by the borrowers will increase but this is not because the banks stimulate the demand. Therefore, regression (3.2) also includes ΔVol_Deny to control the impact from bank approval.

Table 5 reports the estimates from regression (3.1) and (3.2). The regressions are estimated using seemingly unrelated regression (SUR) to allow potential correlations in error terms. The first column of Table 5 contains estimates about the bank mortgage application denial strategy. The coefficient of the suspect dummy variable is negative and significant at 1% level, which suggests that banks indeed deny fewer non-jumbo mortgage applications when they just meet earnings benchmarks. Hence, hypothesis H2A is supported. The second column in Table 5 contains estimates of the strategy to attract more borrowers to accept approved applications. The coefficient of the suspect dummy variable is also negative and marginally significant at 10% level, which weakly supports hypothesis H2B. Instead of using only SUR, OLS is also used to estimate the same system of equations as a robustness check (not tabulated). The point estimates do not change and the only qualitative difference is that the estimate $\beta_{2,1}$ is significant at 5% level.

2.6.4 Future Profitability and Real Earnings Management

To test the association between real earnings management in mortgage originations and future bank profitability, a research design similar to Gunny (2010) is used as follows.

$$\begin{aligned} Income_{i,t+k} = \gamma_0 + \gamma_1 Suspect_{i,t} + \gamma_2 \Delta Vol_{i,t}^{A} + \gamma_3 Suspect_{i,t} \times \Delta Vol_{i,t}^{A} \\ + \sum_m \gamma_{4,m} Control_{m,i,t+k} + \epsilon_{i,t+k} \end{aligned} \tag{4}$$

where $Income_{i,t+k}$ is net income, interest income, or noninterest income of bank i in year $t + k$ scaled by average total risk-weighted assets. Control variables include bank size, capital ratio, liquidity ratio, and the income measure in year t, year fixed effects, and bank fixed effects.

Following hypothesis H3, no association is expected between future profitability and earnings management by manipulating mortgage origination activities, thus γ_3 is expected to be not statistically significant in general. However, as discussed in Section 2.4, manipulation may have different impact on different income measures. Net income is the broadest measure, which includes both revenues and various expenses. Hence, using net income as the dependent variable, γ_3 will reflect the net impact of the cost of manipulation and positive information about future income. Thus, the sign of γ_3 is harder to predict and more likely to be statistically insignificant. Interest income and noninterest income are narrower measures of firm performance, which only include revenues and gains/losses from interest-related and noninterest-related activities but leave out other factors such as interest expenses and bank employee salaries. Hence, using interest income or noninterest income as the dependent variable, γ_3 is more likely to capture the cost of manipulation so that γ_3 is more likely to be negative.

Table 6 reports the association between abnormal mortgage origination volumes and future profitability. The estimates from regression with income one to three years ahead are reported in column one to three. The fourth column contains estimates from a pooled regression using the three-year average income as the dependent variable.

Panel A Table 6 reports estimates of regression (4) using net income as dependent variable. For all specifications, γ_3 is not statistically significant, which supports hypothesis H3. In other words, when evaluating future net income, the net effect of the cost of manipulation and the information from meeting earnings benchmarks is zero. Furthermore, the coefficients of suspect dummy variable (i.e., γ_2) are all positive and significant, which is also consistent with the signaling story. Overall, a positive γ_2 and a not significant γ_3 can be interpreted as manipulating via loan origination activities does not provide extra information than other tools of manipulation or banks optimal select the level of manipulation so that the benefits and costs of manipulation equal to each other.

Panel B Table 6 reports estimates of regression (4) using interest income as dependent variable. For all specifications, γ_3 is negative and at least marginally statistically significant. This finding is different from that in Panel A Table 6 but consistent with the discussion above, because interest income is a finer measure to potentially better capture the interest income reduction aspect of the cost of manipulation. Panel C Table 6 reports estimates of regression (4) using noninterest income as dependent variable and limiting the sample to only include years when housing price decreases.[11] For all specifications, γ_3 is negative and statistically significant except for one year after the manipulation. This finding does not support hypothesis H3 but is also consistent with the previous discussion. The observation that γ_3 is greater in magnitude and more statistically significant for $k = 2, 3$ than $k = 1$ is also consistent with prior literature that document mortgage default hazard function is inverted U-shaped and reaches its maximum 26-30 months after its origination (Elul 2011).

Finally, it is also worth noting that the coefficients of income in year t and the R^2 decrease monotonically as k increases for all income measures, which is consistent with the intuition that the auto-correlation and explanatory power of a lagged variable often decay with time.

[11] When housing price increases, even if the mortgages default, the banks may not suffer from the defaults because banks can liquidate the property for sufficient cash to at least break even.

2.6.5 Robustness Checks

An implicit assumption made in this paper is that profit-maximizing banks would take the securitization opportunities from non-jumbo mortgages so that bank earnings would increase as more non-jumbo mortgages are originated than jumbo mortgages. In other words, it is expected that originating more non-jumbo mortgages can be a tool for earnings management. In this section, this prediction is empirically validated by estimating the association between ΔVol and bank earnings in the following regression.

$$E_{i,t} = \beta_0 + \beta_1 \Delta Vol_{i,t} + \sum_{m} \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t} \tag{6}$$

where $E_{i,t}$ is bank earnings (scaled by average total assets), and control variables include logarithm of bank average total assets, bank book liquidity ratio, bank capital ratio, bank fixed effects, and year fixed effects.

Following the discussion above, β_1 is expected to be positive and significant. However, simply applying regression (6) may be problematic because of the potential existence of reverse causality. Specifically, because increasing $\Delta Vol_{i,t}$ can potentially increase earnings, banks may have incentive to originate more non-jumbo mortgages when their earnings are low, which leads to a negative association between earnings and $\Delta Vol_{i,t}$. Hence, the estimated β_1 from regression (6) will be negatively biased.[12]

An instrumental variable (IV) approach is used to fix the reverse causality issue. Specifically, a new variable $\Delta\overline{App}_{-i,t}$, the average difference between the total volumes of non-jumbo

[12] The reverse causality works against me finding a positive β_1. Hence, if β_1 still positive and significant from regression (2), reverse causality is of less concern.

mortgage applications and the total volumes of jumbo mortgage applications of all the banks *other than* bank i in the sample in year t, is used as an IV for $\Delta Vol_{i,t}$ in regression (6).

A valid IV should be (a) correlated with the endogenous variable but (b) uncorrelated with the error term in the original regression (Larcker and Rusticus 2010). For condition (a), theoretically, when a bank attracts and originates more non-jumbo mortgages, the non-jumbo mortgage applications to the other banks should reduce on average as a result of competition. Therefore, a negative correlation between $\Delta Vol_{i,t}$ and the IV is expected. For condition (b), since the number of applications to the other banks, the IV, can only affect bank i's income statement through competition, and variable that is affected by competition (i.e., $\Delta Vol_{i,t}$) is already included in the regression, the IV should have no incremental effect on bank i's earnings. That is, the IV should not be correlated with the error term as long as the endogenous variable is included in regression (6). Finally, Heckman's 2SLS is applied to estimate the coefficients.

Table 7 reports the estimates of regression (6). The first column in Panel A contains estimates from OLS regression without considering the reverse causality issue. As reported in the column, the coefficient of ΔVol is 0.0188, which is positive and statistically significant at 1% level. As discussed above, the estimated coefficient is negatively biased because of reverse causality and a positive and significant estimate shows even stronger support for the expectation that bank earnings increase as more non-jumbo mortgages are originated than jumbo mortgages. In other words, the coefficient is expected to be even greater in magnitude when the endogeneity issue is resolved.

Panel B Table 7 reports estimates from the first stage regression of the IV approach. The coefficient of the IV (i.e., $\Delta\overline{App}_{-i,t}$) is negative, which matches the competition story. The coefficient is also significant at 1% level, which confirms that the IV is correlated with the endogenous variable (i.e., condition (a)) and suggests that the IV is not a weak instrument. It is also worth noting that the magnitude of the coefficient of the IV is large. This matches the intuition that change in one bank's mortgage origination activities can only affect the other banks' average application volumes to a small extent. The second stage results are reported in the second column of Panel A Table 7. The coefficient of ΔVol from is 0.0343, which is about twice as big as that from OLS. This finding suggests that reverse causality exists indeed, and the marginal impact of mortgage origination activities on bank earnings is underestimated by half if reverse causality is not taken into account. Finally, comparing the results from 2SLS to those from OLS, the signs and significance levels of all the other coefficients are the same across the two regressions in general.

Another implicit assumption made for the main tests is that banks have the ability to manipulate mortgage originations, which is a necessary condition for the real earnings management story to work. To support this argument, the distribution of mortgage loan amount is plotted in Figure 2. If banks cannot or do not manipulate mortgage originations at all, the distribution near jumbo/non-jumbo cut-off should be smooth. However, it is observed in Figure 2 that the density increases right before the cut-off and drops immediately after the cut-off. This finding is consistent with the assumption that banks indeed have the ability to manipulate mortgage originations.

Earnings management may occur only when there are agency conflicts between bank managers and other shareholders. In other words, if a bank is completely privately owned or largely privately owned, the bank managers' interests should be highly aligned with the owners' interests so that earnings management may not arise in these banks. If this is the case, including these banks in the sample will reduce the power of the test and results in less significant estimates. However, if I observe privately owned banks also manipulate ΔVol to meet earnings benchmarks, it can be a concern because in principal private bank managers should have no incentive to manage earnings. To address this issue, regression (2) is performed on a subsample, which consists of banks within lower ten percent of total assets.[13] As reported in Table 8, the coefficients of suspect dummy variable are all not statistically significant, which suggests that private banks do not manipulate loan origination activities to manage earnings.

The origination activities may also be different during the recent financial crisis. Specifically, it is possible that borrowers are more likely to be financially constrained during the crisis years so that the demand and hence the origination of non-jumbo mortgages are higher. Moreover, banks are also more likely to underperform during the crisis years so that there may be more suspects. Therefore, the positive association between ΔVol and $Suspect$ may not be driven by earnings management but by crisis. In general, because regression (2) has already included year fixed effects, this concern can be partially addressed. However, if the financial crisis has different impact on different banks, year fixed effects will not be able to capture this difference and the alternative explanation still cannot be fully eliminated. To address this concern, regression (2) is performed on a subsample that excludes observations from 2007 and 2008. As reported in Table 9, the coefficients of suspect dummy variable are still all positive and statistically significant, which suggests the empirical results reported above more not driven by observations from the crisis years.

Finally, I also examine and find my main results are robust with the following alternative specifications. First, I change the dependent variable from total volume of mortgages originated

[13] I use bank size as a proxy for private and public ownership.

to total number of mortgages originated. Second, I exclude extremely large or small mortgages and only examine the mortgages that are larger than 25 percent of jumbo mortgage threshold and smaller than three times of jumbo mortgage threshold. Third, I change the definition of a suspect bank-year by varying the upper bounds of the intervals that defines a suspect. Fourth, I alter my sample selection by (1) including banks with either no jumbo or no non-jumbo mortgage application within my sample and (2) varying the number of total number of mortgage applications required from 100 to 30, 50, or 200.

2.7 Conclusion

This paper studies whether banks manipulate loan origination activities for loan-transfer-based earnings management and, if yes, how the manipulations affect bank future performance. To accomplish this goal, this paper examines the origination activities of home mortgages and uses a unique database from HMDA that contains mortgage application and origination activity records of all the US commercial banks.

This study finds that the origination volumes of the more liquid non-jumbo mortgages increase when banks just meet earnings benchmarks, which suggests that loan origination activity manipulation is used as a tool for loan-transfer-based earnings management. To originate more non-jumbo mortgages, banks both deny fewer non-jumbo mortgage applications and attract more non-jumbo mortgage borrowers to accept the approved applications. This study also documents that loan origination activity manipulation to meet earnings benchmarks is negatively associated with bank future interest income and noninterest income, which is consistent with the view that real earnings management is costly.

This study contributes to the literature by providing additional evidence on the real effect of loan-transfer-based earnings management. The finding that loan origination manipulation can harm the bank future performance also points out a research question for future research: how tight the regulations of the sales accounting for financial asset transfer should be so that the secondary loan market is still active enough while the negative consequences can be kept at a minimum level.

2.8 Tables and Figures

TABLE 1

Sample Selection Process

All US commercial bank mortgage application level data
Less: Non-conventional mortgage applications
Less: Mortgage records with missing values
Less: Mortgages with property locates in territories and outlying area
Aggregate mortgage level data by bank-years
Less: Bank-years with few mortgage applications
Aggregate Call Report data at annual level
Merge mortgage data with Call Report data (22,633 observations)

TABLE 2

Number of Banks and Mortgage Origination Activities by Year

Year	Bank Observations	Total Number of Mortgage Applications (thousand)	Total Non-jumbo Mortgage Origination Volumes (billion $)	Total Jumbo Mortgage Origination Volumes (billion $)	Total Suspects
1999	1629	3076	116.6	52.3	49
2000	1617	3115	106.4	51.5	62
2001	1876	5068	233.3	78.4	95
2002	2038	5345	302.2	106.4	76
2003	2232	7010	452.3	142.8	102
2004	2355	7051	421.4	208.0	85
2005	2275	7459	460.6	271.0	69
2006	2116	8327	483.3	212.1	77
2007	2134	7006	469.6	195.0	127
2008	2207	5272	368.1	118.2	191
2009	2154	7262	600.7	123.0	301
Total	22633	65991	4014.5	1558.7	1234

TABLE 3

Descriptive Statistics of Bank Fundamentals and Mortgage Origination Activities

Panel A: Bank and Mortgage Application Characteristics

	Mean	Std Dev	Lower Quartile	Upper Quartile
ΔVol	0.0848	0.1145	0.0230	0.1043
ROA	0.0243	0.0180	0.0168	0.0336
Liquidity Ratio	0.2010	0.1229	0.1134	0.2673
Capital Ratio	0.1445	0.0486	0.1125	0.1587
Avg(loan amount)	132.43	116.54	76.70	153.43
Fraction in MSA	0.7508	0.2791	0.6025	0.9650
Avg(home income)	96.52	88.61	66.83	104.03

Panel B: Pearson and Spearman Correlations

	ΔVol	ROA	*Liquidity Ratio*	*Capital Ratio*	*Avg(loan amount)*	*Fraction in MSA*	*Avg(home income)*
ΔVol	-	0.0087***	-0.1712***	0.0064	-0.1225***	-0.0280***	-0.1386***
ROA	-0.0383**	-	0.0976***	0.0625***	-0.1245***	-0.0475***	-0.0635***
Liquidity Ratio	-0.1131***	0.0770***	-	0.4480***	-0.1028***	0.0647***	-0.0794***
Capital Ratio	0.0727***	0.0430***	0.4444***	-	-0.0249***	0.0808***	-0.0381***
Avg(loan amount)	-0.1202***	-0.1981***	-0.2133***	-0.1256***	-	0.2347***	0.5806***
Fraction in MSA	-0.1651***	-0.0745***	0.0924***	0.0967***	0.3482***	-	0.1693***
Avg(home income)	-0.2770***	-0.1393***	-0.1770***	-0.1696***	0.7344***	0.3867***	-

Panel A reports sample statistics, and Panel B report correlations. Variables are defined as in Section 4 and winsorized at the extreme percentiles. Pearson correlations are reported in the upper triangle and Spearman correlations are reported in the lower triangle in Panel C. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

TABLE 4

Changing Mortgage Origination Activities to Meet Earnings Benchmarks

$$\Delta Vol_{i,t} = \beta_0 + \beta_1 Suspect_{i,t} + \sum_m \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t}$$

	Zero Earnings	Prior-Year Earnings	Pooled
Suspect	0.0182*** (0.0063)	0.0247*** (0.0057)	0.0215*** (0.0044)
Miss	0.0091 (0.0077)	-0.0014 (0.0018)	-0.0016 (0.0018)
ROA	0.1433 (0.1303)	0.0695 (0.1027)	0.0854 (0.1033)
Liquidity Ratio	-0.2241*** (0.0163)	-0.2237*** (0.01657)	-0.2235*** (0.0165)
Bank Size	-0.0000*** (0.0000)	-0.0000*** (0.0000)	-0.0000*** (0.0000)
Capital Ratio	0.2466*** (0.0384)	0.2454*** (0.0383)	0.2453*** (0.0384)
Avg(loan size)	-0.0001*** (0.000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)
Fraction in MSA	0.0038 (0.0056)	0.0036 (0.0056)	0.0036 (0.0056)
Avg(home income)	-0.0001*** (0.0001)	-0.0001*** (0.0001)	-0.0001*** (0.0000)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes
R^2	0.12	0.12	0.12

Reported coefficients are estimated using OLS with clustered standard error on banks. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

TABLE 5

Denial Strategy versus Attract Strategy

$$\Delta Vol\_Deny_{i,t} = \beta_{1,0} + \beta_{1,1}Suspect_{i,t} + \sum_{m} \beta_{1,2,m}Control_{m,i,t} + \epsilon_{1,i,t}$$

$$\Delta Vol\_NotAccepted_{i,t} = \beta_{2,0} + \beta_{2,1}Suspect_{i,t} + \beta_{2,2}\Delta Vol\_Deny_{i,t} + \sum_{m} \beta_{2,3,m}Control_{m,i,t} + \epsilon_{2,i,t}$$

	Denial Strategy	Attract Strategy
Suspect	-0.0121*** (0.0047)	-0.0079* (0.0048)
Miss	-0.0032 (0.0024)	0.0006 (0.0024)
ΔVol_Deny		0.4521*** (0.0069)
ROA	0.0893 (0.0678)	0.1478*** (0.0698)
Liquidity Ratio	0.0335*** (0.0093)	-0.0224 (0.0096)
Bank Size	0.0000*** (0.0000)	0.0000 (0.0000)
Capital Ratio	-0.1178*** (0.0201)	-0.0919*** (0.0207)
Avg(loan size)	-0.0001*** (0.0000)	-0.0000 (0.0000)
Fraction in MSA	-0.0095*** (0.0038)	-0.0028 (0.0040)
Avg(home income)	-0.0000** (0.0000)	-0.0001*** (0.0000)
Fixed Effects	Yes	Yes
R^2	0.09	0.17

Reported coefficients are estimated using seemingly unrelated regression. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

TABLE 6

Future Profitability and Abnormal Mortgage Origination Volume

$$Income_{i,t+k} = \gamma_0 + \gamma_1 Suspect_{i,t} + \gamma_2 \Delta Vol_{i,t}^{A} + \gamma_3 Suspect_{i,t} \times \Delta Vol_{i,t}^{A}$$

$$+ \sum_m \gamma_{4,m} Control_{m,i,t+k} + \epsilon_{i,t+k}$$

Panel A: Net Income and Abnormal Mortgage Origination Volume

	$k = 1$	$k = 2$	$k = 3$	3-Year Pooled
ΔVol_t^A	-0.0020** (0.0009)	-0.0045*** (0.0012)	-0.0086*** (0.0019)	-0.0051*** (0.0012)
Suspect$_t$	0.0027*** (0.0005)	0.0026*** (0.0006)	0.0022** (0.0009)	0.0025*** (0.0006)
$Suspect_t \times \Delta Vol_t^A$	-0.0003 (0.0053)	0.0078 (0.0059)	0.0024 (0.0081)	0.0033 (0.0058)
$Miss_t$	0.0013*** (0.0002)	0.0018*** (0.0002)	0.0032*** (0.0035)	0.0021*** (0.0002)
$Miss_t \times \Delta Vol_t^A$	0.0035 (0.0022)	0.0014 (0.0028)	0.0003 (0.0043)	0.0018 (0.0027)
Bank Size$_{t+k}$	-0.0001** (0.0001)	-0.0005*** (0.0001)	-0.0012*** (0.0002)	-0.0006*** (0.0001)
Capital Ratio$_{t+k}$	-0.0075*** (0.0017)	-0.0177*** (0.0026)	-0.0162*** (0.0038)	-0.0154*** (0.0025)
Liquidity Ratio$_{t+k}$	-0.0012* (0.0007)	0.0023** (0.0012)	0.0117** (0.0019)	0.0042*** (0.0011)
$Income_t$	0.8702*** (0.0090)	0.7793*** (0.0128)	0.6534*** (0.0201)	0.7798*** (0.0127)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.69	0.51	0.36	0.57

Panel B: Interest Income and Abnormal Mortgage Origination Volume

	$k = 1$	$k = 2$	$k = 3$	3-Year Pooled
ΔVol_t^A	-0.0015 (0.0015)	-0.0025 (0.0026)	-0.0058* (0.0033)	-0.0030 (0.0030)
$Suspect_t$	0.0018*** (0.0007)	-0.0004 (0.0012)	-0.0001 (0.0013)	0.0010 (0.0010)
$Suspect_t \times \Delta Vol_t^A$	-0.0131** (0.0065)	-0.0194** (0.0086)	-0.0151* (0.0090)	-0.0157*** (0.0061)
$Miss_t$	-0.0000 (0.0003)	0.0009 (0.0006)	0.0003 (0.0005)	0.0005 (0.0004)
$Miss_t \times \Delta Vol_t^A$	0.0039 (0.0034)	-0.0009 (0.0051)	-0.0022 (0.0051)	0.0008 (0.0038)
Bank Size$_{t+k}$	-0.0014*** (0.0001)	-0.0026*** (0.0002)	-0.0032*** (0.0003)	-0.0023*** (0.0002)
Capital Ratio$_{t+k}$	0.0153*** (0.0043)	0.0262*** (0.0076)	0.0284*** (0.0102)	0.0235*** (0.0078)
Liquidity Ratio$_{t+k}$	0.0086*** (0.0019)	0.0169*** (0.0032)	0.0206*** (0.0041)	0.0136*** (0.0032)
$Income_t$	0.8195*** (0.0086)	0.6881*** (0.0128)	0.6021*** (0.0156)	0.7124*** (0.0127)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.88	0.77	0.65	0.74

Panel C: Noninterest Income and Abnormal Mortgage Origination Volume

	$k = 1$	$k = 2$	$k = 3$	3-Year Pooled
ΔVol_t^A	-0.0243** (0.0099)	0.0062 (0.0090)	-0.0046 (0.0045)	-0.0111*** (0.0039)
$Suspect_t$	0.0016** (0.0007)	0.0013 (0.0010)	0.0002 (0.0009)	0.0005 (0.0006)
$Suspect_t \times \Delta Vol_t^A$	-0.0158 (0.0134)	-0.0735*** (0.0204)	-0.0474*** (0.0115)	-0.0230** (0.0097)
$Miss_t$	0.0013*** (0.0003)	0.0012*** (0.0004)	0.0013*** (0.0004)	0.0015*** (0.0003)
$Miss_t \times \Delta Vol_t^A$	0.0017 (0.0090)	0.0071 (0.0101)	0.0090 (0.0055)	0.0063 (0.0086)
$Bank\ Size_{t+k}$	0.0007*** (0.0002)	0.0013*** (0.0003)	0.0010*** (0.0002)	0.0009*** (0.0002)
$Capital\ Ratio_{t+k}$	-0.0033 (0.0047)	-0.0079 (0.0062)	-0.0060 (0.0064)	-0.0045 (0.0048)
$Liquidity\ Ratio_{t+k}$	0.0007 (0.0020)	0.0030 (0.0027)	0.0028 (0.0028)	0.0025 (0.0021)
$Income_t$	0.9216*** (0.0144)	0.5915*** (0.0228)	0.4265*** (0.0223)	0.6478*** (0.0169)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes	Yes
R^2	0.83	0.54	0.43	0.70

Reported coefficients are estimated using OLS with clustered standard error on banks. The first three columns contain estimates with income 1 year, 2 years, and 3 years in the future. The fourth column contains estimates with average income of 3 years in the future. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

TABLE 7

The Effect of Mortgage Origination Activities on Bank Earnings: Results from OLS and 2SLS Regressions

$$E_{i,t} = \beta_0 + \beta_1 \Delta Vol_{i,t} + \sum_m \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t}$$

Panel A: A Comparison of OLS and 2SLS Results

	OLS	2SLS
Intercept	0.0233*** (0.0048)	0.0206*** (0.0053)
ΔVol	0.0188*** (0.0013)	0.0343*** (0.0117)
Liquidity Ratio	-0.0061*** (0.0015)	-0.0056*** (0.0016)
Bank Size	-0.0005 (0.0004)	0.0006 (0.0004)
Capital Ratio	-0.0157*** (0.0031)	-0.0161*** (0.031)
Bank Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
R^2	0.14	0.13

Panel B: First Stage Regression Results

Intercept	1.368*** (0.0727)
$\Delta\overline{App}_{-i,t}$	-35.76*** (2.059)
Liquidity Ratio	-0.0325*** (0.0075)
Bank Size	-0.0089*** (0.0019)
Capital Ratio	0.0239 (0.0153)
Bank Fixed Effects	Yes
Year Fixed Effects	Yes
R^2	0.09

Reported coefficients are estimated using either OLS or 2SLS. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

TABLE 8

Changing Mortgage Origination Activities to Meet Earnings Benchmarks: Smallest Banks

$$\Delta Vol_{i,t} = \beta_0 + \beta_1 Suspect_{i,t} + \sum_m \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t}$$

	Zero Earnings	Prior-Year Earnings	Pooled
Suspect	0.0062 (0.0160)	-0.0102 (0.0146)	-0.0087 (0.0116)
Miss	0.0313 (0.0206)	0.0022 (0.0067)	0.0006 (0.0065)
ROA	1.2120*** (0.4187)	0.9017*** (0.3213)	0.8868*** (0.3264)
Liquidity Ratio	-0.1639*** (0.0478)	-0.1683*** (0.0484)	-0.1687*** (0.0484)
Bank Size	-0.0000*** (0.0000)	-0.0000*** (0.0000)	-0.0000*** (0.0000)
Capital Ratio	0.1305 (0.1195)	0.1418 (0.1225)	0.1421 (0.1223)
Avg(loan size)	0.0013*** (0.0001)	0.0013*** (0.0002)	0.0013*** (0.0001)
Fraction in MSA	-0.0085 (0.0139)	-0.0074 (0.0138)	-0.0073 (0.0138)
Avg(home income)	-0.0005*** (0.0001)	-0.0005*** (0.0001)	-0.0005*** (0.0001)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes
R^2	0.28	0.28	0.28

Reported coefficients are estimated using OLS. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

TABLE 9

Changing Mortgage Origination Activities to Meet Earnings Benchmarks: No Crisis Years

$$\Delta Vol_{i,t} = \beta_0 + \beta_1 Suspect_{i,t} + \sum_m \beta_{2,m} Control_{m,i,t} + \epsilon_{i,t}$$

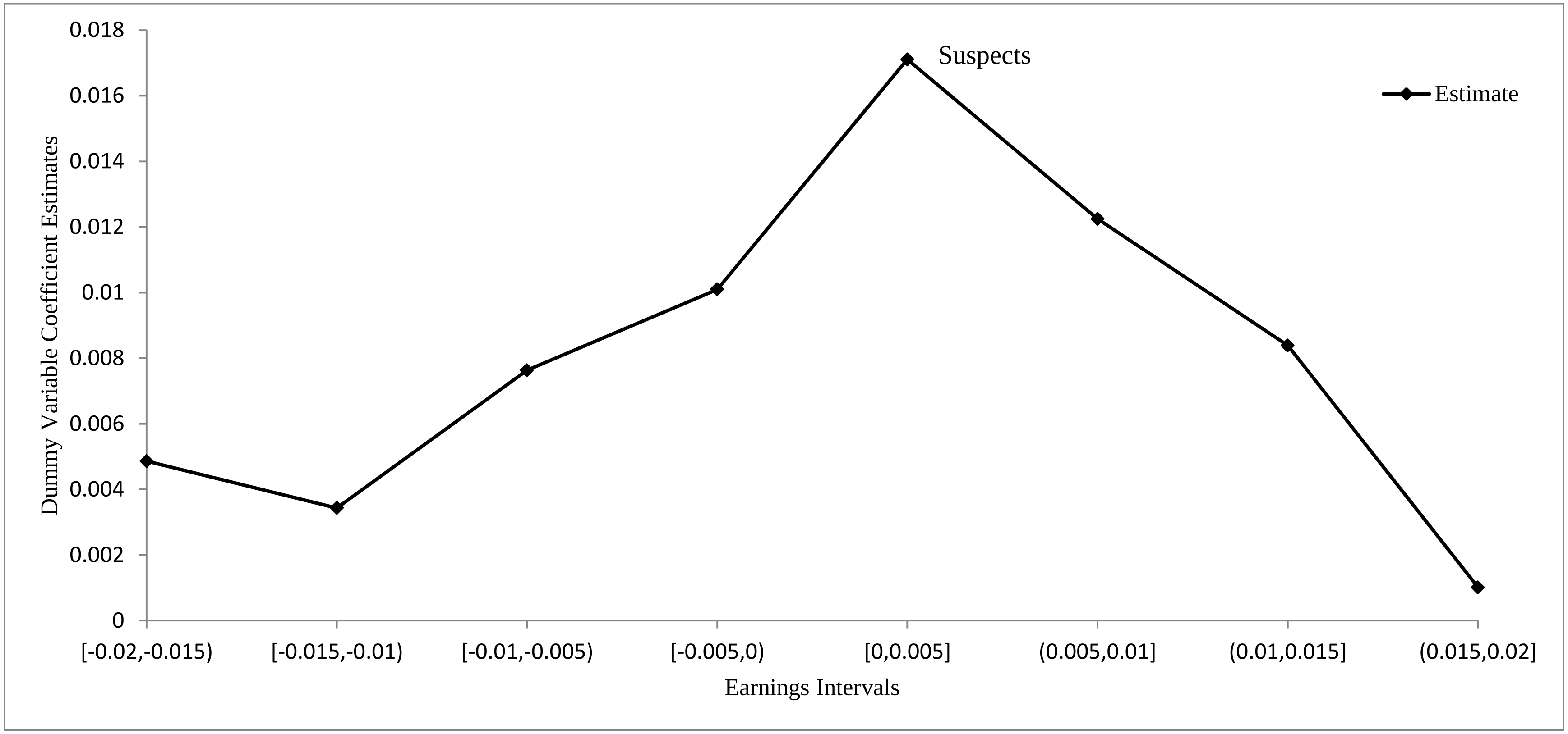
	Zero Earnings	Prior-Year Earnings	Pooled
Suspect	0.0261*** (0.0088)	0.0264*** (0.0065)	0.0255*** (0.0054)
Miss	0.0109 (0.0097)	0.0002 (0.0021)	0.0000 (0.0021)
ROA	0.1929 (0.1497)	0.1323 (0.1227)	0.1530 (0.1235)
Liquidity Ratio	-0.2382*** (0.0478)	-0.2378*** (0.0177)	-0.2376*** (0.0177)
Bank Size	-0.0000*** (0.0000)	-0.0000*** (0.0000)	-0.0000*** (0.0000)
Capital Ratio	0.2557*** (0.0406)	0.2524*** (0.0403)	0.2522*** (0.0404)
Avg(loan size)	-0.0001*** (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)
Fraction in MSA	-0.0057 (0.0060)	-0.0053 (0.0061)	-0.0053 (0.0060)
Avg(home income)	-0.0001** (0.0001)	-0.0001** (0.0001)	-0.0001** (0.0001)
Clustered Standard Error & Fixed Effect	Yes	Yes	Yes
R^2	0.12	0.12	0.12

Reported coefficients are estimated using OLS. The two-tail t-statistics are reported in parentheses. ***, **, * indicate statistical significance at 1%, 5%, and 10% levels, respectively. Variables are defined in Section 6 and are winsorized at the extreme percentiles.

FIGURE 1

Dummy Variable Coefficient Estimates by Earnings Intervals

Panel A: Zero Earnings Benchmark



Panel B: Prior-Year Earnings Benchmark

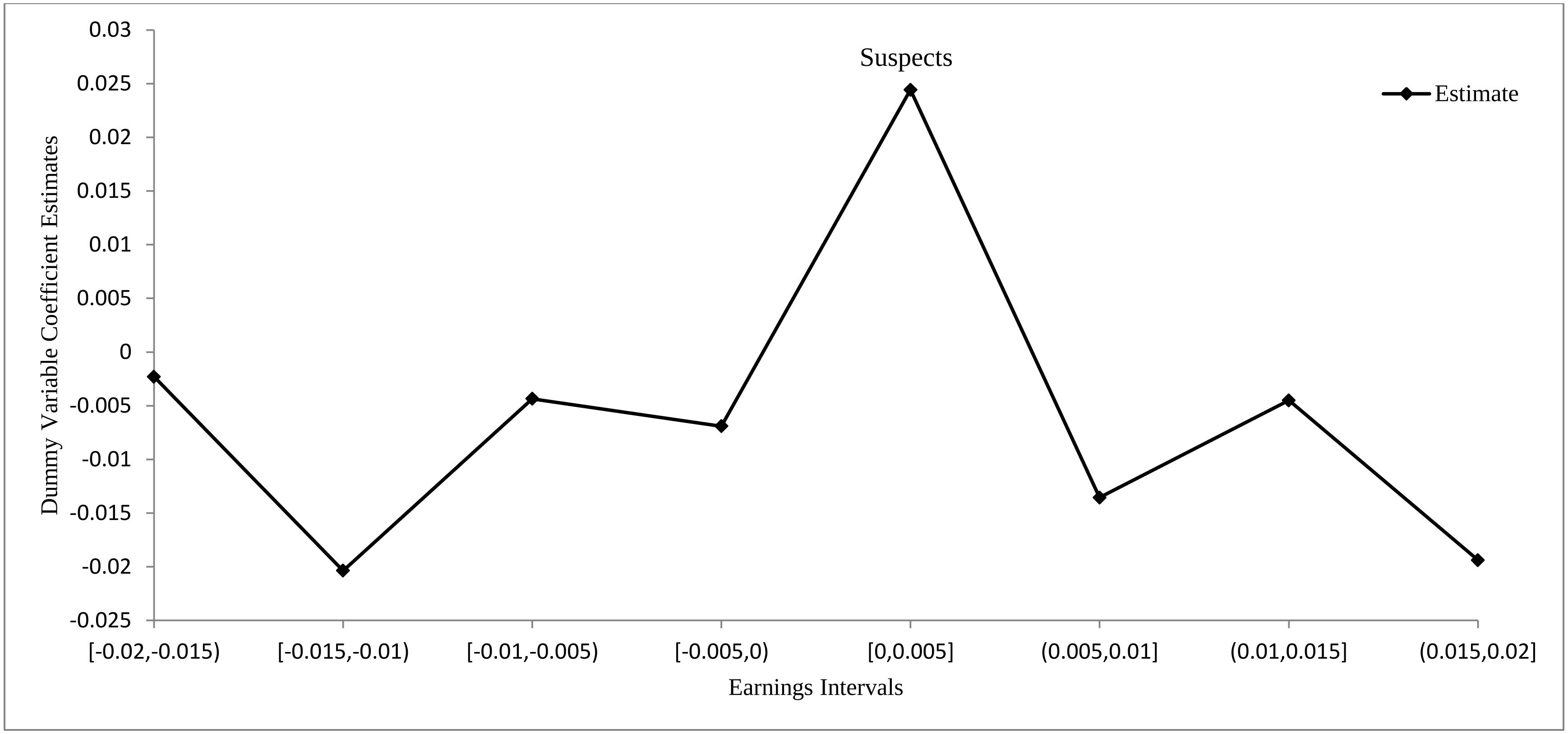
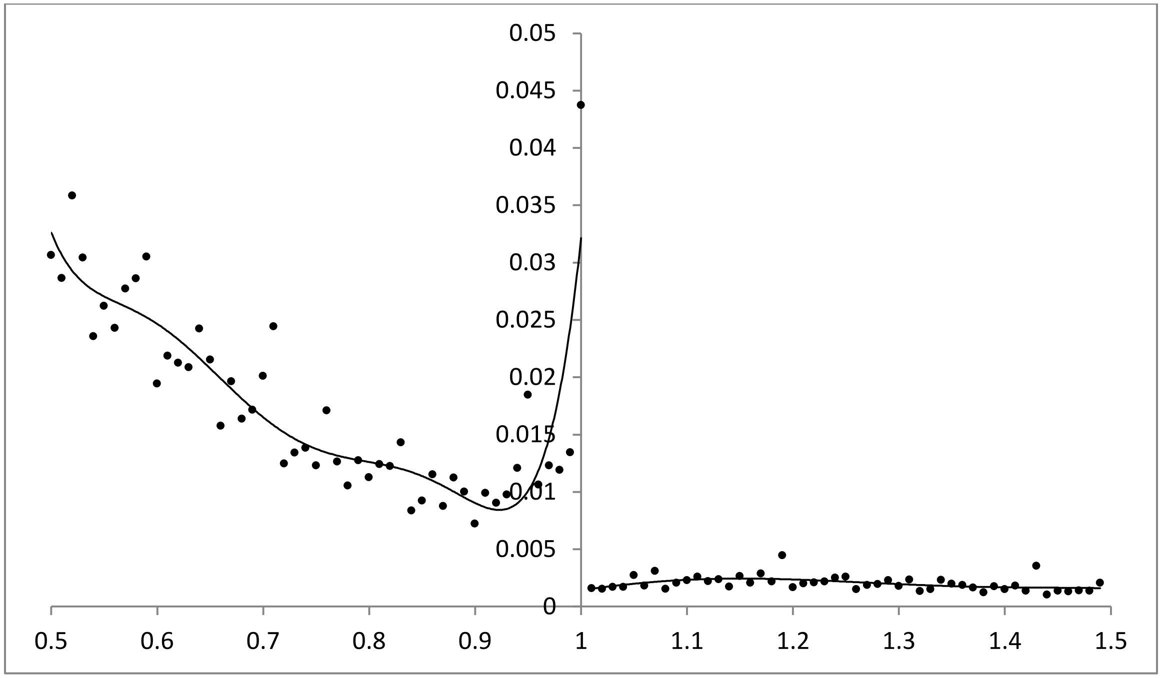


FIGURE 2

Mortgage Loan Amount Distribution



Note: The horizontal axis is the ratio of loan amount to jumbo/non-jumbo cut-off. The vertical axis is the probability. Each point is the probability of a mortgage with loan amount equals (x-0.01,x]. The solid line is the six order polynomial trend line of the points.

3. EVALUATING MARKET-BASED CORPORATE GOVERNANCE REFORM: EVIDENCE FROM A STRUCTRUAL ANALYSIS OF MANDATORY AUDITOR ROTATION

3.1 Introduction

Many current reform proposals of corporate governance involve financial market intervention as an external governance device to protect the shareholders when existing governance devices are considered to be not sufficiently effective (Bebchuk and Hamdani 2006). However, some of these reform proposals have been controversial, and among them, mandatory audit firm rotation has perhaps triggered the most heated debate in the public accounting industry.[1] This paper empirically evaluates the economic costs and benefits of mandatory audit firm rotation by quantifying its impact on individual firms as well as on the industry as a whole. Further, the paper quantitatively explores how the external policy's costs and benefits depend critically on the firms' existing internal governance.

The costs and benefits of mandatory audit firm rotation stem from its impact on the cost structure of auditing and the fundamental conflict of interest between shareholders, managers, and auditors. The supporters argue that the policy can improve auditor independence and, hence, audit quality so that shareholders are better protected. With mandatory rotation, the periodic "fresh look" is also considered to be value enhancing to the shareholders (e.g., PCAOB 2011). However, the opponents claim that the policy can also lead to many incremental costs so that shareholders may be worse off. Among these costs, two stand out. First, mandatory rotation leads

[1] Section 2 contains a review of the debate.

to incremental learning cost for the auditors and switching cost for the clients. That is, auditors have to expend effort to learn their new clients' business, and clients have to expend effort to educate their new auditors about their business. Second, as emphasized in this paper, the policy can potentially reduce the board effectiveness in selecting auditors because it may force the board to select a second-best auditor for the shareholders.

Although the arguments above provide important *qualitative* insights about the impact of the policy, a *quantitative* evaluation remains challenging and elusive but is needed for policy decisions. Without quantitatively assessing the costs and benefits by moving to a world with mandatory rotation, it is impossible for the regulators to determine, for example, the size of the cost of reduced board effectiveness. To fill this gap, this paper quantifies the potential impact of mandatory audit firm rotation and explores how the impact is affected by the interaction between the policy and firm existing internal corporate governance.

Because mandatory audit firm rotation is not yet effective in the United States, a before-and-after analysis creates a major challenge for empirical research. To overcome this difficulty, I deploy a structural approach. That is, I first theoretically model the auditor-client matching process, then estimate the model parameters, and finally simulate new auditor-client matching equilibria with the added constraint of mandatory rotation. The key advantage of the structural approach is that it makes counterfactual analysis possible and, hence, allows the quantification of the impact of the policy, the goal of my research. Specifically, I provide evidence on the following three research questions.

(1) What are the determinants of the equilibrium match outcome between auditors and clients (i.e., public firms) and how is the match outcome affected by clients' existing corporate governance?

(2) What are the economic magnitudes of the impact of mandatory audit firm rotation on different groups' (i.e., client, shareholder, and auditor) welfare?

(3) How does the existing internal corporate governance of firms affect the direction and magnitude of the impact of mandatory audit firm rotation?

To answer these research questions, my analyses proceed in three specific steps. I first develop a theoretical model of auditor-client matching to give guidance and structure for the empirical estimation. In the model, auditors and clients are considered participants of a two-sided matching market, whereby the match outcome is determined by both auditor and client preferences. Their preferences depend on the pair-specific net surplus that they enjoy from matching, which is further determined by benefits and costs of auditing and audit fees. Furthermore, the client preference is assumed to be based on both shareholder preference and manager preference, which are not necessarily fully aligned with each other. Thus, the model highlights that clients' existing internal corporate governance can affect match outcome and, hence, shareholder welfare.

In the second step, I estimate the model parameters based on the theoretical specification using observed data on the matched pairs, their properties, and audit fees. To recover unobserved model parameters, such as client gross benefit from auditing and auditors' auditing cost and learning cost, I use Simulated Method of Moments (SMM) to estimate the structural parameters. An advantage of simulated method of moments is that it fully uses information in one-to-many matching, which helps to pin down the preferences of auditors and clients simultaneously and separately.[2]

Third, with the estimated parameters, I conduct counterfactual analysis to investigate the impact of mandatory audit firm rotation. In the baseline counterfactuals, new equilibria are simulated with the additional constraint that auditors and clients cannot match with each other for more than certain number of consecutive years (e.g., 5, 10, and 20 years). I also vary the client internal corporate governance parameters and examine how changes in internal corporate governance affect shareholder welfare. Finally, to better explore the interaction between the rotation policy and client internal corporate governance, I further evaluate the impact of the policy on the shareholders when client interests are fully aligned with shareholder interests.

My main findings are from the counterfactual analysis and can be summarized as follows. First, I evaluate the impact of mandatory audit firm rotation on the shareholders. My analysis suggests that shareholder lifetime value from auditing can decrease by 2.05 percent to 15.54 percent on average. In other words, if there are benefits of mandatory auditor rotation that are not fully captured by the model, their magnitudes should at least exceed these thresholds to justify the implementation of the policy. The magnitude of the value reduction depends on both rotation interval and the relative size of learning cost to audit cost. For example, shareholder lifetime value from auditing will decrease by 2.92 percent on average when the rotation interval is ten years and learning cost is as large as audit cost.[3] Second, I find a significant fraction of the value reduction is from reduced board effectiveness in selecting auditors. For example, the reduced board effectiveness leads to a 2.17 percent reduction in shareholder value from auditing for a ten-

[2] SMM utilizes information contained in (1) observed match, for example, IBM and PricewaterhouseCoopers (PwC), (2) the fact IBM is not matched with other auditors, and (3) the fact that PwC is also matched with other clients such as Cisco.

[3] Results for other rotation intervals and parameterizations are available in Section 6.

year rotation policy. Moreover, using an individual-firm-level analysis, I find the overall value reduction is mainly from those shareholders of the clients with low insider ownership and, therefore, better internal governance. These shareholders are affected more negatively because, with better internal governance, the boards are already making better choices for the shareholders and, therefore, the cost of reduced board effectiveness from mandatory rotation is amplified for them. This finding also suggests that, at the client level, individual client heterogeneous internal governance has an interaction effect on the impact of the policy. Third, I evaluate the impact of alternative policies that improve internal corporate governance directly. My analysis suggests that average shareholder value from auditing will increase by 0.28 percent if internal governance becomes perfect and board interests are fully aligned with shareholder interests. In this analysis, I also find shareholder value from auditing will decrease by 64.19 percent if board interests become fully aligned with manager interests. Finally, I evaluate the impact of mandatory audit firm rotation when board interests are fully aligned with shareholder interests. It turns out that the cost of reduced board effectiveness increases by approximately 4 percent, which leads to an incremental reduction in shareholder value.

My findings have three key policy implications. First, my estimates suggest that mandatory audit firm rotation has costs to shareholders, so a better justification is needed for its implementation. Second, alternative policies that can improve firm internal governance may work better for the shareholders. Third, mandatory audit firm rotation may counteract other policies intended to improve internal corporate governance.

This paper contributes to the existing literature in the following three ways. First, as far as I know, this paper makes one of the first attempts to use a structural approach to empirically evaluate the cost and benefit of public policies in accounting. Second, this paper extends the literature on government intervention in the financial market by highlighting the possibility that some interventions have unintended costs to shareholder welfare if they reduce the effectiveness of the existing corporate governance of firms. Third, this paper extends the literature on the auditor-client relationship by theoretically developing and empirically estimating a dynamic two-sided matching model, in which both auditor and client preference can affect the match outcome, whereas the majority of existing papers assume only one side of the market has market power.

In the next section, I discuss the industry background and review literature related to my study. In Section 3, I develop the theoretical model that provides explicit structure for the structural estimation. Section 4 specifies the empirical framework and discusses model identification and estimation. Section 5 provides information about data and reduced form evidence. Section 6 reports structural estimates and results from counterfactual analysis. Section 7 concludes the paper.

3.2 Industry Background and Literature Review

3.2.1 Industry Background

After many accounting failures in the early 2000s and the recent financial crisis, governments all over the world have proposed and implemented many corporate governance reforms to better protect the shareholders. For example, as part of the Sarbanes-Oxley Act (SOX), the Public Company Accounting Oversight Board (PCAOB) was created to oversee the audits. In addition, in 2003, the Securities and Exchange Commission (SEC) started to require a majority of the board members and all members of audit committee to be independent.[4]

[4] According to SEC, an independent director is “a person other than an officer or employee of the company or its subsidiaries or any other individual having a relationship, which, in the opinion of the company's board of directors, would interfere with the exercise of independent judgment in carrying out the responsibilities of a director.”

Among these reform proposals, mandatory audit firm rotation is probably one of the most controversial in the public accounting area. Advocates of the policy argue that long auditor tenure may lead to a reduction in auditor independence, and therefore, shareholders are harmed. Hence, by requiring public firms to rotate their auditors on a regular basis, the shareholders can benefit from the periodic “fresh look”. People who oppose the policy claim that the potential cost of the policy is large. For example, mandatory audit firm rotation can lead to losses in the current auditor’s cumulative knowledge of the client’s business, which reduces the audit effectiveness and efficiency (PricewaterhouseCoopers 2012). The policy can also be costly to the clients because they need to spend more time with the new auditors to educate them about the firms’ business. Finally, the policy may also reduce the effectiveness of the board in selecting the best auditors for the shareholders, especially when the clients are required to rotate their best possible auditors for the shareholders.

Because of the complicated nature of the policy, even among the policy makers, there were different opinions. Arthur Levitt, the former SEC chairman, supported the policy and advocated including the policy in SOX. However, Harvey Pitt, Arthur Levitt’s successor, did not agree. Perhaps because of the controversy, SOX finally required mandatory audit partner rotation but not audit firm rotation. Moreover, to better understand the policy, SOX required the General Accounting Office (GAO, now Government Accountability Office) to investigate the potential impact of mandatory audit firm rotation. The GAO report came out in 2003, and the conclusion was more experience was needed to determine whether mandatory audit firm rotation is beneficial.

Eight years after the GAO report, in 2011, PCAOB issued a concept release and proposed mandatory audit firm rotation again. However, again, this proposal was received with disagreements from various parties including the Big-4 auditors. Moreover, in 2013, the Audit Integrity and Job Protection Act was proposed in US Congress and passed in the House to counter the PCAOB proposal. The act explicitly states that, “The Board shall have no authority under this title to require that audits conducted for a particular issuer… by different registered public accounting firms on a rotating basis.” In early 2014, James Doty, the Chairman of PCAOB, claimed that PCAOB did not have an active project in pursuing mandatory audit firm rotation.

In the European Union (EU), mandatory audit firm rotation has been in effect in Italy since 1975. Moreover, a mandatory rotation for an interval of 10 to 24 years was first passed by the EU member states in December 2013 and later approved by the European Parliament in April 2014. This difference in practice for the US and the EU also highlights the important of understanding the costs and benefits of mandatory rotation.

3.2.2 Literature Review

3.2.2.1 Corporate Governance and Auditing

This paper is closely related to the theoretical and empirical literature on corporate governance and auditing. To be more specific, the following two streams of literature are most closely related to my paper.

The first stream of literature focuses on the corporate governance role of auditing for firms. The theoretical models in this stream view auditors as information validators that reduce the agency problem between the shareholders and managers. Ng and Stoeckenius (1979) models auditing as a technology that can detect manipulations in financial reporting. Fellingham and Newman (1985) follow this idea and study the managers’ manipulation decisions in a sequential game framework. Antle (1982, 1984) adds the auditor incentive problem to the analysis and studies a situation where moral hazard exists for both managers and auditors. Arya and Glover (2014) extend Antle's framework and find auditor independence can be achieved using contracts. The empirical papers in this stream focus on whether different auditors can reduce the agency conflict differently. For example, many studies document that Big-N auditors are associated with better audit quality so that the agency problem can be better reduced (DeFond and Zhang 2013). However, Lawrence, Minutti-Meza, and Zhang (2007) argue that the difference between Big-N and non-Big-N auditors can be at least partially attributed to the differences in client characteristics. An additional area of empirical research in this stream studies whether non-audit service will potentially reduce auditor independence and, hence, weaken their role in corporate governance (e.g., Frankel, Johnson, and Nelson 2002). However, the results have been mixed, and the majority of studies find that non-audit service has no significant impact on audit quality (e.g., DeFond, Raghunandan, and Subramanyam 2002, Ashbaugh, LaFond, and Mayhew 2003, Chung and Kallapur 2003, Larcker and Richardson 2004).

The second stream of literature addresses the dynamic auditor-client relationship. The theoretical papers in this stream start from the seminal paper by DeAngelo (1981a), which focuses on audit fee dynamics in a competitive audit market. In DeAngelo (1981a), clients will never replace their incumbent auditors because the auditors use an audit fee lowballing strategy so that incumbents can always set more competitive audit fees. This finding highlights that both lowballing and non-replacement are not necessarily related to low auditor independence but arise naturally from competition. Following this seminal work, many theoretical models have been developed indicating that lowballing can show up in various situations and that auditor independence is often not affected (e.g., Magee and Tseng 1990). Among these studies, many of them also find that symmetric information between clients and auditors leads to no auditor replacement, but endogenous auditor replacement can happen if information asymmetry exists (e.g., Dye 1991 and Kanodia and Mukherji 1994). The empirical studies in this stream largely focus on the association between the auditor replacement decision (i.e., auditor tenure and audit partner tenure) and audit quality. Myers, Myers, and Omer (2003) explore the association between client discretionary accruals and auditor tenure and find longer tenure is associated with lower discretionary accruals, which suggests mandatory audit firm rotation may not be an effective policy to improve audit quality. Consistent with this finding, Ghosh and Moon (2005) document that the investors in the financial market also perceive the financial reports audited by auditors with longer tenure are of higher quality. In contrast, Dopuch, King, and Schwartz (2001) use experiments to study the impact of mandatory audit firm rotation but find rotation can discipline the auditors from issuing biased reports. Carey and Simnett (2006) study the association between audit quality and audit partner tenure and also find mixed results. Blouin, Grein, and Rountree (2007) study how Arthur Andersen clients chose their new auditors after the dissolution of Arthur Andersen. Surprisingly, the authors find that although firms with greater agency concerns were more likely to replace their former audit partner, there was no significant improvement in audit quality after the replacement.

Finally, perhaps the study that is most closely related to mine is by Gerakos and Syverson (2014), who estimate a logit model for clients' choice of auditors. Although both studies try to estimate the potential impact of mandatory audit firm rotation, there are several key differences between our approaches that yield my unique contribution. First and perhaps most importantly, my model focuses on the policy impact from the interaction between the policy and clients' existing internal corporate governance, whereas their model does not have this component.

Second, I estimate a two-sided matching model by allowing both auditor and client preference to affect the match outcome. The estimation allows me to study the impact of mandatory audit firm rotation on both auditor and client utility. Finally, my estimation is based on a dynamic theoretical model, which incorporates the benefits and costs of auditing explicitly.

3.2.2.2 Structural Estimation in Accounting and Corporate Governance

This paper is also related to a small but emerging literature on structural estimation in accounting and corporate governance. According to the literature, one of the biggest advantages of structural estimation is that it can be used for welfare analysis (e.g., Gayle and Miller 2014). For example, Taylor (2010) develops a dynamic CEO turnover model and demonstrates that with perfect corporate governance, the figure for CEOs fired per year is 12 percent, much greater than the 2 percent firing rate observed from the real world. Nikolov and Whited (2013) build a corporate finance model and find agency conflicts can lead to a 22 percent increase in cash holdings. Zakolyukina (2014) estimates a structural model of GAAP violations and finds that 73 percent of CEOs manipulate earnings at least once during their tenure, and as a result of the manipulations, stock prices are biased by approximately 7 percent.

An additional usage of structural estimation is to test how well the theoretical models fit the data. Li (2013) estimates three different models of top executive compensation and finds a mutual monitoring model with individual utility maximization is most consistent with the data. Taylor (2013) develops a dynamic Bayesian learning model for CEO ability and finds that CEO pay is not affected by the bad news about CEO ability, which is consistent with the theoretical model developed by Harris and Holmstrom (1992).

Finally, there are also some recent papers that estimate matching models in different contexts of corporate governance such as the match between CEOs and firms (Pan 2010 and Chen 2014) and the match between directors and firms (Matveyev 2012). My paper is different from these papers not only in the research context but also in theoretical foundation. All previous studies are based on static models, whereas my study is based on a dynamic model.[5]

3.3 A Theoretical Model of Auditor-Client Two-Sided Matching

In this section, a multi-period two-sided matching model is developed to give guidance and explicit structure for the empirical estimation and analysis in Section 4. The model incorporates building blocks from the existing literature and is designed to match my empirical strategy. First, the two-sided matching framework follows Roth and Sotomayor (1992). Second, the feature of the friendly board is borrowed from recent development in corporate governance literature (e.g., Adams and Ferreira 2007, Laux 2008) and is used to model board preference when there is misalignment of interests between shareholders and managers in an audit context (e.g., Fellingham and Newman 1985). Finally, the element of audit fee dynamics is taken from DeAngelo (1981a).

3.3.1 Model Notation

Consider an audit market with N_C clients and N_A auditors, where both N_C and N_A are positive integers.[6] Both auditors and clients are assumed to live for infinite periods and discount future

[5] To be more precise, my theoretical model is designed in such a way that (1) it is multi-period so it can capture important features in the audit market, for example, learning cost, switching cost, and audit fee lowballing; (2) it can be simplified theoretically so that it is estimable using an estimation technique that is originally designed for static matching games. Details are discussed in Section 3 and 4. Because of (2), the theoretical model is not fully dynamic in the sense that it does not include time-varying random shocks (not like, for example, Ericson and Pakes (1995)), which should be viewed as a limitation of the work.

[6] There are several reasons for modeling the audit market as a matching market instead of a perfect competitive market or oligopolistic market. First, as reviewed in Section 2, prior empirical research has documented evidence of not only clients choose auditors (e.g., Gerakos and Syverson 2014) but also auditors choose clients (e.g., Krishnan

with a discount factor δ, where $\delta \in (0,1)$. It is also assumed that there is no information asymmetry between the players. For each period, the player objectives are to find the best possible matches to maximize their discounted sum of future utility. In today's audit market, an auditor can serve multiple clients, but a client can be served by only one auditor in each period.[7] Therefore, the matching is assumed to be a one-to-many matching, and each auditor $j \in \{1,2,\ldots,N_A\}$ is endowed with capacity C_j, which is a positive integer and is the maximum number of clients that j can serve. A list of notations is provided in Table 1.

The timeline of the dynamic matching game is illustrated in Figure 1. For each period t, there are three dates. In date 1, auditor j and client $i \in \{1,2,\ldots,N_C\}$ sign a contract to match with each other. In date 2, the audit is performed. In date 3, the audit fee is paid.

At date 1, the match is determined by both auditor and client preferences (to be specified in details later) and the auditor capacity constraint. The contract is assumed to be single-period. That is, all players will have the option to replace their current matches in the following periods. Following DeAngelo (1981a), I assume that a client incurs a cost of switching, CS, if it replaces its incumbent auditor from period $t-1$. This cost can be interpreted as the net effect of the additional effort needed to negotiate with the new auditor, the potential reduction in audit quality for the current period, and the potential benefit from a "fresh look".

At date 2, for each matched-pair (i,j), auditor j performs the audit for client i. During this process, two types of costs are incurred by the auditor: a learning cost K and an audit cost A,

---

and Krishnan 1997 and Shu 2000). Second, in recent auditing policy debates, such as the debate of mandatory audit firm rotation, both clients and auditors actively express their opinions in order to influence the implementations of the policies, which suggests that the audit market is unlikely to be a perfect competitive market where one side of the market receives zero net utility. Third, empirically, if the market is perfectly competitive, the estimated preference of at least one side should be not be statistically significant.

[7] Only attestation service is considered.

both of which are assumed to be time-invariant. The learning cost K can be interpreted as the effort that an auditor exerts to understand the business of its new client. Thus, learning cost is assumed to be a one-time fixed cost incurred in the first period of the new auditor-client engagement. In contrast, the audit cost A is a routine period cost to an auditor every period to serve each client. Audit cost can be interpreted as the aggregate effort for performing the audits, the cost for bearing the litigation risk, and other variable costs associated with auditing.

Every period client i's financial statements are audited, a time invariant gross benefit g, a function of audit quality q, accrues to the client. This gross benefit is an aggregated measure and may be from various sources, such as reduced cost of debt (e.g., Pittman and Fortin 2004, Minnis 2011) and reduced agency cost (e.g., DeFond 1992). Following the friendly board literature, I model the gross benefit g as a weighted average of the benefit to shareholders g^S and to managers g^M.

$$g \equiv g^S + \omega g^M \tag{1}$$

where $\omega \in [0, \infty)$ is the weight that the board gives to the manager. When choosing the auditor, if the board of director interests are fully aligned with shareholder interests, $\omega = 0$, and the benefit will precisely reflect the shareholder preference for auditing. If the board also care about manager interests, $\omega > 0$, and the board preference is also affected by the manager preference (e.g., Hermalin and Weisbach 2001).

I further assume the gross benefit g is a function such that $\frac{\partial}{\partial q \partial \omega} g < 0$. That is, clients with smaller ω prefer auditors with higher quality q. In Appendix 3A, I develop a micro model of strategic auditing following Fellingham and Newman (1985) to derive this property as an equilibrium outcome of the interaction between clients and auditors. Empirically, this feature of the model allows me to exploit the client heterogeneous preference for audit quality as a function of observed heterogeneity in internal corporate governance, which further allows me to empirically separate the two components of gross benefit g. This heterogeneity is specified and discussed in detail in Section 4.

At date 3, each client pays audit fee, F_t, to its auditor. The audit fee is subscripted by t because it is allowed to vary over time even if the matched pairs do not change. Therefore, audit fee dynamics such as lowballing can appear in the model (e.g., DeAngelo 1981a).

As with typical matching models, I assume all benefit, costs, and audit fees are pair specific. That is, g, K, A, and F_t are functions of the matched auditor and client properties. For example, auditor j's audit quality q_j is an auditor property, and client i's internal governance ω is a client property. In Section 4, more properties will be introduced to develop empirical strategies. Accordingly, client i's per-period utility u_{ijt}^C and auditor j's per-period utility u_{ijt}^A from their match are as follows.

$$\begin{gathered} u_{ijt}^C = g(i,j) - F_t\left(i,j,1\left(i \notin I_{t-1}^j\right)\right) - 1\left(i \notin I_{t-1}^j, t > 1\right) \times CS \\ u_{ijt}^A = F_t\left(i,j,1\left(i \notin I_{t-1}^j\right)\right) - A(i) - 1\left(i \notin I_{t-1}^j\right) \times K(i) \end{gathered} \tag{2}$$

where I_{t-1}^j is auditor j's set of clients in period $t-1$, and $1(\cdot)$ is an indicator function that equals one if all conditions within the parenthesis hold and zero otherwise. As observed in equation (2), the per-period utility functions are affected by not only the matched pairs but also the state variable $\{t, i \notin I_{t-1}^j\}$.

At any period in the game, a forward-looking player's objective is to find a willing match to maximize its total future utility based on every player properties and the state variable $\{t, i \notin$

$I_{t-1}^{j}\}$. Hence, for period t, client i's value function V_{it}^{C} and auditor j's value function V_{jt}^{A} are as follows.

$$V_{it}^{C} = \max_{j_t}\left[g(i,j_t) - F_t\left(i, j_t, 1\left(i \notin I_{t-1}^{j_t}\right)\right) - 1\left(i \notin I_{t-1}^{j_t}, t > 1\right) \times CS + \delta V_{it+1}^{C}\right]$$

$$V_{jt}^{A} = \max_{I_t^j, \mathcal{F}_t^j}\left\{\sum_{i_t \in I_t^j}\left[F_t\left(i_t, j, 1\left(i_t \notin I_{t-1}^{j}\right)\right) - A(i_t) - 1\left(i_t \notin I_{t-1}^{j}\right) \times K(i_t)\right] + \delta V_{jt+1}^{A}\right\} \tag{3}$$

where $\mathcal{F}_t^j$ denotes the set of the audit fees that auditor j charges its clients.

The maximization problem that the players solve is complicated. As rational agents, all players want to find the match that gives them the highest value. However, in a matching game, it is possible that from client i's perspective, its best match is auditor j, but from auditor j's perspective, another client i' is a better match than client i. The possible conflict of interest between the players can be viewed as an additional constraint imposed on the maximization problem. That is, the match outcome should not only be desirable for one side of the market but also be acceptable for the other side of the market so that neither side will deviate from the match. Formally, I define the equilibrium in the next subsection.

3.3.2 Equilibrium

The equilibrium concept used in this study is pairwise stable (e.g., Roth and Sotomayor 1992, Fox 2009, Agarwal 2013). Specifically, an equilibrium is defined as the set of matched pairs and audit fees for every period that player values are maximized subject to the following two constraints.

[Equilibrium Constraint 1] Individual rationality: For any period t, if client i matches with auditor j, both players should prefer being matched than being unmatched.[8]

[Equilibrium Constraint 2] No blocking: For any period t, it is impossible that client i and auditor j' are not matched but prefer each other over their matches.[9]

The no blocking constraint suggests that it is impossible that client i and auditor j match with each other if client i prefers auditor j' more while auditor j' also prefers client i to at least one of its matched client. If this constraint is violated, client i and auditor j' can form a blocking pair and be better off together.

The model thus far is complex to solve and, hence, hard for empirical analysis. Therefore, some additional simplifying assumptions are introduced next to improve the theoretical tractability and empirical feasibility of the model while, as discussed later, maintaining the key tensions in the audit market.

First, I assume the learning cost K, audit cost A, and benefit from audit g to be linear functions of matched pair properties, which are assumed to be time-invariant. Ideally, a richer dynamic framework should allow the player properties to change over time. However, because there is no empirical method developed for estimating such a dynamic matching model yet, this assumption helps to keep the model estimable.

Second, I assume that the clients and auditors share the discounted sum of surplus (i.e., the difference between discounted sum of benefit g and discounted sum of total cost A, K, and CS) via the audit fee, based on an exogenously determined vector λ, of which each element is the

[8] Denote $\succcurlyeq_k$ as player k's revealed preference, the individual rationality constraint can be written for the client as $j \succcurlyeq_i \emptyset$ and for the auditor as $i \succcurlyeq_j \emptyset$.

[9] The no blocking constraint can be written as follows: If client i matches with auditor j, but $j' \succ_i j$, then $i' \succcurlyeq_{j'} i$ for $\forall i' \in I_t^{j'}$.

surplus sharing rule for a particular auditor or client property. For example, when the market is fully competitive, all elements of λ equal one, which suggests the client enjoys all surpluses from matching. In the real world, the surplus sharing rule λ is presumably determined by the bargaining power of the players. The assumption that I make keeps the bargaining process out of the model, which significantly reduces the complexity of the model while highlighting the tensions in the matching process between the players.[10]

The surplus sharing assumption is also added to the equilibrium definition as a third constraint that an equilibrium must satisfy and, more formally, it can be written as follows.

> [Equilibrium Constraint 3] Surplus sharing: if client i and auditor j matches from period t_0 until period $t_0 + T$, the series of audit fee F_{ijt}, $t_0 \leq t \leq t_0 + T$, should satisfy the following equation.

$$\sum_{t=t_0}^{t=t_0+T} \delta^{t-t_0}(g(i,j) - F_{ijt}) = \lambda \left[-K(i) - CS \times 1(t_0 > 1) + \sum_{t=t_0}^{t=t_0+T} \delta^{t-t_0}\big(g(i,j) - A(i)\big) \right]$$

With the expression above, it can also be observed that an additional implication of the surplus sharing assumption is that it converts the complex matching problem to a simpler one that can be described in two steps. In the first step, the players decide whom to match with and the duration of the match without considering the series of audit fee F_t because, as observed from the right-hand side of the equation above, the overall surplus sharing is determined as long as the match is determined. In the second step, the matched pairs figure out a series of audit fee F_t that supports the match so that no player is willing to deviate from the match.[11]

---

[10] Most likely for this reason, some previous structural matching work also makes similar assumptions (e.g., Boyd, Lankford, Loeb and Wyckoff 2013, Sorenson 2007).

[11] DeAngelo (1981a) can be viewed as an extreme example where λ is set to be a vector of ones. In this situation, the author finds the match will last for infinite periods (i.e., no replacement), and a series of audit fee with the feature of lowballing can support the no-replacement match.

Next, I discuss the theoretical results from solving the two-step problem stated above. First, consider the first step, the determination of matching; the following lemma claims the existence and uniqueness of pure strategy equilibrium. [12]

Lemma: There exists a unique pure strategy matching equilibrium in which there is no replacement once players are matched in the first period.

With information symmetry, the above lemma is similar to the findings in DeAngelo (1981a) and Dye (1991). The intuition of this lemma is as follows. Suppose auditor j is the best possible auditor that client i can match with for the first $T \geq 1$ periods; j should also be i's best possible auditor for the next T periods. If not, i should have been matched with the other auditor for the first T periods.

Second, consider the second step, the determination of the series of audit fee F_t. As discussed previously, although the surplus sharing constraint restricts the sharing of total surplus, it still allows dynamics in the audit fee, and hence, the matched pairs must find out the series of audit fee F_t that support the no-replacement matching equilibrium. In particular, starting from the second period, because the clients will incur switching costs when they want to replace auditors, the incumbent auditors have competitive advantage and can earn additional rents. Therefore, the competition in the first period is even more intense than that in a static situation because auditors will charge even lower fees to attract clients. Formally, I have the following proposition.

Proposition: The audit fee in period t is a linear combination of benefit and costs of auditing as follows.

[12] Proofs for lemma and proposition are included in Appendix B.

$$F_{ijt} = (1-\lambda)g(i,j) + \lambda A(i) + \lambda(1-\delta)K(i) + (1-\delta)CS - CS \times 1(t=1) \tag{4}$$

The proposition above is also a classic result that follows DeAngelo (1981a), and it suggests that the audit fee in the first period is lower than the audit fee in the later periods, which is consistent with the documentation from previous audit fee research (e.g., Hay et al. 2006).

3.4 Empirical Specification, Identification, and Estimation

3.4.1 Empirical Specification

The objective of my structural model is to estimate the determinants of match outcome. Specifically, the empirical model is designed to estimate unobserved parameters (i.e., the benefit of auditing, various types of costs associated with auditing, and the surplus sharing rule) from the observed match outcome and observed properties of matched pairs. Following the Lemma, if the surplus sharing constraint is plugged in, the client and auditor maximization problem in the first period can be written as follows.

$$\begin{gathered} \max_{j} \lambda \left[\frac{1}{1-\delta}\left(g(i,j) - A(i)\right) - K(i)\right] \\ \max_{I^j} (1-\lambda) \left[\sum_{I^j} \left[\frac{1}{1-\delta}\left(g(i,j) - A(i)\right) - K(i)\right]\right] \end{gathered} \tag{5}$$

subject to individual rationality and no blocking constraints.

Moreover, following the discussion in Section 3, I assume that the benefit and costs are linear functions of auditor and client properties as follows.

$$\begin{cases} g(i,j) = \alpha Z_j \\ K(i) = \beta_K X_i \\ A(i) = \beta_A X_i \end{cases} \tag{6}$$

where subscript i and j indicate client i and auditor j, X_i is a vector of client properties, Z_j is a vector of auditor properties, and α, β_K, and β_A are vectors of parameters to be estimated that capture the influence of properties on benefit and costs.

Based on the combination of the theoretical specification in equation (5) and empirical specification in equation (6), if client i matches with auditor j, the lifetime value from matching can be further written as follows.

$$\begin{cases} v_i^C = \lambda\left[\left(\frac{\alpha}{1-\delta}\right)Z_j - \left(\frac{\beta_A}{1-\delta} + \beta_K\right)X_i\right] \\ v_j^A = (1-\lambda)\left[\left(\frac{\alpha}{1-\delta}\right)Z_j - \left(\frac{\beta_A}{1-\delta} + \beta_K\right)X_i\right] \end{cases} \tag{7}$$

where v_i^C and v_j^A denote the discounted sum of future utility from the particular matching for client i and auditor j, respectively.

For client i's value v_i^C, because the second term that contains X_i is a constant to the client itself, it is can be eliminated from the function theoretically and is empirically not identifiable from data (i.e., the lack of cross-sectional variation does not allow the researcher to identify the impact of the constant terms from observed outcomes).[13] The same logic also applies to the term that contains Z_j in auditor j's value v_j^A. Moreover, because it is possible that some of the player properties are unobservable to the researcher, I model them as unobserved random shocks that also affect the match. Thus, equation (7) can be re-written as follows.

$$\begin{cases} \tilde{v}_i^C = \tilde{\alpha} z_j + \epsilon_i \\ \tilde{v}_j^A = \tilde{\beta} x_i + \eta_j \end{cases} \tag{8}$$

[13] Theoretically, for any utility function u, another utility function that equals to u plus a constant describes the identical preference as u.

where $\tilde{v}_i^C$ and $\tilde{v}_j^A$ are the player value without the constant terms from their own properties,[14] $\tilde{\alpha} \equiv \lambda\left(\frac{\alpha}{1-\delta}\right)$, $\tilde{\beta} \equiv (\lambda - 1)\left(\frac{\beta_A}{1-\delta} + \beta_K\right)$, x_i and z_j are observed properties of client i and auditor j, and ϵ_i and η_j are the impacts of unobserved properties of client i and auditor j, which are assumed to follow standard normal distribution.[15]

The preference structure in equation (8) is the same as the preference structure of static matching models estimated in the literature (e.g., Agarwal 2013). Hence, $\tilde{\alpha}$ and $\tilde{\beta}$ are identified under standard assumptions.[16] Moreover, similar to many other structural models (e.g., Arcidiacono and Miller 2011), as long as the discount factor δ is determined, the parameters that affect per period utility (i.e., $\lambda\alpha$ and $(1-\lambda)(\beta_A + (1-\delta)\beta_K)$) are also identified.

The following client properties are used in my estimation: *Ln(total assets), receivables + inventories* (scaled by total assets), and *Ln(business segments)*. These properties are widely used in the audit fee literature to measure size, risk, and complexity of the audit.[17] Hence, potentially, they also have a high impact on the auditor preference. Auditor *Big-4 membership* and *industry expertise*, which is measured as a dummy variable that equals 1 if the auditor's total client assets ranks in the top 8 in the industry and equals 0 otherwise, are chosen as the auditor properties.[18] DeAngelo (1981b) theoretically proves that Big-N membership can be viewed as a proxy for audit quality because larger auditors have higher reputation concerns and, hence, less moral

[14] Mathematically, $\tilde{v}_i^C = v_i^C + \lambda\left(\frac{\beta_A}{1-\delta} + \beta_K\right) X_i$ and $\tilde{v}_j^A = v_j^A - (1-\lambda)\left(\frac{\alpha}{1-\delta}\right) Z_j$.

[15] In Appendix D, I prove this empirical specification can support any possible matching equilibrium. That is, there is no matching equilibria that my empirical specification can never justify, regardless of what $\tilde{\alpha}$, $\tilde{\beta}$, ϵ_i, and η_j are.

[16] Details about identification are discussed in Section 4.2.

[17] See Hay et al. (2006) for a review of the properties chosen by the audit fee literature.

[18] Industries are defined following the Fama-French five industry classification.

hazard problems for Big-N auditors.[19] Moreover, as surveyed by DeFond and Zhang (2013), these two properties are widely used as proxies for input-based audit quality.

To incorporate the role of corporate governance in the auditor-client match discussion, I introduce client heterogeneous preference for auditor properties. That is, $\tilde{\alpha}$ is allowed to be individual specific, which takes the following functional form.

$$\tilde{\alpha}_i = \tilde{\alpha}_0 + \tilde{\alpha}_1 x_i^G \tag{9}$$

where x_i^G is a client i's property that proxies its corporate governance.[20] Larcker, Richardson, and Tuna (2007) investigate the associations between 14 dimensions of corporate governance and accounting restatements and find insider power, a factor highly loaded by insider ownership, is the only dimension with a both statistically significant and economically meaningful coefficient. Therefore, I use *insider ownership* as x_i^G.[21] In general, higher insider ownership can improve corporate governance if it can lower the agency conflict between shareholders and managers. However, high insider ownership can also lead to insiders assuming control of the firm, thus exacerbating the agency problem (Larcker and Richardson 2004). For example, Morck, Shleifer, and Vishny (1988) document that an intermediate level of insider ownership indeed harms corporate governance. Thus, following the literature, high insider ownership is a proxy for poor corporate governance. Therefore, according to my theoretical analysis, $\tilde{\alpha}_1$ is expected to be negative and significant.

---

[19] A potentially counter example to the author's notice is Corona and Randhawa (2010), who find reputation concerns may sometimes harm audit quality.

[20] More precisely, board's weight on the manager ω is assumed to be a function of x^G. That is, $\omega \equiv f(x^G)$. I also assume $f(0) = 0$, which means when insider ownership is zero, the board is independent. Hence, $\tilde{\alpha}_1 x^G$ is the first-order Taylor series approximation of ω.

[21] An additional reason to choose insider ownership as the proxy for corporate governance is that it is more exogenous to the matching problem, whereas other corporate governance proxies, such as institutional ownership, are more likely to be affected by the client choice of auditor.

3.4.2 Identification

In this section, I discuss how to use observations (i.e., match-pairs, properties, and audit fee) to pin down unobserved structural parameters (i.e., $\tilde{\alpha}$, $\tilde{\beta}$, and CS). First, I demonstrate the switching cost CS can be estimated using a regression approach. Second, I analyze the identification of parameters of the matching model (i.e., $\tilde{\alpha}$ and $\tilde{\beta}$) by first discussing the model in general and then observing some specific identification issues of my model.

First, I discuss the identification of switching cost CS. As observed from the Proposition in Section 3, the difference between F_1 and F_t, $\forall t > 1$, equals the switching cost CS. Hence, the following corollary claims the identification of switching cost.

Corollary: Switching cost CS is identified by taking the difference of the audit fee in the first period and the fee in the following periods.

This corollary highlights that the switching cost can be identified from a regression, with the audit fee being the dependent variable and a dummy variable for the first period as the independent variable.

Next, I discuss the identification of the empirical model specified in equation (8). In general, the identification of the matching model is proven by Agarwal and Diamond (2013) when the following conditions are satisfied. First, the unobserved shocks are unobservable to only the researchers but are perfectly observed by all the players in the game. For normalization purposes, these shocks are assumed to be identically and independently distributed random draws from a standard normal distribution. Second, when all the properties are zero, the value from matching is normalized to zero. In other words, there is no intercept. Third, at least the preference for one property is fixed to be positive (or negative).[22]

In addition to the general identification conditions noted by the literature, there are also some specific identification issues about my model. First, as discussed in the Corollary, switching cost CS is identifiable from the variation in audit fees but is not identifiable from the matched pairs. That is, other popular potential identification strategy candidates, such as adding a dummy variable of the incumbent client (or auditor) as an element of x_i (or z_j), do not help the identification of CS. In fact, because only approximately five percent of the auditor-client pairs changed in 2012, both of the following competing explanations can explain the low replacement rate well in a static framework: (1) The switching cost is extremely high so that almost no client is willing to switch; (2) the auditor matched in the previous year is already the best possible auditor that the client can be matched with so that the client does not need to replace its auditor. An advantage of my model is that it distinguishes these two explanations by modeling and estimating both the switching cost and the matching process.

Second, the coefficients of x_i for learning cost K and for auditing cost A (i.e., β_K and β_A, respectively) are only jointly identifiable. This is because the structural estimation identifies only $\tilde{\beta}$ (in equation (8)), which is a linear combination of β_K and β_A. Because of this issue, in the counterfactual analysis, I assume different ratios of β_A to β_K and provide intervals for the possible impacts of mandatory audit firm rotation.

[22] This assumption is needed for identification because, for example, if Big-4 auditors and clients with more total assets are observed to always match with each other, it is observationally equivalent that (1) both more total assets and Big-4 membership are preferred and (2) both fewer total assets and non-Big-4 membership are preferred.

3.4.3 Estimation

I use Simulated Method of Moments (SMM) to estimate the model. The advantage of this approach is that it fully uses the information in one-to-many matching games so that the preferences of both sides are identified separately, whereas many other estimation methods identify only the joint surplus.

An SMM estimator identifies structural parameter $\hat{\mu}_{SMM}$ by minimizes the distance between actual moments $\widehat{m}$ from observed data and simulated moments $\widehat{m}(\mu)$ from simulated data (with parameter μ) as follows.

$$\hat{\mu}_{SMM} = \arg\min_{\mu} || \widehat{m} - \widehat{m}(\mu) ||_W \tag{10}$$

where W is the weighting matrix.

To estimate the parameters, two sets of moments are picked. The first set consists of the means of the products of client and auditor properties of the matched pairs, which describe the joint distribution of clients and auditor properties.

$$\widehat{m}_1 = \frac{1}{N_C} \sum_{i=1}^{i=N_C} x_i z_j \times 1(i \in I^j) \tag{11}$$

The second set consists of within-auditor variances of client properties.

$$\widehat{m}_2 = \frac{1}{N_C} \sum_{i=1}^{i=N_C} \left(x_i - 1(i \in I^j) \times \frac{1}{C_j} \sum_{i' \in I^j} x_{i'} \right)^2 \tag{12}$$

The first set of moments provides information about whether certain properties are preferred by the clients and auditors. Intuitively, when a client property x is preferred by the auditors and an auditor property z is preferred by the clients, they should appear together more frequently in the sample. The second set of moments provides information about the relative importance of each property to the auditors. When a certain property has more significant impact on the auditors' preference (i.e., bigger $|\tilde{\beta}|$), its within-auditor variation should be smaller.

The process of estimation is as follows. First, simulate the auditor-client equilibrium matches based on many sets of parameters and calculate the moments from these matches. Second, find and choose the set of parameters that give the smallest distance between simulated and actual moments as the estimates.[23]

3.5 Data and Reduced Form Evidence

3.5.1 Data, Sample, and Descriptive Statistics

The data used in this research are from three sources. First, the client financial statement and business segments data are obtained from Compustat NA database. Second, client-auditor engagement and audit fee information are obtained from Audit Analytics. Finally, client insider ownership data are obtained from Capital IQ database.

The sample selection process is as follows. I start with all NYSE, AMEX, and NASDAQ observations from Compustat for the fiscal year 2012 (5,962 observations). I then eliminate observations of (1) financial institutions (SIC code: 6000-6999) and utility companies (SIC code: 4000-4999), (2) missing or non-positive total assets and lagged total assets, and (3) missing variables to calculate client properties used in estimation (3,221 observations left). Finally, I merge firm financial statement data with insider ownership, auditing, and business segments data and keep only the observations that contain all variables needed for estimation (2,002 observations left).

[23] Detailed estimation process is available in Appendix C. A short version of the simulation process is as follows. First, a panel of random shocks is simulated and kept constant for the estimation. Second, for a certain set of parameters, the player preferences for all possible matches are calculated. Third, the clients are sorted based on the auditor preference and then are sequentially assigned to the auditors based on client preference for the auditors.

Table 2, Panel A reports the descriptive statistics of the variables used in estimation. On average, approximately 11.6 percent of firm total assets consist of inventories and receivables. The distribution of number of business segments is highly right skewed. Although many of the firms have less than 3 business segments, the maximum number of business segments that a firm has is 15. Hence, the logarithm of business segments instead of business segments itself is used in estimation to reduce the impact of outliers. Insider ownership is defined as the fraction of shares owned by the insiders. The mean and standard deviation of insider ownership is 11.4 percent and 14.8 percent. The small mean and standard deviation suggest that the majority of the observations in the sample are with intermediate levels of insider ownership which exacerbates agency problems.

Big-4 is a dummy variable that equals one if the client is matched with a Big-4 auditor. The mean of this variable is 0.702, which means that approximately 70 percent of the firms in the sample are served by Big-4 auditors. This percentage is similar to those reported in previous research, which also samples firms from exchanges other than NYSE, AMEX, and NASDAQ. Industry expertise is also a dummy variable that equals one if the client is matched with an expert of the client's industry. Using the classification method developed by Fama-French, I classify all clients into five industries based on their SIC codes. An auditor is considered an industry expert if the summation of its clients' total assets ranks in the top 8 in the industry. Following this definition, Big-4 auditors are all classified as industry experts in all industries, and, overall, approximately 84 percent of the clients are served by industry experts.

Table 2, Panel B provides Pearson and Spearman correlations. All correlations are significant at the 1 percent level, and the signs of Pearson and Spearman correlations are all consistent with each other. As expected, total assets are positively correlated with the number of business segments and negatively correlated with insider ownership. Both Big-4 and industry expertise are positively correlated with total assets, which suggests larger clients are more likely to match with auditors of good audit quality. In contrast, both Big-4 and industry expertise are negatively correlated with insider ownership, which suggests clients with lower corporate governance are less likely to match with auditors of good quality.

3.5.2 Reduced Form Evidence

In this subsection, reduced form evidence is provided to support my theoretical model and structural estimation. Table 3 examines the joint distribution of client and auditor properties. As discussed in Section 4, if a client property x is preferred by the auditors and an auditor property z is also preferred by the clients, they will be positively associated with each other in the data. Thus, the coefficients from the following two regressions are reported.

$$z_{ij}^{k} = \rho_0 + \rho_1 \ln(Total\ Assets)_{ij} + \rho_2(Inventories + Receivables)_{ij} + \rho_3 \ln(business\ segments)_{ij} + \rho_4 Insider\ Ownership_{ij} + \zeta_{ij} \quad (13.1)$$

$$x_{ij}^{k} = \varphi_0 + \varphi_1 Big4_{ij} + \varphi_2 Industry\ Expertise_{ij} + \xi_{ij} \quad (13.2)$$

where the superscript k indexes different properties, and the subscript ij means these regressions are based on matched pairs.

Before discussing the results from the above regressions, it is worth noting that one limitation of the above regressions is that they take the matched pairs as given and the endogenous two-sided matching process is largely ignored. In other words, these regressions use only the information from matched pairs but ignore the information from unmatched pairs. This limitation results in an endogeneity problem and, hence, the coefficients are biased (Boyd et al. 2013). One advantage of my structural estimation method is that it takes the two-sided matching process into account so that the information from unmatched pairs is also fully used.

Table 3, Panel A performs regressions in equation (13.1). Because both Big-4 and Industry expertise are binary variables, both linear probability model and the Probit model are used to examine the sorting patterns. In general, the estimates from the linear probability model and the Probit model are similar not only in sign but also in significance level. Some results of this multivariate analysis are similar to the results of the univariate analysis reported in Table 2. For example, when other variables are controlled, total assets are still positively associated with audit quality proxies, and insider ownership is still negatively associated with audit quality proxies. However, the associations between inventories + receivables and the audit quality proxies are not statistically significant, and the associations between number of business segments and the audit quality proxies become negative. These findings are different from those in Table 2.

Table 3, Panel B performs regressions in equation (13.2). The main distinction between this set of results and those reported in Table 3, Panel A is that the associations between inventories + receivables/number of business segments and audit quality proxies are positive. However, because of the positive correlations between total assets, inventories + receivables, and number of business segments, it is difficult to determine whether inventories + receivables and number of business segments are preferred properties or not. Moreover, this inconsistency highlights the importance of considering both auditor and client preference simultaneously in a matching market.

Table 4 examines the within-auditor variations in client properties. The first two columns compare variances of client properties calculated within auditors and the pooled sample. If a client property is more preferred by the auditors, good auditors will be more likely to match with clients with that property. Therefore, compared with pooled total variance, the within-auditor variance of the property should be smaller. In Table 4, the within auditor variance of total assets is only approximately two-thirds of its total variance, which suggest it is highly preferred by the auditors. Moreover, the within auditor variances of inventories + receivables and number of business segments are both smaller than total variances, but the differences are not as significant as that of total assets. The within-auditor variance of insider ownership is also smaller than its total variance. This observation suggests that clients with high insider ownership are more likely to match with non-Big-4 auditors, which is consistent with my theoretical prediction that clients with higher insider ownership prefer auditors with low audit quality more. Following the same logic, the third column of Table 4 reports the fractions of variation in client properties within auditors. In particular, the fraction is defined as $1 - R^2$ from separate linear regressions of client properties absorbing the auditor fixed effects. $1 - R^2$ is a natural measure of within-auditor variations because the more that variation can be explained by across-auditor differences (i.e., auditor fixed effects), the larger R^2 will be. Similar as before, all properties have smaller within-auditor variation than total variation.

Table 5 examines the robustness of my theoretical framework by investigating the auditor replacement frequency observed in the sample. More specifically, because my model predicts no auditor replacement will happen, I need to check how well the data matches this prediction. Table 5, Panel A summarizes the replacement percentages for the sample. In 2012, only approximately 5 percent of the clients replaced their auditors, which is close to my theoretical prediction. Moreover, the replacement percentage of the large firms (i.e., firms with total assets above medium) is only approximately 1 percent, which is significantly smaller than that of the small firms and suggests that my model potentially work better for large firms. I also find there is no significant difference between the replacement percentages of firms in different industries. Table 5, Panel B performs Probit regressions of auditor replacement on properties. Overall, clients with more total assets, matched with Big-4 auditors or matched with an audit expert of the client industry are less likely to switch auditors, whereas clients with more business segments or matched with an audit expert of other industry than the client industry are more likely to switch auditors. This finding is also consistent with the findings reported in Table 3, Panel A, which suggest that total assets, Big-4 membership, and industry expertise are preferred properties and that number of business segments is not preferred.

Table 6 presents the associations between the logarithm of audit fee and properties. The parameter of interest is the negative and significant coefficient of new engagement, where new engagement is a dummy variable that equals to one if there is an auditor replacement. Thus, following the Corollary, the absolute value of the coefficient of new engagement is the estimated client switching cost. The signs and significance levels of other properties are consistent with the literature. For example, logarithm of total assets, inventories + receivables, number of business segments, and Big-4 membership are all positively associated with audit fee. The positive associations reflect the fact that clients need to pay more if the audits take more effort and time or if the audit quality is better.

3.6 Estimation Results and Counterfactual Analysis

3.6.1 Estimation Results and Model Fit

Panel A, Table 7 reports the preference parameters obtained from structural estimation as designed in equation (8). The model is estimated with two specifications. Specification I uses only observed properties as covariates and estimates the preference on these properties. Specification II extends specification I by adding player-specific audit fees, which are defined as fixed effects of the players from the audit fee regression, into estimation. The estimates from these two specifications are similar in sign, magnitude, and statistical significance.

For auditors, consistent with the reduce form evidence, I find that the coefficients for log total assets, inventories plus receivables, and log business segments are positive, positive, and negative, respectively, and all are statistically significant. This finding suggests that auditors prefer clients with more total assets, more inventories plus receivables, and less business segments. This is potentially because a larger and riskier client can generate more profits for the auditors, but more business segments can complicate the audits and is not that profitable for auditors. Overall, the magnitudes of the coefficients for the three properties are similar to each other. However, because the mean of log total assets is approximately fifty times larger than that of inventories plus receivables and approximately nine times larger than that of log business segments, the size of the clients is still the most important determinant for auditor preference. Finally, in specification II, the coefficient of the client specific fee is positive and significant, which is consistent with the intuition that auditors prefer clients that generate more client specific fee.

For clients, in general, I find the coefficients for Big-4 membership and industry expertise are positive and significant. This finding suggests that higher audit quality is preferred by clients. Moreover, I find the coefficients of the interactions of insider ownership and audit quality proxies are negative and significant. This suggests that clients with more insider ownership prefer good audit quality less, which is consistent with my theoretical prediction. This finding highlights that the clients' existing internal corporate governance has an impact on their choice of auditor. Finally, the coefficient of auditor specific fee is negative and significant, which is consistent with the intuition that clients prefer auditors with a less auditor specific fee.

The model fit is tested using two methods. First, I use a statistical approach. Specifically, I test the moments fit using a t-test and the overall model fit using a J-test (i.e., χ-squared over-identification test). Panel B, Table 7 examines whether simulated moments from the model are statistically significantly different than the actual moments from observed data. For all moments, I find that the t-statistics are all small, and this implies that the p-values are all greater than 0.1, which means that the null hypothesis that simulated moments are not statistically different from actual moments is not rejected for any of the moments and further means that the model is of decent fit. The J-test examines the model fit by combining all moments together. As in Panel A, Table 7, it turns out that specification I performs better than specification II because specification I is not rejected at the 1 percent level. However, given that the degree of freedom in specification II is higher than that of specification I, specification II is more likely to be rejected by design.[24]

Second, I compare the average estimated client attractiveness (defined as $\tilde{\beta}x_i$) of observed matches with that of the simulated matches. The averages are performed at the auditor level. Intuitively, if the model fit is good, the average estimated client quality of observed matches should be close to that of simulated matches. Figure 2 graphs the relationship between them for the auditors with more than five clients. The size of the circles represents the number of clients that the auditor serves. There are two interesting observations from Figure 2. First, overall, the circles are near the 45 degree line for both Panel A and Panel B, which suggests that both specifications have decent predictive power. It is not surprising that the larger circles are closer to the 45 degree line because simulation errors tend to cancel each other when averaged over a

[24] Strebulaev and Whited (2012) provide detailed discussion about model fit and rejection in structural models.

larger sample. Second, the biggest circles that represent Big-4 auditors are on the top right of the figures, the mid-sized circles that represent auditors in the next tier (i.e., Grant Thornton and BDO) are at the center of the figures, and small circles that represent smaller auditors are on the bottom left of the figures. This observation suggests that auditors of better audit quality are matched with more attractive clients. The rationale for this observation is that as reported in Table 7, clients prefer auditors with better audit quality, which further gives these auditors market power in selecting attractive clients.

3.6.2 Counterfactual Analysis

The counterfactual analysis investigates the potential impact of mandatory audit firm rotation on player welfare as well as the effect of existing corporate governance on the direction and magnitude of the policy impact in simulated worlds. In general, counterfactuals are simulated using the theoretical model, the estimated structural parameters, and the additional constraint that all clients are to replace auditors in 2013 and rotate auditors once every $\mathcal{T}$ years, $\mathcal{T} \in \{5,10,20\}$.[25] More detailed discussion about the design of my counterfactual analysis is available in Appendix 3C2 and 3E.

One key assumption for the counterfactual analysis is that the cost and benefit parameters (i.e., g, A, and K) as well as the surplus sharing rule λ will not change after the implementation of the mandatory audit firm rotation.[26] In the real world, however, it is possible that these parameters will change through certain mechanisms that are not modeled in my study. For example, the gross benefit from auditing g may increase if mandatory rotation causes auditors to work more

[25] No rotation within $\mathcal{T}$ years is allowed to avoid firms to switch back just one year after the mandatory rotation.

[26] This assumption has to be made for the following two reasons. First, in my theoretical framework, I do not model, for example, how auditor incentive to induce effort will change when the contracting space changes. Second, the data used for estimation do not contain information about these incentives. To empirically identify how these incentives will change, perhaps micro-level data on, for example, how auditor labor hours change over time have to be used as in O'Keefe, Simunic, and Stein (1994).

carefully and independently, or instead, the gross benefit g may decrease if the policy causes auditors to work less carefully because client retention does not matter as much as before.[27] Therefore, it is important to note that the results from my counterfactual analysis, especially the results against mandatory audit firm rotation, may also be interpreted as the thresholds for which the policy's incremental out-of-model benefit should exceed for the policy to be beneficial.

Table 8 reports the overall impact of mandatory audit firm rotation on client and shareholder lifetime value from auditing.[28] As in equation (9), for a particular client i, the constant part (i.e., $\tilde{\alpha}_0 z$) is defined as its shareholder value from auditing, and the varying part (i.e., $\tilde{\alpha}_1 x_i^G z$) is defined as the weighted manager welfare. Table 8 is created by varying both the interval of mandatory audit firm rotation $\mathcal{T}$ and the ratio of audit cost A to learning cost K, θ. There are three key observations from the table. First, no matter what $\mathcal{T}$ and θ are, mandatory audit firm rotation is always costly to the client as well as to the shareholders. As $\mathcal{T}$ and θ vary, the policy impact on client value from auditing varies from -1.98 percent to -15.97 percent, and its impact on shareholder value from auditing varies from -2.05 percent to -15.54 percent. This observation is one of the most important results of this paper, and it highlights that mandatory audit firm rotation can be value-destroying for shareholders. Second, the magnitude of learning cost can significantly affect the policy impact. For example, with a 10-year rotation interval, mandatory rotation reduces shareholder lifetime value from auditing by 8.3 percent when learning cost takes its highest possible value but reduces shareholder value by only 2.39 percent when learning cost is zero. Third, after rotation, the new auditor-client match outcome is less efficient for shareholders, which is consistent with the argument of the existence of the cost of reduced board

[27] Although regulators' desired consequence is that audit quality will improve on average when mandatory rotation becomes effective (i.e., g increases), Cameran, Francis, Marra, and Pettinicchio (2013) find evidence of the opposite using data from Italy where mandatory audit firm rotation has been required since 1975.

[28] δ is set to be 0.9.

effectiveness. For example, if learning cost is zero, when rotation interval increases from five years to twenty years, the reduction in shareholder value from auditing increases from 2.05 percent to 2.86 percent. Because longer rotation intervals must lead to smaller total switching costs, this change can come from only the reduced efficiency in the new match outcome.

To further investigate how clients' existing internal corporate governance affects the new match outcome with mandatory audit firm rotation and the impact of the policy, two additional analyses are performed. First, an individual firm-level analysis is conducted to see how the impact of the policy varies among different clients. Figure 3 plots the relationships between the changes in player lifetime value and client insider ownership using nonparametric kernel regressions. In the figure, insider ownership is positively associated with the change in client and shareholder value but negatively associated with manager value, which suggests that the policy has a heterogeneous impact on shareholders of different clients. Specifically, the policy is more harmful to the shareholders of the clients with strong corporate governance but can sometimes be helpful to the shareholders of the clients with weak corporate governance. This finding highlights that the heterogeneity in clients' existing internal governance can lead to heterogeneous policy impact on clients, shareholders, and managers.

Second, focusing on the cost of reduced board effectiveness, Table 9 examines the impact of mandatory audit firm rotation through matching only. That is, only the cost of reduced board effectiveness is considered, whereas both learning cost and switching cost are excluded in the analysis. Consistent with the observation in Table 8, I find that shareholders suffer from the new auditor-client match outcome, whereas managers, in fact, benefit from the new match outcome. For example, for a ten-year rotation, the shareholder value from auditing decreases by 2.17 percent. The magnitudes of the impact also critically depend on the intervals. For example, the magnitude of the impact of a policy with a twenty-year rotation interval is approximately 50 percent higher than that of a policy with a five-year rotation interval. This finding suggests that mandatory rotation will exacerbate the agency problem and a longer rotation interval may not always be helpful to the shareholders. Table 9 also examines the welfare impact of the policy on auditors. The average auditor welfare from matching does not change by design. However, the policy has a different impact on different auditors. In particular, for a ten-year rotation policy, Big-4 auditor lifetime value will decrease by 1.35 percent, but Non-Big-4 auditor lifetime value will increase by 4.97 percent. The decrease in Big-4 auditor value is likely one of the reasons why Big-4 auditors are against mandatory audit firm rotation.

Because mandatory audit firm rotation can be costly, a frequently suggested alternative to the policy is to enhance internal governance by enhancing the audit committee independence and performance. Specifically, for example, enhancing the expertise of audit committees, reinforcing the audit committee's responsibility for overseeing the audit firms, and PCAOB to cooperate with audit committees to enhance audit effectiveness are widely recognized as good alternatives (e.g., Deloitte 2012). Table 10 explores how changes in audit committee independence or changes in corporate governance in general affect shareholder value from auditing by varying model parameter $\widetilde{\alpha_1}$, i.e., how influential insider ownership is on the client preference for audit quality.[29] In the model, smaller $\widetilde{\alpha_1}$ is interpreted as better governance because insider ownership will bias the client preference less for smaller $\widetilde{\alpha_1}$. When $\widetilde{\alpha_1}$ is set to be zero (i.e., board interests are fully aligned with shareholder interests), I find shareholder lifetime value from auditing

[29] $\widetilde{\alpha_1}$ corresponds to $\frac{\omega}{insider\ onwership} g^M$ in the model. Hence, a reduction in $\widetilde{\alpha_1}$ can be either a reduction in $\frac{\omega}{insider\ onwership}$, the marginal impact of insider ownership on the weight put to the managers, or a reduction in g^M, the part of manager utility that is not aligned with shareholders'. Both situations can be interpreted as an improvement in corporate governance. I do not model specific policies or mechanisms that lead to changes in $\widetilde{\alpha_1}$. However, changes in, for example, disclosure policy, compensation scheme, and board composition all can potentially affect $\widetilde{\alpha_1}$.

increases by 0.28 percent. When $\widetilde{\alpha_1}$ becomes greater, the shareholder value from auditing decreases monotonically. For example, when $\widetilde{\alpha_1}$ is set to be positive infinity (i.e., board interest are fully aligned with manager interests), I find shareholder value from auditing decreases by 64.19 percent. An important observation from the table is that the increase in shareholder value from auditing is relatively small even if internal corporate governance becomes perfect and insider ownership does not bias the board preference. This observation suggests that the audit committees perform reasonably well in the real world.

Finally, Table 11 investigates the impact of mandatory audit firm rotation with perfect internal corporate governance (i.e., $\widetilde{\alpha_1} = 0$). Again, it turns out that mandatory audit firm rotation is still costly to the shareholders. Moreover, compared to the results reported in Table 8, for any combination of $\mathcal{T}$ and θ, the reduction reported in Panel A, Table 11 is always greater and the incremental magnitude is 0.1 percent to 0.15 percent of shareholder value from auditing. For example, when $\mathcal{T} = 10$ and $\theta = 1$, the policy will decrease the shareholder value from auditing by 2.92 percent with the current level of internal governance but will reduce the shareholder value by 3.04 percent if the internal governance is perfect. This finding is, however, not surprising because boards are already making the best choice for the shareholders when internal governance is perfect and the cost of reduced board effectiveness from mandatory rotation increases. Panel B, Table 11 supports this explanation by quantifying the cost of reduced board effectiveness. Comparing the values in Panel B, Table 11 with those in Table 9, it is observed that the cost of reduced board effectiveness increases on average by approximately 4.0 percent.[30] This finding highlights that mandatory audit firm rotation will become even more value-destroying when internal governance strengthens and that it is important for the regulators

[30] For example, for a ten-year rotation policy, the increase in the cost of reduced board effectiveness is (2.26-2.17)/2.17≅4.15%.

to recognize that there is a fundamental conflict between mandatory audit firm rotation and other policies that improve internal corporate governance.

3.6.3 Value of Auditing and Cost of Mandatory Auditor Rotation

In this subsection, I provide evidence from my model and prior literature to better discuss and interpret the meaning of the estimated intervals in the previous subsection.

As discussed above, one of the limitations of my model is that it cannot distinguish learning cost and audit cost so that I allow the ratio of them to vary from zero to infinity in the previous subsection. However, prior auditing literature has provided guidance to narrow down the estimated intervals. O'Keefe et al. (1994) survey audit professions and document that the auditor labor hours do not increase significantly for first-year engagements, which suggests the learning cost is probably small. Hence, although it is still hard to claim the learning cost is exactly zero, one may focus more on ranges near the lower bound of the estimated intervals. For example, if learning cost is at most as large as audit cost, the range of cost of mandatory auditor rotation to shareholders is narrowed down as 2.39 percent to 2.92 percent of their value from auditing, which is much smaller than the one reported in 3.6.2.

Next, I estimate the value of auditing using two approaches. First, I derive the value of auditing using the estimates from my model and counterfactual analysis. Second, I survey prior literature to obtain proxies for estimating value of auditing, which could be viewed as a robustness check of the first approach.

To estimate the value of auditing using my model, I focus on the net switching cost. In the counterfactual analysis, the net switching cost reduces value of auditing by 0.22 percent (i.e., total cost 2.39 percent minus learning cost 0.00 percent minus cost reduced matching efficiency

2.17 percent). According to the Corollary, switching cost can also be estimated by calculating the difference between first year audit fees and following year audit fees. Hence, by summing the discounted switching cost of all clients, the total net switching cost for mandatory auditor rotation can be estimated and equals 0.54 billion dollars. Dividing this number by 0.22 percent yields 247.2 billion dollars, which is the estimated value of auditing. Multiplying the number by the upper and lower bounds of the narrow interval [2.39%, 2.92%], the cost of mandatory auditor rotation is between 5.9 billion dollars to 7.2 billion dollars, which are large in quantity but small compared to total market capitalization, 6619.9 billion dollars.

I then estimate the value of auditing using the estimates/proxies obtained from prior literature. The first proxy for benefit of auditing is the estimated as the reduced cost of debt. Mansi, Maxwell and Miller (2004) document that bond rating are better and bond interest rates are lower if clients are served by large auditors. When clients are matched with large auditors, bond interest rate reduces by 44.5 basis points even if large auditors' impact on bond rating is already controlled and reduces by 57.4 basis points if large auditors' impact on bond rating is included.[31] Using these estimates, I estimate the total saved cost of debt as $\sum Total\ Debt \times 1(Big4) \times Interest\ Rate\ Reduction$. Using the observations from my sample, the estimated discounted sum of total saved costs of debt by matching with Big-4 auditors are 86.1 billion dollars (44.5 basis points) and 111.0 billion dollars (57.4 basis points).

The second proxy for benefit of auditing is estimated as the increased stock market reaction to earnings. Teoh and Wong (1993) find that the earnings response coefficients (ERC) are larger by 0.317 for clients of large auditors. In other words, reported earnings are less underpriced when

[31] 57.4 basis points are estimated as 100 ×(0.445+large auditors' impact on bond rating 0.970 × impact of bond rating on cost of debt 0.1333). Coefficients are taken from Mansi et al (2004).

they are audited by large auditors. By assuming the difference in estimated ERC can be applied to not only unexpected earnings but also common equity, I estimate the total reduced cost of equity as $\sum Total\ Book\ Equity \times 1(Big4) \times \Delta ERC$. It is worth noting that, however, this assumption can potentially lead to overestimation of benefit of auditing because investors could have more information about equity than unexpected earnings, hence the underpricing of equity can be smaller. For 2012, using the observations from my sample, the estimated total saved cost of equity by matching with Big-4 auditors is 750.0 billion dollars.

The proxy for cost of auditing is audit fees. The summation of all audit fees from Audit Analytics database in 2012 is 13.18 billion dollars.[32] The summation of all audit fees of my sample is 3.62 billion dollars, which is approximately 27.47 percent of total audit fees reported in Audit Analytics database. Using the estimates from the third specification of audit fee regression reported in Table 6, the estimated discounted sum of Big-4 auditor premium in my sample is 10.9 billion dollars.[33]

Combining the estimates above, the lifetime value of matching with Big-4 auditors in the audit market is 825.2 billion dollars (large auditors' impact on bond rating excluded) and 850.1 billion dollars (large auditors' impact on bond rating included). Multiply both numbers by the upper and lower bounds of the narrow interval [2.39%, 2.92%], the cost of mandatory auditor rotation varies from 19.7 billion dollars to 24.8 billion dollars. As expected, these estimates are larger than the ones from my model because using ERC can overestimate the benefit of auditing.

[32] Because Audit Analytics only contains records reported to SEC, the estimated total audit fee is smaller than the total audit fee in the US market. For example, the total audit fee for Deloitte is 2.859 billion from Audit Analytics database while this number increases to 4.08 billion according to Deloitte website: http://www2.deloitte.com/us/en/pages/about-deloitte/articles/facts-and-figures.html.

[33] For each client, Big-4 auditor premium is estimated as $audit\ fee - \exp(\ln(audit\ fee) - 0.390 \times 1(\text{Big4}))$, where 1(Big4) is an indicator function that equals one if the client matches with a Big-4 auditor and zero otherwise.

However, in terms of order of magnitude, the estimates are close to each other, which further suggest that my model generates reasonable estimates.

3.7 Conclusion

Among many current corporate governance reform proposals, mandatory audit firm rotation has been controversial. In this paper, I deploy a structural approach to quantitatively evaluate the economic costs and benefits of the policy with a focus on examining how the policy impact depends critically on firms' existing internal governance.

There are four key findings in this paper. First, I find the cost of a ten-year rotation policy to shareholders is 5.9 billion to 7.2 billion dollars. Second, I find a significant fraction of the reduction results from reduced board effectiveness in selecting auditors and hence the value reduction effect is amplified for firms with low insider ownership, which suggests that at the individual firm level, internal governance has an interaction effect on the impact of the policy. Third, I find strengthening public firm internal governance, an alternative to mandatory rotation, increases shareholder value from auditing up to 0.28 percent. Fourth, when the internal governance of public firms strengthens and board interests become fully aligned with shareholder interests, I find, because of a 4-percent increase in the cost of board effectiveness, mandatory rotation becomes even more value-destroying to the shareholders.

These findings have the following policy implications. First, mandatory audit firm rotation is not necessarily a good solution for improving shareholder welfare. Or, to justify the implementation of mandatory auditor rotation, the out-of-model benefit of the policy should at least exceed the estimated thresholds. Second, other alternative policies that directly improve firms' internal corporate governance may work better than mandatory rotation. Third, mandatory audit firm rotation will become even more undesirable to the shareholders as firms' internal corporate governance improves over time.

Finally, my study suffers from the following limitations, some of which can be areas of future research. First, my model is still relatively simple as a consequence of the assumption that the properties are constant over time. A more comprehensive dynamic model may also take the changes in the properties into account. Second, in my counterfactual analysis, I assume the benefit and cost of auditing as well as surplus sharing rule do not change before or after the implementation of mandatory audit firm rotation. For future work, one may extend my work by, for example, estimating a bargaining model between auditors and clients and testing how policies such as mandatory audit firm rotation will affect the surplus sharing between the players. Finally, my model treats other decisions of the firms, such as board composition and manager compensation, as exogenous. Future research may relax these assumptions and incorporate more endogenous choices into the estimation.

3.8 Figures and Tables

Figure 1: Timeline of the Dynamic Matching Game

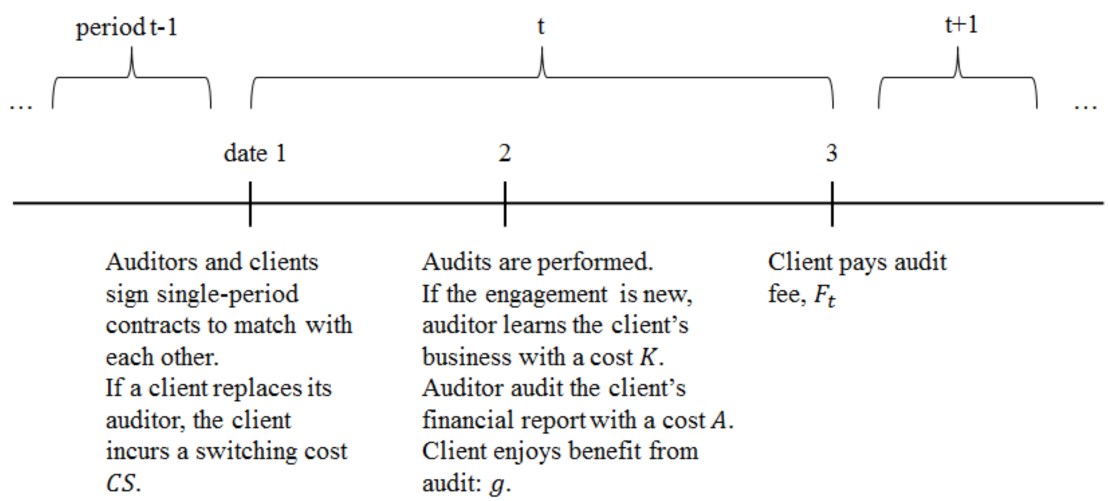
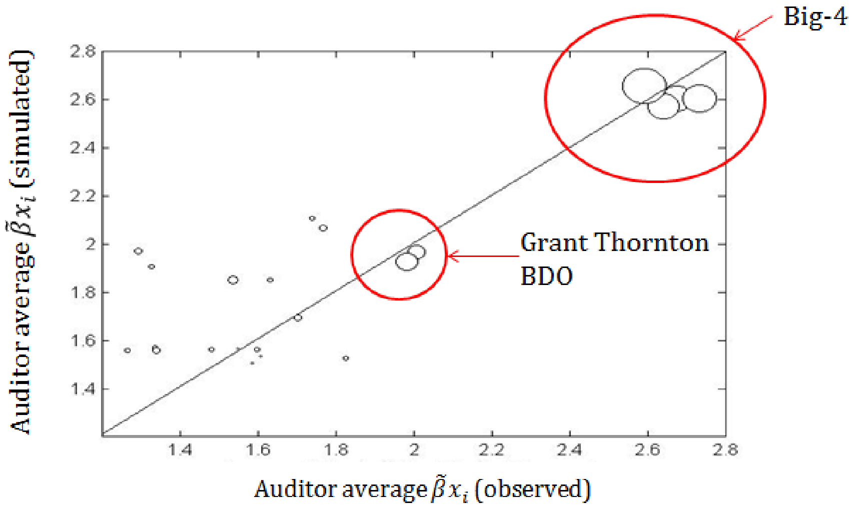
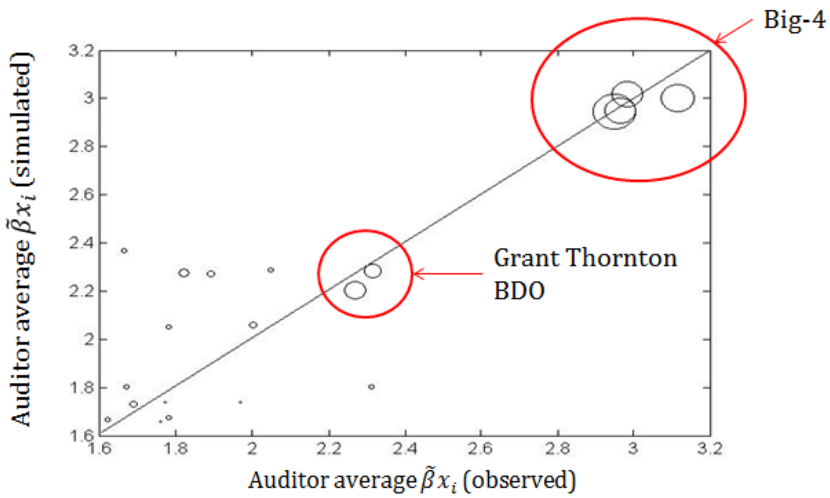


Figure 2: Model Fit: Observed vs. Simulated Client Attractiveness by Auditors

Panel A: Model Fit - Specification I



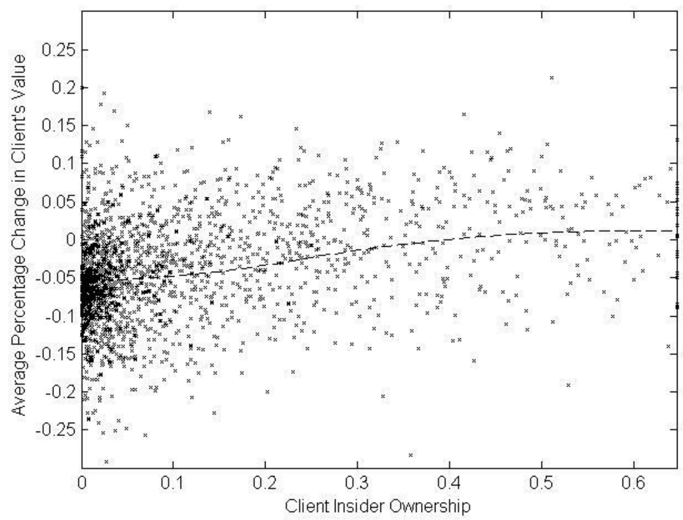
Panel B: Model Fit - Specification II



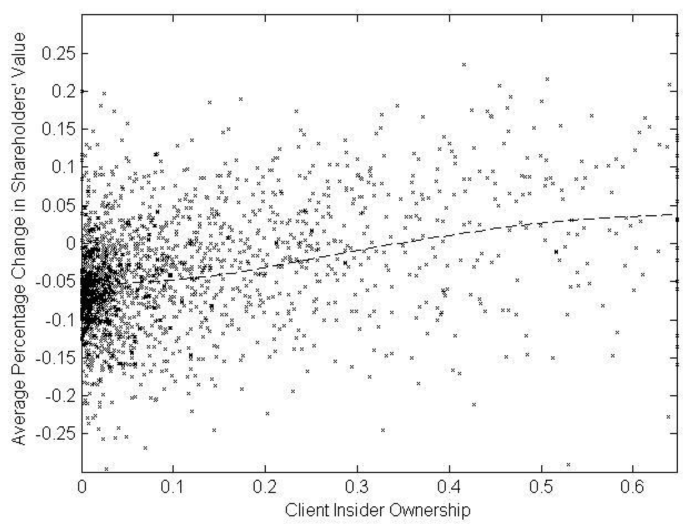
Note: This figure graphs average estimated client quality from observed data against average estimated client quality from simulated data to show model fit. Panel A shows the model fit of structural estimation specification I. Panel B shows the model fit of structural estimation specification II. The auditors with more than 5 clients are graphed in the figure. Each circle represents one auditor and the size of the circle represents the number of clients. The solid line is the 45 degree line.

Figure 3: Impact of Mandatory Audit Firm Rotation on Clients with Different Insider Ownership

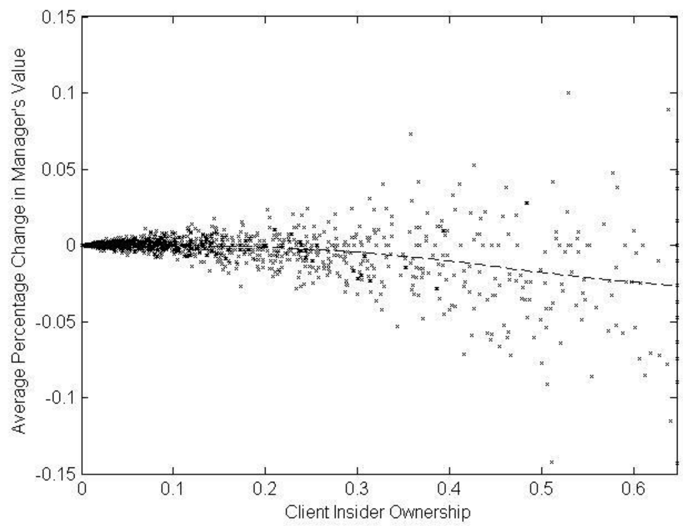
(A) Relationship between Insider Ownership and Average Change in Client Lifetime Value from Auditing



(B) Relationship between Insider Ownership and Average Change in Shareholder Lifetime Value from Auditing



(C) Relationship between Insider Ownership and Average Change in Manager Lifetime Value from Auditing



Note: This figure shows the relationship between insider ownership and client, shareholder, and manager value with mandatory audit firm rotation for the rotation interval equals to 10 years and the ratio of audit cost to learning cost equals to 0.1. Each dot is a simulated firm. The dashed lines are from non-parametric kernel regressions of bandwidth 0.1.

Table 1: A Checklist of Notations in the Theoretical Framework

Notation	Definition
g	Gross benefit of auditing for clients
A	Auditor’s variable audit cost that occurs every period
K	Auditor’s fixed learning cost that only occurs in the first period of engagement
CS	Client’s fixed switching cost that only occurs in the period of changing auditor
δ	Discount factor
Ft	Audit fee in period *t*
λ	An exogenous vector that describes how surplus is split between the players
g^M	Gross benefit/disutility of auditing for managers
g^S	Gross benefit of auditing for shareholders
ω	Client’s (i.e., board’s) weight on manager’s utility
q	Audit quality (modeled as auditor’s detection probability of manipulation in Appendix 3A)
θ	The ratio of audit cost to learning cost $\equiv A/K$.

Table 2: Descriptive Statistics

Panel A: Auditor and Client Properties

	N	Mean	Std Dev	Min	Max
Ln(Total Assets)	2002	6.159	2.023	1.955	10.938
Inventories + Receivables	2002	0.116	0.128	0	0.560
Ln(business segments)	2002	0.591	0.681	0	2.708
Insider Ownership	2002	0.114	0.148	0.001	0.648
Big-4	2002	0.702	0.457	0	1
Industry Expertise	2002	0.839	0.367	0	1
Ln(Audit Fee)	2002	13.682	1.197	11.137	16.714

Panel B: Pearson and Spearman Correlations of the Properties

	Ln(Total Assets)	*Inventories + Receivables*	*Ln(business segments)*	*Insider Ownership*	*Big-4*	*Industry Expertise*	*Ln(Audit Fee)*
Ln(Total Assets)	-	0.376	0.4030	-0.373	0.568	0.498	0.885
Inventories + Receivables	0.506	-	0.216	-0.119	0.199	0.182	0.360
Ln(business segments)	0.398	0.276	-	-0.111	0.162	0.150	0.417
Insider Ownership	-0.495	-0.215	-0.154	-	-0.340	-0.346	-0.403
Big-4	0.577	0.276	0.163	-0.380	-	0.672	0.631
Industry Expertise	0.499	0.245	0.150	-0.326	0.672	-	0.563
Ln(Audit Fee)	0.880	0.448	0.405	-0.508	0.641	0.557	-

Note: Panel A reports descriptive statistics of the sample. Panel B reports Pearson (upper triangle) and Spearman (lower triangle) correlations of the variables. All the correlations are statistically significant at 1% level. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders.

Big-4 is a dummy variable that equals to 1 if the auditor is one of the Big-4 auditors and equals to 0 otherwise. *Industry Expertise* is a dummy variable that equals to 1 if the auditor is of top 8 total client total assets of the client's industry and equals to 0 otherwise.

Table 3: Sorting between Clients and Auditors

Panel A: Regression of Auditor Properties on Client Properties

	Big-4		*Industry Expertise*	
	OLS	Probit	OLS	Probit
Ln(Total Assets)	0.123*** (0.005)	0.542*** (0.027)	0.082*** (0.004)	0.598*** (0.036)
Inventories + Receivables	-0.028 (0.686)	-0.315 (0.305)	0.005 (0.059)	-0.424 (0.395)
Ln(business segments)	-0.049*** (0.013)	-0.201*** (0.060)	-0.028** (0.011)	-0.147* (0.077)
Insider Ownership	-0.450*** (0.060)	-1.535*** (0.236)	-0.457*** (0.051)	-1.867*** (0.255)
R^2 / *Log Likelihood*	0.35	-798.3	0.28	-540.1

Panel B: Regression of Client Properties on Auditor Properties

	Ln(Total Assets)	*Inventories + Receivables*	*Ln(business segments)*	*Insider Ownership*
Big-4	1.881*** (0.108)	0.039*** (0.008)	0.166*** (0.044)	-0.063*** (0.009)
Industry Expertise	1.166*** (0.134)	0.030*** (0.010)	0.139*** (0.055)	-0.086*** (0.011)
R^2	0.35	0.04	0.03	0.14

Note: Panel A reports the coefficients from regressions of auditor properties on client properties. Panel B reports the coefficient from regressions of client properties on auditor properties. Standard errors are reported in the parenthesis. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders. *Big-4* is a dummy variable that equals to 1 if the auditor is one of the Big-4 auditors and equals to 0 otherwise.

Industry Expertise is a dummy variable that equals to 1 if the auditor is of top 8 total client total assets of the client's industry and equals to 0 otherwise. *, **, *** indicate statistical significance at 10%, 5%, 1% level, respectively.

Table 4: Within Auditor Variation in Client Properties

	Within Auditor Variance	Total Variance	Fraction of Variation Within Auditor
Ln(Total Assets)	2.671	4.089	62.6%
Inventories + Receivables	0.016	0.016	91.2%
Ln(business segments)	0.444	0.464	91.9%
Insider Ownership	0.017	0.022	75.0%

Note: The first column reports within auditor variance of client properties, the second column reports the pooled variance of client properties, the third column reports $1 - R^2$ from a separate linear regression of client properties absorbing the auditor fixed effects. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders.

Table 5: Evidence of Auditor Replacement

Panel A: Auditor Replacement Frequency

	Total Observations	Total Auditor Replacements	Replacement Percentage
Full Sample	2002	104	5.2%
Large Firms	1001	12	1.2%
Small Firms	1001	92	9.2%
Test 1: Large firms and small firms have the same replacement rate.	χ^2-stats: 73.16	p-value: 0.00	
Industry - Consumer	448	22	4.9%
Industry - Manufacturing	477	21	4.4%
Industry - High Tech	521	26	5.0%
Industry - Health	360	26	7.2%
Industry - Other	196	9	4.6%
Test 2: Firms in different industries have the same replacement rate.	χ^2-stats: 3.60	p-value: 0.46	

Panel B: Probit Regression of Auditor Replacement on Properties

	I	II	III
Ln(Total Assets)	-0.336*** (0.037)		-0.117** (0.046)
Inventories + Receivables	0.612 (0.444)		0.594 (0.472)
Ln(business segments)	0.261*** (0.089)		0.231** (0.094)
Big-4		-1.169*** (0.129)	-0.810*** (0.213)
Industry Top-8		-0.134 (0.126)	0.609*** (0.198)
Industry Expertise			-0.980*** (0.246)
Big-4 × Insider Ownership			0.398 (0.957)
Industry Expertise× Insider Ownership			0.588 (0.744)
Client's Industry Fixed Effects	Yes	No	Yes
Log Likelihood	-352.4	-336.5	-317.7

Note: Panel A reports the auditor replacement frequency in 2012. Panel B reports the estimates from Probit regressions of auditor replacement decisions on properties. Standard errors are reported in the parenthesis. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders. *Big-4* is a dummy variable that equals to 1 if the auditor is one of the Big-4 auditors and equals to 0 otherwise. *Industry Expertise* is a dummy variable that equals to 1 if the auditor is of top 8 total client total assets of the client's industry and equals to 0 otherwise. *, **, *** indicate statistical significance at 10%, 5%, 1% level, respectively.

Table 6: Audit Fee Regressions.

	I	II	III
New Engagement		-0.104** (0.053)	-0.103** (0.052)
Ln(Total Assets)	0.513*** (0.007)	0.428*** (0.008)	0.426*** (0.008)
Inventories + Receivables	0.451*** (0.102)	0.437*** (0.094)	0.441*** (0.094)
Ln(business segments)	0.151*** (0.019)	0.174*** (0.018)	0.171*** (0.018)
Big-4		0.323*** (0.047)	0.390*** (0.053)
Industry Expertise		0.090 (0.082)	0.095 (0.073)
Big-4 × Insider Ownership		0.138 (0.234)	0.154 (0.234)
Industry Expertise× Insider Ownership		-0.384* (0.209)	-0.390* (0.209)
Client's Industry Fixed Effects	Yes	Yes	Yes
Auditor Fixed Effects	No	No	Yes
R^2	0.80	0.83	0.83

Note: This table reports the association between logarithm of audit fees and properties. Standard errors are reported in the parenthesis. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders. *Big-4* is a dummy variable that equals to 1 if the auditor is one of the Big-4 auditors and equals to 0 otherwise. *Industry Expertise* is a dummy variable that equals to 1 if the auditor is of top 8 total client total assets of the client's industry and equals to 0 otherwise. *, **, *** indicate statistical significance at 10%, 5%, 1% level, respectively.

Table 7: Preference Parameters from Structural Estimation and Model Fit

Panel A: Parameter Estimates

	I	II
Preference on Client Properties x_i		
Ln(Total Assets)	0.436*** (0.025)	0.452*** (0.010)
Inventories + Receivables	0.358*** (0.064)	0.413*** (0.079)
Ln(business segments)	-0.612*** (0.034)	-0.596*** (0.044)
Client Specific Fee		1.938*** (0.064)
Preference on Auditor Properties z_j		
Big-4	2.908*** (0.348)	2.908*** (0.515)
Industry Expertise	2.494*** (0.211)	2.588*** (0.335)
Big-4 × Insider Ownership	-1.685*** (0.356)	-1.689*** (0.067)
Industry Expertise× Insider Ownership	-1.141*** (0.237)	-2.547*** (0.123)
Auditor Specific Fee		-0.174*** (0.037)
J-test statistics	14.59	36.62
p-value	0.012	0.000

Panel B: Moment Fit

Moments	Actual	Simulated	t-stats
Ln(Total Assets) × *Big-4*	4.8505	4.7312	-0.110
Ln(Total Assets) × *Industry Expertise*	5.5523	5.6159	0.088
Inventories + Receivables × *Big-4*	0.0934	0.0922	-0.058
Inventories + Receivables × *Industry Expertise*	0.1063	0.1077	0.095
Ln(business segments) × *Big-4*	0.4655	0.4142	-0.491
Ln(business segments) × *Industry Expertise*	0.5341	0.5148	-0.277
Insider Ownership × *Big-4*	0.0572	0.0636	0.497
Insider Ownership × *Industry Expertise*	0.0774	0.0890	1.548
Within auditor *Var(Ln(Total Assets))*	2.6706	2.7682	0.433
Within auditor *Var(Inventories + Receivables)*	0.0156	0.0155	-0.160
Within auditor *Var(Ln(business segments))*	0.4444	0.4467	0.093
Within auditor *Var(Insider Ownership)*	0.0171	0.0173	0.139

Note: This table reports the preference parameters estimated from the main structural model. Standard errors are reported in the parenthesis. *Ln(Total Assets)* is the logarithm of client's total assets, *Inventories + Receivables* is client's total inventories plus receivables scaled by total assets, *Ln(business segments)* is the logarithm of client's number of business segments, *Insider Ownership* is the percentage of shares outstanding owned by the insiders. *Big-4* is a dummy variable that equals to 1 if the auditor is one of the Big-4 auditors and equals to 0 otherwise. *Industry Expertise* is a dummy variable that equals to 1 if the auditor is of top 8 total client total assets of the client's industry and equals to 0 otherwise. *Client Specific Fee* and *Auditor Specific Fee* are estimated as the fixed effects from the audit fee regression. *, **, *** indicate statistical significance at 10%, 5%, 1% level, respectively.

Table 8: Counterfactual Analysis: Impact of Mandatory Audit Firm Rotation

Panel A: Impact of Mandatory Audit Firm Rotation on Client Lifetime Value from Auditing (in %)

			5-year	10-year	20-year
θ	Highest Learning Cost	0	-15.97 (-20.97,-14.59)	-8.43 (-14.24,-6.81)	-4.67 (-11.60,-2.67)
		0.5	-4.31 (-9.21,-2.92)	-3.33 (-9.09,-1.67)	-3.08 (-9.99,-1.07)
		1	-3.25 (-8.14,-1.85)	-2.87 (-8.62,-1.20)	-2.94 (-9.85,-0.93)
		2	-2.65 (-7.53,-1.23)	-2.60 (-8.35,-0.93)	-2.86 (-9.77,-0.84)
	Lowest Learning Cost	∞	-1.98 (-6.85,-0.56)	-2.31 (-8.06,-0.64)	-2.77 (-9.67,-0.75)

Panel B: Impact of Mandatory Audit Firm Rotation on Shareholder Lifetime Value from Auditing (in %)

			5-year	10-year	20-year
θ	Highest Learning Cost	0	-15.54 (-20.82,-14.11)	-8.30 (-14.43,-6.61)	-4.69 (-12.02,-2.67)
		0.5	-4.30 (-9.47,-2.87)	-3.37 (-9.46,-1.69)	-3.16 (-10.47,-1.14)
		1	-3.27 (-8.44,-1.85)	-2.92 (-9.01,-1.24)	-3.02 (-10.33,-1.00)
		2	-2.69 (-7.85,-1.26)	-2.67 (-8.75,-0.99)	-2.94 (-10.25,-0.92)
	Lowest Learning Cost	∞	-2.05 (-7.02,-0.62)	-2.39 (-8.46,-0.71)	-2.86 (-10.16,-0.83)

Note: This table reports the impact of mandatory audit firm rotation on clients' and shareholder lifetime value. Panel A reports impact on clients as a whole and Panel B reports impact on shareholders. θ is defined as the ratio of audit cost to learning cost. 5-year, 10-year, 20-year are the length of rotation intervals. The percentages are calculated as average change in players' lifetime value scaled by the players' lifetime value without mandatory audit firm rotation. In simulation, infinite is set to be one million. 95% intervals are reported in parenthesis and are generated from simulation.

Table 9: Counterfactual Analysis: Impact of Mandatory Audit Firm Rotation through Matching Only

	5-year	10-year	20-year
Impact on Clients through Matching:			
Change in Client Value (%)	-1.80 (-5.34,-0.67)	-2.13 (-6.31,-0.80)	-2.56 (-7.58,-0.96)
Change in Shareholder Value (%)	-1.83 (-5.59,-0.71)	-2.17 (-6.60,-0.84)	-2.61 (-7.93,-1.01)
Change in Manager Value (%)	1.83 (0.71, 5.59)	2.17 (0.84, 6.60)	2.61 (1.01, 7.93)
Impact on Auditors through Matching:			
Change in Auditor Value (%)	0 (0,0)	0 (0,0)	0 (0,0)
Change in Big-4 Auditor Value (%)	-1.15 (-3.75,-0.22)	-1.35 (-4.43,-0.26)	-1.63 (-5.32,-0.32)
Change in Non-Big-4 Auditor Value (%)	4.21 (0.82,13.78)	4.97 (0.96,16.26)	5.97 (1.16,19.55)

Note: This table reports the impact of mandatory audit firm rotation through matching only (i.e., impact from learning cost and switching cost are excluded). 5-year, 10-year, 20-year are the length of rotation intervals. The percentages are calculated as average change in player lifetime value from matching only scaled by the player lifetime value without mandatory audit firm rotation. 95% intervals are reported in parenthesis and are generated from simulation.

Table 10: Counterfactual Analysis: Impact of Improving and Worsening Internal Corporate Governance on Shareholder Lifetime Value from Auditing (in %)

		Percentage of $\widehat{\widetilde{\alpha_1}}$	Change in Shareholder Lifetime Value (%)
$\widetilde{\alpha_1}$	Fully Aligned with Shareholders	0%	0.28 (-0.20,1.14)
		50%	0.19 (-0.25,0.68)
		200%	-0.14 (-1.01,0.54)
		600%	-3.59 (-6.61,-0.93)
		1000%	-7.31 (-10.09,-4.78)
	Fully Aligned with Managers	∞	-64.19 (-67.78,-59.44)

Note: This table reports the impact of improving and worsening internal corporate governance on shareholder value from auditing (i.e., increase or decrease the impact of insider ownership by varying $\widetilde{\alpha_1}$). The percentages are calculated as average change in shareholder lifetime value scaled by the shareholder lifetime value before any improvement or decline in internal corporate governance. In simulation, infinite is set to be one million. 95% intervals are reported in parenthesis and are generated from simulation.

Table 11: Counterfactual Analysis: Impact of Mandatory Audit Firm Rotation on Shareholder Lifetime Value from Auditing When Client Interests are Fully Aligned with Shareholder Interests ($\widetilde{\alpha_1} = 0$) (in %)

Panel A: Overall Impact of Mandatory Audit Firm Rotation

$\widetilde{\alpha_1} = 0$			5-year	10-year	20-year
θ	Highest Learning Cost	0	-15.64 (-19.89,-14.11)	-8.41 (-13.46,-6.57)	-4.84 (-10.92,-2.59)
		0.5	-4.40 (-8.68,-2.82)	-3.49 (-8.55,-1.62)	-3.30 (-9.40,-1.05)
		1	-3.37 (-7.66,-1.79)	-3.04 (-8.11,-1.17)	-3.17 (-9.26,-0.91)
		2	-2.79 (-7.08,-1.20)	-2.79 (-7.85,-0.92)	-3.09 (-9.18,-0.84)
	Lowest Learning Cost	∞	-2.15 (-6.44,-0.56)	-2.50 (-7.57,-0.63)	-3.00 (-9.09,-0.75)

Panel B: Impact of Mandatory Audit Firm Rotation through Matching Only

	5-year	10-year	20-year
Impact on Clients/Shareholders through Matching:			
Change in Shareholder Value (%)	-1.91 (-5.13,-0.71)	-2.26 (-6.05,-0.83)	-2.71 (-7.27,-1.00)
Change in Manager Value (%)	1.91 (0.71, 5.13)	2.26 (0.83, 6.05)	2.71 (1.00, 7.27)

Note: This table reports the impact of mandatory audit firm rotation on clients' and shareholder value when client interests are fully aligned with shareholder interests ($\widetilde{\alpha_1} = 0$). Because client and shareholder interests are fully aligned, the impact on them is the same by definition. θ is defined as the ratio of audit cost to learning cost. 5-year, 10-year, 20-year are the length of rotation intervals. The percentages are calculated as average change in players' lifetime value scaled by the player lifetime value without mandatory audit firm rotation. In simulation, infinite is set to be one million. 95% intervals are reported in parenthesis and are generated from simulation.

APPENDIX

Appendix 2A: Accounting for Mortgage Banking

Banks report mortgage loans held for sale at lower of cost or market value (SFAS 65) or may also elect to report individual mortgage loans at fair value. For mortgages booked under historical cost, banks have to either sell or securitize them to recognize gains. Moreover, even for mortgages initially at fair value, loan securitization often leads to additional discretion in fair value estimation. This is because the retained tranches by the banks often do not have market prices and need inputs that are unobservable to measure the fair value (Karaoglu 2005).

In this appendix, I provide a hypothetical example of the accounting process for mortgage securitization and show how earnings management can be realized.[47] In a typical asset-backed securitization, banks first transfer the pool of assets to be securitized to a Special-Purpose Entity (SPE) or a GSE. The SPE then structure the pool of assets into different tranches with different risks and sell them to the investors.[48] The SPEs then transfer cash to the banks. For this transaction, in general, either of the following accounting approaches may be used. The first approach is referred as "sales accounting", where the SPE is viewed as a separate entity from the banks so that gains/losses may be recognized. The other approach is referred as "secured borrowing", where the SPE is viewed as a part of the bank. Therefore, the SPE has to be consolidated and no gains/losses may be recognized. To determine whether an SPE should be consolidated or not, the US GAAP requires a control approach. That is, the SPE should be

[47] The example used in this subsection is developed based on Deloitte Securitization Accounting Booklet (8th Edition, 2010).

[48] Details of the securitization process have been discussed in several papers (e.g., Dechow, Myers, and Shakespeare 2010) hence are not included in this paper.

consolidated as long as the assets securitized are still under the control of the bank (Schipper and Yohn 2007). Before 2009, the term Qualifying SPE (QSPE) is used to classify the SPEs that meet the control condition as regulated by SFAS 140 and FIN 46(R). However, beginning from 2010, SFAS 166/167 removed the QSPE provision and made the control condition much harder to be satisfied. Because I focus on earnings management specifically, the example used here is about the sales accounting.

Let us consider a hypothetical pool of mortgages with an aggregate principal amount of 100 million dollars. The net carrying amount of the mortgage pool is assumed to be 98 million.[49] The bank first structures the mortgage pool into different tranches, namely Class A, Class A-, Class IO, and Class R. Class A is designed to be riskless, so the market price for shares in this tranche is 100% of the principal. Class A- is designed to be riskier than Class A. Therefore, in this example, it is assumed that there is a 10% discount in price for shares in this tranche. Class IO stands for interest only strip, which can be the gap between the interests collected and the interests paid out to the investors. Class R is the residual interest, which is the interest retained by the bank. Because there does not exist an active market for Class IO and Class R tranches, the fair value of these two classes are based on the management estimation. The hypothetical principal amount, price, and fair value of each tranche are provided in Panel A Table 1. Besides the tranches listed in the table, another asset involved in the transaction is the Mortgage Servicing Right (MSR), which measures the value of the mortgage related bank services such as collecting interests monthly.

[49] Net carrying amount is defined as principal amount + accrued interest + purchase premium + differed origination costs – deferred origination fees – purchase discount – loss reserves.

During the transaction, Class A and Class A- are sold to the investors in fair value, while Class IO, Class R, and MSR, consequently, are acquired by the bank and booked in (estimated) fair value. Because the bank is allowed to capitalize both acquired tranches and MSR, gains/losses from the transaction are possible to occur. The procedure to calculate gain is provided in Panel B Table 1, and the journal entries for the transaction are provided in Panel C Table 1.

For the example used in this study, Panel B Table 1 shows a positive 3.5 million gain can be recognized from the securitization transaction. To see where the gain comes from, one should focus on the items of which the values are subject to estimation (i.e., Class IO, Class R, and MSR). Any valuation change in these items can directly affect the calculated net proceeds and the recognized gain. Hence, this process creates an opportunity for the bank managers to manage earnings. That is, when bank managers want to manage earnings upwards, they may use their discretion to report greater estimates for these items.

An Example of Accounting for Mortgage Securitization

Panel A: The Deal Structure

	Principal Amount	Price	Fair Value
Class A	$ 90,000,000	100	$ 90,000,000
Class A-	10,000,000	90	9,000,000
Class IO			2,000,000
Class R			1,000,000
TOTAL	$ 100,000,000		$ 102,000,000

Panel B: Gain Calculation

Cash from bond Class A sold	$ 90,000,000
Cash from bond Class A- sold	9,000,000
FV, Class IO	2,000,000
FV, Class R	1,000,000
FV, MSR	500,000
Less: transaction cost	1,000,000
Net Proceeds	101,500,000
Net Carrying Amount	98,000,000
Pretax Gain	$ 3,500,000

Panel C: Journal Entries

	Debt	Credit
Cash Proceeds	$ 99,000,000	
Class IO	2,000,000	
Class R	1,000,000	
MSR	500,000	
Net Carrying Amount		$ 98,000,000
Cash for transaction cost		1,000,000
Pretax Gain		3,500,000

Notations:

Class A: risk free tranche.

Class B: risky tranche with a discount of 10% in principal value.

Class IO: interest only strip.

Class R: residual interest.

Net Carrying Amount: principal amount + accrued interest + purchase premium + differed origination costs – deferred origination fees – purchase discount – loss reserves.

MSR: mortgage servicing rights.

Appendix 3A: A Micro Model of Client's Preference for Audit Quality

In this appendix, I develop a micro model of client's preference for audit quality. The model setup follows closely to Fellingham and Newman (1985).

I consider a client as a pubic firm that is owned by shareholders and operated by a manager. The shareholders cannot choose auditors by themselves but have to be delegated by the board of directors. The board of directors may care about not only the shareholders but also the manager. Thus, similar to equation (1) but more broadly, the client's utility (i.e., board of directors' utility), u^C, can be expressed as follows:

$$u^C = u^S + \omega u^M \tag{A1}$$

where u^S is shareholders' utility, and u^M is manager's utility. ω is the weight that board of directors put on the manager. For perfectly independent board, $\omega = 0$; for a friendly board, $\omega > 0$.

The risk neutral manager needs to report the firm performance every period. Moreover, he can choose whether to truthfully report or not. If the manager tells the truth, he earns baseline utility u_0^M. If the manager manipulates the financial reports and the manipulation is not detected by both auditor and regulator, his utility becomes $u_0^M + B$, where B, a private benefit. While the realization of private benefit is private information, its distribution is common knowledge.

An auditor is hired to detect manipulation. The auditor can detect manipulation with probability q when a manipulation happens. If the auditor does not detect a manipulation, the manipulation may still be detected by the regulator later with conditional probability p.

If the manager manipulates the financial reports and the manipulation is detected by auditor, the manager incurs a cost C_A^M for being detected, and, hence, his utility is $u_0^M - C_A^M$. Similarly, if the manager manipulates the financial reports and is not detected by auditor but by the regulator, his utility is assumed to be $u_0^M - C_R^M$. Hence, the manager's expected utility of manipulation is as follows.

$$u_0^M + B(1-p)(1-q) - C_A^M q - C_R^M (1-q)p \tag{A2}$$

From equation (2), it is clear that the manager will manipulate if and only if $B(1-p)(1-q) - C_A^M q - C_R^M (1-q)p > 0$. That is, the manager's manipulation probability is:

$$\Pr(manipulate) = \Pr\left(B > \frac{\frac{q}{1-q} C_A^M + p C_R^M}{1-p}\right) \equiv 1 - \mathbb{F}(B^*) \tag{A3}$$

where $\mathbb{F}(\cdot)$ is the cumulative distribution function of private benefit B, and B^* is the threshold above which the manager will manipulate.

It is easy to see that the manipulation probability is decreasing in p and q. For simplicity, I assume B is a binary variable with probability r to be B_h and probability $(1-r)$ to be B_l, $B_h > B^* > B_l$. Hence, in expectation, the manager's utility is:

$$u^M = u_0^M + [B_h(1-p)(1-q) - C_A^M q - C_R^M (1-q)p]r \tag{A4}$$

Taking first order condition with respect to q, I have the following inequality holds. [50]

$$\frac{\partial u^M}{\partial q} = r[-B_h(1-p) - C_A^M + C_R^M p] < 0 \tag{A5}$$

Lemma A: Manager's utility decreases as auditor's detection probability increases.

---

[50] Because $B_h > B^*$, it is easy to show $B_h(1-p) > C_R^M p$.

Now I specify how manipulation and auditing affect shareholders' utility. If the manager truthfully report, shareholders' utility is u_0^S. If the manager manipulates financial reports, there are also three situations: (1) if manipulation is not detected, shareholders' utility is $u_0^S - C_N^S$; (2) if manipulation is detected by the auditor, shareholders' utility is $u_0^S - C_A^S$; (3) if manipulation is detected by the regulator, shareholders' utility is $u_0^S - C_R^S$, where C_k^S, $k \in \{N, A, R\}$, is the cost occurs to the shareholders if manipulation is not detected, detected by the auditor, and detected by the regulator, respectively. I also assume $C_A^S < C_R^S < C_N^S$, which suggests detection is always better than no detection and detected by auditor is better than detected by regulators. Hence, in expectation, the shareholders' utility is:

$$u^S = u_0^S - [C_N^S(1-p)(1-q) + C_A^S q + C_R^S(1-q)p]r \tag{A6}$$

Taking first order condition with respect to q, I have the following inequality holds.

$$\frac{\partial u^S}{\partial q} = r[(1-p)C_N^S - C_A^S + pC_R^S] > 0 \tag{A7}$$

Lemma B: Shareholders' utility increases as auditor's detection probability increases.

Combining equation (A1), (A5), and (A7), I have the impact of auditor's detection probability on board's utility as follows.

$$\frac{\partial u^C}{\partial q} = r[(1-p)(-\omega B_h) + \omega C_A^M + p(-\omega C_R^M)] \tag{A8}$$

Further take first order condition with respect to ω, I have the following inequality holds.

$$\frac{\partial u^C}{\partial q \partial \omega} = r[(1-p)(-B_h) + C_A^M - pC_R^M] < 0 \tag{A9}$$

The above inequality shows the client prefers auditor's detection probability q less as ω increases. Hence, the following result holds.

Result: Clients with better corporate governance (i.e., smaller ω) prefer auditors with higher detection probability/audit quality q more.

Q.E.D.

Appendix 3B: Proofs for Lemma, Proposition, and Corollary

3B1: Proof for Lemma

In this proof, I first construct a match and then prove it is pairwise stable and unique.[51]

The match is constructed as follows. First, calculate the total surplus from a certain pair of auditor j and client i as if there will be no replacement in the future as follows.

$$V_{ij} = \frac{1}{1-\delta}\left(g_j - A_i\right) - K_i \tag{B1.1}$$

where g is the benefit of auditing for the client, A is the variable audit cost, and K is the fixed learning cost.

λ is an exogenous surplus sharing rule based on properties, and it describes how much surplus that the client can enjoy. Using this parameter, the auditor j and client i's value from the match above can be written as follows.

[51] In the proofs, benefit and costs of auditing for a certain pair, client i and auditor j, is denoted using subscripts instead of functions expositional simplicity. For expositional simplicity, the subscript i for client in benefit g is also eliminated. However, the nature that g is affected by both client and auditor is not changed.

$$v_{ij}^{A} = (1-\lambda)V_{ij}$$
$$v_{ij}^{C} = \lambda V_{ij} \tag{B1.2}$$

The clients are then ranked according to v_{ij}^{A}. Hence, the top ranked client is most attractive to the auditors. Assign the top ranked client to the auditor j that maximizes v_{ij}^{C}. This process is repeated for each client, and the higher ranked clients are assigned first. When a client's most desirable auditor runs out of capacity, the client is then assigned to the next available auditor that gives the client highest v_{ij}^{C}.

Next, I prove that the match described by the assignment above (repeated for infinite periods) is pairwise stable. According to the construction process, no blocking constraint is satisfied because both auditors and clients are already assigned to the best possible match. The construction eliminates the situation that an auditor j' prefers client i more than its matched client i', if client i matches with auditor j but it prefers j' to j. This is because if i is more preferred by the auditors, i has the chance to choose its auditor first, and, hence, j' will be chosen by i instead of j.

When the assignment in the first period is the one described above, I then show there will be no replacement afterwards. Starting from the second period, the players' state variable is updated by the match in the first period and they will face the same decision problem every period afterwards (i.e., the one with additional learning and switching cost). Hence, if there will be any replacements, they should happen in the second period. In this situation, still consider about the top ranked client and its auditor constructed as before, there will be no replacement for this pair because the client and its auditor is even more attractive to each other without the switching cost.

This logic can be applied to lower ranked clients as well. And, hence, the constructed assignment repeated for infinite periods is a pairwise stable equilibrium.

Next, I prove this equilibrium is unique by contradiction. If there were other equilibria, they can be classified into one of the following categories.

Type (1): After the replacement in period T, $1 < T < \infty$, there is no replacement afterwards. Following the logic described before, the assignment in period T and afterwards can only be the one constructed above.

Moreover, for the first $T - 1$ periods, suppose the most recent replacement to the replacement in period T takes place in period T'. In other words, there is no replacement between T' and T. Suppose from the assignment in period T' to the assignment in period T, client i and i' switched their auditors from j' and j, respectively, to j and j', respectively. Therefore, the players' value from period T' is as follows.

For the clients:

$$v_{i,T'}^{C} = \lambda\left(-CS + \sum_{t=1}^{t=T-T'-1} \delta^{t-1}\left(g_{j'} - A_i - K_i \times 1(t=1)\right) + \delta^{T-T'}\left(V_{ij} - CS\right)\right)$$

$$v_{i',T'}^{C} = \lambda\left(-CS + \sum_{t=1}^{t=T-T'-1} \delta^{t-1}\left(g_{j} - A_{i'} - K_{i'} \times 1(t=1)\right) + \delta^{T-T'}\left(V_{i'j'} - CS\right)\right) \qquad \text{(B1.3)}$$

For the auditors:

$$v_{j,T'}^{A} = (1-\lambda)\left(-CS + \sum_{t=1}^{t=T-T'-1} \delta^{t-1}\left(g_j - A_{i'} - K_{i'} \times 1(t=1)\right) + \delta^{T-T'}\left(V_{ij} - CS\right)\right)$$

$$v_{j',T'}^{A} = (1-\lambda)\left(-CS + \sum_{t=1}^{t=T-T'-1} \delta^{t-1}\left(g_{j'} - A_{i} - K_{i} \times 1(t=1)\right) + \delta^{T-T'}\left(V_{i'j'} - CS\right)\right) \quad \text{(B1.4)}$$

where $v_{i,T'}^{C}$ is client i's value at period T', $v_{j,T'}^{A}$ is auditor j's value at period T', and, again, V_{ij} is defined as in equation (B1.1).

Suppose the reason for the replacement in period T is because client i and client j find it is better for both of them to be matched with each other, the following inequalities hold.

$$\lambda\left(V_{ij} - CS\right) \geq \lambda V_{ij'}$$
$$(1-\lambda)\left(V_{ij} - CS\right) \geq (1-\lambda) V_{i'j} \quad \text{(B1.5)}$$

Thus, for period T', client i and auditor j should have matched with each other in the first place because the inequalities above implies the following inequalities hold.

$$\lambda\left(-CS+\sum_{t=1}^{t=T-T'-1}\delta^{t-1}\left(g_{j'}-A_i-K_i\times 1(t=1)\right)+\delta^{T-T'}\left(V_{ij}-CS\right)\right)$$

$$\leq \lambda\left(-CS+V_{ij}\right)$$

$$(1-\lambda)\left(-CS+\sum_{t=1}^{t=T-T'-1}\delta^{t-1}\left(g_j-A_{i'}-K_{i'}\times 1(t=1)\right)+\delta^{T-T'}\left(V_{ij}-CS\right)\right) \tag{B1.6}$$

$$\leq (1-\lambda)\left(-CS+V_{ij}\right)$$

Hence, when the logic above is applied to each period earlier than T', it follows that there will be no replacement after the first period and the equilibrium is exactly the one constructed as before.

Type (2): For $\forall T>0$, there exist replacements in period $T''>T$. Since the number of players in the game is finite, the number of possible assignments is also finite. Thus, because there are infinite periods, there should be replacements in period T_1 and T_2, $T_2>T_1$, that have the same assignment. Moreover, there should be another replacement takes place in period T_3, $T_1<T_3<T_2$, that results in a different assignment than the one in period T_1 and T_2. When there are multiple replacements between T_1 and T_2, It is possible that T_3 is not unique. However, let us first focus on the T_3 that is closest to T_2.

Suppose from the assignment in period T_3 to the assignment in period T_2, client i and i' switched their auditors from j' and j, respectively, to j and j', respectively. And, denote the next replacement for either of these pairs is in period $T_4>T_2$. The players' value from period T_3 is as follows.

For the clients:

$$v_{i,T_3}^{C} = \lambda\left(-CS + \sum_{t=1}^{t=T_2-T_3-1} \delta^{t-1}\left(g_{j'} - A_i - K_i \times 1(t=1)\right)\right.$$
$$\left.+ \delta^{T_2-T_3}\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_j - A_i - K_i \times 1(t'=1)\right)\right)\right)$$
$$+ \delta^{T_2-T_1} v_{i,T_4}^{C} \tag{B1.7}$$

$$v_{i',T_3}^{C} = \lambda\left(-CS + \sum_{t=1}^{t=T_2-T_3-1} \delta^{t-1}\left(g_j - A_{i'} - K_{i'} \times 1(t=1)\right)\right.$$
$$\left.+ \delta^{T_2-T_3}\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_{j'} - A_{i'} - K_{i'} \times 1(t'=1)\right)\right)\right)$$
$$+ \delta^{T_2-T_1} v_{i,T_4}^{C}$$

For the auditors:

$$v_{j,T_3}^{A} = (1-\lambda)\left(-CS + \sum_{t=1}^{t=T_2-T_3-1} \delta^{t-1}\left(g_j - A_{i'} - K_{i'} \times 1(t=1)\right)\right.$$
$$\left.+ \delta^{T_2-T_3}\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_j - A_i - K_i \times 1(t'=1)\right)\right)\right) \tag{B1.8}$$
$$+ \delta^{T_2-T_1} v_{j,T_4}^{A}$$

$$v_{j',T_3}^{A} = (1-\lambda)\left(-CS + \sum_{t=1}^{t=T_2-T_3-1} \delta^{t-1}\left(g_{j'} - A_i - K_i \times 1(t=1)\right)\right.$$

$$\left. + \delta^{T_2-T_3}\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_{j'} - A_{i'} - K_{i'} \times 1(t'=1)\right)\right)\right)$$

$$+ \delta^{T_2-T_1} v_{j,T_4}^{A}$$

Similar as before, suppose the reason for the replacement in period T_2 is because client i and client j find it is better for both of them to be matched with each other, and assume the replacements after period T_4 do not change, the following inequalities hold.

$$\begin{aligned} &\lambda\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_j - A_i - K_i \times 1(t'=1)\right)\right) \\ &\qquad \geq \lambda \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_{j'} - A_i - K_i \times 1(t'=1)\right) \\ &(1-\lambda)\left(-CS + \sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_j - A_i - K_i \times 1(t'=1)\right)\right) \\ &\qquad \geq (1-\lambda)\left(\sum_{t'=1}^{t'=T_4-T_2-1} \delta^{t'-1}\left(g_j - A_{i'} - K_{i'} \times 1(t'=1)\right)\right) \end{aligned} \tag{B1.9}$$

However, similar as the situation in (1), the inequalities above suggests that for period T_3, client i and auditor j should have matched with each other in the first place.

This logic can be applied to the rest of T_3 (if any) between T_1 and T_2, and the conclusion is that there should be no replacement between T_1 and T_2. This result contradicts the assumption that there is at least one replacement between T_1 and T_2, and suggests that there does not exist equilibrium of type (2).

Overall, the uniqueness is proven by combining the results for type (1) and (2).

Q.E.D.

3B2: Proof for Proposition

Because the players will face exactly the same decision problem after the first period, audit fee starting from the second period of the engagement will be constant. Denote the audit fee in the first period as F_1 and audit fee in later periods as F, client i's and auditor j's present value can be written as follows.

$$\begin{aligned} v_{ij}^{C} &= \frac{1}{1-\delta}\left(g_{ij}-F\right)-F_1+F \\ v_{ij}^{A} &= \frac{1}{1-\delta}(F-A)-K+F_1+F \end{aligned} \tag{B2.1}$$

Starting from the second period, the client can choose whether to replace the incumbent or not. Similar to DeAngelo (1981a), the incumbent can earn quasi-rent because of the switching cost CS. If the client stays with the incumbent, its present value in the second period is:

$$v_{ij_{stay}}^{C} = \frac{1}{1-\delta}(g_{ij}-F) \tag{B2.2}$$

While if the client replaces auditor, its present value is:

$$v_{ij_{replace}}^{C} = -CS + \frac{1}{1-\delta}\left(g_{ij}-F\right)-F_1+F \tag{B2.3}$$

The competition (from the exogenous surplus sharing rule) in the audit market leads to the equality of $v_{ij_{stay}}^{C}$ and $v_{ij_{replace}}^{C}$. Furthermore, combine this equation with equation (B1.1) and (B1.2), audit fee F_1 and F can be solved as follows.

$$\begin{aligned} F_1 &= (1-\lambda)g_{ij} + \lambda A_i + \lambda(1-\delta)K_i - \delta CS \\ F &= (1-\lambda)g_{ij} + \lambda A_i + \lambda(1-\delta)K_i + (1-\delta)CS \end{aligned} \tag{B2.4}$$

Thus, in general, audit fee for period t can be written as follows.

$$F_t = (1-\lambda)g_{ij} + \lambda A_i + \lambda(1-\delta)K_i + (1-\delta)CS - 1(t=1) \times CS \tag{B2.5}$$

Q.E.D.

3B3: Proof for Corollary

According to the Proposition, it is easy to see that the following equation holds for $t \geq 2$.

$$F_t - F_1 = CS \tag{B3.1}$$

Hence, Corollary proven.

Q.E.D.

Appendix 3C: Estimation, Moment Fit, and Counterfactual Details

3C1: Estimation

The SMM estimator is defined as follows.

$$\hat{\mu}_{SMM} = \arg\min_{\mu} ||\,\widehat{m} - \widehat{m}(\mu)||_W \tag{C1.1}$$

To obtain $\hat{\mu}_{SMM}$, three issues need to be addressed: the choice of weighting matrix W, the simulation process, and the algorithm for finding $\hat{\mu}_{SMM}$. These issues are discussed in details here.

Ideally, one should use the efficient weighting matrix as the weighting matrix. However, this approach is computationally infeasible. Therefore, I use an approximation of the efficient weighting matrix W from the following bootstrap procedure. First, randomly sample N_A auditors and the clients matched with them from the set of all auditors with replacement. Second, compute the moments from the sample. Third, repeat the first two steps for 50,000 times and calculate the variance matrix of the moments. The weighting matrix is then set to be the inverse of the variance matrix.

In general, the match outcomes are simulated with the following steps. First, a panel of client and auditor unobserved properties (i.e., random shocks) are simulated and kept constant for the estimation. Second, given a set of parameters, the observed properties, and the unobserved properties, the players' preferences for all possible matches are calculated. Third, the clients' are first sorted based on the auditors' preference for them and then are sequentially assigned to the auditors based on clients' preference for the auditors. If the more preferred auditors run out of capacity, the clients are assigned to the next available most preferred auditor. For each round of simulation, I simulate 100 matching market.

To find the set of parameters that minimize the distance between actual moments and simulated moments, I first use a Genetic Algorithm to reduce the possibility of finding local optimum and then use a local derivative-free Pattern Search to find the precise estimates.

3C2: Counterfactual Design: Mandatory Audit Firm Rotation

To perform the analysis, I first need to combine the structural parameters and the coefficients estimated in the audit fee regression so that benefit from auditing g_{ij} and the mixture of cost A_{ij} and K_{ij} are identified. Because the unit of player-specific fee is the same as that of audit fee (i.e., logarithm of dollar), only specification II has a link to the audit fee regression and can be used to create counterfactuals.

To normalize the unit of preference for logarithm of dollar, the structural parameters are first divided by the player's preference on player-specific audit fees. Specifically, using equation (7) and (8), the normalized parameters $\bar{\alpha}$ and $\bar{\beta}$ can be written as follows.

$$\begin{cases} \bar{\alpha} \equiv \dfrac{\tilde{\alpha}}{|\tilde{\alpha}_F|} = \lambda \left[\dfrac{\alpha}{|\alpha_F|}\right] \equiv \lambda\alpha \\ \bar{\beta} \equiv \dfrac{\tilde{\beta}}{\tilde{\beta}_F} = (\lambda - 1)\left[\dfrac{\beta_A + (1-\delta)\beta_K}{\beta_F}\right] \equiv (\lambda - 1)[\beta_A + (1-\delta)\beta_K] \end{cases} \tag{C3.1}$$

where $\tilde{\alpha}_F$ and $\tilde{\beta}_F$ are the estimated structural parameters for player-specific audit fees, and α_F and β_F are per period preference of player-specific audit fees, which equal to 1 when the unit of utility is logarithm of dollars.

For the audit fee regression reported in Table 6, its functional form can be written as follows.

$$F_{ijt} = \gamma_z z_j + \gamma_x x_i - \gamma_{CS} d_{ijt} + controls + \varphi_{ijt} \tag{C3.2}$$

where γ_z and γ_x are coefficients for auditor properties z_j and client properties x_i, d_{ijt} is a dummy variable that equals to 1 if the engagement is new, and, hence, γ_{CS} is the switching cost.

Combining this expression with the expression in Proposition 1, the γ's can be rewritten as follows.

$$\begin{cases} \gamma_z = (1-\lambda)\alpha \\ \gamma_x = \lambda[\beta_A + (1-\delta)\beta_K] \end{cases} \tag{C3.3}$$

Thus, by using equation (C3.1) and (C3.3), per period benefit b_{ij} and the mixture of cost A_{ij} and K_{ij} can be obtained as follows.

$$\begin{cases} g_{ij} = (\gamma_z + \bar{\alpha})z_j \\ A_i + (1-\delta)K_i = (\gamma_x - \bar{\beta})x_i \end{cases} \tag{C3.4}$$

Assume there is no sharing for the switching cost when mandatory audit firm rotation is implemented; if client i matches with auditor j for $\mathcal{T}$ years under mandatory audit firm rotation, their values from the match are as follows.

$$\begin{cases} v_{ij,\mathcal{T}}^{C} = \lambda\left(\dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\left(g_{ij} - A_i\right) - K_i\right) - CS \\ v_{ij,\mathcal{T}}^{C} = (1-\lambda)\left(\dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\left(g_{ij} - A_i\right) - K_i\right) \end{cases} \tag{C3.5}$$

Denote the ratio of A_i to K_i as θ and combine equation (6) and (C3.1) – (C3.4) to eliminate λ, the following formulas link equation (C3.5) to estimated parameters and can be used for counterfactual simulation and welfare analysis.

$$\begin{cases} v_{ij,\mathcal{T}}^{C} = \dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\bar{\alpha}z_j - \left(\dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\theta + 1\right)\dfrac{\gamma_x x_i}{1+\theta-\delta} - \gamma_{CS} \\ v_{ij,\mathcal{T}}^{C} = \dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\gamma_z z_j + \left(\dfrac{1-\delta^{\mathcal{T}}}{1-\delta}\theta + 1\right)\dfrac{\bar{\beta}x_i}{1+\theta-\delta} \end{cases} \tag{C3.6}$$

With mandatory audit firm rotation, for each $\mathcal{T}$ periods, auditors and clients choose each other in a restricted set (i.e., the set without prior matched players) to maximize the values in equation

(C3.6) subject to individual rationality and no-blocking constraints. Hence, it is easy to see that players will simply switch between two equilibria once every $\mathcal{T}$ periods. It is also worth noting that θ itself only affects the welfare but not the players' preference because it enters the value functions as a scalar only.

Finally, using equation (C3.6), new matches are simulated based on calculated values and the assignment strategy similar to the one described for estimation. Clients are further weighted by their market capitalization to capture the difference in client size.

Appendix 3D: Proof: Any matching equilibrium can be supported by at least a set of parameters and error terms

In this appendix, I prove any arbitrary match can be supported by at least a set of parameters and error terms. That is, there does not exist any match cannot be justified by the empirical specification.

Suppose there is an arbitrary match $\{(j, I_j)\}_{j=1}^{N^A}$, where j denotes a particular auditor and I_j denotes the set of clients that matches with j. For this proof, I first ignore the utility from observed characteristics, but focus on error terms only.

Let the utility from unobserved characteristic (i.e. error term) of auditor j be j. Thus, auditor N^A is the most attractive auditor and auditor 1 is the least attractive auditor to the clients. Similarly, let the utility from unobserved characteristic of clients that matched with auditor j be j. Thus, elements in I_{N^A} are most attractive to the auditors and elements in I_1 are least attractive to the auditors.

It is easy to see that the error terms described above lead to a pairwise stable matching equilibrium because, for any match can be described arbitrarily by $\{(j, I_j)\}_{j=1}^{N^A}$, it can be supported by at least the error terms described above.

Finally, if the observed characteristics are also considered, one just needs to keep the summation of utility from observed characteristics and the error term constant (i.e., the utility from auditor j be j, and utility from clients matched with auditor j also be j) and adjust the error terms by the impact of observed characteristics.

Q.E.D

Appendix 3E: A Two-by-Two Example of Benefit/Cost Analysis

In this appendix, I develop a two-by-two example to show various situations where my theoretical model can deliver net benefit from mandatory auditor rotation.

Consider a world of two auditors and two clients. To simply the analysis, it is assumed that (1) one auditor can only serve one client, (2) auditors and clients prefer being matched than being unmatched so that individual rationality constraint is always satisfied, and (3) within a specific match, the auditor and client share half of the total surplus.

Situation 1:

Suppose auditors are differentiated by audit quality (H for high and L for low, H>L) and clients are differentiated by their size (B for big and S for small, B>S). Shareholders prefer higher audit quality.

When board of director interests are fully misaligned with shareholder interests, thus the auditor-client match without mandatory auditor rotation is (H, S) and (L, B) while the match after mandatory auditor rotation will be (H, B) and (L, S). From *average* shareholder perspective (i.e., shareholders of client B weighted by B and shareholders of client S weighted by S), the latter match is more desirable (HB+LS>HS+LB). In other words, mandatory auditor rotation delivers a net benefit to the shareholders.

Situation 2:

Suppose auditors are differentiated by industry expertise (M for manufacturing and A for airlines) and clients are differentiated by their industry (m for manufacturing and a for airlines). Because industry expertise can improve audit quality, shareholders prefer the industry experts of the clients' industry.

When board of director interests are fully misaligned with shareholder interests, the auditor-client match without mandatory auditor rotation is (M, a) and (A, m) while the match after mandatory auditor rotation will be (M, m) and (A, a). From shareholder perspective, the latter match is more desirable. In other words, mandatory auditor rotation delivers a net benefit to the shareholders.

BIBLIGRAPHY

Agarwal, N. (2013). An empirical model of the medical match. working paper.

Agarwal, N., and Diamond, W. (2013). Identification and estimation in two-sided matching markets. Cowles Foundation for Research in Economics, Yale University.

Ahmed, A. S., Takeda, C., and Thomas, S. (1999). Bank loan loss provisions: a reexamination of capital management, earnings management and signaling effects. Journal of Accounting and Economics, 28(1), 1-25.

Antle, R. (1982). The auditor as an economic agent. *Journal of Accounting Research*, 503-527.

Antle, R. (1984). Auditor independence. *Journal of Accounting Research*, 1-20.

Antle, R., and Eppen, G. D. (1985). Capital rationing and organizational slack in capital budgeting. *Management Science*, 31(2), 163-174.

Ashbaugh, H., LaFond, R., and Mayhew, B. (2003). Do non-audit services compromise auditor independence? Further evidence. *The Accounting Review*,78(3), 611-639.

Arya, A., and Glover, J. (2014). Auditor independence revisited. *Journal of Accounting, Auditing and Finance*, 29(2), 188-198.

Baccara, M., Imrohoroglu, A., Wilson, A. and Yariv, L. (2012). A field study on matching with network externalities. *The American Economic Review*, 102(5), 1773-1804.

Bartov, E., Givoly, D., and Hayn, C. (2002). The rewards to meeting or beating earnings expectations. *Journal of Accounting and Economics*, 33(2), 173-204.

Bartov, E. (1993). The timing of asset sales and earnings manipulation. *Accounting Review*, 840-855.

Beatty, A., Chamberlain, S. L., and Magliolo, J. (1995). Managing financial reports of commercial banks: The influence of taxes, regulatory capital, and earnings. *Journal of Accounting Research*, *33*(2), 231-261.

Beatty, A. L., Ke, B., and Petroni, K. R. (2002). Earnings management to avoid earnings declines across publicly and privately held banks. *The Accounting Review*, *77*(3), 547-570.

Bebchuk, L. A., and Hamdani, A. (2006). Federal Corporate Law: Lessons from History. *Columbia Law Review*, 1793-1838.

Bens, D., Nagar, V., and Skinner, D. Franco Wong, 2003, Employee stock options, EPS dilution and stock repurchases. *Journal of Accounting and Economics*, *36*(1), 3.

Blouin, J., Grein, B. M., and Rountree, B. R. (2007). An analysis of forced auditor change: The case of former Arthur Andersen clients. *The Accounting Review,*82(3), 621-650.

Boyd, D., Lankford, H., Loeb, S., and Wyckoff, J. (2013). Analyzing the determinants of the matching of public school teachers to jobs: Disentangling the preferences of teachers and employers. *Journal of Labor Economics*, 31(1), 83-117.

Burgstahler, D., and Dichev, I. (1997). Earnings management to avoid earnings decreases and losses. *Journal of accounting and economics*, *24*(1), 99-126.

Bushee, B. (1998). The Influence of Institutional Investors on Myopic RandD Investment Behavior. *The Accounting Review*, 73(3), 305-333.

Cameran, M., Francis, J. , Marra, A., and Pettinicchio, A. K. (2013). Are there adverse consequences of mandatory auditor rotation? Evidence from the Italian experience. *Auditing: A Journal of Practice and Theory*, in-press.

Carey, P., and Simnett, R. (2006). Audit partner tenure and audit quality. *The Accounting Review*, 81(3), 653-676.

Chen, L. (2014). Managerial talent misallocation and the cost of moral hazard. working paper.

Cheng, Q., and Warfield, T. D. (2005). Equity incentives and earnings management. *The Accounting Review*, *80*(2), 441-476.

Chung, H., and Kallapur, S. (2003). Client importance, non-audit services, and abnormal accruals. *The Accounting Review*, 78(4), 931-955.

Corona, C., and Randhawa, R. (2010). The auditor's slippery slope: An analysis of reputational incentives. *Management Science*, 56(6), 924-937.

DeAngelo, L. E. (1981a). Auditor independence, 'low balling', and disclosure regulation. *Journal of Accounting and Economics*, 3(2), 113-127.

DeAngelo, L. E. (1981b). Auditor size and audit quality. *Journal of Accounting and Economics*, 3(3), 183-199.

Dechow, P. M., Myers, L. A., and Shakespeare, C. (2010). Fair value accounting and gains from asset securitizations: A convenient earnings management tool with compensation side-benefits. *Journal of accounting and economics*, *49*(1), 2-25.

Dechow, P. M., and Shakespeare, C. (2009). Do managers time securitization transactions to obtain accounting benefits?. *The Accounting Review*, *84*(1), 99-132.

Dechow, P. M., and Sloan, R. G. (1991). Executive incentives and the horizon problem: An empirical investigation. *Journal of accounting and Economics*,*14*(1), 51-89.

DeFond, M. L. (1992). The association between changes in client firm agency costs and auditor switching. *Auditing-a Journal of Practice and Theory*, 11(1), 16-31.

DeFond, M. L., Raghunandan, K., and Subramanyam, K. R. (2002). Do non–audit service fees impair auditor independence? Evidence from going concern audit opinions. *Journal of Accounting Research*, 40(4), 1247-1274.

DeFond, M. L., and Zhang, J. (2013). A review of archival auditing research. working paper.

Degeorge, F., Patel, J., and Zeckhauser, R. (1999). Earnings management to exceed thresholds. *The Journal of Business*, 72(1), 1-33.

Deloitte. (2010). Securitization accounting: The ins and outs (and some do's and don'ts) of FAS 166, 167, and counting… Available at: www.deloitte.com/view/en_US/us/Services/audit-enterprise-risk-services/financial-instrument-valuation-securitization/financial-accounting-reporting/c61f310b35a76210VgnVCM200000bb42f00aRCRD.htm

Deloitte (2012) Alternatives to mandatory audit firm rotation. Available at: http://pcaobus.org/Rules/Rulemaking/Docket037/ps_Echevarria.pdf

Dopuch, N., King, R. R., and Schwartz, R. (2001). An experimental investigation of retention and rotation requirements. *Journal of Accounting Research*, 39(1), 93-117.

Dye, R. A. (1991). Informationally motivated auditor replacement. *Journal of Accounting and Economics*, 14(4), 347-374.

Elul, R. (2011). Securitization and mortgage default. *Working paper*.

Ertan, A. (2013). Real Earnings Management in the Financial Industry. *Working paper*.

Ericson, R., and Pakes, A. (1995). Markov-perfect industry dynamics: A framework for empirical work. *The Review of Economic Studies*, 62(1), 53-82.

Farrell, K. A., and Whidbee, D. A. (2003). Impact of firm performance expectations on CEO turnover and replacement decisions. *Journal of Accounting and Economics*, *36*(1), 165-196.

Fellingham, J., and Newman, P. (1985). Strategic considerations in auditing. *The Accounting Review*, 634-650.

Fischer, P. E., and Verrecchia, R. E. (2000). Reporting bias. *The Accounting Review*, 75(2), 229-245.

Frankel, R., Marilyn F. Johnson, and Karen K. Nelson (2002) The relation between auditors' fees for nonaudit services and earnings management. *The Accounting Review*, 77(supplement), 71-105.

Fox, J. T. (2009). Estimating matching games with transfers. working paper

Gayle, G. L., and Miller, R. A. (2014). Identifying and testing models of managerial compensation. *Review of Economic Studies*, forthcoming.

Gerakos, J. J., and Syverson, C. (2014). Competition in the audit market: policy implications. National Bureau of Economic Research.

Ghosh, A., and Moon, D. (2005). Auditor tenure and perceptions of audit quality. *The Accounting Review*, 80(2), 585-612.

Gunny, K. A. (2010). The Relation Between Earnings Management Using Real Activities Manipulation and Future Performance: Evidence from Meeting Earnings Benchmarks. *Contemporary Accounting Research*, *27*(3), 855-888.

Harris, M., and Holmstrom, B. (1982). A theory of wage dynamics. *The Review of Economic Studies*, 49(3), 315-333.

Hay, D. C., Knechel, W. R., and Wong, N. (2006). Audit fees: A meta-analysis of the effect of supply and demand attributes. *Contemporary Accounting Research*, 23(1), 141-191.

Hermalin, B. E., and Weisbach, M. S. (2001). Boards of directors as an endogenously determined institution: A survey of the economic literature (No. w8161). National Bureau of Economic Research.

Herrmann, D., Inoue, T., and Thomas, W. B. (2003). The sale of assets to manage earnings in Japan. *Journal of Accounting Research*, *41*(1), 89-108.

Hölmstrom, B. (1979). Moral hazard and observability. *The Bell Journal of Economics*, 74-91.

Hope, O. K., and Thomas, W. B. (2008). Managerial empire building and firm disclosure. *Journal of Accounting Research*, 46(3), 591-626.

Kanodia, C., and Mukherji, A. (1994). Audit pricing, lowballing and auditor turnover: A dynamic analysis. *The Accounting Review*, 593-615.

Karaoglu, N. (2005). Regulatory capital and earnings management in banks: The case of loan sales and securitizations. *FDIC Center for Financial Research Working Paper*, 1-37.

Kothari, S. P., and Lester, R. (2012). The role of accounting in the financial crisis: lessons for the future. *Accounting Horizons*, *26*(2), 335-351.

Krishnan, J., and Krishnan, J. (1997). Litigation risk and auditor resignations. *The Accounting Review*, 539-560.

Larcker, D. F., and Richardson, S. A. (2004). Fees paid to audit firms, accrual choices, and corporate governance. *Journal of Accounting Research*, 42(3), 625-658.

Larcker, D. F., Richardson, S. A., and Tuna, I. (2007). Corporate governance, accounting outcomes, and organizational performance. *The Accounting Review*,82(4), 963-1008.

Larcker, D. F., and Rusticus, T. O. (2010). On the use of instrumental variables in accounting research. *Journal of Accounting and Economics*, *49*(3), 186-205.

Laux, V. (2008). Board independence and CEO turnover. *Journal of Accounting Research*, 46(1), 137-171.

Lawrence, A., Minutti-Meza, M., and Zhang, P. (2011). Can Big-4 versus non-Big 4 differences in audit-quality proxies be attributed to client characteristics?. *The Accounting Review*, 86(1), 259-286.

Li, C. (2013). Mutual monitoring within top management teams: A structural modeling investigation. working paper.

Loutskina, E. (2011). The role of securitization in bank liquidity and funding management. *Journal of Financial Economics*, 100(3), 663-684.

Loutskina, E., and Strahan, P. E. (2009). Securitization and the declining impact of bank finance on loan supply: Evidence from mortgage originations. *The Journal of Finance*, *64*(2), 861-889.

Magee, R. P., and Tseng, M. C. (1990). Audit pricing and independence. *The Accounting Review*, 315-336.

Mansi, S. A., Maxwell, W. F., & Miller, D. P. (2004). Does auditor quality and tenure matter to investors? Evidence from the bond market. *Journal of Accounting Research*, 42(4), 755-793.

Matsunaga, S. R., and Park, C. W. (2001). The effect of missing a quarterly earnings benchmark on the CEO's annual bonus. *The Accounting Review*,*76*(3), 313-332.

Matveyev, E. (2012). How do firms and directors choose each other? Evidence from a two-sided matching model of the director labor market. working paper.

Minnis, M. (2011). The value of financial statement verification in debt financing: Evidence from private US firms. *Journal of Accounting Research*, 49(2), 457-506.

Morck, R., Shleifer, A., and Vishny, R. W. (1988). Management ownership and market valuation: An empirical analysis. *Journal of Financial Economics*, 20, 293-315.

Myers, J. N., Myers, L. A., and Omer, T. C. (2003). Exploring the term of the auditor-client relationship and the quality of earnings: A case for mandatory audit firm rotation?. *The Accounting Review*, 78(3), 779-799.

Ng, D. S., and Stoeckenius, J. (1979). Auditing: Incentives and truthful reporting. *Journal of Accounting Research*, 1-24.

Nikolov, B., and Whited, T. M. (2013). Agency conflicts and cash: estimates from a dynamic model. *Journal of Finance*, Forthcoming.

O'Keefe, T. B., Simunic, D. A., and Stein, M. T. (1994). The production of audit services: Evidence from a major public accounting firm. *Journal of Accounting Research*, 241-261.

Pan, Y. (2012). The determinants and impact of executive-firm matches. working paper.

PCAOB (2011) Concept release on auditor independence and audit firm rotation.

Pittman, J. A., and Fortin, S. (2004). Auditor choice and the cost of debt capital for newly public firms. *Journal of Accounting and Economics*, 37(1), 113-136.

PricewaterhouseCoopers. (2012). Mandatory audit firm rotation: why other changes would be better for investors. Available at: http://www.pwc.com/us/en/point-of-view/mandatory-audit-firm-rotation.jhtml

Roth, A., and Sotomayor, M. (1992). Two-sided matching: A study in game-theoretic modeling and analysis (No. 18). Cambridge University Press.

Roychowdhury, S. (2006). Earnings management through real activities manipulation. *Journal of Accounting and Economics*, *42*(3), 335-370.

Ryan, S. G. (2007). Financial instruments and institutions: Accounting and disclosure rules. Hoboken, NJ: John Wiley and Sons.

Ryan, S. G. (2008). Accounting in and for the Subprime Crisis. *The Accounting Review, 83*(6), 1605-1638.

Ryan, H. E., and Wiggins, R. A. (2004). Who is in whose pocket? Director compensation, board independence, and barriers to effective monitoring. *Journal of Financial Economics*, 73(3), 497-524.

Schipper, K., and Yohn, T. L. (2007). Standard-setting issues and academic research related to the accounting for financial asset transfers. Accounting Horizons, 21(1), 59-80.

Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *The Quarterly Journal of Economics*, 655-669.

St-Pierre, K. E. (1983). Auditor risk and legal liability. UMI Research Press.

Strebulaev, I., and Whited, T. (2012). Dynamic models and structural estimation in corporate finance. working paper.

Shu, S. (2000). Auditor resignations: Clientele effects and legal liability. *Journal of Accounting and Economics*, 29(2), 173-205.

Sørensen, M. (2007). How smart is smart money? A two-sided matching model of venture capital. *Journal of Finance*, 62(6), 2725-2762.

Taylor, L. A. (2010). Why are CEOs rarely fired? Evidence from structural estimation. *Journal of Finance*, 65(6), 2051-2087.

Taylor, L. A. (2013). CEO wage dynamics: Estimates from a learning model. *Journal of Financial Economics*, 108(1), 79-98.

Teoh, S. H., and Wong, T. J. (1993). Perceived auditor quality and the earnings response coefficient. *Accounting Review*, 346-366.

Zakolyukina, A. (2014). Measuring intentional GAAP violations: A structural approach. working paper.

Zang, A. Y. (2012). Evidence on the trade-off between real activities manipulation and accrual-based earnings management. *The Accounting Review*, *87*(2), 675-703.