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An Empirical Analysis of the Effect of Female Board Directors on Bank Holding Company Performance

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Abstract: We examine whether the number of women serving on boards of directors of U.S. bank holding companies (BHC) affected financial performance during the financial crisis of 2008–2012. In so doing, we specifically address a sizeable gap in the academic literature on the effect of female board directors on bank performance. Our research is unique because an emerging body of research indicates that the number of female directors positively influences nonfinancial firm performance; however, until now there has been little research on the effect of female directors on the financial performance of BHCs.

Another unique contribution of our research is our dataset, which consists of demographic data on BHC boards of directors that we constructed using publicly available definitive proxy statements filed by the largest BHCs from 1994–2014. Using our dataset, we explore the link between critical mass theory and BHC financial performance during this 21-year span and, in particular, during the financial crisis. We conclude that during the financial crisis, controlling for financial and board governance characteristics, BHCs with at least three female directors braved the crisis better, significantly outperforming BHCs with fewer female directors, as measured by Tobin's Q. This conclusion contrasts with the results over the full 21-year span. Over the longer time period, we conclude that both the performance of BHCs with at least three female directors was not statistically different than that of BHCs with fewer female directors and BHCs with at least two female directors on average showed significantly lower performance.

1 Introduction

The significant gap in academic research on the effect of bank board gender diversity on financial performance motivates us to examine whether the number of women serving as directors of U.S. BHCs affects financial performance. Specifically, we investigate whether the number of female board members affected BHC financial performance in the 21 years from 1994–2014 and, in particular, during the 2008–2012 financial crisis (financial crisis). While an emerging body of research indicates that the number of women serving on boards of directors affects the financial performance of nonfinancial firms, until now, there has been little investigation of the effect of female directors on the financial performance of banks and BHCs.

Board governance is influenced by a range of factors, from heavily researched characteristics of independence and size to gender diversity, a factor less thoroughly investigated. The banking industry is unique, however, and therefore banks' board structures are not comparable to those of other industries. Banks have large informational asymmetries, which make monitoring and governance more difficult and give their boards a role distinct from that of nonfinancial firms (Levine [2004]). For example, contrary to nonfinancial firms, banks with a greater number of inside directors show better financial performance (Adams and Mehran [2012]). Further, banking regulations impose minimum capital requirements to mitigate risk, which can affect the ability of the market to discipline banks (Ciancanelli and Reyes-Gonzalez [2000]). Banks are regulated, and their strategies influence the market. This distinguishes them from nonfinancial firms, and therefore generalizing findings from nonfinancial firms to banks is problematic. Consequently, there is a need for research on how boards of directors govern banks and the factors that affect that governance.

Inadequate bank governance played a significant role in the financial crisis (García-Meca et al [2015] and Kashyap et al [2008]). In response, the Basel Committee on Banking Supervision (Basel Committee) took steps to regulate and strengthen corporate governance in banks (García-Meca et al [2015]). The Basel Committee's corporate governance guidelines hold banks' boards of directors responsible for strategy, oversight, protection of stakeholder interests, and the safety of banking operations (Basel [2015]). Banks play a distinctive role in the market, and bank failures and successes can substantially influence the allocation of resources throughout the economy (Pathan and Faff [2013]).

To examine our research question, we create a unique dataset of board director demographic data based on publicly available definitive proxy statements filed with U.S. Securities and Exchange Commission (SEC) Form DEF 14A (DEF 14A) by the largest U.S. BHCs from 1994–2014. The sample under investigation consists of 55 of the largest 90 publicly traded BHCs as of March 31, 2014, measured by total assets. These 55 BHCs capture approximately 63 percent of the banking industry's total assets.

Our research is unique because it applies critical mass theory to an empirical model of BHC financial performance. Catalyst (2011a) finds that corporations with at least three women on the board outperform those with fewer women. We test whether this tipping point is relevant for large BHCs. Pathan and Faff (2013) use the DEF 14A to look at the percentage of women on boards. As is discussed in detail in section 2, the literature review, critical mass theory suggests that a specific number of women is needed to have an effect on group decision making. This is crucial to our research on board gender diversity, because it is not the percentage of women on boards, but the critical mass of women that makes a difference on a board's decision making. Our research also differs in that it focuses on the largest BHCs in 2014, a post-financial crisis baseline, while Pathan and Faff use the pre-financial crisis baseline of 2004 to identify the largest BHCs for their investigation.

To evaluate the relationship between board gender diversity and BHC financial performance, we build on the model of Tobin's Q developed by Adams and Mehran (2012). James Tobin developed Q in the late 1960s as the ratio of a firm's market value to replacement value of the firm's assets (see Tobin [1969 and 1978] and Brainard and Tobin [1968]). If the ratio exceeds 1, firms invest more because market value is greater than cost (Lindenberg and Ross [1981]). We discuss the reasoning behind our choice of Tobin's Q in more detail in section 3.3.

We specifically address a sizeable gap in the literature on the governance of large U.S. BHCs by examining female board representation and its effect on BHC performance. To our knowledge, no other study explores the link between critical mass theory and financial performance during the financial crisis. We hypothesize that it takes at least three female directors—referred to hereafter as the "magic number 3"—on a board to significantly and positively affect performance during the financial crisis. In our research and in critical mass theory, the magic number 3 is an integral concept because it represents a tipping point. Based on our research, we conclude that having at least three female directors at a BHC during the financial crisis resulted in higher performance as measured by Tobin's Q. In comparing these findings to the 21-year sample from 1994–2014, the performance of BHCs with at least three female directors was not statistically different than that of BHCs with fewer female directors, and BHCs with at least two female directors on average showed significantly lower performance. We therefore conclude that the effect of women on boards of U.S. BHCs differs depending on the economic environment.

Our paper is structured as follows. Section 2 presents a literature review. Section 3 describes our data and modeling methodology. Section 4 provides our empirical results, and section 5 presents our conclusions.

2 Literature Review

Our literature review is organized into five sections. In section 2.1, we describe some of the factors that affect how well boards govern. In sections 2.2–2.4, we introduce the effect of gender on board governance and firm financial performance. In section 2.5, we hypothesize the effect of female board directors on BHC performance.

2.1 Factors That Affect How Well Boards Govern

Several factors influence a board's ability to govern well. Two of the most heavily researched board characteristics are the number of directors and director independence, but the results for each are equivocal. Many studies find that the number of directors on a board is negatively related to firm performance, citing groupthink and free rider problems as reasons for this effect (de Andres et al [2005]; Eisenberg et al [1998]; Staikouras et al [2007]; and Yermack [1996]).

Conversely, there is evidence that board size is positively related to performance, particularly in banks, where institutional structures are complex, governance is difficult, and boards are subject to strict regulations (Adams and Mehran [2012]; de Andres and Vallelado [2008]; Belkhir [2009]; and Pathan and Faff [2013]).

Director independence is negatively related to performance when banks have high levels of informational asymmetry; however, independent directors can bring helpful outside perspectives and unbiased monitoring of executives when they have access to all necessary information (Adams and Ferreira [2007]; Pathan and Faff [2013]; and Raheja [2005]). In addition to board size and independence, directors' attendance at meetings can affect firm performance. When directors attend a high proportion of scheduled board meetings, firm performance improves (Chou et al [2013]). Further, committees play a crucial role in corporate governance, with the nominating, compensation, and auditing committees emerging as the most important since the passage of the Sarbanes-Oxley Act of 2002 (Peterson and Philpot [2007]). We recognize that several factors affect how well a board governs; however, these factors are not central to our analysis. We address some of these factors by using board governance control variables in our analysis, as detailed in section 3.5.

2.2 Impact of Gender on Board Governance

Over the past decade, academic literature has examined the influence of board gender diversity on board governance. The presence of women on boards has been shown to affect leadership, attendance, and committee membership—all of which, as previously noted, play a role in a board's ability to govern effectively (Chou et al [2013]; Eagly and Carli [2003]; and Peterson and Philpot [2007]). Research has demonstrated that men and women differ in their leadership styles, with women tending to lead in a more democratic and participative manner than men (Eagly and Carli [2003]). This tendency toward a collaborative leadership style can change the way a board approaches certain tasks (Nielsen and Huse [2010]). More specifically, the proportion of female directors on the board is positively associated with long-term, qualitative strategy through increased board development activity and decreased conflict (Nielsen and Huse [2010]).

Additionally, men are more likely to exhibit a laissez-faire style of management in which they are frequently absent and uninvolved (Eagly and Carli [2003]). Female directors, on the other hand, are significantly less likely to have attendance issues than their male counterparts (Adams and Ferreira [2009]). When the number of female directors increases, male attendance improves substantially (Adams and Ferreira [2009]). High meeting attendance by directors has been shown to enhance firm performance (Chou et al [2013]). Thus, the academic literature suggests that an increased presence of women on a board, and therefore improved attendance, may enhance board governance (Adams and Ferreira [2009]).

With the steadily increasing participation of women on boards, researchers are finding gender differences in committee assignments (Adams and Ferreira [2009]; Farrell and Hersch [2005]; and Peterson and Philpot [2007]). Previous research held that female directors would be relegated to low-profile board committees—such as public affairs committees—and underrepresented on important monitoring and governance committees (Bilimoria and Piderit

[1994] and Kesner [1988]). More recent evidence suggests, however, that this is no longer the case. Peterson and Philpot (2007) find that while women are more likely to sit on committees related to public affairs, women are equally as likely as men to sit on nominating, corporate governance, compensation, finance, or audit committees. Adams and Ferreira (2009) find that women are more likely than men to sit on audit, nominating, and corporate governance committees. The presence of women on the board of directors, and particularly in these committees, leads to tougher monitoring (Adams and Ferreira [2009]). More stringent monitoring, however, may not have a positive effect on firm performance. Board gender diversity is valuable for firms with weak governance, but on average, gender diversity does not add value and may lead to over-monitoring and negative performance outcomes for firms (Adams and Ferreira [2009]).

2.3 Board Gender Diversity and Financial Performance

Overall, academic research on the direct effect of board gender diversity on firm performance is inconclusive. Many studies report a positive association between board gender diversity and financial performance. Carter et al (2003) and Campbell and Mínguez-Vera (2008) find that performance in nonfinancial firms improves when board gender diversity increases. In one of the few studies that examine gender on bank boards, García-Meca et al (2015) find similarly positive associations between female board representation and performance in European banks. The gray literature supports these positive findings as well.[1] Catalyst (2011a) finds that firms with the most women on the board outperformed those with the least women in terms of return on sales and return on invested capital (Catalyst [2011a]). Two reports from Credit Suisse (2012, 2014) find that firms with at least one female director had a higher share price than firms with no women (Credit Suisse [2012, 2014]). Some studies, however, find that the effect of gender diversity is null or negative (Adams and Ferreira [2009]). In Norway, where a regulation requires at least 40 percent female board representation, firms affected by the quota show decreased profitability—particularly if the firm had few women on its board before the quota was implemented (Matsa and Miller [2013] and Smith [2014]). During the financial crisis, however, Norway was one of the most economically sound nations and one that experienced economic growth (Pine [2011]). More research is needed to determine if the gender board requirements were a factor in the economic success. In Kenya, Ekadah and Mboya (2012) find that board gender diversity has no effect on bank financial performance.

Despite the mixed findings in the relationship between board gender diversity and firm performance, empirical evidence suggests that small banks with female leadership in chief executive officer (CEO) or chair positions were more likely to survive during the financial crisis (Palvia et al [2013]). One possible explanation for this is that gender-diverse boards may be more effective at managing risk and making difficult decisions in times of crisis (Dhir [2015]). Historically, the stereotype that women are more risk averse than men was considered unfavorable because aversion to risk taking was perceived to prevent firm success. In the post-financial crisis period, however, there is a greater emphasis on understanding and controlling risks to ensure long-term survival of the firm; therefore, women's lower risk appetite may now be viewed more favorably (Hutchinson et al [2014] and Schubert et al [1999]). The association

[1] We define gray literature as research produced and published by companies that is not published in an academic journal.

between board gender diversity and decreased bank risk taking is empirically supported. A higher proportion of women on a board is associated with less volatility in return on average assets (ROAA) and lower leverage (Mateos de Cabo et al [2011]).

Moreover, a higher proportion of women on boards of directors moderates excessive risk taking, which improves firm performance as measured by return on assets (ROA) (Hutchinson et al [2014]).[2] Research on the financial crisis suggests that inadequate bank governance and excessive risk were to blame, and that firms with stronger governance fared better during the crisis (Francis et al [2012] and Kashyap et al [2008]). While literature on board gender diversity comes to contradictory conclusions regarding performance overall, recent research suggests that having women on the board of directors may have been especially beneficial during and after the financial crisis.

2.4 Critical Mass and the Magic Number 3

While the direct relationship between board gender diversity and performance is still unclear, we find that a critical mass of three women has consistently increased the effectiveness of women in leadership roles. The magic number 3 signifies that within a male-dominated group, a critical mass of at least three women must be reached in order for those women to have a significant impact on group decision making (Kramer et al [2006] and Torchia et al [2011]).

The critical mass theory was first developed by Kanter (1977). She was inspired by Asch's (1955) experiment on opinions and social pressure, in which he finds that hearing three unanimous—though clearly incorrect—answers to basic questions caused 31.8 percent of subjects to change their answer to match that of the majority, but a majority of more than three did not significantly increase this rate. Based on this experiment, Kanter identifies four types of groups that affect minority-majority interactions, ranging from homogenous "uniform" groups to perfectly balanced groups. She focuses on skewed groups, which have a small minority referred to as "tokens" that have very little sway on the opinions of the dominant majority. When the minority grows, the group becomes tilted. In tilted groups, minority members begin to have some say in matters and are no longer dismissed as tokens. Kanter details the experiences of token women and ultimately finds that a minority of two women is not sufficient to overcome tokenism. She calls for more research to be done into the "tipping point" at which a group goes from skewed to tilted (Kanter [1977]).

Simply having at least one woman on a board of directors does not affect a bank or firm's performance (Campbell and Mínguez-Vera [2008] and Ekadah and Mboya [2012]). Empirical evidence shows, however, that a critical mass of at least three women improves organizational innovation and increases board activity (Torchia et al [2011] and Schwartz-Ziv [2014]). This shift in dynamics past the tipping point of three women is supported qualitatively from interviews conducted by Kramer et al (2006) with female board directors, all of whom reported that they were more effective when two of their colleagues were also women. Further, having at

[2] ROA is calculated as net income divided by total assets at year end. ROAA is calculated as net income divided by average total assets at period ends (most commonly quarters). ROAA captures volatility in total assets throughout the year; however, ROA and ROAA are often very close in value and both are widely used as performance measures in academic research.

least three women on a board can positively affect a firm's financial performance (Joecks et al [2012]). Reports from McKinsey (2007) and Catalyst (2011a) bolster this finding. The literature points to a critical mass of three women as the tipping point for initiating corporate changes, which we adopt as our magic number 3 factor.

2.5 Hypothesis Development

Though there is conflicting academic research regarding how female directors affect performance in nonfinancial firms, very few researchers have studied banks specifically, and no research to date has combined critical mass theory with bank performance. Banks' unique structure and role in the economy make generalizing findings about nonfinancial firms to banks problematic (Levine [2004]). The financial crisis and the Basel Committee's response to this crisis reveal that a closer examination of bank governance is necessary, and the role of women on boards has become an increasingly important piece of bank governance. A large gap exists in the literature regarding board gender diversity in banks. Pathan and Faff (2013) are among the first to examine women on bank boards in the United States. They conclude that gender diversity improved bank performance before the passage in 2002 of the Sarbanes-Oxley Act, but that effect was significantly weaker after its passage and during the financial crisis. Pathan and Faff use the percentage of women on the board as their independent variable; however, this may not be the most accurate way to measure the value of gender diversity in a group. Because the percentage of women is dependent on board size, this measure does not accurately capture the difference between skewed and tilted groups.

In contrast, we take into account critical mass theory and hypothesize that a BHC with at least three women affects firm performance. Based on evidence from nonfinancial firms during the financial crisis, we predict that female leadership is particularly helpful during times of crisis. Therefore, we hypothesize that the magic number 3, which signifies the critical mass of at least three women on a BHC's board of directors, is significantly and positively associated with performance during the financial crisis.

3 Data and Methodology

3.1 Sample and Coverage

Our sample consists of 55 of the largest 90 publicly traded BHCs as of 2014Q1, measured by total assets over the time period 1994–2014. To collect key internal governance characteristics including gender, board size, and composition, we limit our research to publicly traded BHCs so we can obtain this information from firm (DEF 14A) proxy statements. In addition, due to comparability concerns and the availability of data, we restrict our sample to only top tier BHCs headquartered in the United States and whose primary line of business was commercial banking throughout the full time series. These requirements enable us to collect balance sheet data from the year-end Consolidated Financial Statements for Holding Companies (Form FR Y-9C) and BHC annual reports (Form 10-K) through third-party provider SNL Financial, and stock price and return data from the Center for Research in Security Prices (CRSP). Our final dataset has 996 observations across 55 BHCs, representing roughly 63 percent of the banking industry, measured by total assets. On average, each BHC had 18 years of board history out of 21 possible years in our dataset.

The list of the largest 90 BHCs is obtained from the call report (formerly called Consolidated Reports of Condition and Income) and reflects those with the highest reported total assets as of March 31, 2014. We cross-reference this list with the SEC's EDGAR filings and determine that 15 of these BHCs were either privately held or foreign-owned, and therefore did not report DEF 14A proxy statements. After examining the remaining BHCs, we exclude an additional 15 BHCs whose primary line of business was something other than commercial banking during some portion of the 1994–2014 time series. This is determined by their lack of reporting to banking regulators, most notably during the pre-financial crisis periods.[3]Another five BHCs are dropped due to missing financial data. Thus, a total of 35 BHCs are excluded from our initial sample of 90, leaving us a final sample size of 55 BHCs.

3.2 Board Governance Variables

Board governance characteristics are manually collected from the DEF 14A proxy statements of annual meetings through the SEC EDGAR filings. Our governance variables include the following: gender, size, age, time began service, number of meetings, insiders, and CEO-chair duality. The governance variable central to our analysis, gender, is determined from the courtesy or referenced pronoun of each director listed. We count the number of board members for each BHC per year to determine size.

Figure 1 depicts the trend in total board size and number of directors by gender across the full sample period. As shown, despite the steady increase in the number of women on BHC boards, the boards of directors in our sample are overwhelmingly male. We also collect age and time began service from proxy statements, honoring the data provided in the DEF 14A forms despite identified discrepancies.[4] For directors listed as a nominee or for proxy statements that do not list when a board member started his or her service, we document the DEF 14A filing year. Our dataset accounts for breaks in service, given that this information is provided in the proxy statements. We convert this measure to years of service for each board member in our analysis.[5]

Figure 1: Average Board Size and Directors by Gender Over the Full Sample Period (1994–2014)

Figure 1 depicts the average board size of the 55 BHCs in our sample for each year of our sample. The average BHC board size has been steadily decreasing, despite some bumps, from approximately 17 board members in 1995 to approximately 12 members in 2014, where it appears to be hovering. Despite this downward board size trend, the average number of women on BHC boards has been steadily increasing from 1 to 2 across our sample period. This corresponds to an increase in average percent of women on a board, from approximately 5.77 percent in 1994 to 15.87 percent in 2014.

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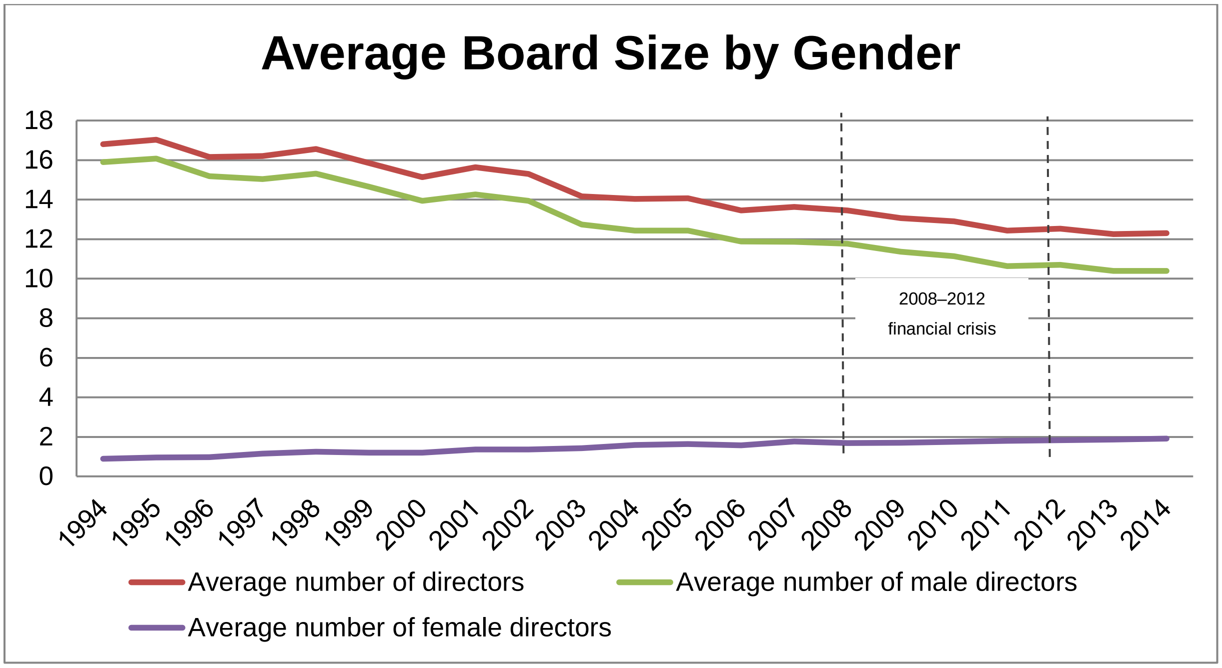
[3] Excluded by this criterion are some of the largest BHCs today (e.g., Goldman Sachs, e*TRADE, and Morgan Stanley) that were not classified as commercial banks until after 2008 and therefore did not report FR Y-9C forms to the Board of Governors of the Federal Reserve System.

[4] When such detail is available, we determine time began service as the year a director joins a BHC rather than that of a predecessor or subsidiary.

[5] It should be noted that female-specific age and years of service variables are missing for years of data when boards had no females.

Figure 1: Average Board Size and Directors by Gender Over the Full Sample Period (1994–2014)



We gather additional board characteristics from the DEF14A forms to control for factors that may affect board governance and profitability. These factors include number of meetings, which may indicate the responsiveness of a board; CEO-chair duality, which is an important structural component of the board; and the number of inside directors, which tells us the number of directors with insider information and potential conflicts of interest between management goals and overall firm success. The number of meetings variable is the total number of regular and special meetings held by the board during a particular year. To determine the number of insiders that sit on the board, we rely on the board director biographies. We define an insider of the board as someone who is currently or has previously been an executive officer or employee of the BHC, subsidiary, or a previously merged or acquired BHC. All other directors are considered "independent." We then use the insider variable in our analysis as a percentage of board size. CEO-chair duality is a dummy variable indicating whether the chief executive officer is also the chair of the board. Additionally, we calculate turnover from the director data by summing the number of new director names that appear in the proxy statement each year with the number of directors who no longer appear in that given year. We then take this number as a percentage of total board size. The use of this variable is described with our results in section 4. Based on the date in which each report was filed with the SEC, we develop the year variable associated with the governance characteristics.

3.3 Financial Performance Variables

To evaluate the relationship between BHC financial performance and board structure, we use Tobin's Q and ROAA as our primary measures of financial performance. Tobin's Q is widely defined as the ratio of a firm's market value to its total assets and is used to measure firm value across industries (e.g., Campbell and Mínguez-Vera [2008]; Wernerfelt and Montgomery [1988]; Demsetz and Villalonga [2001]; and Smirlock et al [1984]). Using variables from 10-K forms, we calculate Q using this accepted ratio, where market value equals total assets plus market capitalization minus common equity. This formula is consistent with other literature (e.g., Adams and Mehran [2012] and Campbell and Mínguez-Vera [2008]). ROAA is calculated as net income as a percentage of the average total assets and obtained from FR Y-9C forms. We rely on past research to determine that these measures are strong indicators of profitability.

ROA is perhaps the most widely used measure of performance across industries, as it provides a clear benchmark for profitability and efficiency levels of the firm (Mateos de Cabo et al [2011]). Several studies use ROA as a measure for performance for research on board characteristics (Belkhir [2009]; García-Meca et al [2015]; and Pathan and Faff [2013]). For reasons we discuss in section 4, our ROAA model may suffer from reverse causality, and so we rely on our model of Tobin's Q to draw conclusions.

Many aspects of Tobin's Q make it the preferred performance measure for our research. One of the major benefits is that Tobin's Q has a clear metric for interpretation, as a greater Q value indicates that a firm is more effectively using resources (Campbell and Mínguez-Vera [2008]). Its calculation also limits the effects of distortions from tax regulations and accounting conventions to which other accounting measures are subject (Wernerfelt and Montgomery [1988]). Tobin's Q is a unique measure of performance because it takes the market into account (Smirlock et al [1984] and Demsetz and Villalonga [2001]). The inclusion of the market, which takes into account investor perceptions and future expectations, makes Q a forward-looking performance measure, as opposed to accounting measures that simply provide a snapshot of performance (Demsetz and Villalonga [2001]). This is particularly important in times of economic distress, such as during the financial crisis, when both performance and market outlook were poor. Additionally, because the calculation for Q includes the market, it accounts for risk, unlike many accounting-based performance measures, such as return on equity and ROA (Wernerfelt and Montgomery [1988] and Smirlock et al [1984]). Risk is an important aspect of performance, because while the direct outcomes of risky practices may not be certain, volatility will likely be higher. In times of economic crisis, risky banks suffer the most. Lastly, Tobin's Q is widely used in research on board effectiveness, which supports our choice of metric for this research (de Andres and Vallelado [2008]; Adams and Mehran [2012]; Campbell and Mínguez-Vera [2008]; and Pathan and Faff [2013]).

3.4 Descriptive Statistics

Table 1 shows the descriptive statistics for the variables used in our model specification. We report four different board governance variables related to the presence of women on boards of directors, two measures of financial performance, and model-specific control variables. As noted in table 1, we show descriptive statistics for two different time periods: our full sample (1994–2014) and the financial crisis (2008–2012). Most BHCs in our sample have very few women on their boards, with a mean percent female of approximately 11 percent across the full time series. The average percent of women on boards increased from approximately 6 percent in 1994 to 16 percent in 2014. This low percentage is consistent with previous reports documenting the underrepresentation of women among directors of nonfinancial firms (Adams and Ferreira [2009]; Joecks et al [2012]; Bilimoria and Piderit [1994]; Torchia et al [2011]; and Catalyst [2011b]). As is evident in figure 1, this percentage increases over time and translates into approximately one to two women on a board across the full time series. Because the average number of women begins at one, Kanter (1977) would identify this as skewed. The study notes that as a minority grows, however, the group becomes tilted. Kanter refers to a tipping point in terms of the number of women that results in a change of board dynamic. The percent female variable, though, does not capture this effect, as it depends on total board size. Thus, tracking the number of women on the board would enable us to incorporate this critical mass concept.

Each magic number in our analysis is a dummy variable indicating whether it satisfies the following conditions: magic number 1 (MN1) indicates whether there is at least one woman on the board of directors for a given year; magic number 2 (MN2), whether there are at least two women; and magic number 3 (MN3), whether there are at least three women on the board. Of the 996 BHC-year observations across the full time series, approximately 87 percent, 45 percent, and 13 percent had at least one, two, and three women on the board, respectively. During the financial crisis, approximately 94 percent, 59 percent, and 16 percent of the 267 observations had at least one, two, and three women on the board, respectively, as shown in the board governance variables portion of table 1.

Table 1: Summary Statistics on the Financial and Board Governance Variables for the Full Sample Period (1994–2014) and Crisis (2008–2012)

Variable	Obs (Full)	Obs (Crisis)	Mean (Full)	Mean (Crisis)	Std Dev (Full)	Std Dev (Crisis)	Min (Full)	Min (Crisis)	Max (Full)	Max (Crisis)
Financial variables										
Tobin's Q	992	267	1.08	1.01	0.08	0.04	0.91	0.91	1.67	1.13
ROAA	942	256	1.04	0.52	0.72	0.99	–5.90	–5.90	3.16	3.16
Assets ($ billion)	953	263	130.65	195.90	375.93	500.47	0.39	5.14	2572.77	2359.14
Volatility	988	267	0.27	0.39	0.17	0.23	0.07	0.09	1.31	1.31
Capital ratio	948	258	9.53	10.72	2.15	2.12	4.35	6.03	17.58	17.28
Board governance variables										
Meetings	925	264	8.76	10.21	3.93	4.75	4.00	4.00	34.00	34.00
Duality	991	267	0.68	0.64	0.47	0.48	0.00	0.00	1.00	1.00
Percent insider	996	267	0.19	0.18	0.10	0.11	0.04	0.06	0.60	0.60
Age	996	267	60.42	61.41	3.47	2.93	19.67	52.22	71.00	69.00
Years of service	996	267	9.55	9.99	3.41	3.51	0.95	1.00	21.30	21.30
Turnover	857	255	0.17	0.16	0.15	0.14	0.00	0.00	0.96	0.83
Percent female	996	267	0.11	0.14	0.08	0.08	0.00	0.00	0.46	0.46
MN1	996	267	0.87	0.94	0.33	0.24	0.00	0.00	1.00	1.00
MN2	996	267	0.45	0.59	0.50	0.49	0.00	0.00	1.00	1.00
MN3	996	267	0.13	0.16	0.34	0.37	0.00	0.00	1.00	1.00

3.5 Model Specification

Our sample consists of data for 55 of the largest 90 public U.S. BHCs over 21 years (1994–2014). We focus specifically on the financial crisis for much of our analysis. This sample period is of particular interest because of the number and scope of bank failures throughout the country, largely due to risky banking practices (Tarraf and Majeske [2013]). As discussed in the literature review, many studies have mixed findings on how a diverse board, and particularly female directors, may affect performance during times of economic distress.

Because our data consist of firms over time, we use panel data regression analysis to determine the effect of gender makeup of the board of directors on performance. We determine that a fixed effects model is best because of potential intrinsic differences that may make some BHCs more likely to both be more profitable and to hire more women. Furthermore, a Hausman test indicates that a fixed effects model is more suitable than a random effects model. Thus, the models include year and BHC fixed effects. Our models are robust to account for potential heteroscedasticity in our data. For the full sample, we cluster standard errors by BHC and year, and for the crisis period we cluster only by BHC. Due to the fewer number of years during the financial crisis period, statistically we are unable to cluster by year.

The following model for Tobin's Q and ROAA was used:

$$PERF = f(X_{it}, G_{it}) + \alpha_i + \delta_t + \epsilon_{it} \qquad (1)$$

PERF refers to each performance measure, *i* is for each BHC, and *t* is each year of the sample. X refers to our financial and board control variables, and G refers to the gender variable. All independent variables are lagged by one year. The error term is ϵ, while α_i and δ_t are the BHC and year fixed effects terms, respectively.

Our model for Tobin's Q is largely based on Adams and Mehran's (2012) model. We include size, ROA, equity capital ratio, and volatility as financial control variables, and we use board size, CEO-chair duality, and number of meetings as board governance control variables. The natural logarithm of total assets is a proxy for firm size, and the standard deviation of monthly stock return multiplied by the square root of 12 is a measure of volatility. One notable difference between our model and Adams and Mehran's (2012) model is that we use the widely accepted formula of common equity/total assets for the capital ratio (as opposed to their alternative calculation). The descriptions of these variables and their expected signs in the models are shown in table 2.

Table 2: Determinants of Tobin's Q and Their Expected Signs

Control variable	Expected sign	Rationale
Log(assets)	Ambiguous	Positive—Large banks may be immune ("Too big to fail") Negative—Biggest banks may be the most vulnerable
Volatility	Negative	As banks become more volatile, trust in performance decreases
ROAA	Positive	Increasing returns signal better performance
Capital ratio	Ambiguous	Equity capital may be more risky, so the directional relationship could be positive or negative

Our ROAA model is based on Demirguc-Kunt and Huizinga's (2010) model, with size, asset growth, overhead expenses, equity capital ratio, and noninterest income as our financial control variables and the same board governance variables as our model for Tobin's Q. The proxy for size and the capital ratio calculation are consistent with those in our Tobin's Q model. Asset growth is the inflation-adjusted growth rate of assets using the Consumer Price Index (CPI) inflation rate, and overhead is the ratio of overhead costs to total assets. Unlike Demirguc-Kunt and Huizinga, we combine non-trading and trading income into one variable—noninterest income as a percentage of total operational income—because we are not interested in the individual effects of these components. We draw no conclusions from this model for reasons we discuss in the next section.

4 Results

In the analysis of our dataset, we choose to focus on the financial crisis because of the particularly unique economic environment that banks faced during that time. Table 3 presents the regression results for Tobin's Q during this time period. For each model specification, we include a set of board governance and financial performance covariates. From 2008 to 2012, the financial performance covariates are not significant. We consider variables to be significant only if they are significant at least at the 5 percent level.[6] Time fixed-effects likely capture a majority of the yearly variations in firm performance and macroeconomic fluctuations that affect all BHCs similarly, including during the financial crisis. Across most models, the number of firm meetings is positive and significant, indicating that a higher frequency of board meetings is positively associated with Tobin's Q during the financial crisis.

In models 1–4, we introduce the female variables percent female, magic number 1, magic number 2, and magic number 3. The gender variables percent female and magic number 3 are positive and significant at the 5 percent and 1 percent level respectively. This shows that BHCs with at least three female directors, relative to those with fewer female directors, and BHCs with a higher percentage of female directors are associated with a higher Tobin's Q during the financial crisis.

T-tests indicate that on average, female directors are younger and have fewer years of service than their male counterparts. We therefore add controls for the age and service years of female directors, and these results are presented in table 3, models 5–8. Data on the age and service of female directors is only available for a BHC-year observation with at least one female director. Because the value of age and service of female directors does not and cannot exist in a year when a BHC has no females, we use the dummy variable adjustment method in our model (see Allison 2001). We set the age and service of female directors equal to zero for BHCs that have no females in that particular year and include a dummy variable indicating any BHC-year observations missing these variables. This ensures that all observations for BHC-year combinations with no females are not dropped from the regression. For all other BHC-year observations, we preserve the original data. As a robustness check, we run models 5–8 with the original controls for age and service of females, but restrict the sample to just BHCs with at least one female director. These results are presented in supplemental table A.

[6] For female variables that are significant at the 10 percent level, we investigate the effect of an additional set of control variables.

The introduction of average age and service of female directors explains some of the difference in Tobin's Q between BHCs with at least three female directors and those with fewer female directors. However, the significant positive association at the 1 percent level between magic number 3 and Tobin's Q persists across the three models 4, 7 and 8, even after controlling for the age and service of female directors. This conclusion is supported in the model specifications in supplemental table A including only BHCs with at least one female director.[7]

Table 3: Year and BHC Fixed Effects Models of Tobin's Q During the Financial Crisis (2008–2012)

This table shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables. All of the independent variables are lagged by one year. Gender variables include percent female, measured as the number of women as a percentage of total board size, and magic numbers 1–3, measured as dummy variables indicating whether there are at least one, two, or three women, respectively, on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Average age of women is used as a proxy for progressiveness in models 5 and 7 and is calculated as the mean age of women per BHC per year. We introduce another proxy for progressiveness in models 6 and 8: average service years for women. This is calculated as the average number of years of service of women per BHC per year. We set the age and service of female directors equal to zero for BHCs that have no females in that particular year and include a dummy variable indicating any BHC-year observations missing these variables. The dummy variable is omitted from the table. The sample consists of 52 BHCs over the time period 2008–2012. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

[7] The exclusion of BHCs with no females from supplemental table A alters the interpretation of the coefficient on magic number 3. In table 3, magic number 3 is relative to the base group of BHCs with zero, one, or two females while in supplemental table A, magic number 3 should be interpreted relative to a base group of BHCs with one or two females.

Table 3: Year and BHC Fixed Effects Models of Tobin's Q During the Financial Crisis (2008–2012)

	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q	Model 5 Tobin's Q	Model 6 Tobin's Q	Model 7 Tobin's Q	Model 8 Tobin's Q
Board Size	-0.00113	-0.00117	-0.00114	-0.00200*	-0.00114	-0.00115	-0.00202*	-0.00194*
	(0.00116)	(0.00118)	(0.00127)	(0.00118)	(0.00110)	(0.00109)	(0.00108)	(0.00103)
Meetings	0.000720*	0.000917**	0.000781*	0.000637	0.000848**	0.000842**	0.000778**	0.000755**
	(0.000411)	(0.000368)	(0.000394)	(0.000397)	(0.000377)	(0.000364)	(0.000372)	(0.000360)
Percent Insider	-0.0223	-0.0334	-0.0333	-0.0227	-0.0294	-0.0428	-0.0264	-0.0379
	(0.0439)	(0.0442)	(0.0443)	(0.0432)	(0.0435)	(0.0421)	(0.0432)	(0.0411)
Duality	-0.00437	-0.00234	-0.00404	-0.00607	-0.00326	-0.00233	-0.00452	-0.00366
	(0.00656)	(0.00550)	(0.00682)	(0.00665)	(0.00535)	(0.00546)	(0.00526)	(0.00532)
ROAA	0.00184	0.00193	0.00216	0.00182	0.00179	0.00172	0.00164	0.00153
	(0.00129)	(0.00133)	(0.00138)	(0.00136)	(0.00128)	(0.00129)	(0.00132)	(0.00129)
Log(assets)	-0.0144	-0.0167	-0.0153	-0.0156	-0.0149	-0.0138	-0.0161	-0.0146
	(0.0124)	(0.0117)	(0.0129)	(0.0122)	(0.0115)	(0.0117)	(0.0110)	(0.0112)
Volatility	-0.00679	-0.00979	-0.00824	-0.00618	-0.00816	-0.00899	-0.00749	-0.00792
	(0.00700)	(0.00630)	(0.00665)	(0.00678)	(0.00652)	(0.00646)	(0.00628)	(0.00637)
Capital Ratio	-0.00195	-0.00194	-0.00192	-0.00174	-0.00192	-0.00200	-0.00175	-0.00185
	(0.00157)	(0.00159)	(0.00157)	(0.00153)	(0.00157)	(0.00160)	(0.00154)	(0.00157)
Percent Female	0.102**				0.0734**	0.0430		
	(0.0402)				(0.0279)	(0.0313)		
MN1		0.0258						
		(0.0229)						
MN2			0.00185					
			(0.00485)					
MN3				0.0216***			0.0208***	0.0187***
				(0.00607)			(0.00624)	(0.00645)
Average age of women					-0.000335		-0.000301	
					(0.000704)		(0.000702)	
Average services years for women						-0.00157**		-0.00156***
						(0.000592)		(0.000554)
Observations	248	248	248	248	248	248	248	248
R-squared	0.311	0.313	0.286	0.318	0.327	0.347	0.345	0.367
Adjusted R-squared	0.273	0.274	0.246	0.280	0.284	0.305	0.303	0.326
Number of BHCs	52	52	52	52	52	52	52	52

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

The next step in validating the results from these regressions is to address any factors that may be wrongfully influencing our results. As with almost all studies of this matter, endogeneity is a major concern. We include a variety of ways to increase confidence that endogeneity does not affect the legitimacy of our findings. First, as previously stated, we use year and BHC fixed effects. Year fixed effects in the model allow us to control for economic conditions that affect all BHCs in our sample uniformly. BHC fixed effects control for unobserved intrinsic differences that do not change over time in individual BHCs. Controlling for these intrinsic differences is important when addressing endogeneity, because they may have an effect on the relationship between female directors and higher profitability, which could affect our results.

Reverse causality is a crucial concern in this study. Perhaps BHCs that are performing well seek to diversify their boards and add more female directors. Or, maybe women seek out highly profitable BHCs to join as directors. In addressing reverse causality, our models lag magic number variables by one year. This partially addresses reverse causality because future Tobin's Q cannot retroactively affect the past number of women. Autocorrelation may, however, be a factor. As an additional test of reverse causality, we run specifications with the gender variables as dependent variables, as seen in table 4.[8]

Table 4: Tobin's Q—Reverse Causality Models of Gender Variables During the Crisis (2008–2012)

This table shows the results from the reverse causality models with gender variables as dependent variables. The sample consists of 52 BHCs over the time period 2008–2012. The first model of percent female is a generalized linear model linked to logit. Models 2–5 of the magic numbers are logit models. All of the independent variables are lagged by one year and time dummies for each year are included for all five models. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Turnover percent is used as an additional control variable in model 5 and is calculated by adding the number of new director names per year with the number of directors who no longer appear in that given year, and then taking this number as a percentage of total board size. Standard errors, corrected for heteroscedasticity, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

[8] See supplemental table B for results of the reverse causality logit model with standard errors clustered by BHC.

Table 4: Tobin's Q—Reverse Causality Models of Gender Variables During the Crisis (2008–2012)

Variables	Model 1 Percent female	Model 2 MN1	Model 3 MN2	Model 4 MN3	Model 5 MN3
Tobin's Q	1.113	8.426	6.803	6.437	5.417
	(1.024)	(6.259)	(4.760)	(4.967)	(4.365)
Board size	–0.0377***	0.148	0.115*	0.0900	0.110
	(0.0126)	(0.116)	(0.0637)	(0.0694)	(0.0702)
Meetings	–0.00225	0.131	–0.00406	0.0254	
	(0.00790)	(0.0992)	(0.0404)	(0.0509)	
Percent insider	–0.351	5.690*	–1.652	–4.576**	–4.518**
	(0.342)	(3.024)	(1.608)	(2.006)	(1.984)
Duality	0.137*	–0.947	0.858**	0.131	
	(0.0781)	(0.909)	(0.338)	(0.407)	
ROAA	0.0535	0.0958	0.254	0.508	0.490
	(0.0432)	(0.350)	(0.224)	(0.360)	(0.299)
Log(assets)	0.155***	1.404*	0.929***	0.322***	0.337***
	(0.0238)	(0.757)	(0.159)	(0.124)	(0.101)
Volatility	0.225	3.547*	0.686	0.0148	
	(0.270)	(1.944)	(1.143)	(1.685)	
Capital ratio	0.0114	0.183	–0.0303	0.0157	
	(0.0179)	(0.115)	(0.0946)	(0.0974)	
Turnover percent					–0.610
					(1.368)
Constant	–5.506***	–35.67**	–24.75***	–15.57**	–14.48***
	(1.310)	(16.62)	(6.291)	(6.527)	(5.092)
Observations	248	248	248	248	240
Pseudo R-squared		0.217	0.246	0.133	0.131

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1

In this regression, we use turnover percent as a control variable for magic number 3, as we expect that with a higher turnover rate, BHCs are likely to hire more female directors instead of keeping the same directors who have historically been male. Table 4 shows the logit model of the gender variables during the financial crisis, in which Tobin's Q is consistently not significant. From this information, we are confident that Tobin's Q is not a determinant of any of the gender variables of interest. To address the threat of multicollinearity, we check variance inflation factors (VIF) for each control variable in the model. Size has a very high VIF, indicating that it may be the cause of collinearity in the model. As a result, we drop log(assets) in some specifications and find that the exclusion of this variable does not greatly change the magnitude or significance of the point estimates in our models. We present these results in supplemental table C.

The results for Tobin's Q over the full time series are shown in table 5. As expected and outlined in table 2, ROAA is consistently positive and significant at the 1 percent level. All other financial performance variables and board governance variables do not have a significant relationship with Tobin's Q. Similar to table 3, models 1, 4, 5, and 8 in table 5 introduce the female variables percent female, magic number 1, magic number 2, and magic number 3. Magic number 2 is negative and significant at the 5 percent level. This suggests that having at least two women on the board decreases Tobin's Q. The differing results for magic number 2 and magic number 3 in each time period suggest that the relationship between the number of females on boards of U.S. BHCs and Tobin's Q varies across economic environments.

Similar to during the financial crisis, t-tests show that the average age and years of service is lower for females than male directors over the full time series. Consequently, we introduce controls for the age and service of females into models that include percent female and magic number 2. We follow the same dummy variable adjustment method as the crisis period for our female age and service variables. In models 2, 3, 6, and 7 of table 5, we set the age and service of female directors equal to zero for BHCs that have no females in that particular year and include a dummy variable for any BHC-year observations missing these variables. Results for models 2, 3, 6, and 7 run with the original coded female age and service variables are presented in supplemental table D. The sample in these models is restricted to BHCs with at least one female director.

The coefficient on magic number 2 remains negative and significant at the 5 percent level even after controlling for the age and service of female directors. Therefore after holding the age and service of female directors constant, BHCs with at least two female directors still have a lower Tobin's Q than BHCs with zero or one female director on average. These coefficients are only significant at the 10 percent level in the alternative specification presented in supplemental table D. However, the same conclusion holds; namely that there is a difference in average expected Tobin's Q for BHCs with zero or one female relative to those with at least two female directors even after controlling for the age and service of female directors.

Table 5: Year and BHC Fixed Effects Models of Tobin's Q Across the Full Time Period (1994–2014)

This table shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables. All independent variables are lagged by one year. Gender variables include percent female measured as the number of women as a percentage of total board size, and magic numbers 1–3 measured as dummy variables indicating whether there are at least one, two, or three women, respectively, on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Average age of women is used as a proxy for progressiveness in models 2 and 6 and is calculated as the mean age of women per BHC per year. We introduce another proxy for progressiveness in models 3 and 7—average service years for women. This is calculated as the average number of years of service of women per BHC per year. We set the age and service of female directors equal to zero for BHCs that have no females in that particular year and include a dummy variable indicating any BHC-year observations missing these variables. The dummy variable is omitted from the table. The sample consists of 55 BHCs over the time period 1994–2014. Standard errors, corrected for heteroscedasticity and clustered by BHC and year, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Table 5: Year and BHC Fixed Effects Models of Tobin's Q Across the Full Time Period (1994–2014)

	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q	Model 5 Tobin's Q	Model 6 Tobin's Q	Model 7 Tobin's Q	Model 8 Tobin's Q
Board size	-5.75e-05	0.000237	-0.000185	-0.000247	0.000769	0.00103	0.000701	-0.000239
	(0.00121)	(0.00116)	(0.00115)	(0.00119)	(0.00132)	(0.00130)	(0.00124)	(0.00128)
Meetings	-0.000155	-5.13e-06	-4.89e-05	-0.000287	6.71e-05	0.000123	8.94e-05	-0.000299
	(0.000710)	(0.000694)	(0.000684)	(0.000707)	(0.000675)	(0.000683)	(0.000669)	(0.000704)
Percent Insider	0.0337	0.0255	0.0352	0.0463	0.0303	0.0251	0.0325	0.0453
	(0.0399)	(0.0403)	(0.0396)	(0.0411)	(0.0383)	(0.0404)	(0.0392)	(0.0399)
Duality	0.000784	0.000827	0.000727	-8.22e-05	0.000126	-8.40e-05	-1.17e-06	-0.000101
	(0.00476)	(0.00477)	(0.00476)	(0.00495)	(0.00456)	(0.00464)	(0.00465)	(0.00496)
ROAA	0.0249***	0.0248***	0.0248***	0.0244***	0.0247***	0.0245***	0.0246***	0.0245***
	(0.00799)	(0.00794)	(0.00790)	(0.00784)	(0.00774)	(0.00770)	(0.00769)	(0.00781)
Log(assets)	-0.0186	-0.0203*	-0.0201*	-0.0171	-0.0207*	-0.0211*	-0.0211*	-0.0169
	(0.0119)	(0.0116)	(0.0117)	(0.0119)	(0.0120)	(0.0118)	(0.0119)	(0.0117)
Volatility	0.00746	0.00286	0.00469	0.00795	0.00479	0.00249	0.00376	0.00856
	(0.0170)	(0.0154)	(0.0166)	(0.0173)	(0.0152)	(0.0143)	(0.0152)	(0.0171)
Capital Ratio	-0.00134	-0.00167	-0.00151	-0.00166	-0.00127	-0.00151	-0.00138	-0.00159
	(0.00237)	(0.00223)	(0.00235)	(0.00234)	(0.00236)	(0.00224)	(0.00235)	(0.00235)
Percent Female	-0.0786*	-0.114**	-0.107**					
	(0.0458)	(0.0514)	(0.0507)					
MN1				0.00225				
				(0.0104)				
MN2					-0.0224**	-0.0218**	-0.0225**	
					(0.00888)	(0.00873)	(0.00895)	
MN3								0.000917
								(0.00753)
Average age of women		-0.00115				-0.00101		
		(0.000719)				(0.000679)		
Average service years for women			0.000304				9.45e-05	
			(0.000727)				(0.000711)	
Observations	859	859	859	859	859	859	859	859
R-squared	0.632	0.638	0.633	0.629	0.640	0.644	0.640	0.629
Adjusted R-squared	0.592	0.598	0.593	0.590	0.601	0.605	0.600	0.590
Number of BHCs	55	55	55	55	55	55	55	55

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

To draw accurate conclusions from our table 5 findings, we use the same endogeneity and multicollinearity tests we outline for the financial crisis. Having lagged gender variables suggests a one-way causality direction. In the reverse causality regressions shown in table 6, Tobin's Q is consistently not significant.[9] Therefore, our model for Tobin's Q likely does not suffer from reverse causality since Tobin's Q is not a determinant of percent female or magic number 2. Size had a high variance inflation factor as during the crisis, and so we dropped log(assets) from the model to find no notable changes in the results, as seen in supplemental table F.

Table 6: Tobin's Q—Reverse Causality Models of Gender Variables Across the Full Time Period (1994–2014)

This table shows the results from the reverse causality models of the gender variables as dependent variables. The sample consists of 55 BHCs over the time period 1994–2014. Models 1–2 of percent female are generalized linear models linked to logit. Models 3–6 of the magic numbers are logit models. All independent variables are lagged by one year for all six models. Controls include a dummy variable for each year. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Turnover percent is used as an additional control variable in models 2 and 5, and is calculated by adding the number of new director names per year with the number of directors who no longer appear in that given year, and then taking this number as a percentage of total board size. Standard errors, corrected for heteroscedasticity, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

[9] We also conducted this regression with standard errors clustered by BHC as shown in supplemental table E, in which Tobin's Q remained not significant.

Table 6: Tobin's Q—Reverse Causality Models of Gender Variables Across the Full Time Period (1994–2014)

Variables	Model 1 Percent female	Model 2 Percent female	Model 3 MN1	Model 4 MN2	Model 5 MN2	Model 6 MN3
Tobin's Q	0.153	0.382	0.135	0.173	1.513	–1.562
	(0.408)	(0.399)	(1.735)	(1.504)	(1.350)	(1.829)
Board size	–0.0262***	–0.0261***	0.0994***	0.112***		0.154***
	(0.00650)	(0.00652)	(0.0284)	(0.0214)		(0.0303)
Meetings	0.00102		0.0805*	0.0358		0.0169
	(0.00561)		(0.0428)	(0.0244)		(0.0342)
Percent insider	–0.531**	–0.574**	–1.032	–2.455***	–2.751***	–2.768**
	(0.235)	(0.239)	(1.290)	(0.944)	(0.883)	(1.226)
Duality	0.0856*	0.105**	–0.223	0.652***	0.719***	0.00805
	(0.0482)	(0.0492)	(0.285)	(0.182)	(0.177)	(0.246)
ROAA	0.0764**	0.0627**	0.571***	0.251		0.430
	(0.0366)	(0.0300)	(0.201)	(0.159)		(0.265)
Log(assets)	0.149***	0.136***	0.644***	0.553***	0.514***	0.468***
	(0.0172)	(0.0165)	(0.133)	(0.0729)	(0.0712)	(0.0814)
Volatility	0.257		5.501***	–0.342		–0.916
	(0.209)		(1.604)	(0.806)		(1.387)
Capital ratio	–0.00899		0.0570	–0.128**	–0.0674	–0.170**
	(0.0130)		(0.0672)	(0.0501)	(0.0481)	(0.0838)
Turnover		0.212			–0.0426	
		(0.175)			(0.595)	
Constant	–5.041***	–5.087***	–13.39***	–12.87***	–11.57***	–8.206***
	(0.630)	(0.572)	(3.004)	(2.349)	(2.314)	(2.715)
Observations	859	804	859	859	810	849
Pseudo R-squared			0.188	0.220	0.184	0.196

Note: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Our models for ROAA, however, do not withstand our reverse causality tests. We conducted these same reverse regressions with ROAA as the independent variable, and on our most stringent test, the results suggested that ROAA may have an effect on our gender variables. As seen in supplemental tables G and H, our reverse causality tests indicate that ROAA is not significant when we cluster standard errors by BHC, but it is significant and positive when we do not cluster standard errors. This suggests that ROAA could be a determinant of gender diversity. Thus, we cannot defend the meaning of the ROAA model, and we draw no conclusions about the relationship between gender diversity and ROAA.

5 Conclusion

This study examines the relationship between the number of women on boards of directors and BHC financial performance. We use a 21-year time span and 55 BHCs to conduct our analysis. The results provide strong support for our hypothesis that the magic number 3 was the tipping point for women on BHC boards during the financial crisis, as it is significantly and positively associated with performance.

Our findings also show a negative relationship between performance and the magic number 2 for the full time series 1994–2014. Magic number 2 did not have a significant relationship with performance during the financial crisis. Furthermore, magic number 3 had a positive relationship with performance during the financial crisis, but no significant relationship exists during the financial crisis. These findings indicate that the relationship between women on boards and financial performance differs depending on the economic environment.

Although we did not expect to find a significantly negative relationship between having at least two female directors and performance over the full sample period, literature on female leadership and tokenism may provide some explanation for this finding. The magic number 3 is the tipping point at which women are taken seriously as board members, while a fewer number of female directors is not sufficient to overcome tokenism (Kramer et al [2006] and McKinsey [2007]). Magic number 2 captures BHCs with at least two females, which includes BHCs with exactly two females and those with three or more females. Additional research is needed to isolate these effects and test if having an exact number of women has differing relationships with performance. The magic number of three women, however, did have a unique effect during the financial crisis. Perhaps having at least three women on the board during the financial crisis enhanced the level of responsiveness needed to more quickly overcome the volatile economic conditions of the crisis. Further research is needed to explore this relationship.

Due to the high cost of manually collecting key governance variables, we focus on a relatively small number of BHCs. Analysis on the full 21-year sample period ensures there is variation in governance variables that often do not change quickly over time. When we subset our analysis using the financial crisis years, however, the number of observations significantly decreases. There is a tradeoff, but this specific time period is particularly noteworthy, and therefore our work can be considered a starting point for further research to explore a larger sample of banks. There are other time periods of interest before the 2008 financial crisis; however, the presence of three women on a board was rare before 2002, as only 7 percent (22) of these observations had at least three female directors.

Because so few BHCs had at least three female directors before 2002, we are not able to investigate the impact of female directors on performance during periods such as the dot-com crisis of 2000, an economic downturn of smaller magnitude than the financial crisis. As the number and frequency of women on boards rises, further research is needed to analyze the effects of this magic number during differing economic environments, including crises of smaller magnitudes.

Though the results of our study are robust, we recommend exercising caution when generalizing our findings to the whole banking industry. We consider the largest 90 BHCs, of which we include 55 BHCs in our sample that make up approximately 63 percent of the banking industry in terms of total assets. As of the first quarter of 2014, when we began our analysis, there were more than 1,150 top tier BHCs. The remainder of the industry, which largely includes smaller BHCs, could perhaps show different characteristics than the largest banking firms. We also limit our study to publicly traded BHCs, and therefore our results cannot be generalized to banks that are neither BHCs nor publicly traded. Because our baseline for determining the sample of banks was post- financial crisis, our results exclude seven commercial banks that did not survive the 2008 business cycle.[10] Additional data collection and analysis are needed to explore these research questions.

BHCs also have complicated hierarchical structures that make it hard to identify the ownership and control of individual institutions. Each top tier BHC could have lower-level BHCs and subsidiaries that are separately chartered with their own board. More research is needed to determine if lower-level BHCs and subsidiary boards have the same relationship between board gender composition and financial performance as top tier BHCs. The banking industry has seen vast consolidation and increased complexity as a result of mergers and acquisitions over the last two decades, and this could affect the result of our study given our sample period. We evaluate the largest 90 BHCs based on their asset size in a single point in time—March 31, 2014—as opposed to analyzing the largest BHCs in each given year. Future research may consider addressing this issue to explore the effect of mergers and acquisitions.

The changing statutory framework has also been a major factor in the evolution and complexity of the banking industry. Although we account for year fixed effects, we do not specifically control for the varying effects of laws and regulations on BHC performance in our analysis.

We see future opportunities to further this discussion by accounting for the effects of major statutes such as Dodd–Frank Wall Street Reform and Consumer Protection Act of 2010. When more data become available, we can consider this important piece of legislation in future analysis, as well as measure gender's effects on bank performance post- financial crisis. This is especially important because we find that the economic environment plays a major role in the findings.

[10] Out of the 162 commercial banks that failed during the financial crisis, only seven were large enough as of 2006 to have been included in our sample (see Aubuchon and Wheelock [2010]). Many of the largest bank failures, most notably Washington Mutual Inc. (the holding company for Washington Mutual Bank or WaMu, a Seattle-based thrift), were savings banks and thrifts, which we excluded from our sample.

Our research contributes to the discussion of optimal board governance by exploring the relationship between a critical mass of women on BHC boards of directors and performance. During the financial crisis, controlling for financial and board governance characteristics, BHCs with at least three women on their boards braved the crisis better, significantly outperforming BHCs with fewer female directors. This conclusion contrasts with the results over the 21-year span. Over this longer period, the performance of BHCs with at least three female directors was not statistically different than that of BHCs with fewer female directors, and BHCs with at least two female directors on average showed significantly lower performance.

These findings lead us to conclude that the relationship between women on boards of U.S. BHCs and financial performance, as measured by Tobin's Q, varies across economic environments. This raises important questions about the relationship between board structure and performance over the economic cycle.

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Supplemental Tables

Supplemental Table A: Year and BHC Fixed Effects Models of Tobin's Q During the Financial Crisis (2008–2012) With and Without Dummy Variable Adjustment Method

Table A shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables. All of the independent variables are lagged by one year. Gender variables include percent female, measured as the number of women as a percentage of total board size, and magic number 3, measured as a dummy variable indicating whether there is at least three women on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Average age of women is used as a proxy for progressiveness and is calculated as the mean age of women per BHC per year. We introduce another proxy for progressiveness: average service years for women. This is calculated as the average number of years of service of women per BHC per year. In this table, we introduce two measures each for average age of women and average service years for women. In models 1, 3, 5, and 7, average age of women and average service years for women uses the dummy variable adjustment method, setting the age and service of female directors equal to zero for BHCs that have no females in that particular year. We also include a dummy variable in these models indicating any BHC-year observations missing these variables, of which has been omitted from the table. In models 2, 4, 6, and 8, average age of women2 and average service years for women2 uses the original controls for age and service of females, but the sample is restricted to BHCs with at least one female director. The sample consists of 52 BHCs over the time period 2008–2012. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Supplemental Table A: Year and BHC Fixed Effects Models of Tobin's Q During the Financial Crisis (2008–2012) With and Without Dummy Variable Adjustment Method

Variables	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q	Model 5 Tobin's Q	Model 6 Tobin's Q	Model 7 Tobin's Q	Model 8 Tobin's Q
Board Size	-0.00114	-0.00144	-0.00115	-0.00155	-0.00202*	-0.00228**	-0.00194*	-0.00236**
	(0.00110)	(0.00110)	(0.00109)	(0.00109)	(0.00108)	(0.00107)	(0.00103)	(0.00104)
Meetings	0.000848**	0.00105***	0.000842**	0.000973***	0.000778**	0.000967***	0.000755**	0.000880**
	(0.000377)	(0.000353)	(0.000364)	(0.000359)	(0.000372)	(0.000354)	(0.000360)	(0.000355)
Percent Insider	-0.0294	-0.0445	-0.0428	-0.0465	-0.0264	-0.0403	-0.0379	-0.0409
	(0.0435)	(0.0404)	(0.0421)	(0.0406)	(0.0432)	(0.0402)	(0.0411)	(0.0393)
Duality	-0.00326	-0.000205	-0.00233	0.00101	-0.00452	-0.00173	-0.00366	-0.000616
	(0.00535)	(0.00482)	(0.00546)	(0.00496)	(0.00526)	(0.00469)	(0.00532)	(0.00480)
ROAA	0.00179	0.00201	0.00172	0.00187	0.00164	0.00183	0.00153	0.00167
	(0.00128)	(0.00125)	(0.00129)	(0.00120)	(0.00132)	(0.00129)	(0.00129)	(0.00121)
Log(assets)	-0.0149	-0.0183*	-0.0138	-0.0192*	-0.0161	-0.0194*	-0.0146	-0.0200*
	(0.0115)	(0.0105)	(0.0117)	(0.0106)	(0.0110)	(0.00997)	(0.0112)	(0.0100)
Volatility	-0.00816	-0.0104*	-0.00899	-0.0117*	-0.00749	-0.00950	-0.00792	-0.0105
	(0.00652)	(0.00601)	(0.00646)	(0.00637)	(0.00628)	(0.00586)	(0.00637)	(0.00629)
Capital Ratio	-0.00192	-0.00245*	-0.00200	-0.00259*	-0.00175	-0.00230	-0.00185	-0.00244*
	(0.00157)	(0.00146)	(0.00160)	(0.00149)	(0.00154)	(0.00142)	(0.00157)	(0.00145)
Percent Female	0.0734**	0.0603**	0.0430	0.0408				
	(0.0279)	(0.0255)	(0.0313)	(0.0286)				
MN3					0.0208***	0.0195***	0.0187***	0.0186***
					(0.00624)	(0.00631)	(0.00645)	(0.00651)
Average age of women	-0.000335				-0.000301			
	(0.000704)				(0.000702)			
Average age of women2		-0.00121**				-0.00117**		
		(0.000503)				(0.000510)		
Average services years for women			-0.00157**				-0.00156***	
			(0.000592)				(0.000554)	
Average services years for women2				-0.00145***				-0.00143***
				(0.000508)				(0.000491)
Observations	248	231	248	231	248	231	248	231
R-squared	0.327	0.394	0.347	0.394	0.345	0.415	0.367	0.418
Adjusted R-squared	0.284	0.354	0.305	0.355	0.303	0.377	0.326	0.380
Number of BHCs	52	50	52	50	52	50	52	50
Dummy Variable Adjustment Method	Yes	No	Yes	No	Yes	No	Yes	No

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table B: Tobin's Q—Reverse Causality Model of Gender Variables During the Financial Crisis (2008–2012) With BHC Standard Error Clustering

Table B shows the results from the reverse causality model with gender variables as dependent variables, in which standard errors are clustered by BHC. The sample consists of 52 BHCs over the time period 2008–2012. The first model of percent female is a generalized linear model linked to logit. Models 2–5 of the magic numbers are logit models. All of the independent variables are lagged by one year, and time dummies for each year are included for all five models. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Turnover percent is used as an additional control variable in model 5 and is calculated by adding the number of new director names per year with the number of directors who no longer appear in that given year, and then taking this number as a percentage of total board size. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	Model 1 Percent female	Model 2 MN1	Model 3 MN2	Model 4 MN3	Model 5 MN3
Tobin's Q	1.113	8.426	6.803	6.437	5.417
	(1.354)	(7.761)	(6.612)	(6.054)	(7.113)
Board size	–0.0377*	0.148	0.115	0.0900	0.110
	(0.0201)	(0.161)	(0.104)	(0.116)	(0.131)
Meetings	–0.00225	0.131	–0.00406	0.0254	
	(0.0105)	(0.144)	(0.0561)	(0.0704)	
Percent insider	–0.351	5.690	–1.652	–4.576	–4.518
	(0.638)	(4.853)	(2.747)	(3.385)	(3.461)
Duality	0.137	–0.947	0.858*	0.131	
	(0.121)	(1.144)	(0.516)	(0.604)	
ROAA	0.0535	0.0958	0.254	0.508	0.490
	(0.0488)	(0.348)	(0.288)	(0.429)	(0.321)
Log(assets)	0.155***	1.404	0.929***	0.322	0.337*
	(0.0430)	(0.859)	(0.268)	(0.229)	(0.188)
Volatility	0.225	3.547*	0.686	0.0148	
	(0.287)	(2.152)	(1.186)	(1.669)	
Capital ratio	0.0114	0.183	–0.0303	0.0157	
	(0.0277)	(0.158)	(0.139)	(0.148)	
Turnover percent					–0.610
					(1.921)
Constant	–5.506***	–35.67*	–24.75***	–15.57*	–14.48*
	(1.651)	(18.98)	(8.073)	(8.339)	(8.526)
Observations	248	248	248	248	240
Pseudo R-squared		0.217	0.246	0.133	0.131

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table C: Year and BHC Fixed Effects Models of Tobin's Q During the Financial Crisis (2008–2012) After Dropping Log(assets)

Table C shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables after log(assets) was dropped due to potential multicollinearity. All of the independent variables are lagged by one year. Gender variables include percent female, measured as the number of women as a percentage of total board size, and magic numbers 1–3, measured as dummy variables indicating whether there are at least one, two, or three women, respectively, on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. The sample consists of 52 BHCs over the time period 2008–2012. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q
Board size	-0.00123	-0.00128	-0.00125	-0.00211*
	(0.00116)	(0.00117)	(0.00128)	(0.00118)
Meetings	0.000711*	0.000904**	0.000772*	0.000629
	(0.000410)	(0.000377)	(0.000397)	(0.000401)
ROAA	0.00191	0.00206	0.00228	0.00190
	(0.00132)	(0.00138)	(0.00142)	(0.00140)
Volatility	-0.00536	-0.00798	-0.00654	-0.00470
	(0.00681)	(0.00648)	(0.00666)	(0.00661)
Capital ratio	-0.00131	-0.00119	-0.00125	-0.00103
	(0.00161)	(0.00164)	(0.00162)	(0.00154)
Duality	-0.00390	-0.00179	-0.00343	-0.00557
	(0.00672)	(0.00572)	(0.00696)	(0.00681)
Percent female	0.106***			
	(0.0365)			
MN1		0.0249		
		(0.0223)		
MN2			0.00207	
			(0.00483)	
MN3				0.0218***
				(0.00555)
Constant	1.031***	1.018***	1.042***	1.053***
	(0.0213)	(0.0278)	(0.0222)	(0.0214)
Observations	248	248	248	248
R-squared	0.302	0.299	0.273	0.306
Adjusted R-squared	0.269	0.266	0.240	0.274
Number of BHCs	52	52	52	52

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplement Table D: Year and BHC Fixed Effects Models of Tobin's Q Across the Full Time Period (1994–2014) With and Without Dummy Variable Adjustment Method

Table D shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables. All of the independent variables are lagged by one year. Gender variables include percent female, measured as the number of women as a percentage of total board size, and magic number2, measured as a dummy variable indicating whether there are at least two women on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Average age of women is used as a proxy for progressiveness and is calculated as the mean age of women per BHC per year. We introduce another proxy for progressiveness: average service years for women. This is calculated as the average number of years of service of women per BHC per year. In this table, we introduce two measures each for average age of women and average service years for women. In models 1, 3, 5, and 7, average age of women and average service years for women uses the dummy variable adjustment method, setting the age and service of female directors equal to zero for BHCs that have no females in that particular year. We also include a dummy variable in these models indicating any BHC-year observations missing these variables, of which has been omitted from the table. In models 2, 4, 6, and 8, average age of women2 and average service years for women2 uses the original controls for age and service of females, but the sample is restricted to BHCs with at least one female director. The sample consists of 52 BHCs over the time period 2008–2012. Standard errors, corrected for heteroscedasticity and clustered by BHC and year, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Supplement Table D: Year and BHC Fixed Effects Models of Tobin's Q Across the Full Time Period (1994–2014) With and Without Dummy Variable Adjustment Method

Variables	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q	Model 5 Tobin's Q	Model 6 Tobin's Q	Model 7 Tobin's Q	Model 8 Tobin's Q
Board size	0.000237	1.54e-05	-0.000185	-0.000491	0.00103	0.000719	0.000701	0.000250
	(0.00116)	(0.00118)	(0.00115)	(0.00117)	(0.00130)	(0.00142)	(0.00124)	(0.00132)
Meetings	-5.13e-06	0.000145	-4.89e-05	0.000112	0.000123	0.000249	8.94e-05	0.000212
	(0.000694)	(0.000686)	(0.000684)	(0.000686)	(0.000683)	(0.000678)	(0.000669)	(0.000668)
Percent Insider	0.0255	-0.00820	0.0352	-0.00126	0.0251	-0.00643	0.0325	-0.000356
	(0.0403)	(0.0441)	(0.0396)	(0.0406)	(0.0404)	(0.0447)	(0.0392)	(0.0416)
Duality	0.000827	0.00745	0.000727	0.00606	-8.40e-05	0.00641	-1.17e-06	0.00528
	(0.00477)	(0.00455)	(0.00476)	(0.00438)	(0.00464)	(0.00451)	(0.00465)	(0.00441)
ROAA	0.0248***	0.0216***	0.0248***	0.0217***	0.0245***	0.0215***	0.0246***	0.0217***
	(0.00794)	(0.00766)	(0.00790)	(0.00764)	(0.00770)	(0.00753)	(0.00769)	(0.00754)
Log(assets)	-0.0203*	-0.0190	-0.0201*	-0.0200	-0.0211*	-0.0197	-0.0211*	-0.0207
	(0.0116)	(0.0136)	(0.0117)	(0.0134)	(0.0118)	(0.0138)	(0.0119)	(0.0136)
Volatility	0.00286	-0.00143	0.00469	-0.000224	0.00249	-0.00105	0.00376	-6.88e-05
	(0.0154)	(0.0139)	(0.0166)	(0.0143)	(0.0143)	(0.0129)	(0.0152)	(0.0132)
Capital Ratio	-0.00167	-0.000458	-0.00151	-0.000325	-0.00151	-0.000345	-0.00138	-0.000248
	(0.00223)	(0.00250)	(0.00235)	(0.00258)	(0.00224)	(0.00254)	(0.00235)	(0.00261)
Percent Female	-0.114**	-0.0874*	-0.107**	-0.0778				
	(0.0514)	(0.0475)	(0.0507)	(0.0479)				
MN2					-0.0218**	-0.0161*	-0.0225**	-0.0160*
					(0.00873)	(0.00876)	(0.00895)	(0.00876)
Average age of women	-0.00115				-0.00101			
	(0.000719)				(0.000679)			
Average age of women2		-0.00117				-0.00110		
		(0.000812)				(0.000787)		
Average service years for women			0.000304				9.45e-05	
			(0.000727)				(0.000711)	
Average service years for women2				0.000554				0.000394
				(0.000746)				(0.000719)
Observations	859	754	859	754	859	754	859	754
R-squared	0.638	0.632	0.633	0.628	0.644	0.635	0.640	0.631
Adjusted R-squared	0.598	0.586	0.593	0.581	0.605	0.589	0.600	0.585
Number of BHCs	55	55	55	55	55	55	55	55
Dummy Variable Adjustment Method	Yes	No	Yes	No	Yes	No	Yes	No

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table E: Tobin's Q—Reverse Causality Model of Gender Variables Across the Full Time Period (1994–2014) With Standard Errors Clustered by BHC

Table E shows the results from the reverse causality logit model of the gender variables as dependent variables with standard errors clustered by BHC. The sample consists of 55 BHCs over the time period 1994–2014. Models 1 and 2 of percent female are generalized linear models linked to logit. Models 3–6 of the magic numbers are logit models. All independent variables are lagged by one year, and dummy variables for each year are included for all six models. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. Turnover percent is used as an additional control variable in models 2 and 5, and is calculated by adding the number of new director names per year with the number of directors who no longer appear in that given year, and then taking this number as a percentage of total board size. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	**Model 1 Percent female**	**Model 2 Percent female**	**Model 3 MN1**	**Model 4 MN2**	**Model 5 MN2**	**Model 6 MN3**
Tobin's Q	0.153	0.621	0.135	0.173	1.482	–1.562
	(0.795)	(0.801)	(3.281)	(2.871)	(3.006)	(3.798)
Board size	–0.0262*	–0.0263*	0.0994*	0.112***	0.121**	0.154***
	(0.0137)	(0.0138)	(0.0509)	(0.0415)	(0.0475)	(0.0493)
Meetings	0.00102		0.0805	0.0358		0.0169
	(0.0113)		(0.0882)	(0.0474)		(0.0663)
Percent insider	–0.531		–1.032	–2.455		–2.768
	(0.545)		(2.816)	(2.085)		(2.413)
Duality	0.0856		–0.223	0.652*		0.00805
	(0.0993)		(0.532)	(0.351)		(0.400)
ROAA	0.0764		0.571**	0.251		0.430
	(0.0514)		(0.238)	(0.218)		(0.367)
Log(assets)	0.149***	0.149***	0.644**	0.553***	0.599***	0.468**
	(0.0491)	(0.0413)	(0.281)	(0.161)	(0.161)	(0.212)
Volatility	0.257		5.501***	–0.342		–0.916
	(0.287)		(1.736)	(1.191)		(1.442)
Capital ratio	–0.00899		0.0570	–0.128		–0.170
	(0.0299)		(0.140)	(0.109)		(0.181)
Turnover percent		0.154			–1.182*	
		(0.179)			(0.676)	
Constant	–5.041***	–5.476***	–13.39**	–12.87***	–15.22***	–8.206
	(1.401)	(1.215)	(5.592)	(4.235)	(4.651)	(5.740)
Observations	859	818	859	859	818	849
Pseudo R-squared			0.188	0.220	0.192	0.196

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table F: Year and BHC Fixed Effects Models of Tobin's Q Across the Full Time Period (1994–2014) After Dropping Log(assets)

Table F shows the results from fixed effects regressions of the relationship between Tobin's Q and various gender variables after log(assets) was dropped due to potential multicollinearity. All independent variables are lagged by one year. Gender variables include percent female measured as the number of women as a percentage of total board size and magic numbers 1–3 measured as dummy variables indicating whether there are at least one, two, or three women, respectively, on a board. Tobin's Q is calculated as (total assets + market capitalization – common equity)/total assets. ROAA equals net income as a percentage of the average total assets. Volatility is measured as the standard deviation of monthly stock return multiplied by the square root of 12. Capital ratio equals common equity/total assets. The sample consists of 55 BHCs over the time period 1994–2014. Standard errors, corrected for heteroscedasticity and clustered by BHC and year, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	Model 1 Tobin's Q	Model 2 Tobin's Q	Model 3 Tobin's Q	Model 4 Tobin's Q
Board size	-0.000413	-0.000524	0.000275	-0.000608
	(0.00119)	(0.00117)	(0.00128)	(0.00126)
Duality	0.00146	0.000755	0.00107	0.000525
	(0.00476)	(0.00493)	(0.00454)	(0.00492)
Meetings	-0.000195	-0.000296	7.46e-06	-0.000330
	(0.000710)	(0.000717)	(0.000680)	(0.000704)
Percent Insider	0.0330	0.0424	0.0285	0.0427
	(0.0411)	(0.0431)	(0.0401)	(0.0415)
ROAA	0.0244***	0.0241***	0.0243***	0.0240***
	(0.00833)	(0.00820)	(0.00818)	(0.00809)
Capital Ratio	-0.00191	-0.00210	-0.00188	-0.00201
	(0.00249)	(0.00243)	(0.00249)	(0.00243)
Volatility	0.00647	0.00707	0.00396	0.00789
	(0.0185)	(0.0187)	(0.0170)	(0.0183)
Percent Female	-0.0595			
	(0.0471)			
MN1		0.00101		
		(0.0108)		
MN2			-0.0191**	
			(0.00877)	
MN3				0.00381
				(0.00870)
Observations	859	859	859	859
R-squared	0.625	0.623	0.631	0.624
Adjusted R-squared	0.585	0.584	0.592	0.584
Number of BHCs	55	55	55	55

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table G: ROAA—Reverse Causality Model of Magic Number 3 Across the Full Sample Period (1994–2014)

Table G shows the results from the reverse causality logit model of magic number 3 as the dependent variable with dummy variables for each year. The sample consists of 55 BHCs over the time period 1994–2014. Model 1 of percent female is a generalized linear model linked to logit. Models 2–4 of the magic numbers are logit models. ROAA is calculated as net income as a percentage of the average total assets. Capital ratio equals common equity/total assets. Asset growth is the inflation-adjusted growth rate of assets using the CPI inflation rate, and overhead is the ratio of overhead costs to total assets. Noninterest income is non-trading and trading income divided by total operational income. Turnover percent is used as a control variable in model 2 and is calculated by adding the number of new director names per year with the number of directors who no longer appear in that given year, and then taking this number as a percentage of total board size. Standard errors, corrected for heteroscedasticity, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	Model 1 Percent female	Model 2 MN1	Model 3 MN2	Model 4 MN3
ROAA	0.0695**	0.303*	0.287**	0.439*
	(0.0312)	(0.156)	(0.135)	(0.227)
Board size	–0.0290***	0.0806***	0.112***	0.156***
	(0.00669)	(0.0277)	(0.0223)	(0.0323)
Duality	0.0899*	–0.226	0.740***	0.0448
	(0.0495)	(0.289)	(0.188)	(0.248)
Meetings	0.000563	0.107**	0.0227	0.0101
	(0.00533)	(0.0450)	(0.0247)	(0.0342)
Percent insider	–0.534**	–0.298	–2.658***	–2.694**
	(0.243)	(1.374)	(0.969)	(1.217)
Log(assets)	0.158***	0.717***	0.597***	0.474***
	(0.0170)	(0.155)	(0.0781)	(0.0826)
Capital ratio	–0.00638	0.0635	–0.128**	–0.150*
	(0.0128)	(0.0620)	(0.0497)	(0.0848)
Asset growth	0.0105	0.689	0.185	–0.181
	(0.0201)	(0.879)	(0.134)	(0.524)
Overhead expense	–2.098	22.58*	–10.61	–3.295
	(2.156)	(12.14)	(9.136)	(12.07)
Noninterest income	–0.000222	0.00135	–0.0109	5.65e-05
	(0.000176)	(0.00120)	(0.0119)	(0.00173)
Constant	–4.865***	–14.00***	–13.06***	–10.22***
	(0.392)	(2.734)	(1.764)	(1.819)
Observations	831	831	831	811
Pseudo R-squared		0.182	0.234	0.193

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.

Supplemental Table H: ROAA—Reverse Causality Model of Magic Number 3 Across the Full Sample Period (1994–2014) With Standard Errors Clustered by BHC

Table H shows the results from the reverse causality logit model of magic number 3 as the dependent variable with dummy variables for each year and standard errors clustered by BHC. The sample consists of 55 BHCs over the time period 1994–2014. Model 1 of percent female is a generalized linear model linked to logit. Models 2–4 of the magic numbers are logit models. ROAA is calculated as net income as a percentage of the average total assets. Capital ratio equals common equity/total assets. Asset growth is the inflation-adjusted growth rate of assets using the CPI Inflation Rate, and overhead is the ratio of overhead costs to total assets. Noninterest income is non-trading and trading income divided by total operational income. Standard errors, corrected for heteroscedasticity and clustered by BHC, are in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels.

Variables	**Model 1 Percent female**	**Model 2 MN1**	**Model 3 MN2**	**Model 4 MN3**
ROAA	0.0695	0.303	0.287	0.439
	(0.0602)	(0.232)	(0.212)	(0.434)
Board size	–0.0290**	0.0806	0.112**	0.156***
	(0.0142)	(0.0511)	(0.0437)	(0.0526)
Duality	0.0899	–0.226	0.740**	0.0448
	(0.101)	(0.558)	(0.358)	(0.409)
Meetings	0.000563	0.107	0.0227	0.0101
	(0.0108)	(0.0875)	(0.0478)	(0.0623)
Percent insider	–0.534	–0.298	–2.658	–2.694
	(0.557)	(2.964)	(2.113)	(2.445)
Log(assets)	0.158***	0.717**	0.597***	0.474**
	(0.0468)	(0.314)	(0.162)	(0.215)
Capital ratio	–0.00638	0.0635	–0.128	–0.150
	(0.0300)	(0.120)	(0.113)	(0.190)
Asset growth	0.0105	0.689	0.185	–0.181
	(0.0283)	(0.971)	(0.167)	(0.688)
Overhead expense	–2.098	22.58	–10.61	–3.295
	(5.109)	(22.05)	(19.02)	(22.62)
Noninterest income	–0.000222	0.00135	–0.0109	5.65e-05
	(0.000245)	(0.00124)	(0.0126)	(0.00227)
Constant	–4.865***	–14.00***	–13.06***	–10.22**
	(0.948)	(5.376)	(3.143)	(4.576)
Observations	831	831	831	811
Pseudo R-squared		0.182	0.234	0.193

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, and * p<0.1.