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WOMEN DIRECTORS ON PUBLIC COMPANY BOARDS: DOES A CRITICAL MASS AFFECT LEVERAGE?

Cindy K. Harris, Ursinus College

ABSTRACT

This study examines the relationship between corporate leverage (the ratio of total debt to total assets) and gender diversity on US public company boards, with particular focus on boards that have at least 25% women directors. Using this critical mass of women eliminates from consideration boards with lesser female representation, whose female directors may be marginalized in their contributions to board functioning and decision-making. I hypothesize that when boards have this minimum threshold of gender diversity, the influence of risk-averse female directors will impact board decisions related to financing, resulting in lower debt ratios when compared to boards with no female directors. Drawn from the listing of firms compiled annually by Catalyst, the sample is comprised of Fortune 500 firms with no women on their board and firms with at least 25% women directors on their board, respectively, for the two year period 2012 and 2013. Using a total sample of 78 firms, and controlling for determinants of capital structure and board governance variables, I find a significant negative relationship between boards with at least 25% women directors and corporate leverage. Further, the presence of at least 25% women on the board has a significant moderating effect on the association between both board size and board age, and corporate leverage, leading to an even stronger negative relationship. The evidence suggests that substantial board gender diversity is a corporate governance factor that can influence firm outcomes, and adds insight into the factors that can affect corporate financing choices of US public companies.

INTRODUCTION

The role of the board of directors is to protect shareholders' interests by insuring that management is accountable for their decisions and actions. Boards act to reduce or eliminate the principal-agent problem through a variety of mechanisms and processes collectively described as corporate governance – they add value through advising the executive officers and monitoring management's actions. Certainly, "the idea that experienced board members act as valuable monitors and advisors for CEOs and that firms seek directors who have particular backgrounds to maximize shareholder wealth" is a key component of corporate governance (Ahern & Dittmar, 2012).

Research on how boards function, make decisions and the effects of their monitoring role have long focused on board composition. As the number of women on corporate boards of directors has slowly grown, an emerging area of corporate governance research is examining how gender diversity of corporate boards influences board functioning and firm outcomes. Recent academic studies have chiefly focused on establishing the linkages between female representation on boards and aspects of corporate performance, including profitability, growth and shareholder value. The results have been inconsistent. Some have found no significant link between board diversity and firm performance, using two measures of profitability, Tobin's Q and return on assets (Adams & Ferreira, 2009) (Rose, 2007). Carter, D'Souza, Simkins, & Simpson (2010) observe a significant positive relationship between the number of women on all of the major board committees and return on assets ("ROA".)

In studies that examine the link between gender diversity of the board and firm performance, gender diversity is measured in a variety of ways. Researchers have used count data (number of female directors) (Carter, D'Souza, Simkins, & Simpson, 2010), at least one female on the board (Adams & Ferreira, 2009) as well as a continuous measure of the percentage of women on the board (Rose, 2007) to test the relationship between the presence of female directors and a variety of financial performance outcomes. However, the sample data used in these studies was comprised of relatively low representation of female directors on boards. In 1996, women held only 10.2% of Fortune 500 board seats while 10 years later in 2005 that figure grew to just 14.7% (Catalyst). Consequently, researchers have faced difficulty in isolating the impact of a single female director, or a very small group of female directors, on corporate performance (Bilimoria, 2006).

Internationally, there is increased movement toward boardroom gender quotas. Being the first, in 2003 Norway passed a quota mandating 40% female directors effective in 2008. Countries that followed include Spain, Iceland and France with a 40% quota, and Belgium, Italy, and the Netherlands with lower percentage quotas of 30-33% (Ahern & Dittmar, 2012). Malaysia has imposed a 30% quota for new appointments to boards

(<http://www.economist.com/blogs/economist-explains/2014/03/economist-explains-14>, 2014), while Germany is implementing a requirement of 30% of their non-executive board seats be held by women in 2016 (<http://www.independent.co.uk/news/world/europe/germany-to-introduce-legal-quota-for-women-in-boardrooms-8947277.html>, 2013). Further, the European Commission is considering imposing quotas. While no such groundbreaking policy exists in the United States, there is a national campaign by the organization *2020 Women on Boards* urging the goal to increase the percentage of women on U.S. company boards to 20% or greater by the year 2020. (<http://www.2020wob.com/>)

Further, although there are a growing number of research papers that examine gender diversity in relation to firm performance, there are few studies that examine the link between the presence of female board directors on corporate boards and the relative amount of debt financing, and these studies do not specifically focus on US firms. There is some research that considers the link between female directors and insolvency risk as well as the composition of debt. Wilson and Altanlar examine insolvency risk in their study of UK private companies using 2007-2008 data, and find that having a higher ratio of female directors is associated with lower insolvency risk (Wilson & Altanlar, 2009). In a study of firms across 33 countries (in which the US represented 22% of the sample) using 2006-2010 data, Alves examines the relationship between board of director composition and firm financing mix. Findings noted that when the board chair is not an executive, there is “some evidence that a more gender diverse board of directors is associated with more long term financing” (Alves, Couto, & Francisco, 2014).

In their study of mandated female representation on boards in Norway from 2001 to 2009, Ahern and Dittmar observed that the effect of the legislated 40% gender quota led firms to increase in size, undertake more acquisitions, increase leverage (defined as total liabilities divided by total assets), and decline in operating performance. Since “boards of directors are likely to be involved with acquisition decisions and major changes to financial policies, and because boards became younger and less experienced” after the quota took effect, they assert that the increased participation of female directors on boards weakened board monitoring and advising. In addition, Ahern and Dittmar suggest the observed financial effects may be the result of male directors changing their behavior in response to the presence of more female board members. (Ahern & Dittmar, 2012)

This research study addresses two research gaps in the literature. First, focusing on board gender diversity, it utilizes a critical threshold of female directors, expressed as 25% or more of the board, which may affect the dynamics of the board, thereby exerting a strong influence on corporate governance and in turn, firm outcomes. Rather than the mere presence of a female on the board, or a count of female directors, using this critical mass of women on the board “puts a higher standard of compositional diversity” on the board and avoids the likelihood of “gender-based token dynamics” (Bilimoria, 2006). Second, focusing only on US firms, the study considers the link between this critical percentage of female board directors (board diversity) and corporate leverage using Fortune 500 firms, providing new insight into a governance factor which may be an additional determinant of capital structure in the US.

This paper is organized as follows. In section 2, the literature related to the effect of board diversity on corporate governance and firm outcomes is discussed, including gender differences in behavior, decision making and risk taking. Literature addressing capital structure theory follows. In section 3 the main hypothesis is presented. The sample data and model are presented in section 4, and section 5 presents the empirical results, analysis and discussion. Section 6 and 7 outline the conclusions drawn from the study and its limitations, respectively.

LITERATURE REVIEW

Effect of Board Diversity on Corporate Governance and Firm Outcomes

Gender differences in behavior have been observed in aspects of corporate governance. In a study over the period 1996-2003, comparing S&P firms with at least one female director to those without, Adams & Ferreira observed that women appear to behave differently – they attend a higher percentage of committee and board meetings than their male counterparts, and the greater the fraction of women on the board, the better is attendance behavior of male directors (Adams & Ferreira, 2009). Not only may women impact the behavior of their male peers on the board, but also “female directors could more closely correspond to the concept of the independent director emphasized in theory” since “they do not belong to the ‘old boys club’” (Adams & Ferreira, 2009).

Are women the new 'independent' directors? When a director is independent, the director has no material relationship with the company, as a partner, shareholder or officer of an entity that has a relationship with the company (i.e. its subsidiary). The importance of independence is that it ensures the director has no business interests that could otherwise interfere with exercising objective judgment in their oversight role. In research prior to the minimum requirements for independence, the degree to which boards were comprised of independent directors was a corporate governance variable included in studies to gauge board effectiveness and oversight. However, since 2002, US publicly traded firms are required to have a majority of independent directors on its board. Given the slow but steady growth of women on corporate boards, it may be that the presence of female directors now plays a comparable role influencing the quality of board monitoring and decision-making that independent board directors previously played, when independence was not a mandate. In short, "gender diverse boards may be a better monitor of managers because women directors are more independent" than male directors (Simpson, Carter, & D'Souza, 2010). Since other researchers conclude that more independent boards tend to hold more debt (Alves, Couto, & Francisco, 2014), if female directors are viewed as the new proxy for independence, then one might expect firms with more women on their boards to have higher debt ratios.

However, prior literature suggests that women are more conservative and risk averse than men, and exhibit less risky behavior in financial decisions. Psychological research demonstrates that, in areas such as finance, men are more overconfident than women. They tend to overestimate the precision of their knowledge regarding the value of a financial security and "hold unrealistic beliefs about how high their returns will be and how precisely these can be estimated" (Barber & Odean, 2001). In Barber and Odean's study conducted for the period 1991-1997, they observe that men traded stock investments 45% more frequently than women, and realized lower net returns from excessive trading than women, especially among single men. In a similar vein, empirical evidence from a study by Huang using executive data (CEO and CFO) from 1993-2005 reveals that male executives exhibit relative overconfidence in significant corporate decision making compared with women. In particular male executives undertake more acquisitions and issue debt more often than female executives. (Huang & Kisgen, 2013)

Relevant corporate governance research further supports the effects of gender differences on firm outcomes related to debt. Research by Palvia et al (2013) find that female CEOs and board chairs in US banks assess risk more conservatively and hold higher levels of equity capital and reduce default risk during periods of market stress. They observe that "female executives and directors are less overconfident in their risk assessments and may inherently promote more conservative business strategies that reduce bank default risk" (Palvia, Vahamaa, & Vahamaa). Wilson (2009) finds that the ratio of female directors on boards is associated with a lower risk of insolvency in private companies, "providing support to the concept that women are more risk-aware or risk-averse and can add value to the management and decision-making capability of the company."

Capital Structure Theories

Capital structure, or leverage, refers to the degree to which firms finance through borrowing or debt rather than through the issuance of stock to support operating and investing activity and increase profitability. Two fundamental theories exist in the corporate finance literature, which explain the factors influencing leverage. These are the trade-off theory and the pecking order theory. These theories can predict different management behaviors in relation to financing choices, particularly in relation to the effect of board of directors' composition on those choices (Alves, Couto, & Francisco, 2014)

The trade-off theory suggests that firm's evaluate the costs and benefits of each source of financing, debt versus equity, in deciding how much of each to utilize. In short, firms seek an optimal balance of debt while considering the positive effects of the debt tax shield (savings from deductibility of interest payments to debt holders) as well as its costs in the form of bankruptcy risk or financial distress (Alkhatib, 2012). However, debt holders are not able to exercise control on the use of funds they provide, since managers may act in their own interests or in the interests of stockholders, thereby potentially increasing the riskiness of the firm's asset investments. Thus, effective corporate governance is essential to insure that management acts as an agent for company shareholders when selecting and maintain an appropriate balance of financing.

Unlike the trade-off theory, the pecking order theory does not predict firms seek a target leverage ratio. Instead, the theory relates to the preferred order in which firms seek funding sources. Firms favor internal funding (retained earnings) to external sources; within external sources, firms seek debt financing before equity financing, due to the

relatively cheaper cost of financing through debt. Further, within debt, firms prefer short-term debt over long-term debt (Myers, 1984). The order of preference stems from information asymmetries between managers and outside investors (Alves, Couto, & Francisco, 2014). Use of internal financing allows managers to pursue new investment opportunities without the repercussions of external financing.

Under the pecking order theory, short-term debt and long-term debt financing are ranked second and third, respectively, while financing through internal and external equity sources are ranked first and last, respectively. This paper is examining the effect of board gender diversity on corporate leverage, defined as the sum of short-term and long-term debt divided by total assets. Since ranking is not relevant to the analysis, the paper relies on the trade-off theory of capital structure. Given the research findings of the observed differences between decision-making and risk preference of women versus men, female directors may influence how firms assess the optimal balance of debt and equity financing. Models of capital structure that focus on firm characteristics alone miss this important factor for explaining differences in firm behavior. (Huang & Kisgen, 2013)

HYPOTHESES

This research study considers the impact of gender diversity on US corporate board functioning through substantial female director representation, and examines its effect on the corporate leverage (the sum of short-term and long-term debt divided by total assets). In particular, I expect boards with a critical mass of female directors - at least 25% - to be associated with a lower amount of leverage than corporate boards with no female directors. Given females' differences in behavior as well as predilection to assume less risk, corporate boards with greater gender diversity will seek to avoid the potential bankruptcy costs and financial distress associated with debt financing and pursue alternative sources of funding. As such, relying on the trade-off theory of capital structure, companies with gender diverse boards are expected to have a lower optimal balance of debt financing relative to total assets. In addition, it is expected that the presence of this critical mass of women on the board will interact with other corporate governance variables, impacting their influence on corporate leverage. Specifically, the presence of at least 25% female directors on the board is expected to moderate the association between both average board age and average board size and corporate leverage, resulting in a lower debt ratio.

Hypothesis 1: The presence of a gender diverse corporate board of directors, measured as at least 25% female directors on the board, is negatively associated with the corporate leverage (the debt-to-asset ratio.)

Hypothesis 2: The presence of a gender diverse corporate board of directors, measured as at least 25% female directors on the board, decreases the association between both board age and board size on corporate leverage (the debt-to-asset ratio.)

SAMPLE DATA AND MODEL

Sample Data

This study builds on a sample of firms drawn from two census lists compiled annually by Catalyst: Fortune 500 companies with zero women directors and Fortune 500 companies with 25% or more women directors. (<http://www.catalyst.org/knowledge/2012-catalyst-census-fortune-500-women-board-directors>) (<http://www.catalyst.org/knowledge/2013-catalyst-census-fortune-500-women-board-directors>). The sample is comprised of firms that are on each Catalyst list in both 2012 and 2013 and for which financial and corporate governance data is available for both years. Industry SIC codes, financial statement data, and financial ratios were obtained from the Mergent Online database ("Mergent"). Corporate governance data was found in the firm's annual proxy filings and annual reports.

Financial firms (with SIC codes 6000-6999) are excluded from the sample because they are subject to specific capital requirement regulations that can potentially influence their financing choices (Alves, Couto, & Francisco, 2014). The initial sample of non-financial firms results in 110 companies. Other exclusions include firms whose corporate structure changed in 2013 (mergers, spinoffs), firms not subject to standard corporate reporting requirements (REIT, limited partnerships), firms with abnormal debt ratios (near or exceeding 100% and with negative stockholders' equity), and firms for which information was unavailable. **Table 1** summarizes the construction of the final sample of 78 Fortune 500 firms, which includes 23 companies with zero women directors

(“all- male” boards) in both years (2012 and 2013), and 55 companies with at least 25% women directors (“diverse” boards) in both years.

	Firms with ≥25% Women Directors “Diverse Boards”	Firms with Zero Women Directors “All Male Boards”	Total Sample
Firms listed on Catalyst Census in 2012 and 2013	68	42	110
Financial firms	9	4	13
Corporate change (spinoff, merger)	3	4	7
Non-corporate structure (partnership, REIT)	1	5	6
No Proxy filing	0	2	2
Long-term debt ratios near or exceeding 100%	0	2	2
Other	0	2	2
Sample total	55	23	78

Table 2 summarizes the industry breakdown by each subgroup and for the total sample. In both subgroups as well as the total sample, the majority of firms are in the manufacturing sector. While firms with diverse boards are least represented in mining and construction, their second largest concentration is in wholesale and retail trade. Firms with all-male boards also have their second largest concentrations are in wholesale and retail trade as well as transportation, communication and utilities, but in contrast, are least represented in the services category.

SIC code (Industry)	Firms with ≥25% Women Directors “Diverse Boards”		Firms with Zero Women Directors “All Male Boards”		Total Sample	
	count	%	Count	%	Count	%
1000-1999 (Mining, Construction)	2	4%	3	13%	5	6%
2000-3999 (Manufacturing)	28	51%	10	44%	38	49%
4000-4999 (Transportation, Communication, Utilities)	6	11%	4	17%	10	13%
5000-5999 (Wholesale, Retail Trade)	12	22%	4	17%	16	21%
7000-8999 (Services)	7	13%	2	9%	9	11%
Total	55	100%	23	100%	78	100%

Table 3 reports the average number of female directors in firms with diverse boards by industry sector for the two-year period 2012 and 2013. In both years, every industry has at least 3 women on their board and the highest average representation of women is in the manufacturing and transportation sector.

SIC code (Industry)	2012	2013
1000-1999 (Mining, Construction)	3.00	3.00
2000-3999 (Manufacturing)	3.57	3.57
4000-4999 (Transportation, Communication, Utilities)	3.83	3.50
5000-5999 (Wholesale, Retail Trade)	3.25	3.33
7000-8999 (Services)	3.43	3.43

Model and Dependent Variable

The regression model used in this paper is as follows:

$$DebtAsset13 = B_0 + B_1FemaleDir12 + B_2Board\ characteristics\ (BDS_{Size12}, BD_{Age12}, CDual12) +$$

B_3 Determinants of Debt Financing (Risk (LogRev12), Growth (TAGrowth), Profitability (ROA12), Asset Tangibility (PPEtoTA12), Non-debt Tax Shield (TaxShield12) + B_4 Industry + FemaleDir12*BDSIZE + FemaleDir12*BDAGE12

The debt to asset ratio (*DebtAsset13*) is measured as the book value of total debt divided by total assets as reported by Mergent for the fiscal year end 2013. Total debt is the sum of reported short-term and long-term debt, but does not include current liabilities, so as to account for only interest-bearing debt. The independent variables are measured for the fiscal year 2012. The one-year lag is used to reflect that the characteristics of the board and its composition influence decisions that may have an impact in a subsequent period. Likewise, financing decisions are made based on earlier measures of a firm's financial position.

Independent variable: Critical Mass of Female Directors

This paper hypothesizes that the gender diversity of a company's board of directors affects the board's selection of corporate financing as measured by the debt-to-asset ratio. Board diversity is measured using a dummy variable to capture a critical threshold of female directors (i.e. at least 25% female directors) in order to measure the effect of substantial female representation on the board.

In firms where there is only one woman on the board, she may be perceived as a token, having no substantive impact on financial outcomes (Terjesen, Sealy, & Singh, 2009). Findings from prior studies examining the impact of board gender diversity on board governance and firm financial outcomes were limited by the lower levels of female board representation, which led to mixed findings of the impact of female directors on the board. To improve investigating the impact of board gender diversity, Simpson, Carter, and D'Souza (2010) assert that "a threshold or critical mass of women on the board or a dummy variable may be preferable." Bilimoria used a dummy variable for women corporate officers, to examine the relationship between women corporate directors and women corporate officers noting that a "critical mass of women in the senior management team (25% or more) serves as a measure of whether women are considered real, not token, contributors to the operations of the top executive team" (Bilimoria, 2006) Further, Post, Rahman, and Rubow (2011) find that "three women on the board (versus a percentage) seems to be a critical threshold and at that level there are positive associations with corporate social responsibility" (Post, Rahman, & Rubow, 2011).

FemaleDir12 is a dummy variable where '1' signifies that female directors comprise at least 25% of the board of directors and '0' signifies a board with zero female directors. As noted in prior research, utilizing a dummy variable that captures a critical threshold of female board directors may provide a clearer measure of the impact of board gender diversity on firm financial outcomes. Using this binary measure of female board presence suggests that the female directors are not likely to be mere window dressing of the board; rather, using the critical level of at least 25% females on the board increases the likelihood that female directors can make true contributions to board functioning and influence the board decision making process.

The presence of a critical mass of female directors may enhance their influence on the board's decision making process related to financing. Given females' demonstrated differences in behavior as well as their risk-averse or risk-avoidance preference, corporate boards with substantial gender diversity will avoid the risks of debt financing and pursue alternative sources of funding, relying more heavily on internal sources of funds (retained earnings) or equity financing (issuance of stock). Consequently, a negative association is expected between *FemaleDir12* and corporate leverage.

Control Variables: Board Characteristics

The board characteristic variables used in this study are traditional measures found in the corporate governance literature. These characteristics can affect the quality of oversight and the nature of decision-making by board directors, impacting firm outcomes.

A. Board Size

Board size is a variable associated with the number of links the board has to its environment (Johnson, Schnatterly, & Hill, 2013). It has been argued that board size can affect the efficiency of board functioning in one of two ways. One view is that larger firms have larger boards in order to meet the needs of more complex business transactions

and decision making and consequently, board oversight is positively associated with its size (Alves, Couto, & Francisco, 2014). The alternate argument is larger boards may experience “poorer communication and increased decision making time associated with larger groups” resulting in a less effective monitoring role (Morales, Ballesta, & Meca). Underlying this latter assertion is the notion that directors who are more dissimilar could disagree, creating more board conflict and too much board monitoring, negatively impacting firm financial outcomes. One study noted that among “companies with a market capitalization of at least \$10 billion, typically those with the smallest boards generated better shareholder returns” (Lublin, 2014).

BDSIZE12 represents the total number of directors on the board at the fiscal year end 2012. Given the competing arguments on the impact of board size on corporate governance, no prediction is made as to the relationship between board size and corporate leverage.

B. Average Board Age

BDAGE12 is the average age of the board directors at the fiscal year end 2012, calculated by dividing the sum of all director ages by the number of directors on the board. This personal characteristic of a board member is a proxy for experience, reflecting the director’s ability to effectively monitor and advise (Ahern & Dittmar, 2012). Further, age may also be correlated with risk aversion (Johnson, Schnatterly, & Hill, 2013). As observed by Ahern and Dittmar (2012), in Norway, younger boards that resulted from the addition of younger, less experienced female directors was associated with increased leverage. Given this observation, a negative association between average board age and corporate leverage is predicted.

C. CEO Duality

An important indicator of CEO power over a board is CEO duality (Baliga & Moyer, 1996), a term used to describe a combined leadership structure where the same individual holds both the position of board chair and CEO. CEO duality is typically included in studies examining the effects of corporate governance on firm outcomes, but its impact has been mixed. Advocates of CEO duality cite the value added as a result of a single, unified leadership position and note that adequate independent oversight of management can be achieved through other appropriate board mechanisms, measures and activities. Opponents of CEO duality argue it leads to CEO entrenchment, which “occurs when managers gain so much power that they are able to use the firm to further their own interests rather than the interests of shareholders” (Hermalin & Weisbach, 2003). With less board control over management, CEO duality can restrict the monitoring role of the board as directors may become more acquiescent.

CDUAL12 represents whether the CEO of the corporation is also the board chair for the fiscal year end 2012. *CDUAL12* is a dummy variable where ‘1’ signifies that CEO duality exists and ‘0’ signifies split leadership. With regard to capital structure, some studies find that firms are more leveraged when managers are more entrenched while others have found that firms with entrenched CEOs use less leverage and short term debt (Alves, Couto, & Francisco, 2014). Since prior research results are mixed regarding CEO duality impact on firm performance measures as well as levels of corporate debt, no prediction is made as to the relationship between CEO duality and corporate leverage.

Control Variables: Determinants of debt

Consistent with prior research on financing choices and cost of debt financing, the following control variables are included in the analysis as determinants of a firm’s capital structure and its financing choices.

A. Risk

Firm size has been identified by capital structure literature as one of the determinants of financing mix (Frank & Goral, 2009). Given its size and tendency to be more diversified, a larger firm is less likely to default on its debt or be prone to bankruptcy, and thus has lower risk. Consequently, since a larger firm is more likely to rely more on debt financing than a smaller firm, a positive relationship is expected between firm size and leverage.

Firm size is measured using the log of total revenues for fiscal year end 2012 (*LogREV12*). Measuring firm size with the one year lag acknowledges “the spurious relation between size and the debt ratio that arises because of the relation between size and past profitability (profitable firms become larger) and the short-term relation between profitability and leverage (profitable firms increase their net worth).” (Titman & Wessels, 1988).

B. Growth

Growth is measured by the percentage increase in total assets (*TAGrowth*) for the period from fiscal year end 2012 to fiscal year end 2013. Annual percentage growth in the firms' total assets is an indicator of a firm's financial strength and may increase its financing demands. Results are mixed in terms of the relationship between growth and leverage, with some studies revealing a positive outcome and others a negative association (Alkhatib, 2012). Consequently, no prediction is made regarding the association between growth and the debt ratio.

C. Profitability

Profitability is measured using Return on Assets for fiscal year end 2012 (*ROA12*) as reported by Mergent. Specifically, the ratio reflects the annual net income divided by average total assets for the period. Measuring profitability in the earlier year (2012) acknowledges the likelihood that profitability has more than just a short-term immediate effect on the observed leverage ratio (Titman & Wessels, 1988). While firms with higher profits generate higher retained earnings, reducing their need for debt financing, higher profits can also provide those firms with greater access to lower cost debt financing, motivating those firms to seek greater leverage. Consequently, no prediction is made regarding the association between profitability and the debt ratio.

D. Tangibility of assets

The ratio of total property, plant and equipment (net) to total assets at the fiscal year end 2012 (*PPEtoTA12*) is used to measure the tangibility of firm assets. Such assets are long-term, substantial investments by the firm, which generally require significant amounts of financing. Firms with a larger investment in property, plant and equipment have greater collateral, increasing their ability to issue debt secured by property. Findings by Alves and Ferreira (2011) suggest a strong, positive relationship is expected between asset tangibility and firm leverage.

E. Non-debt Tax Shield

TaxShield12 represents the ratio of depreciation expense to total property, plant and equipment (net) for the fiscal year end 2012, and is used to measure the non-debt tax shield. Tax deductions for depreciation are substitutes for the tax benefits of debt financing (i.e. interest expense deduction), and as such, "firms with large non-debt tax shields relative to their expected cash flow include less debt in their capital structure." (Titman & Wessels, 1988) Firms which have the tax savings benefit of larger tax deductions for depreciation have less motivation to borrow. Therefore, *TaxShield12* is expected to be negatively associated with the debt-to-asset ratio.

F. Industry

Industry is the company's classification according to the Standard Industrial Classification (SIC), obtained from Mergent. The five industries referenced in this study are mining (mining and construction), manufacturing, communication (transportation, communication, and utilities), retail trade (wholesale and retail trade) and services. Each industry is represented by a dummy variable for that industry and the services industry is withheld from the model for comparison purposes. It is expected that industry will have a positive relationship with corporate leverage, since relative to the services industry the other sectors will have different levels of asset investment and will seek a different optimal balance of debt financing.

EMPIRICAL RESULTS, ANALYSIS AND DISCUSSION

Descriptive Statistics

Means of the dependent variable and independent variables discussed above are presented for each subgroup in **Tables 4A, 4B** and for the total sample in **Table 4C**.

In this sample, the average debt to asset ratio in 2013 reveals that firms with at least 25% female directors carry an average debt ratio that is more than 3% lower than firms with no female directors. The debt ratio of firms with diverse boards and all male boards is 25.01% and 28.24%, respectively. For both diverse and all-male boards, the minimum debt ratio is zero. The maximum ratio for diverse boards is 61.91% in contrast to a maximum ratio of 81.99% for all male boards. While the average dollar amount of total debt in 2013 for firms with diverse boards is more than twice that for the all-male boards, in both years the average total assets for diverse boards is more than three times the average total assets of all-male boards. The percentage of female directors in diverse boards ranges from 25% to 46.7%, with an average of 31.18% in 2012.

The difference in the financial measures of asset growth and sales are important to note. The average annual growth rate of total assets for firms with diverse boards is 4.01% as compared to *TAGrowth* of 12.22% for all-male boards. Likewise, the average 2012 revenue for firms with diverse boards is more than three times the level for all-male boards.

Other financial measures are quite similar between the two subgroups in this sample. The average *ROA12* is 5.17% for firms with diverse boards and 5.45% for all-male boards. The average *PPEtoTA12* is nearly the same, with 27.70% for firms with diverse boards and 28.17% for all-male boards. Similarly, the average *TaxShield12* is nearly the same, with 3.09% for firms with diverse boards versus 3.18% for all-male boards.

With regard to corporate governance variables, the average *BDAge12* for all-male boards is 62.66 years, approximately one year older than the average age of 61.52 years for diverse boards. Within diverse boards, however, male directors on average are nearly three years older than female directors; female directors' average age is 59.58 versus male directors' average age of 62.48. Nearly half of all-male boards have CEO duality (11 out of 23 firms) whereas 65% of diverse boards have this leadership structure (36 out of 55). Further, the average board size of diverse boards is 11.18 members, while the all-male boards have an average of 9.30 directors.

TABLE 4A: ALL MALE BOARDS: DESCRIPTIVE STATISTICS				
Variable	Mean	Std Dev	Minimum	Maximum
DebtAsset13%	28.24	21.18	-	81.99
FemaleDir12%	n/a	n/a	n/a	n/a
BdSize12	9.30	1.64	6.00	12.00
MAge12	62.66	5.54	49.40	71.10
CDual12%	48.00	51.08	n/a	n/a
Rev12 ('000)	\$9,086,483	\$4,582,280	\$4,850,500	\$20,090,724
TAGrowth%	12.22	21.03	(12.52)	79.10
ROA12%	5.45	6.01	(5.94)	19.26
PPEtoTA12%	28.17	22.31	3.63	85.37
TaxShield12%	3.18	2.73	0.55	11.60

TABLE 4B: DIVERSE BOARDS: DESCRIPTIVE STATISTICS				
Variable	Mean	Std Dev	Minimum	Maximum
DebtAsset13%	25.01	13.77	-	61.91
FemaleDir12%	31.18	6.13	25.00	46.67
BdSize12	11.18	1.81	7.00	17.00
BDAge12	61.52	2.91	51.60	66.90
CDual12%	65.45	47.99	n/a	n/a
Rev12 ('000)	\$30,314,024	\$35,399,093	\$83,680	\$152,256,000
TAGrowth%	4.01	13.36	(36.12)	48.76
ROA12%	5.17	6.83	(21.11)	21.08
PPEtoTA12%	27.70	21.84	2.64	82.56
TaxShield12%	3.09	1.86	0.42	11.30

TABLE 4C: TOTAL SAMPLE: DESCRIPTIVE STATISTICS				
Variable	Mean	Std Dev	Minimum	Maximum
DebtAsset13%	25.96	16.23	-	81.99
NumFDir12	2.45	1.74	-	7.00
BdSize12	10.63	1.95	6.00	17.00
BDAge12	61.85	3.87	49.40	71.10
CDual12%	60.26	49.25	0%	100%
Rev12 ('000)	\$24,054,621	\$31,300,192	\$83,680	\$152,256,000
TAGrowth%	6.43	16.30	(36.12)	79.10
ROA12%	5.25	6.56	(21.11)	21.08
PPEtoTA12%	27.84	21.83	2.64	85.37
TaxShield12%	3.12	2.13	0.42	11.60

Additional sample statistics are provided in Table 5 and Table 7. **Table 5** provides the sample means for the independent and dependent variables by industry sector. **Table 7** provides the Pearson correlation matrix for the variables, revealing no significant correlations among the variables included in this study. See Table 7 in the appendix.

TABLE 5: SAMPLE MEANS BY INDUSTRY					
	Mining	Manufacturing	Communication	Retail Trade	Service
DebtAsset13 (%)	22.52%	24.94%	40.60%	24.65%	18.30%
FemaleDir12 (% of firms within industry)	40.00%	73.68%	60.00%	75.00%	77.78%
BDSIZE12 (count)	9.80	11.00	10.60	10.13	10.44
BDAGE12 (years)	66.13	61.66	60.84	62.05	61.09
CDUAL12 (%)	60.00%	68.42%	50.00%	43.75%	66.67%
REV12 (in thousands)	\$10,356,003	\$23,996,792	\$18,205,589	\$35,711,284	\$17,685,094
TAGROWTH (%)	16.54%	7.93%	4.02%	2.00%	5.06%
ROA12 (%)	3.73%	6.91%	1.26%	4.61%	4.67%
PPEtoTA12 (%)	58.34%	20.11%	51.24%	28.37%	16.62%
TAXSHIELD12 (%)	4.31%	2.67%	3.82%	2.99%	2.95%

Regression Results, Analysis and Discussion

The empirical results are summarized in **Table 6**, providing the coefficients and p-values for the independent variables for the basic regression (with no interaction terms) and the regression with interaction terms (FemaleDir12*BDSIZE12 and FemaleDir12*BDAGE). These empirical findings are corrected for heteroscedasticity. See Table 6 in the Appendix.

The result in the basic regression for the variable FemaleDir12 is consistent with the prediction, and supports Hypothesis 1. The variable FemaleDir12 reveals a negative and statistically significant coefficient (-6.01, p-value .08), meaning that boards with at least 25% women directors are associated with a debt to asset ratio that is 6% lower than boards with no women directors. The corporate governance variables, board size (*BDSIZE12*) and board age (*BDAGE12*) are highly statistically significant. Board size is positively associated with corporate leverage, although the coefficient (2.1, p-value .03) reflects a relatively small impact. The results estimate that an increase in the board size by one director is associated with an increase in the debt ratio of 2.1%. In short, larger boards are associated with slightly higher leverage. Similarly, the coefficient on board age is small, but statistically significant (-.64, p-value .05). This inverse relationship with corporate leverage suggests that an increase in average board age

by one year is associated with a decrease of less than 1% in the debt to asset ratio. In short, older boards are associated with marginally lower leverage. The corporate governance variable CEO duality (*CDual12*) does not have a statistically significant association with corporate leverage.

TABLE 6: EMPIRICAL RESULTS¹

	Basic Regression		Regression with Interaction Terms ²	
	coefficient	p-value	coefficient	p-value
FemaleDir12	-6.01	.0808*	-98.17	.0224**
BDSIZE12	2.10	.0327**	3.17	.0681*
BDAGE12	-.64	.0508**	-1.35	.0123***
CDual12	1.97	.5553	2.06	.5340
Log(Rev12)	-1.73	.0748*	-1.71	.0514**
TAGrowth	.19	.0082***	.20	.0084*
ROA12	-.75	.0004*	-.68	.0006***
PPEtoTA12	.13	.0816*	.15	.0638*
TaxShield12	1.91	.0048***	2.03	.0011***
Mining	-4.60	.2856	-3.27	.3506
Manufacturing	6.83	.0537**	6.90	.0549**
Communication	10.77	.0606*	7.85	.1277
RetailTrade	7.91	.0797*	7.48	.1000*
FemaleDir12*BDSIZE12			-2.04	.1542
FemaleDir12*BDAGE12			1.82	.0035
Adjusted R²	.2954		.3304	
Significance level	1%***, 5%***, 10%*			

While all of the financial control variables are statistically significant, the value of the coefficients suggests a relatively immaterial impact on corporate leverage. In addition, the signs on the coefficients for both *Log(Rev12)* and *TaxShield12* are the opposite of the predicted sign. While firm size as measured by *Log(Rev12)* was expected to be positively associated with the debt ratio, the results reflect a negative coefficient (-1.73, p-value .07). Thus, while larger firms that generally bear less risk of default are expected to have a higher debt ratio, these results reflect a negative association with the debt ratio. However, the small coefficient indicates a relatively immaterial impact on the relationship. While *TaxShield12* was expected to be negatively associated with the debt ratio, the results reflect a positive coefficient (1.91, p-value .005). Similarly, the small coefficient indicates a relatively immaterial impact on the debt ratio. Given the lower interest rates in 2012, it may be that firms with higher depreciation expense relative to total property, plant and equipment still pursued debt financing. The depreciation deduction is not a substitute for the interest expense deduction, when debt financing can be obtained at a low cost.

There is an observed statistically significant relationship between three industry sectors and the debt ratio. Relative to the service industry, manufacturing, communication and retail trade all reflect a positive relationship with corporate leverage. These results clearly indicate there are industry norms for financing that can influence a particular firm's leverage.

The regression with interaction terms expands the analysis to consider whether the presence of 25% or more female directors moderates the association between board size and board age, respectively, and corporate leverage. As with the basic regression, the result for the regression with interaction terms for the variable *FemaleDir12* is consistent with the prediction, and supports Hypothesis 1. The coefficient (-98.17, p-value .02) indicates that the presence of 25% or more women directors on the board is associated with a lower debt-to-asset ratio. Further, in this regression, the coefficients on the control variables for board age and board size and the financial determinants of debt reported

¹ Both regressions reflect correction for heteroscedasticity.

² Interaction terms were tested for joint significance with *FemaleDir12*; when tested together, both terms are statistically significant (F value=.064), but when tested one at a time with *FemaleDir12*, neither term is significant.

the same signs as in the basic regression. With the exception of communication, the same industries maintained their statistical significance.

The coefficients on the interaction terms reflect opposite outcomes from each other. The negative coefficient on the interaction term *FemaleDir12*BDSIZE12* is not statistically significant (-2.04, p-value .15). Nonetheless, the direction of the coefficient suggests when boards are larger and there is greater gender diversity on the board, it may be associated with a lower debt ratio. In contrast, the positive coefficient on the interaction term *FemaleDir12*BDAge12* is statistically significant (1.82, p-value .003). This result reflects that given average board age, when there is greater gender diversity on the board, it is associated with a higher debt ratio.

Statistical tests were run to test the joint significance of each interaction term individually with the variable *FemaleDir12*, using sample mean values for each variable. In both instances, the results proved not to be statistically significant. However, when both interaction terms are included and tested for their joint significance with the variable *FemaleDir12*, using sample mean values for each variable, the results are statistically significant (F-value .06). Thus, given average board size of 10.63 directors and average board age of 61.85 years, the presence of at least 25% female directors on the board is associated with a debt ratio that is 7.29% lower than the debt ratio for all male boards. Thus, Hypothesis 2 is supported. The presence of this critical mass of female directors has a moderating effect on both board size and board age (at their respective means) and further reduces the debt ratio from the reported 6% in the basic regression.

These results indicate the opposite interaction effect of *FemaleDir12* with board size and board age, respectively. When a board is larger and comprised of at least 25% female directors, it is associated with lower corporate leverage. The substantial cohort of female directors appears to be influencing board decision making to select lower levels of debt relative to total assets. This result is consistent with the argument that female directors are bringing their risk-averse attitude to board discussions, influencing boards to seek a lower level of optimal debt financing. On the other hand, when a board is on average older in age and comprised of at least 25% female directors, it is associated with higher corporate leverage. In this circumstance, the substantial cohort of female directors appears to be impacting board decision making to select greater levels of debt relative to total assets. This outcome is consistent with the argument that female directors, who may have less experience than male directors, are influencing boards to seek higher debt financing. In this sample, female directors are on average 3 years younger than male directors. However, when the two interaction terms are considered together with *FemaleDir12*, the effect of risk-averse female directors more than offsets the effect of less experienced, younger female directors, resulting in an increased negative association between board gender diversity and corporate leverage.

SUMMARY AND CONCLUSION

“Boards around the world are under increasing pressure to choose female directors” (Adams & Ferreira, 2009). The rationale for inclusion of women on boards is that it can lead to positive outcomes in terms of corporate governance, which impacts firm performance as well as value to shareholders. Competent women are not substitutes for traditional corporate directors with identical abilities and talents; rather they have unique characteristics that create additional value (Carter, D’Souza, Simkins, & Simpson, 2010)

The results of this study reveal that when boards have a minimum threshold of gender diversity, defined as 25% or more female directors, the influence of risk-averse female directors will impact board decisions related to financing, resulting in lower debt ratios when compared to boards with no female directors. Using this critical mass of women eliminates from consideration boards with lesser female representation, whose female directors may be marginalized in their contributions to board functioning and decision-making. Further, the presence of at least 25% women on the board has a significant moderating effect on the association between both board size and board age, respectively, and corporate leverage. Overall, the presence of this critical mass of female directors interacts with these two board characteristics, resulting in an increased negative association, as indicated by the estimated lower debt ratio. The evidence suggests that substantial board gender diversity is a corporate governance factor that can influence firm outcomes, and adds insight into the factors that can affect corporate financing choices of US public companies.

Although their numbers have steadily grown, women are an underrepresented group on boards of directors in the U.S. despite their decades of participation in the workforce. If women are given a greater voice and ability to contribute at the board level, companies can potentially realize the benefits of their leadership. In short, “gender

diversity on boards may lead to freer expression of ideas, especially when women have power” thereby enhancing financial policy decision making (Triana, Miller, & Trzebiatowski, 2013).

LIMITATIONS AND FUTURE RESEARCH

This study highlights the empirical association between a critical mass of female directors on US public company boards and corporate leverage. However, it does not suggest a causal relationship. The endogenous nature of corporate boards limits the interpretation of the results of this research study. Endogeneity concerns arise because of omitted unobservable firm characteristics (Adams & Ferreira, 2009). It is difficult to determine if firms with lower leverage are generally larger, and simply attract more female directors (who self-select) to their larger boards or whether female board members contribute to board monitoring functions and decision making, which leads to lower levels of debt financing relative to total assets. Clearly, firm attributes are likely to affect both the incentives of women to join their boards and the incentives of firms to include female directors on their boards.

“Board composition is not exogenously determined but rather is affected by prior decisions and firm characteristics that in turn affect board decisions. Thus, any observed relationship between board composition and firm outcomes may in fact be caused by the factors that determined the board composition in the first place” (Johnson, Schnatterly, & Hill, 2013).

Nonetheless this research reflects the strong negative association that exists between corporate leverage in Fortune 500 companies and a critical mass of female directors on the board. One way in which this study can be enhanced is to expand the analysis to include firms whose board of directors has at least one female director or a percentage of female directors below the minimum threshold of 25% used in this paper. With the growing participation of women on corporate boards, a continuous measure or a step-function of the percentage of female board directors may now yield more relevant results that were not observed in earlier studies due to the relatively low number of female board directors. Another way to expand this research is to consider a longer lag period, as a one year lag may not be sufficient to infer a consistent connection between the critical mass of female directors on corporate boards and a firm’s debt ratio. Last, given the significant association of industry with the debt ratio observed in this study, narrowing the focus to a larger sample drawn from a single, specific industry may also yield informative results about the impact of board gender diversity on corporate leverage.

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APPENDIX

TABLE 7: PEARSON CORRELATION COEFFICIENTS (n=78)

Prob > |r| under H0: Rho=0

	Debt Asset 13	Femal eDir 12	BD Size 12	Cdu al 12	BD Age 12	Log Rev 12	TA Growt h	ROA1 2	PPE toTA 12	Tax Shiel d 12	Min- ing	Manu- - factur- -ing	Com muni- cation
Female Dir12	-0.091 0.428												
BDSIZE 12	0.094 0.412	0.442 <.0001											
Cdual 12	-0.067 0.558	0.164 0.151	0.074 0.519										
BDAGE 12	-0.242 0.033	-0.136 0.237	- 0.017 0.884	0.145 0.205									
LogRev 12	-0.135 0.238	0.296 0.009	0.250 0.027	0.124 0.281	0.108 0.348								
TA Growth	0.151 0.188	-0.231 0.042	0.096 0.402	- 0.127 0.268	0.068 0.557	- 0.114 0.322							
ROA 12	-0.306 0.006	-0.020 0.861	0.172 0.132	0.050 0.661	0.164 0.152	0.040 0.730	0.219 0.054						
PPEto TA12	0.289 0.010	-0.010 0.932	- 0.151 0.187	- 0.077 0.503	0.074 0.522	- 0.051 0.660	-0.020 0.865	-0.145 0.205					
Tax Shield 12	0.378 0.001	-0.020 0.859	- 0.086 0.453	- 0.044 0.702	- 0.124 0.281	0.026 0.823	0.001 0.990	-0.148 0.196	0.515 <.0001				
Mining	-0.056 0.627	-0.175 0.125	- 0.112 0.329	- 0.001 0.991	0.291 0.010	- 0.086 0.452	0.163 0.153	-0.061 0.596	0.368 0.001	0.148 0.197			
Manu- Facturi ng	-0.062 0.588	0.068 0.555	0.187 0.101	0.163 0.155	- 0.050 0.664	- 0.037 0.750	0.090 0.433	0.248 0.029	-0.347 0.002	- 0.204 0.073	- 0.255 0.024		
Comm un- ication	0.348 0.002	-0.088 0.442	- 0.006 0.961	- 0.080 0.484	- 0.101 0.380	- 0.130 0.258	-0.057 0.620	-0.235 0.039	0.414 0.000	0.261 0.021	- 0.100 0.382	-0.374 0.001	
Retail Trade	-0.041 0.719	0.050 0.664	- 0.132 0.249	- 0.171 0.134	0.026 0.824	0.229 0.044	-0.139 0.225	-0.050 0.664	0.012 0.915	- 0.030 0.793	- 0.133 0.246	-0.495 <.0001	-0.195 0.087