Female directors, CEO overconfidence and excess cash

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Abstract

Is the moderating effect of female board representation on the CEO overconfidence sufficiently strong to alter the firms' excess cash decisions? We address this question using data on 1,163 US-listed firms for 2000-2017. Prior research posits that overly confident CEOs hold less cash compared to their rational counterparts. We show that having more female directors on the board not only stops the decline in excess cash due to the overconfident CEO but also increases excess cash holdings in those firms. Better female board representation enhances corporate decision making through effective monitoring and thus, taming the CEO's biased behavior i.e., overconfidence.

JEL Classification: G30, G32, G38

Keywords: Female directors; excess cash; CEO overconfidence; effective monitoring; board diversity.

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1. Introduction

Motivated by the growing pressure from regulators and societies, firms around the world are increasing their female board representation.[1] To assess whether gender-diverse boards are influential, the majority of studies focus on firm performance, value, and risk-taking (e.g., Carter et al. (2003); Farrell and Hersch (2005); Adams and Funk (2012); Liu and Mauer (2011). Further, there is a rapidly growing body of literature which investigates whether female board representation influences firms' corporate outcomes and through which governance channels this is achieved (e.g., Adams and Ferreira (2009); Miller and Triana (2009); Ahern and Dittmar (2012); Matsa and Miller (2013). The key message from these studies is that female board representation impacts several firm policies (i.e., merger and acquisitions, investment, and innvation), mainly through effective monitoring.

Our main objective in this study is to examine whether female board representation affects the firm's excess cash holdings by mitigating the influence of overconfident managers. We provide a broader picture by studying the indirect effect of female board representation on the firm's corporate policies and focusing the attention on the behavior of overconfident CEOs in the presence of female directors. More specifically, we examine how female directors on the board can influence a firm's cash holding policy (i.e. excess cash) by moderating the CEO's overconfidence.

Determining the level of a firm's cash holding is one of the crucial decisions for the managers. The literature on cash holdings has extensively identified the determinants of the cash level in firms (Opler et al., 1999; Bates et al., 2009) proposing several hypotheses to justify the findings.[2] More recently, few studies shift their attention to examine the effect of cash in excess of the level, i.e. excess cash, on the firm's value. The emphasize on excess cash is due to firms' recent and continuous accumulation of cash reserves (Bates et al., 2009; Bates et al., 2018) and the fact that excess cash is

[1] As part of corporate governance reforms around the world to increase the number of female board representations, different types of measures are introduced from mandatory regulations (e.g., Belgium – 2006, France - 2011, Norway - 2011, and Italy – 2015) to general recommendations (UK - 2011). For more details see e.g., Isidro and Sobral (2015) and Terjesen et al. (2015).

[2] Some of these hypotheses are: (i) the transaction motive (Meltzer, 1963); (ii) the precautionary motive (Bates et al., 2009); (iii) the agency motive (Jensen, 1986; Dittmar et al., 2003); (iv) the financial constraints motive (Almeida et al., 2004); (v) the tax motive (Foley et al., 2007); (vi) the diversification motive (Duchin, 2010); and (vii) the product market competitiveness motive (Fresard, 2010).

the most easily accessible form of cash for the use of managers and major shareholders (Schauten et al., 2013). Moreover, excess cash also has the potential to capture information about a firm's future raw and abnormal stock returns, risk, investment, and profitability (Simutin, 2010).

Studies on the relation between excess cash holding and firm value provide relatively mixed evidence. The theory of excess cash flow argues that excess cash decreases firm value because managers use it to pursue their own objectives at the shareholders' expense (Jensen, 1986). Simutin (2010) finds that firms with excess cash invest considerably more in the future but do not experience strong future profitability compared to their low-cash peers. Hence, Simutin (2010) argues that excess cash holdings proxy for risky growth opportunity. Several other studies discuss that excess cash can be regarded as a cushion for any shortfall in future cash flows (Bates et al., 2009) or it can be used to reduce the reliance on costly external financing while funding future investments (Almeida et al., 2004; Acharya et al., 2007). Furthermore, Asem and Alam (2014) show that investors' outlook for the firm's prospect determines the relation between excess cash and firm's value. Huang and Mazouz (2018) suggest that excess cash holding indirectly affects firm value through its impact on stock liquidity. They find that excess cash increases trading activity and reduces the liquidity premium required by investors.

Despite the extensive literature on cash and excess cash holding levels, most of the suggested determinants remain at the firm level characteristics. A recently growing literature attempts to investigate the effect of several managerial traits and behavioral biases on the level (Huang-Meier et al., 2016; Deshmukh et al., 2018) and value (Aktas et al., 2019) of cash holdings. One of the most prominent behavioral biases is the CEO overconfidence.

Overconfidence is defined as a form of cognitive bias known as a self-attribution bias (Doukas and Petmezas, 2007). Therefore, overconfident CEOs tend to overestimate their firm's future cash flow[3] leading them to view their firms as being undervalued by the market (Malmendier et al., 2011). Hence, these overconfident CEOs perceive external financing to be overly costly and rely more

[3] Overconfidence leads to underestimation of risks or overestimation of gains. In this study, we focus on the latter definition in line with previous work in behavioural finance. For more details, see Heaton (2002), Hackbarth (2008), and Ben-David et al. (2013).

on internal funding to finance their investment.[4] Relative to rational CEOs, overconfident CEOs are found to hold more valuable cash (Aktas et al., 2019) and overinvest when abundant internal funds are available (Heaton, 2002; Malmendier and Tate, 2005). They also engage in value-destroying merger and acquisitions (Malmendier and Tate, 2008; Benson and Ziedonis, 2010)), invest more in innovation (Hirshleifer et al., 2012), and earn substantially lower abnormal returns post share repurchase announcements (Andreou et al., 2018). More importantly, overconfident CEOs are found to hold 24% less cash, save less cash out of current cash flow, and hold less cash to fund the firm's growth opportunities relative to their rational counterparts (Deshmukh et al., 2018). Deshmukh et al. (2018) argue, building on a trade-off model, that overconfident CEOs perceive external financing to be unduly costly and expect this cost to decrease in the future as investors learn the true value of the (undervalued) firm. Therefore, these CEOs delay financing investments with external money and rely more on internal funds, leading to lower cash levels., Contrary to these findings, Huang-Meier et al. (2016) report significant differences in cash holding levels between overconfident and non-overconfident CEOs. They find that overconfident managers hold more cash for future growth opportunities and their precautionary demand for cash is less than that of non-overconfident CEOs. Furthermore, conditioning managerial overconfidence on gender, Zeng and Wang (2015) find that female CEOs of Chinese-listed firms are associated with higher levels of cash holdings compared to male CEOs. This indicates that female CEOs are more conservative (more concerned with the precautionary motive and less about the opportunity cost of cash) than male CEOs.

The literature on corporate governance indicates that one of the main roles of corporate boards is to monitor and help managers to make better strategic decisions (Helland and Sykuta, 2004; Coles et al., 2008; Graham et al., 2011). Schwartz-Ziv and Weisbach (2013) find evidence that board members are mainly characterized as active monitors on top management. In particular, a strong and independent board of directors helps overconfident CEOs in making better acquisition decisions (Kolasinski and Li, 2013) and reduces investment and risk exposure (Banerjee et al., 2015). More recently, an emerging strand of literature focuses on the effects of female directors on males at the

[4] For further details, see Malmendier and Tate (2005), Malmendier et al. (2011), and Aktas et al. (2019).

executive and directorship levels.[5] For example, building on the monitoring effect hypothesis where the increase of female directors is viewed as a better governance mechanism, Adams and Ferreira (2009) argue that gender-diverse boards provide better monitoring on firm's decisions. They find that firms with more female directors are more likely to hold CEOs accountable for poor stock price performance. Chen et al. (2019) show that increased female board representation plays a governance role through a moderating effect on the CEOs' overconfidence where this change in board structure is sufficiently strong to affect the firm's investment and M&A decisions. Banerjee et al. (2018) also suggest that appointing an independent female director helps to bring overconfident CEOs' capital expenditure decisions closer to their non-overconfident counterparts. Main et al. (2018) argue that increased gender equality on the board results in positive changes in male directors' behaviors. They find that men directors, who work alongside women directors on the board within their directorship network, engage in fewer risk-taking decisions, exhibit greater personal responsibility, and deliver improved CEO accountability.

Gender diversity acts as a corporate governance tool, so that more gender-diverse boards increase the monitoring on CEOs because female directors are found to be more effective monitors than male directors leading to higher monitoring on CEOs (Adams and Ferreira, 2009). In addition, the presence of female directors leads male CEOs to adjust their biased behavior, i.e., overconfidence, to what is an appropriate one, i.e., rational behavior.[6] Therefore, we argue that female board representation reduces the CEO's overconfidence about investment strategies and the firm's cash flow, which results in fewer aggressive growth projects and more reliance on external financing. Subsequently, the firm's excess cash level increases. We hypothesize a positive association between the female board representation and excess cash holdings conditional on the CEO's overconfidence.[7]

[5] The theory of planned behaviour (Ajzen, 1991) and the notion of social influence (Latané, 1981; Cialdini and Goldstein, 2004) argue that an individual's behavior is conditioned by the subjective norms and social context in which they find themselves. This theory helps explaining whether the behavior of male CEOs, i.e. overconfidence, could be affected by the presence and the behavior of female board directors.

[6] In addition to the previously cited literature, see Levi et al. (2014) for a good discussion on the reasons why females are less overconfident than males.

[7] One of the main criticisms regarding the potential influence by female directors on firm policies is that the female directors are the minority on the board and it is unlikely they can have a considerable impact on a firm's decisions (Kanter, 1977; Farrell and Hersch, 2005; Adams and Ferreira, 2009).

To test our hypothesis, we use a sample of 1,163 non-financial US-listed firms over the period from 2000 to 2017. We conduct panel OLS regressions along with various other models and analyses, i.e. instrumental variable (IV) model, difference-in-difference model, OLS regressions using propensity score matching and dynamic GMM regressions. Controlling for firm and year fixed effects, as well as, other firm, CEO, and board characteristics, our analyses provide strong evidence for the female monitoring hypothesis. First, as expected, we find that CEO overconfidence reduces the firm's excess cash holding. However, when we interact CEO overconfidence with female board representation, our results show a significantly positive association between the interaction term and excess cash holdings. This finding indicates that the presence of female directors on the board alleviates the CEO's overconfidence and leads to an increase in excess cash levels. The results are robust to alternative econometric specifications, measures of female board representation, and CEO overconfidence. In further analyses, we attempt to identify the channels through which this increase occurs. We find that female directors in the presence of overconfident CEOs tend to increase the firm's operating profit while decreasing the capital and R&D expenditures. In addition, we test whether the increase in excess cash holdings due to female directors is associated with higher benefits to shareholders. Using a modified version of Faulkender and Wang's (2006) model, we find that an increase in female representation significantly increases the value of a dollar of cash both economically and statistically, conditional on having an overconfident CEO. Finally, we investigate whether the presence of female directors reduces the CEOs' biased believes regarding the firms' excess cash holdings when cash flow increases. First, we find that more female directors on the board increase the firm's savings of excess cash holdings out of an extra dollar of cash flow, conditional on the firm being managed by the overconfident CEO. Second, we show that female board representation continues to play a role in taming the CEO's overconfidence by altering the CEO's behavior and it increases excess cash holdings even when the firm is in a sub-optimal financial position.

This paper contributes to the literature on female board representation, CEO overconfidence,

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However, we examine a possible indirect effect of female board representation on firm's excess cash through the influence on the overconfident CEO who has the power to determine firm policies.

and cash holding. While several studies test the direct relation between female directors on the board and corporate outcomes (Adams and Ferreira, 2009; Gul et al., 2011), we further complement these studies by introducing an additional phenomenon, i.e. CEO overconfidence, and investigate the indirect role of female board representation on the firm's top management and how this could change the corporate decisions. More precisely, our results indicate that the presence of female directors acts as an effective monitoring tool in reducing the CEO overconfidence through which it changes the decisions on the firms' excess cash holding. Moreover, our paper contributes to the CEO overconfidence literature by building on the findings of Chen et al. (2019) and Banerjee et al. (2018) in that overconfidence behavior can be tamed and monitored by providing a simple corrective governance mechanism, i.e., better female board representation. Both Chen et al. (2019) and Banerjee et al. (2018) find that the presence of female directors is associated with significant improvements in acquisition deals and firm performance, as well as, a reduction in aggressive investments and firm-specific risk, conditional on having an overconfident CEO. Further extending their studies, we show that the increase in female board representation is also associated with a significant increase in the relation between overconfident CEOs and the firms' excess cash holding. Finally, our study provides a new channel explaining the firm's excess cash holdings, namely "monitoring effect by female board representation". While Deshmukh et al. (2018) provide evidence that firms with the overconfident CEO hold less cash compared to their rational counterparts, they did not take into consideration how the cash holding decisions of these overconfident CEOs would have changed given the presence of female directors on board. In addition, a recent study by Atif et al. (2019) shows that female directors play a role in affecting the firm's corporate cash holdings levels. They report a negative relationship between female directors and cash holding levels. Our focus overlaps with their paper, yet our paper differs from theirs based on the following criteria: First, while they assume managers to be rational, we relax this assumption and test how female directors affect cash holdings in the presence of biased managerial behavior, i.e., overconfidence. Second, they define cash holdings as the ratio of cash and marketable securities to net assets, while we use excess cash holdings levels given the role of excess cash as the most easily accessible form of cash for the use of managers and major shareholders. Third, we identify the main channels through which the increase in excess cash holdings occurs. Finally, we

use a different sample and time period compared to theirs. Therefore, we further complement the above two papers by showing that female directors play a significant role in monitoring and reducing the biased behavior of overconfident CEOs which subsequently alter their decisions so that they hold more excess cash.

The remainder of this study is organized as follows. Section 2 describes our sample, how we measure our variables and shows the empirical model used for hypothesis testing. Section 3 provides descriptive statistics and discusses the main results. Section 4 addresses endogeneity concerns. Section 5 reports the results of our robustness tests and further analyses. Section 6 concludes.

2. Data Selection and Empirical Design

2.1. Data Sample

The data sample of firms comes from Compustat and is based on all available data for US-listed firms on AMEX, NYSE, and NASDAQ. To avoid any survivorship bias in the data we include both active and inactive publicly traded firms. Financial firms and the utilities are excluded because these firms operate in different regulatory supervisions. Further, we restrict our sample to firms with headquarters in the US. We require total assets to have a greater value than capital expenditures, and both to have positive values. We drop data where total liabilities are greater than total assets, and where the sum of long-term and short-term debt is greater than total assets. We use CRSP, IRRC/RiskMetrics, and ExecuComp databases for data on stock returns, director characteristics, managerial overconfidence and CEO characteristics, respectively. To construct the CEO overconfidence measure we use CEO option compensation variables; hence, we limit our sample to firms with available CEO option data and remove any firms without reported options data, following Malmendier and Tate (2005) and Campbell et al. (2011). All variables are winsorized at the 1% and 99% percentiles to reduce the effects of outliers. Our final data sample consists of 8,017 observations across 1,163 firms between 2000 and 2017.[8]

[8] IRRC/RiskMetrics data is available from 1996. However, our sample period starts from 2000 because of high number of missing observations for few variables in our model between 1996 and 2000.

2.2. Test Variables

We measure female board representation in several ways. We use the equally weighted fraction of total (outsider) female directors on the board, *FemaleRatio (FIndepRatio)*, which is calculated as the number of total (outsider) female directors dividend by the total number of (outsider) directors on the board (Gul et al., 2011; Levi et al., 2014). Also, we use the tenure weighted fraction of female directors, *TWFemaleRatio*, which is the weighted fraction of female directors with the weights being the tenure of each female director relative to the total board tenure (Schwartz-Ziv and Weisbach, 2013; Chen et al., 2019).

Our second key variable is the CEO overconfidence. A commonly used measure for the CEO's level of confidence is the option-based measure (e.g., Malmendier and Tate (2005); Campbell et al. (2011); Hirshleifer et al. (2012). We measure the level of CEO's confidence by using the value of his unexercised but exercisable options known as CEO option moneyness, *OptionMoneyness*. To construct this variable we follow the method by Campbell et al. (2011). First, we calculate the realizable value per option as the ratio of the total realizable value of exercisable options to the number of exercisable options. Second, we subtract the realizable value per option from the fiscal-year-end stock price to obtain an estimate of the average exercise price of options. Finally, to compute the average percentage moneyness of the options, we divide the realizable value per option by the estimated average exercise price. We use this continuous time-variant variable as a measure of CEO confidence because previous literature argue that overconfidence varies with past experience and performance (Hilary and Menzly, 2006; Billett and Qian, 2008) and we also try to capture the interaction effect of the variation between CEO overconfidence and female board representation over time.

One way to measure the effect of female directors on excess cash holdings, by mitigating the CEO's biased behavior (overconfidence), is to interact the CEO confidence measure, i.e. the option-based measure (*OptionMoneyness*), with the female board representation measure and regress the firm's excess cash variable on this interaction term. However, the main disadvantage of this approach is that the CEO option-based measure is likely to be affected by the CEOs' career path that is essential in outlining the CEO's management style (Chen et al., 2019). To overcome this problem, we follow

Chen et al. (2019) and construct an industry-based measure of the CEO overconfidence, *Overconfidence*, to capture the cross-industry differences in overconfidence. This is a binary variable that takes the value of one if the average CEO option moneyness for the industry in that year (using the 2-digit SIC code) is greater than the median average *OptionMoneyness* across all industries.

The choice of this variable is motivated by previous studies who find that individual's behavior could vary considerably across industries due to differences in industry-wide work practices and growth prospects (Form, 1979). Furthermore, field studies also find evidence that overconfidence behavior has a higher propensity to develop in industries where the decision-making process is non-repetitive and unclear which leads to difficulties in forming decisions based on previous actions (Simon and Houghton, 2003). Therefore, the dispersion of overconfidence among CEOs varies considerably across industries (Ferris et al., 2013; Chen et al., 2019).

2.3. Dependent Variable

Our goal in this paper is to examine whether female directors on the board affects the overconfident CEO in making the decision to hold cash. Thus, we follow Bates et al. (2009) and estimate, for each year, the excess cash holding for firm *i* as the residual of the following cross-sectional regression:

$$Cash_i = \alpha + \beta_1 CF_i + \beta_2 Leverage_i + \beta_3 MTB_i + \beta_4 Size_i + \beta_5 NWC_i + \beta_6 CAPEX_i + \beta_7 DIV_i + \beta_8 R\&D_i + \beta_9 IndustrySigma_i + \beta_{10} Aquisition_i + \beta_{11} Age_i + \varepsilon_i \quad (1)$$

Where *Cash* is the cash and short-term cash scaled by total assets; *CF* is earnings after interest, dividends, and taxes, but before depreciation scaled by total assets; *Leverage* is the ratio of total debt to net assets; *MTB* is the market value of assets scaled by total assets; *Size* is the natural log of total assets; *NWC* is net working capital (net of cash), scaled by total assets; *CAPEX* is capital expenditures scaled by total assets; *DIV* is a dummy variable with a value of one if the firm pays dividends, and zero otherwise; *R&D* is the research and development expenditures scaled by total assets; *IndustrySigma* is industry cash flow risk, defined as the mean of the ratio of the standard deviations of cash flows to the total assets over 20 years for firms in the same industry (by 2-digit SIC code);

Acquisition is the value of acquisitions; and *Age* is the natural logarithm of firm age. The residual ε_i is used as a proxy for firm *i*'s excess cash (*ExCash*) in a given year.

2.4. Control Variables

Following the cash and corporate governance literature, we use several control variables. *LnSales* is the natural logarithm of net sales; *Debt-to-Equity* is long-term debt plus debt in current liabilities scaled by the market value of equity; *ROA* is the return of assets calculated as earnings before interests and tax scaled by total assets; *ReturnVol* is the standard deviation of monthly equally weighted stock returns; *R&DDummy* is a dummy that is equal to one if a firm invests in R&D that year, and zero otherwise; *Dividend* is dividends scaled by the market value of equity; *IndepRatio* is the number of outsider directors on the board scaled by the board size; *Busy*[9] is the number of directors on the board who also sit on the board of other firms scaled by the board size; *Inactive* is the number of directors on the board who attend ;less than 75% of the board meetings in that year scaled by the board size; *LnBoardSize* is the natural logarithm of total number of directors on the board; *CEOTenure* is the number of years the CEO has been in position; *CEOOwnership* is the fraction of total shares outstanding owned by the CEO; *Duality* is a dummy that is equal to one if the CEO is also the chairman of the board.

2.5. Empirical Methodology

The period for the main analysis is 2000–2017. To test the main hypothesis (i.e. whether female representation on the board increases the excess cash by controlling the CEO overconfidence), we use the following panel fixed-effects (FE) OLS regression model:

[9] We follow a more conservative definition for board busyness where we use the percentage of busyness that incorporates every director serving on another board. However, we obtain virtually similar results if we use the definition by Fich and Shivdasani (2006) who define a busy board if 50% of the directors on the board serve on three or more other boards.

$$ExCash_{i,t} = \alpha + \beta_1 Female\ Representation_{i,t-1} + \beta_2\ Overconfidence_{i,t-1} + \beta_3 Female\ Representation_{i,t-1} \times Overconfidence_{i,t-1} + \Theta X_{i,t-1} + \eta_i + \phi_t + \varepsilon_{i,t-1} \quad (2)$$

where $ExCash_{i,t}$ is excess cash holding of firm *i* in year *t*. $Female\ Representation_{i,t-1}$ denotes three different "female ratio" variables for firm *i* in year *t–1*: *FemaleRatio*, *FIndepRatio*, and *TWFemaleRatio*; $Overconfidence_{i,t-1}$ is the dummy for high overconfidence intensity in that industry where the firm operates. $X_{i,t-1}$ is a vector of control variables (i.e., *LnSales, Debt-to-Equity*, *ROA*, *ReturnVol*, *R&DDummy*, *Dividend*, *IndepRatio*, *Busy*, *Inactive*, *LnBoardSize*, *CEOTenure*, *CEOOwnership*, and *Duality*); η_i represents firm fixed effects while ϕ_t denotes year fixed effects to account for any time trends in cash holdings (Bates et al., 2018); All explanatory variables and controls are lagged by one year. Standard errors are clustered at the firm level.

The fixed-effects approach is used in this model because we compare firms regarding the relation between female directors and firm's excess cash, and FE controls for the omitted variables that differ between firms but are constant over time. After conducting the Hausman test, we decide to use the fixed-effects approach for the analyses.

3. Main Results

3.1. Descriptive Statistics

The summary statistics in Table 1 indicate that, on average, firms in our sample have 11.4% of their boards comprised of female directors and the average tenure weighted female ratio is 9.2%. On average, 13.6% of all outsider directors on the board are female directors. The average female ratio in our sample (11.4%) is slightly higher than those of Chen et al. (2019) and Banerjee et al. (2018) who report averages of 10.4% and 10.3% for their female directors ratios, respectively. The ratio of CEO overconfidence (*Overconfidence*) indicates that 37% of our sample belongs to industries where CEOs are likely to suffer from overconfidence about their firm's prospects. The mean value of our dependent variable (*ExCash*) shows that an average firm holds a positive excess cash of 0.035% which is in line with previous literature such as Huang and Mazouz (2018). As per firm

characteristics, on average, firms have 9.8% of return on assets (ROA), 4.9% of return volatility, 1.3% of dividends, and 53.4% of firms invest in R&D. In addition, there are two mean values which should be highlighted namely Sales (in $millions) and debt-to-equity ratio. The average firm in our sample has annual sales of $6,177 million and a debt-to-equity ratio of 34.9%. These mean values are relatively large (greater than the 75th percentile). One possible explanation for this right-skewed distribution is that our sample contains several larger firms. As to the CEO and board characteristics, we find that the CEO, on average, holds 2.2% of the firm's outstanding shares and worked in that position for 8.5 years. The average board size is approximately 9 board members, 72% of them are outsider directors. Finally, around half of the board members (48.5%) are busy directors who sit on the boards of other firms and just over 1% of the board members (1.2%) are inactive members who are found to attend less than 75% of the board meetings.

<Insert Table 1>

Figure 1 provides a visual summary of the cross-sectional yearly distribution of our excess cash and female board representation measures over the sample period. The solid line represents the mean values of *ExCash*. Figure 1 shows that excess cash levels are affected by major financial crisis where firms use their excess cash as a buffer against any liquidity shortfalls. There is a dramatic decline in the level of excess cash held by US firms from 2000 to 2002 which represents the technology bubble period with a drop from around 20% to 2.2%. Another decline is during the financial crisis of 2007 where it reached the lowest level of -8.7%. Later, it smoothly fluctuates until the year 2016 with a level of 7.9%. As per the female board representation measures, we can observe a steady increase in the ratios of female directors on boards (dotted lines) over the whole sample period with an increase from around 8.2%, 10.7%, and 6.1% in year 2000 to 18%, 20.6%, and 14% in year 2017 for *FemaleRatio*, *FIndepRatio*, and *TWFemaleRatio*, respectively. One noticeable exception is the dramatic increase of our three main ratios between 2003 and 2004. This jump is due to the Sarbanes-Oxley (SOX) Act in 2003 which mandates the enhancement of governance levels, among which is the increase in the female board representation.

<Insert Figure 1>

Figure 2 provides another perspective to our main variables of interest namely *ExCash* and

female board representation measures[10]. In particular, it shows the yearly distribution of mean excess cash levels for two groups of firms with high (solid line) and low (dotted line) female board representation. An overall view provides preliminary evidence that firms with high presence of female directors hold, on average, higher levels of excess cash holdings compared to their counterpart firms with low presence of female directors, across the entire time period of our sample. Hence, Figure 2 implies that there might be a positive association between excess cash levels and greater female board representation in firms with the overly confident CEO.

<Insert Figure 2>

3.2. Main Regression Analysis

Table 2 presents the main analysis for the relation between female board representation and firm's excess cash, conditional on high CEO overconfidence.[11] In Column I, *Overconfidence* has statistically significant and negative estimates that support our expectations and the findings in the literature (e.g., Deshmukh et al. (2018). Firms with the overconfident CEO have lower excess cash holdings (about 1.71% less). *FemaleRatio* does not have any statistical significant estimates. A possible explanation is that the potential effect of female board representation cannot be observed when the rational CEO is present. As the rational CEO can take optimal decisions for the firm sufficiently, the possible contribution by female directors is only marginal. Since *FemaleRatio* presents all firms with either overconfident or rational CEOs, the result is mixed and unclear. *FemaleRatio* × *Overconfidence* is the main variable of interest and denotes the female board representation in the firms with the overconfident CEO. Its positive and statistically significant estimate indicates that firms with higher female board representation have higher excess cash holdings when the CEO is overconfident. In particular, excess cash level increases by 0.49% (= 0.049 × 0.102) with a one-standard-deviation increase (about 10%) in *FemaleRatio* for the firms with the overconfident CEO. This is an interesting

[10] In this figure we use *FemaleRatio* as a female board representation measure. In unreported figures, we observe similar patterns when using *FIndepRatio* and *TWFemaleRatio*.

[11] In Table B.1 in Appendix B, Column I provides evidence that CEO overconfidence has a negative impact on excess cash levels which is consistent with prior literature (e.g., Deshmukh et al. (2018). Furthermore, Columns II, III, and IV show that female board representation on its own does not have a strong impact on excess cash levels. These findings confirm our hypothesis that the effect of female directors on excess cash is only effective (significant) when the firm deviates from its optimal cash level due to the overly confident CEO.

finding because it suggests that having more female directors on the board not only stops the decline in excess cash due the overly confident CEO but also increases excess cash holdings in those firms. Consider the interpretation of the magnitude with an average firm in our sample that has nine board members, and one of them is a female director (see Table 1). Switching one of the male directors to a second female director would be associated with a 0.54% increase in excess cash (= 0.049 × (1/9)) when the firm has the overconfident CEO. Overall, the findings show the effect of female board representation on the increase in excess cash levels when the overconfident CEO is present.

<Insert Table 2>

Column II of Table 2 provides results with *FIndepRatio*. Statistically significant and negative estimate for *Overconfidence* indicates that the overconfident CEO decreases excess cash holdings in firms by 1.76%. Similar to the previous result, the variable for female board representation, i.e. *FIndepRatio,* cannot provide any statistically significant outcome. Focusing on the main explanatory variable, i.e. *FIndepRatio* × *Overconfidence*, we show that excess cash level in firms increases as the fraction of independent female directors on the board increases when the firm's CEO is overconfident. Specifically, a 12.8% increase in *FIndepRatio* is associated with a 0.56% (= 0.044 × 0.128) increase in the excess cash level when the overconfident CEO is present. In other words, adding a second female outsider director on the board of seven directors by replacing one male outsider director (see Table 1) leads to a jump of 0.63% (= 0.044 × (1/7)) in excess cash when the firm is managed by the overconfident CEO. These findings imply how female outsider directors can increase excess cash holdings for firms with overconfident managers.

The results for *TWFemaleRatio* are given in Column III, Table 2. As before, *Overconfidence* has statistically a significant and negative estimate that suggests firms with the overconfident CEO have less excess cash. While *TWFemaleRatio* does not provide any significant interpretation, the result for *TWFemaleRatio* × *Overconfidence* indicates that excess cash holdings increase by 0.47% (= 0.043 × 0.110) for firms with the overconfident CEO when *TWFemaleRatio* increases by one-standard-deviation (about 11%). Particularly, the raise in excess cash is about 0.39% (= 0.043 × (1/11)) for firms with the overly confident CEO when the board with 11 directors replaces one tenured male director with a second tenured female director (see Table 1). Overall, these findings

suggest that female directors on the board tame the overconfident CEO and help the CEO to take decisions leading to higher excess cash holdings in the firm.

Previous research documents the potential effect of industry on the firm's cash holdings policies. For example, Fresard (2010) shows that the degree of competition in industry significantly affects the firm's cash holdings. Therefore, to control for time-varying industry characteristics, we include the 10-K Text-based Network Industry Concentration (TNIC) in our model, following Hoberg and Phillips (2016). Additionally, we control for industry fixed effects instead of firm fixed effects. In these untabulated analyses, we obtain qualitatively similar results to our main findings.

4. Endogeneity Analyses

Even though the results are in line with our hypothesis that female board representation mitigates CEOs' overconfidence and lead them to increase the firms' excess cash holding levels, it could be still argued that these results are biased as they are driven by the endogenous nature of board structure (Wintoki et al., 2012). First, one could argue that our results are driven by a reverse causality where overconfident CEOs have an influential role on the board member appointments; hence, they prefer the all-male board to avoid extra monitoring imposed by female directors (Adams and Ferreira, 2009). On the contrary, risk-averse female directors could self-select to serve on the board of firms led by rational CEOs with less aggressive strategies (Farrell and Hersch, 2005; Hirshleifer et al., 2012). Second, our results could be driven by unobserved heterogeneity. Some unobserved firm and CEO factors could be driving both the selection of female directors and the CEOs confidence level (Niessen-Ruenzi and Ruenzi, 2018; Chen et al., 2019). To mitigate these endogeneity concerns, we use four approaches namely: (i) instrumental variable using 2-stage least square approach (2SLS); (ii) difference-in-difference model; (iii) propensity score matching; and (iv) dynamic GMM estimation method.

4.1. Instrumental Variable Method

To be able to make a causal inference and address the issue that excess cash holdings and female board representation may be simultaneously determined, we follow Adams and Ferreira (2009), Levi

et al. (2014), and Chen et al. (2017) and use a similar instrumental variable approach. Specifically, we employ two different instrumental variables namely: (i) the female-to-male participation ratio; and (ii) the fraction of male directors linked to female directors. Our first instrumental variable, *FMRatio,* is calculated as the female participation ratio divided by the male participation ratio in the state where the firm has the headquarter. Female (male) participation ratio is measured as the percentage of the civilian non-institutional population of female (male) group in the civilian labor force. Firms in states where the female-to-male participation ratio is higher are more likely to find qualified female candidates for the board of directors due to access to larger talent pool. Hence, firms with headquarters in states where the female-to-male participation ratio is high, are expected to have greater representation of women on the board. The data used to construct this variable is downloaded from US Census Bureau website. Our second instrumental variable, *LinkedMRatio*, is the fraction of a firm's male directors who sit on other boards with at least one female director. The intuition behind using this instrument is that the more connected male directors are to women, the more female directors should be observed (Adams and Ferreira, 2009). Therefore, the greater this fraction is, the greater the female board representation should be. Moreover, it is unlikely that *FMRatio* and *LinkedMRatio* affect excess cash holdings of firms, i.e. *ExCash*, directly. Hence, we believe that the exclusion restriction for these instruments is likely to be satisfied.

Given the main explanatory variable is the interaction between female board representation and *Overconfidence* in our analysis, we address the concerns raised in Atanasov and Black (2017) regarding the IV regression.[12] We estimate the following panel regressions for each instrumental variable separately. In the first stage, we regress the variable for female board representation namely *FemaleRatio, FIndepRatio* or *TWFemaleRatio* on the instrument, i.e. *FMRatio (LinkedMRatio)*, along with *Overconfidence*, *FMRatio* × *Overconfidence* (*LinkedMRatio* × *Overconfidence),* and the control variables used in our main analysis. In this first stage, we also instrument the interaction between female board representation and *Overconfidence* through *FMRatio* × *Overconfidence* (*LinkedMRatio* × *Overconfidence)*. Hence, we also regress this interaction term on the same set of variables described above with the only difference that the instrument is *FMRatio* × *Overconfidence* (*LinkedMRatio* ×

[12] See Atanasov and Black (2017) for a detailed description of these concerns.

Overconfidence), instead. In the second stage, we regress the excess cash level, i.e. *ExCash*, on the instrumented variable for female board representation, the instrumented interaction between female board representation and *Overconfidence,* along with *Overconfidence* and control variables. Similar to our previous analyses, all left hand-side variables are lagged by one year, and we include year and firm fixed effects in all regressions in both stages.

Table 3 reports the results using *FMRatio* as the instrumental variable. Columns I-VI present the first-stage results. In Columns I, III and V, the instrument, i.e. *FMRatio*, provides statistically significant and positive results. These findings indicate that firms operating in states with high female-to-male participation ratio have more female directors on the board. Shifting the focus to Columns II, IV and VI, we find statistically significant and positive coefficient estimates for the instrument, i.e. *FMRatio* × *Overconfidence*. These results suggest that the positive relation between female board representation and *FMRatio* holds considering the overconfident CEO. These first-stage results are consistent with the findings in literature.

Columns VII to IX summarize the second-stage results. In all specifications, the coefficient estimates for interaction terms remain consistently positive and statistically significant. For the average firm, a one-standard-deviation (about 4.8%) increase in the fraction of female directors on the board is associated with a 1.03% (= 0.215 × 0.048) jump in excess cash holdings when the CEO is overly confident. Moreover, the increase in *ExCash* is 0.92% (= 0.171 × 0.054) and 0.96% (= 0.195 × 0.049) respectively, considering the instrumented interaction terms with *FIndepRatio* and *TWFemaleRatio* in Columns VIII and IX.

<Insert Table 3>

The results using the fraction of male directors linked to female directors, *LinkedMRatio,* as an instrumental variable are reported in Table 4. Similar to Table 3, columns I-VI present the first-stage results. Consistent with the rationale behind this instrument, in Columns I, III and V, the instrument, i.e. *LinkedMRatio*, provides statistically significant and positive results. This suggests that the more connected male directors are to women, the more female directors are on boards. As per Columns II, IV and VI, we find statistically significant and positive coefficient estimates for the

instrument, i.e. *LinkedMRatio* × *Overconfidence*. These findings indicate that the positive relation between female board representation and *LinkedMRatio* holds considering the overconfident CEO.

Columns VII to IX report the results for the second-stage regressions. All three regressions confirm the significant and positive effect of the fraction of female directors on excess cash holding conditional on CEO overconfidence. For the average firm, a one-standard-deviation (about 4.8%) increase in the fraction of female directors on the board is associated with a 0.475% (= 0.099 × 0.048) jump in excess cash holdings when the CEO is overly confident. Moreover, the increase in *ExCash* is 0.481% (= 0.089 × 0.054) and 0.671% (= 0.137 × 0.049) respectively, considering the instrumented interaction terms, i.e. *Inst(FIndepRatio* × *Overconfidence)* and *Inst(TWFemaleRatio* × *Overconfidence)*, in Columns VIII and IX.

<Insert Table 4>

Both of our instruments are not subject to the issues of weak instruments, under-identification or over-identification. To address these issues, we first conduct Cragg-Donald's Wald F-test for weak instruments and find that all F statistics are above the Stock-Yogo critical F-statistic value of 19.93: Our instruments pass the weak instrument test. Second, we perform Anderson's canonical correlation Chi-square test for under-identification. The Chi-square values are statistically significant at the 1% level which suggests that canonical correlation is different from zero and under-identification is not an issue in our analyses. Finally, we obtain insignificant Hansen J statistics, which suggests that the null hypothesis that over-identification restrictions are valid cannot be rejected and that our instruments are appropriate.[13]

4.2. Difference-in-Difference Method

The Sarbanes-Oxley Act (SOX) instituted new requirements for public company boards, and in 2003, the Securities and Exchange Commission (SEC) approved and adopted governance-related reforms suggested by the three major US stock exchanges: NYSE, NASDAQ, and AMEX. The most prominent reform requirement is that "… *A majority of the board of directors must be comprised of Independent Directors* …". Starting from 2003 all US-listed firms have to comply with the

[13] See Tables 3 and 4 for details of all test statistics.

requirement of having a majority of independent directors. This change in the board structure along with others due to SEC regulations must have impacted the female board representation as well because the insider directors have been replaced with new outsider directors who might have been women. In fact, Figure 1 shows a sudden jump for all female board representation variables right after 2003 considering the firms in our sample.[14] Hence, this natural experiment provides an opportunity to investigate the effect of increased female board representation in firms with the overly confident CEO on the excess cash level in those firms through an exogenous shock on the board structure.

The period for this model is 2000–2007. The sample has two four-year periods around SEC announcements.[15] The multivariate analysis is conducted using a triple-difference analysis. Dummy variables are used for the post-2003 and firms with the overconfident CEO, along with the interactions of these variables with the variables for female board representation. We can therefore evaluate the possible influence of female directors on excess cash after the changes in the board when the overconfident CEO is present. This paper tries to demonstrate that excess cash changes occur because of the changes in fraction of female directors on the board. It examines whether, after the shock, increased female board representation has a positive effect on excess cash holdings in firms with the overly confident CEO. This claim is represented by the interaction of *FemaleRatio* (or *FIndepRatio* or *TWFemaleRatio)* with the *Post* and *Overconfidence* dummies. *FemaleRatio* × *Post,* and *Overconfidence* × *Post* are the interaction variables of *FemaleRatio*, *Overconfidence,* and *Post.* The model does not include the following stand-alone variables: *FemaleRatio*, *FemaleRatio* × *Overconfidence*. Table B.2 of Appendix B shows that these variables are highly correlated with *FemaleRatio* × *Post* and *FemaleRatio* × *Overconfidence* × *Post*, 0.77 and 0.84, respectively. Moreover, these variables would cause further multicollinearity issues. In fact, Variance Inflation Factor (VIF) and Tolerance values of the all variables in the model improve drastically, once we drop *FemaleRatio* and *FemaleRatio* × *Overconfidence*. Hence, we have to exclude these variables. Year

[14] From 2003 to 2004, the total number of (independent) female directors in our sample increases drastically (from 767 to1,092) from 883 to 1,304 while the total number of (independent) directors changes (from 5,862 to 5,972) from 8,590 to 8,519. These numbers imply that firms overall fire more male directors and hire more female directors after SOX.

[15] In untabulated analyses, we repeat the exercise for different time periods, i.e. 6 years and 10 years, and obtain similar robust results.

and firm fixed effects, along with controls (*LnSales, Debt-to-Equity*, *ROA*, *ReturnVol*, *R&DDummy*, *Dividend*, *IndepRatio*, *Busy*, *Inactive*, *LnBoardSize*, *CEOTenure*, *CEOOwnership*, and *Duality)*, are added to the model. All variables are lagged by one year. The model does not have an indicator for the post-period because it is subsumed in the year fixed effect. Standard errors are clustered at the firm level. The model is specified as follows:

$$ExCash_{i,t} = \alpha + \beta_1 Overconfidence_{i,t-1} + \beta_2\, Overconfidence_{i,t-1} \times Post_{i,t-1} + \beta_3 Female\ Representation_{i,t-1} \times Post_{i,t-1} + \beta_3 Female\ Representation_{i,t-1} \times Overconfidence_{i,t-1} \times Post_{i,t-1} + \Theta X_{i,t-1} + \eta_i + \phi_t + \varepsilon_{i,t-1} \quad (3)$$

where $ExCash_{i,t}$ is excess cash holding of firm *i* in year *t*. $Female\ Representation_{i,t-1}$ denotes three different "female ratio" variables for firm *i* in year *t–1*: *FemaleRatio*, *FIndepRatio*, and *TWFemaleRatio*. $Overconfidence_{i,t-1}$ is the dummy for high overconfidence intensity in that industry where the firm operates. $Post_{i,t-1}$ is a dummy that is equal to one for years after 2003, i.e., post-shock period. $X_{i,t-1}$ is a vector of control variables. η_i represents firm fixed effects while ϕ_t denotes year fixed effects.

Table 5 provides the results. The negative coefficient estimates for *Overconfidence* and *Overconfidence* × *Post* suggest that overconfident CEOs decrease excess cash levels in firms before and after the shock alike. This is consistent with our previous findings. More importantly, we find *FemaleRatio* × *Overconfidence* × *Post* has statistically significant and positive estimate. This result implies that more female directors on the board after the shock not only stop the decline in excess cash due the overly confident CEO but also increase excess cash holdings in those firms. In particular, the excess cash level increases by 0.85% (= 0.082 × 0.104) in firms managed by the overconfident CEO when the fraction of female directors on the board increases by one-standard-deviation (about 10.4%) due the SEC regulations. Furthermore, the increase in *ExCash* is 0.78% (= 0.063 × 0.124) and 1.20% (= 0.111 × 0.108) respectively, for the models using *FIndepRatio* and *TWFemaleRatio* in Columns II and III. Overall, these results support our original findings of a positive link between female board representation and excess cash in firms with the overly confident CEO.

<Insert Table 5>

4.3. Propensity Score Matching Method

If firms with female directors are fundamentally different from those with no female directors, then the control variables employed in our main estimation model that capture linear relations could be inadequate. Under this assumption (unobserved heterogeneity), our results could be biased and could pick up non-linear effects of the control variables on excess cash holdings. To mitigate this concern, we create two samples that are comparable across all the control variables but differ only on whether the firm has more than two female directors on the board or have no female directors. To construct these samples, we implement a propensity score matching (PSM) process following Drucker and Puri (2005) and match firms with more than two female directors with firms exhibiting similar characteristics but have no female directors on the board.

Specifically, we run a logit model to estimate propensity scores, p(Y=1/X=x), based on the probability of receiving a binary treatment, Y, conditional on all the control variables, X. Based on our study, we regard having more than two female directors on the board as "treatment" and we estimate the probability of having more than two female directors on the board using a set of independent variables. The independent variables are similar to those used as control variables in Eq. (2). Then, for each firm-year with more than two female directors, we use the propensity score to find a comparable firm-year without a female director on the board based on the nearest-neighbor method. To ensure the adequacy of the matching estimation method, we require that the absolute difference in propensity scores among pairs does not exceed 0.01. If there are more firms-years without a female director on the board that meet this criterion, we retain the firm-year with the smallest difference in the propensity scores. We obtain 979 pairs of matched observations.

As a robustness check, we construct the "treatment" and "control" groups based on various other criteria: (i) whether the firm has more than three female directors on board or no female directors; (ii) whether the firm lies on the top 25th percentile of female ratio (*FemaleRatio*) or on the bottom 25th percentile; (iii) whether the firm lies on the top 25th percentile of independent female ratio (*FIndepRatio*) or on the bottom 25th percentile; (iv) whether the firm lies on the top 25th percentile of tenure female ratio (*TWFemaleRatio*) or on the bottom 25th percentile. We repeat our main analysis with Eq. (2) using these five different set of paired samples and report the findings in

Table 6. For each of the four constructed samples, we obtain 211, 809, 632, and 1377 pairs of matched observations, respectively.

<Insert Table 6>

The results reported in columns I-III of Table 6 indicate that there are significant differences in excess cash holdings for firms with the overconfident CEO when they have more than two female directors compared to when there are no female directors on the board. In particular, the coefficient estimates for interaction terms (using *FemaleRatio* and *FIndepRatio*) remain consistently positive and statistically significant at the 10% level. For the average firm, a one-standard-deviation, equals 11% (13.3%), increase in the fraction of total (independent) female directors on the board is associated with a 0.77% (= 0.070 × 0.11) (0.73%= 0.055 × 0.13) jump in excess cash holdings when the CEO is overly confident. Furthermore, as per columns IV-VI, these results also hold and show higher coefficients' magnitudes when firms with the overconfident manager have more than three female directors compared to the firms without any female directors. The increase in *ExCash* is 1.68% (= 0.112 × 0.15) and 1.65% (= 0.094 × 0.176) respectively, considering the interaction terms with *FemaleRatio* and *FIndepRatio*. This provide initial support for the critical mass theory (Schwartz-Ziv, 2017). Finally, as per columns VII-IX, we find that the coefficient estimates for interaction terms (using *FemaleRatio* and *TWFemaleRatio*) are also significantly positive where *ExCash* values increase by 1.23% and 1.10% as *FemaleRatio* and *TWFemaleRatio* increase by one standard deviation (11.7% and 14.2%), respectively. The interaction term using *FIndepRatio* provides insignificant results. Overall, we conclude that our main results are not driven by none observable characteristics.

4.4. Dynamic GMM Method

Despite the use of an instrumental variable approach to mitigate the endogeneity bias resulting from reverse causality, the method has been criticized as finding a truly exogenous variable is difficult (Wintoki et al., 2012). Furthermore, the reverse causality issues in governance research tend to be of a dynamic nature (Wintoki et al., 2012). Projecting this to our paper means that female board representation and CEO overconfidence are affected by the past realization of excess cash holdings; hence, only past excess cash holding levels would be in the information set considered by

overconfident CEOs and the existing board when making their decisions. Therefore, we use a dynamic panel system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). The use of this method enhances the efficiency of our estimator and the power of hypothesis tests by allowing more instrumental variables to be included in the estimation (Roodman, 2009). The system GMM identification assumes that past endogenous variables in levels are not correlated with the current residual terms in first differences and those past variables in first differences are not correlated with the residual terms in levels. We include the lags of our main explanatory variables (female board representation measures and *Overconfidence*) and control variables as a part of the dynamic GMM model. Our instruments are lagged using 14 to 17 years lagging period.

The results reported in Table 7 show significant and positive coefficients for the interaction terms – for all three "female ratio" measures – indicating that female board representation reduces the CEO overconfidence leading them to increase the firm's excess cash holdings. Excess cash levels increase by 3.53% (= 0.346 × 0.102), 3.19% (= 0.249 × 0.128), and 3.36% (=0.305 × 0.110) with a one-standard-deviation increase in *FemaleRatio*, *FIndepRatio,* and *TWFemaleRatio,* respectively*,* for the firms with the overconfident CEO. These findings are consistent with our main hypothesis.

<Insert Table 7>

In addition to AR(1), we report AR(2) test for second-order autocorrelation in the first-differenced residuals, which if present, could render the GMM estimator inconsistent, and Hansen test of over-identifying restrictions. We also report the Difference-in-Hansen test that evaluates the validity of the additional differenced-instruments required for systems estimation and used in the level equations. All of our system GMM models pass all the diagnostic tests.

5. Robustness Tests and Further Analyses

5.1.Robustness tests

We conduct several robustness tests to check the validity of our main results.[16] First, it is well established in the literature that CEO overconfidence affects shareholder wealth non-monotonically. While a moderate level of overconfidence maximizes firm value, high and low levels of CEO overconfidence decrease firm value (Goel and Thakor, 2008). Hence, Goel and Thakor (2008) show that board of directors acting in the shareholders' best interest will fire a CEO who is excessively overconfident. Empirically, Campbell et al. (2011) also find that the harmful effects of CEO overconfidence are likely driven by the subset of CEOs with relatively high-overconfidence levels. Following the same spirit, we test whether female directors play a more effective "*governance*" role in altering the firm's excess cash holdings in the presence of excessively overconfident CEOs. We re-estimate our main model using the group of firms with high CEO overconfidence. Following Aktas et al. (2019), we assign firms to high CEO overconfidence group if the CEOs' *Moneyness* belongs to the top 15th percentile during that year.[17] Consistent with our expectations, we find that firms with high CEO overconfidence have significantly positive and larger coefficients on the interaction term.[18]

Second, we re-estimate our main model using different measures to capture the CEO overconfidence level at the industry and individual CEO levels. For the first set of measures we re-calculate our main variable *Overconfidence* using a different industry classification, Fama-French 48, and define it as *Overconfidence* $_{FF48}$. Then, we use the high industry overconfidence representation measure, *OverconfidenceRep* $_{FF48.}$ Overall, our main results hold when we replace *Overconfidence* with *Overconfidence* $_{FF48}$ and *OverconfidenceRep* $_{FF48}$. In our second set of overconfidence measures, we use three variables at the individual CEO level in order to overcome some concerns about the option-based measure of overconfidence, *OptionMoneyness*. We use the *UEOptionPayRatio* which is defined as the value of unexercised (vested) exercisable options scaled by the CEO total pay. We also

[16] All subsequent findings in this subsection are provided in Appendix B, tables B.3 – to B.11.
[17] We also consider different cut-offs such as 10th and 40th percentile brackets to represent different levels of excessiveness in overconfidence and obtained robust results.
[18] In untabulated analyses, we also re-estimate our main model using a group of moderate CEO overconfidence only. In line with the theoretical model of Goel and Thakor (2008), we find the interaction term to be statistically insignificant for all of the three independent variables. This indicates that female directors do not find it necessary to alter the firm's excess cash holdings when CEOs are moderately overconfident and act in the best interest of shareholders.

calculate *LnUEOptionValue* which is the natural logarithm of the value of unexercised exercisable options. The use of these measures is to alleviate the concern that the CEO Option Moneyness variable does not capture whether the unexercised options are economically important to the CEO (Banerjee et al., 2015). In addition, we use *ValueRatio* which is defined as the ratio of the intrinsic value to the exercise price of the option, where the intrinsic value is calculated as the stock price at exercise minus the exercise price (Chen et al., 2019). Then, we aggregate the *ValueRatio* for each CEO every year and divided it over the number of options exercised. Contrary to this new measure, CEO Option Moneyness is based on the average value of all exercisable options held, part of which could be newly vested exercisable options that do not necessarily reflect the CEO's exercise behavior. Therefore, using the *ValueRatio* we expect the presence of female directors to reduce the *ValueRatio* (less overconfident option exercise choices) leading to larger excess cash holdings. The findings are all qualitatively similar to those in Table 2.

Third, to exclude the possibility that our main results are driven by the decisions of newly appointed CEOs, we keep firms in our sample only if their CEOs remain in the office for at least 4 years. On the contrary, it could be argued that entrenched managers refrain from holding excess cash as they do not want to draw the attention of activist shareholders. For example, Faleye (2004) show that excess cash holdings increase proxy contest which is usually followed by an increase in executive turnover. Therefore, we remove firms from the sample if their CEOs serve in the same firm with the tenure below 75th percentile of sample CEO tenure. To verify that our results do not merely reflect a mechanical change in overconfidence due to CEO replacements, we exclude years when there is a CEO change in the firm around female director appointments. The findings support our main results and show that the estimated coefficients for the interaction terms – for all measures of female board representation – remain positive and statistically significant.

Fourth, throughout our analyses, we control for CEO characteristics. One potential concern, however, is that the decisions on cash holdings could be influenced by the firm's CFO and board of directors. Following Ben-David et al. (2007) and Florackis and Sainani (2018), we control for potential CFO effects on cash holding decisions by including *CFOOverconfidence* which is defined as a dummy that equals one if the average CFO option moneyness for the industry in that year (using the

2-digit SIC code) is greater than the median average CFO option moneyness across all industries, *CFOAge* as the age of the CFO in years, and *CFOOwnership* as the fraction of the firm's shares owned by the CFO. Furthermore, a recently growing literature reports a significant effect of board overconfidence on firm's value (Schrand and Zechman, 2010; Kind and Twardawski, 2016). To control for board of director's overconfidence on cash holding decisions, we add board of director's overconfidence measure as an additional control variable. *BoardOverconfidence* is defined as a dummy that equals one if the average board option moneyness for the industry in that year using the 2-digit SIC code is greater than the median average board option moneyness across all industries. For board option moneyness, the executive members of the board are included. Finally, as per Adams (2016) "*This is the age of the female director. Before this, it was the age of the independent director*", we aim to eliminate the possible remaining effect of board independence on the relationship between female directors and excess cash. Hence we control for *IndepRatio* and CEO overconfidence interaction in our model. We obtain robust findings including all these additional controls. In further tests, we restrict the sample to firms with only male CFOs to eliminate the potential effect of female CFOs on our results. Also, we re-run model 2 by replacing *Overconfidence* with *CFOOverconfidence* and *BoardOverconfidence.* The findings support our hypothesis as the significant and positive coefficients on the interaction terms remain robust.[19]

Fifth, we argue that monitoring is the main channel through which female directors tame the biased behavior of overconfident CEOs leading to higher levels of excess cash. Coles et al. (2014) show that this monitoring power can be weakened (strengthened) by the presence of co-opted (non-co-opted) directors. Co-opted directors, who were appointed after the CEO assumes office, may tend to assign their allegiance to the CEO regardless of whether they are classified as independent using traditional measures. Furthermore, Coles et al. (2014) show that there is a positive (negative) association between co-opted (non-co-opted) boards and investment level. This supports the idea that CEOs that have captured the board to a greater extent are able to invest more than otherwise would

[19] Despite the reported significant and positive coefficients on the interaction terms between female directors and CEO overconfidence, one of the main drawbacks in this analysis is that we lose large number observations due to the CFO data availability which may contribute to the weakening of the significance of the results compared to our main findings in Table 2.

have been the case which may affect the level of excess cash in the firm. As a robustness test, we follow Coles et al. (2014) and reconstruct our main female director variables considering that the female director should be appointed before the current CEO assumes office (Non-Co-opted female directors). The results are consistent with our main findings.

Sixth, we re-estimate our main model by excluding firm-year observations for the first three years after such a firm is declared public. The rationale behind this exclusion is that some CEOs in newly public firms obtain stock options at the issue price rather than the first-day closing price (Banerjee et al., 2015). This leads to having deep-in-the-money option which signals a false overconfidence behavior. Our main findings remain robust.

Lastly, in order to verify that the results are not driven by other unobserved characteristics that could affect our causal interpretation, we re-run our main analyses by changing the variables of female board representation with the following measures: *FemaleTenure*, *FOwnership* , *BEthnicity* as , *BOwnership* , *IndepRatio* , *IOwnership* , *EIndex* , *CEOChange* , and *CEOPay* a. For all of these variables, when interacted with the CEO overconfidence, we find the coefficient to be insignificant. This provides robust evidence for our main results that they are not driven by any unobserved factors which could be associated with *ExCash*.

5.2.Value of Cash

In this section, we aim to test whether the increase in excess cash holdings due to female directors is associated with higher benefits to shareholders. Therefore, we implement the model of Faulkender and Wang (2006). This model tests whether a change in cash holdings leads to a change in firm value. Specifically, we estimate the following equation: [20]

$$ExcessRet_{i,t} = \alpha + \beta_1 \Delta\text{CashRatio}_{i,t-1} + \beta_2 Female\ Representation_{i,t-1} +$$

$$\beta_3 Overconfidence_{i,t-1} + \beta_4 Female\ Representation_{i,t-1} \times Overconfidence_{i,t-1} +$$

[20] ΔCashRatio, Overconfidence×ΔCashRatio, and Female Representation variables (FemaleRatio, FindepRatio and TWfemaleRatio)×ΔCashRatio are significantly and highly correlated to each other with values ranging from 58% to 67%. In order to eliminate this multicollinearity issue, we exclude Overconfidence×ΔCashRatio and FemaleRatio×ΔCashRatio from the model.

$$\beta_5 \Delta\text{CashRatio}_{i,t-1} \times Female\ Representation_{i,t-1} \times Overconfidence_{i,t-1} + \Theta X_{i,t-1} + \eta_i + \phi_t + \varepsilon_{i,t-1} \quad (5)$$

where the dependent variable *ExcessRet*, which is defined as a firm's excess return between the current and the previous year, corresponds to the difference between the firm's stock return and the return of that firm's benchmark portfolio over the same period. Following Daniel and Titman (1997), the benchmark portfolios are the Fama and French (1993) 25 value-weighted portfolios constructed by independent sorting stocks on size and book-to-market characteristics. *ΔCashRatio* is the change in cash holdings between the current and the previous year over market value of equity at the end of the previous year. $X_{i,t-1}$ is a vector of control variables: *ΔEarnings* is the change in earnings before extraordinary items over market value of equity. *ΔNetAssets* is the change in net assets over market value of equity. *ΔR&D* is the change in research and development expenses over market value of equity. *ΔInterest* is the change in interest expenses over market value of equity. *ΔDividend* is the change in common dividends over market value of equity. *NetFinancing* is total equity issuance minus repurchases, plus debt issuance minus debt redemption, scaled by market value of equity. The model also includes *CashRatio*, which is the cash holdings over market value of equity, and *Leverage*, which is the sum of long-term debt and debt in current liabilities over the sum of long-term debt, debt in current liabilities, and market value of equity. Both variables – *CashRatio* and *Leverage* – interact with Δ*CashRatio*. We include year and industry fixed effects to control for time and industry trends on excess returns.

Table 8 reports the main findings. The results show positive and significant coefficients on the triple interaction terms of Female Representation variables (FemaleRatio, FindepRatio and TWfemaleRatio)×Overconfidence×ΔCashRatio. These results indicate that an increase in female representation significantly increases the value of a dollar of cash both economically and statistically, conditional on having an overconfident CEO. The coefficient estimate of the triple interaction term in columns I, II, and III shows that the value that investors assigns to a dollar of cash is \$0.041, \$0.038, and \$0.038 higher if FemaleRatio, FindepRatio, and TWfemaleRatio, respectively, increase by one

standard deviation (about 10%) while the firm is managed by an overconfident CEO. To check whether having a female representation on board further improves the value of cash when there is an overconfident CEO, we replicate the work of Aktas et al. (2019). In untabulated results, we find consistent results with a positive value on the coefficient for Overconfidence×ΔCashRatio. Further, incorporating the female board representation measures leads to improvement in significance and magnitude of the main result suggesting that female board representation improves the value of cash.

<Insert Table 8>

5.3.Sources of Cash

We show that female board representation, conditional on the presence of overconfident CEOs, increases the level of the firm's excess cash. Next, we attempt to identify the channels through which this increase occurs. We follow Jiang and Lie (2016) and Dessaint and Matray (2017) and examine six different ways which potentially explain the incremental effect of female board representation with overconfident CEOs on excess cash. Jiang and Lie (2016) and Dessaint and Matray (2017) argue that the increase in excess cash may come from: an increase in revenues (i.e. operating profits, sales growth) or new financing (debt or equity); or a decrease in net working capital requirements, debt requirements, investments (i.e. capital expenditures, R&D), dividends, or share repurchases.[21] In particular, we examine the effect of the interaction term (female board representation measures and overconfidence) on the changes in operating profits, capital expenditures, R&D expenses, new financing, dividends, and share repurchases. We define *Operating Profit* as the operating income after depreciation over total revenues, *Capital Expenditures* is the firm's capital expenditures over total assets, *R&D Expenditures* is the firm's research and development expenses over total revenues, *New Financing* is the issuance of long-term debt plus sale of new stocks scaled by equity market value, *Dividends* is the dividends paid scaled by the firm's market value of equity, *Share Repurchases* is the purchase of common and preferred stocks over last year's net income. The changes refer to the differences between the current and the next year.

[21] In unreported analyses, we also explore other alternative channels, i.e. net working capital, sales growth, and debt retirement, and we do not find any statistically significant support for these channels.

Panel A of Table 9 provides the analyses regarding the changes in revenues and investments. Columns I, II, and III show positive and statistically significant coefficients for the interaction terms between female board representation (*FemaleRatio, FIndepRatio*, or *TWFemaleRatio*) and *Overconfidence*, respectively. This indicates that female directors in the presence of overconfident CEOs tend to increase the firm's operating margin which may lead to an increase in excess cash. On average, the change in operating margin increases by 0.49% (= 0.049 × 0.102) with a one-standard-deviation increase (about 10%) in *FemaleRatio* for the firms with the overconfident CEO. Similarly, an increase of one standard deviation in *FIndepRatio* and *TWFemaleRatio* is associated with a 0.42% (= 0.033 × 0.128) and 0.43% (= 0.039 × 0.110) increase in the change in operating margin when the overconfident CEO is present, respectively. Next, we examine whether female board representation, conditional on CEO overconfidence, increases excess cash through a decrease in capital expenditure and R&D channels. The coefficients of the interaction terms, in columns IV to VIII, are negative and statistically significant. Consistent with the expectations, these results suggest that the monitoring by female directors on the overconfident CEO reduces investments which can exacerbate excess cash level in the firm.

Panel B of table 9 shows the analyses reflecting the firm's new financing decisions and payout policies. We find no evidence that, conditional on CEO overconfidence, female directors choose new investments (debt or equity) or payout policies (dividends or share repurchases) as potential channels to increase excess cash holdings.

<Insert Table 9>

5.4.The Role of Cash Flow

Prior literature provides evidence that cash flow (Harford et al., 2008) and CEO overconfidence (Deshmukh et al., 2018; Aktas et al., 2019) play a role in determining the firm's cash holdings. Deshmukh et al. (2018) show a positive relation between cash flow and cash holdings. However, when CEO overconfidence is interacted with cash flow, they find a negative association between the interaction term and cash holdings. One possible explanation is that when a firm receives a windfall of cash flow from previous investments, overconfident CEOs perceive this extra cash flow as a

validation of their "biased" beliefs about the firm's quality. Hence, they view current external financing as even more costly which leads them to rely more on cash balances and widen the difference of cash levels between firms managed by them and their rational counterparts, respectively (Deshmukh et al., 2018).

In this section, we further investigate whether the presence of female directors reduces the CEOs' biased believes regarding the firms' excess cash holdings when cash flow increases. We extend the model of Deshmukh et al. (2018) by asking the following question: does the increase in female board representation changes the overconfident CEOs' excess cash holding decision when the firms have higher cash flows? To answer this question, we follow the approach by Deshmukh et al. (2018) and further augment their model by studying a triple interactive effect of cash flow, CEO overconfidence, and female board representation (*CashFlow* x *Overconfidence* x (*FemaleRatio* or *FIndepRatio* or *TWFemaleRatio*)) on the change in excess cash holdings, *ΔExCash*.

As per Table 10, we find positive and significant cash flow coefficients which indicate that, on average, firms in the sample increase their excess cash holding levels with an extra dollar of cash flow. This is consistent with our expectations. Furthermore, the interaction terms between cash flow and CEO overconfidence are found to be negative and insignificant for Columns I and II but significant for Column III at the 5% level. This finding suggests that firms managed by overconfident CEOs hold less excess cash for each extra dollar of cash flow compared to the firms managed by rational CEOs. This finding is also in line with that of Deshmukh et al. (2018). We also find in Columns II and III that, on average, having female directors on the board increases the amount of excess cash holdings. The coefficients on the triple interaction terms - for all three models - are found positive and statistically significant. The positive sign suggests that more female directors on the board increase the firm's savings of excess cash holdings out of an extra dollar of cash flow, conditional on the firm being managed by the overconfident CEO. This result is also consistent with our original findings in Table 2.

<Insert Table 10>

In further analyses, we test whether our results hold under a sub-optimal financial position, i.e., financial constraints. Following previous literature (e.g., Almeida et al. (2004); Huang and

Mazouz (2018); Aktas et al. (2019), we separate our sample into two groups of financially constrained and unconstrained firms, using SA index (Hadlock and Pierce, 2010), dividend payments (Almeida et al., 2004), and credit rating of the debt (Aktas et al., 2019) as proxies for financial constraints. More specifically, we define firms as financially constrained if they: (i) fall in the top tertile value of the SA index, (ii) fall in the bottom tertile of the dividend ratio, (iii) and have no credit rating information on the debt or its long-term debt is associated with a speculative grade rating. We follow the approach by Almeida et al. (2004), who study the impact of financial constraints on the relation between cash flow and the change in cash holdings. The results in Table B.12, Appendix B confirm our main findings that female board representation plays a role in taming CEO overconfidence through which excess cash increases even when those firms are financially constrained.

6. Conclusion

In this study, we examine whether female directors alter the firm's excess cash holding decisions through mitigating managerial confidence level. Previous literature confirms that overconfident CEOs perceive their firms to be undervalued by the market; therefore, they regard external financing to be overly costly. Hence, they use internal funds to finance new investments. As a result, they hold lower level of cash compared to rational CEOs (Deshmukh et al., 2018). Based on the monitoring effect hypothesis, which predicts that female board representation provides a good layer of governance on top management, we find evidence that having more female directors on the board not only stops the decline in excess cash due the overly confident CEO but also increases excess cash holdings in those firms. Our finding is based on a sample of 1,163 US-listed firms on AMEX, NYSE, and NASDAQ between 2000 and 2017. We obtain robust result using various models, i.e. instrumental variables, dynamic system GMM, difference-in-difference and propensity score matching. We find supporting results with alternative CEO overconfidence measures, additional controls for the CEO, the board and firm characteristics. Furthermore, we find that an increase in female board representation significantly increases the value of a dollar of cash both economically and statistically, conditional on having an overconfident CEO. Also, we find that female directors in the presence of overconfident CEOs tend to increase the firm's operating profit and decrease the capital and R&D expenditures providing

channels through which excess cash increases. Our results also hold in scenarios when cash flow increases and when the firm is in a sub-optimal financial position, i.e., financially constrained.

Our findings have an important implication on the interplay between the firm's financial decision making i.e., excess cash holdings and its corporate governance policies. Specifically, we believe that the appointment of female directors on boards provides a simple governance tool that helps moderate the biased decision making by overconfident CEOs concerning the level of excess cash at the firm. Furthermore, these findings have implications on investors who reward firms that increase their female board representation through assigning a higher dollar value to each dollar of cash held by the firm, when these firms are managed by overconfident CEOs. Thus, the findings of this paper may provide guidance for firms in restructuring their boards to improve corporate governance and firm's financial decision making.

References

Acharya, V.V., Almeida, H., Campello, M., 2007. Is cash negative debt? A hedging perspective on corporate financial policies. J Finan Intermediation. 16, 515-554.

Adams, R.B., 2016. Women on boards: The superheroes of tomorrow? Leadersh Q. 27, 371-386.

Adams, R.B., Ferreira, D., 2009. Women in the boardroom and their impact on governance and performance. J Finan Econ. 94, 291-309.

Adams, R.B., Funk, P., 2012. Beyond the glass ceiling: Does gender matter? Manag Sci. 58, 219-235.

Ahern, K.R., Dittmar, A.K., 2012. The changing of the boards: The impact on firm valuation of mandated female board representation. Q J Econ. 127, 137-197.

Ajzen, I., 1991. The theory of planned behavior. Organ Behav Hum Decis Process. 50, 179-211.

Aktas, N., Louca, C., Petmezas, D., 2019. CEO overconfidence and the value of corporate cash holdings. J Corp Financ. 54, 85-106.

Almeida, H., Campello, M., Weisbach, M.S., 2004. The cash flow sensitivity of cash. J Financ. 59, 1777-1804.

Andreou, P.C., Cooper, I., de Olalla Lopez, I.G., Louca, C., 2018. Managerial overconfidence and the buyback anomaly. J Empirical Finance. 49, 142-156.

Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. J Econometrics. 68, 29-51.

Asem, E., Alam, S., 2014. Cash hoards and changes in investors'outlook. J Finan Res. 37, 119-137.

Atanasov, V.A., Black, B.S., 2019. The trouble with instruments: Re-Examining shock-based IV designs. Northwestern Law & Econ Research Paper, ECGI - Finance Working Paper

Atif, M., Liu, B., Huang, A., 2019. Does board gender diversity affect corporate cash holdings? J Bus Finance Account. 46, 1003-1029.

Banerjee, S., Humphery-Jenner, M., Nanda, V., 2015. Restraining overconfident CEOs through improved governance: Evidence from the Sarbanes-Oxley Act. Rev Financial Stud. 28, 2812-2858.

Banerjee, S., Masulis, R.W., Upadhyay, A., 2018. Mitigating Effects of Gender Diverse Board in Companies Managed by Overconfident CEOs. Stevens Institute of Technology School of Business Research Paper.

Bates, T.W., Chang, C.-H., Chi, J.D., 2018. Why has the value of cash increased over time? J Finan Quant Anal. 53, 749-787.

Bates, T.W., Kahle, K.M., Stulz, R.M., 2009. Why do US firms hold so much more cash than they used to? J Financ. 64, 1985-2021.

Ben-David, I., Graham, J.R., Harvey, C.R., 2007. Managerial overconfidence and corporate policies. National Bureau of Economic Research,

Ben-David, I., Graham, J.R., Harvey, C.R., 2013. Managerial miscalibration. Q J Econ. 128, 1547-1584.

Benson, D., Ziedonis, R.H., 2010. Corporate venture capital and the returns to acquiring portfolio companies. J Finan Econ. 98, 478-499.

Billett, M.T., Qian, Y., 2008. Are overconfident CEOs born or made? Evidence of self-attribution bias from frequent acquirers. Manag Sci. 54, 1037-1051.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J Econometrics. 87, 115-143.

Campbell, T.C., Gallmeyer, M., Johnson, S.A., Rutherford, J., Stanley, B.W., 2011. CEO optimism and forced turnover. J Finan Econ. 101, 695-712.

Carter, D.A., Simkins, B.J., Simpson, W.G., 2003. Corporate governance, board diversity, and firm value. Finan Rev. 38, 33-53.

Chen, J., Leung, W.S., Goergen, M., 2017. The impact of board gender composition on dividend payouts. J Corp Financ. 43, 86-105.

Chen, J., Leung, W.S., Song, W., Goergen, M., 2019. Why female board representation matters: The role of female directors in reducing male CEO overconfidence. J Empirical Finance. 53, 70-90.

Cialdini, R.B., Goldstein, N.J., 2004. Social influence: Compliance and conformity. Annu Rev Clin Psychol. 55, 591-621.

Coles, J.L., Daniel, N.D., Naveen, L., 2008. Boards: Does one size fit all? J Finan Econ. 87, 329-356.

Coles, J.L., Daniel, N.D., Naveen, L., 2014. Co-opted boards. Rev Financial Stud. 27, 1751-1796.

Daniel, K., Titman, S., 1997. Evidence on the characteristics of cross sectional variation in stock returns. The Journal of Finance. 52, 1-33.

Deshmukh, S., Goel, A.M., Howe, K.M., 2018. Do CEO Beliefs Affect Corporate Cash Holdings? Available at SSRN https://ssrn.com/abstract=2566808

Dessaint, O., Matray, A., 2017. Do managers overreact to salient risks? Evidence from hurricane strikes. J Finan Econ. 126, 97-121.

Dittmar, A., Mahrt-Smith, J., Servaes, H., 2003. International corporate governance and corporate cash holdings. J Finan Quant Anal. 38, 111-133.

Doukas, J.A., Petmezas, D., 2007. Acquisitions, overconfident managers and self-attribution bias. Europ Finan Manage. 13, 531-577.

Drucker, S., Puri, M., 2005. On the benefits of concurrent lending and underwriting. J Financ. 60, 2763-2799.

Duchin, R., 2010. Cash holdings and corporate diversification. J Financ. 65, 955-992.

Faleye, O., 2004. Cash and corporate control. J Financ. 59, 2041-2060.

Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. J Finan Econ. 33, 3-56.

Farrell, K.A., Hersch, P.L., 2005. Additions to corporate boards: the effect of gender. J Corp Financ. 11, 85-106.

Faulkender, M., Wang, R., 2006. Corporate financial policy and the value of cash. J Financ. 61, 1957-1990.

Ferris, S.P., Jayaraman, N., Sabherwal, S., 2013. CEO overconfidence and international merger and acquisition activity. J Finan Quant Anal. 48, 137-164.

Fich, E.M., Shivdasani, A., 2006. Are busy boards effective monitors? J Financ. 61, 689-724.

Florackis, C., Sainani, S., 2018. How do chief financial officers influence corporate cash policies? J Corp Financ. 52, 168-191.

Foley, C.F., Hartzell, J.C., Titman, S., Twite, G., 2007. Why do firms hold so much cash? A tax-based explanation. J Finan Econ. 86, 579-607.

Form, W., 1979. Comparative industrial sociology and the convergence hypothesis. Annual Review of Sociology. 5, 1-25.

Fresard, L., 2010. Financial strength and product market behavior: The real effects of corporate cash holdings. J Financ. 65, 1097-1122.

Goel, A.M., Thakor, A.V., 2008. Overconfidence, CEO selection, and corporate governance. J Financ. 63, 2737-2784.

Graham, J.R., Hazarika, S., Narasimhan, K., 2011. Corporate governance, debt, and investment policy during the great depression. Manag Sci. 57, 2083-2100.

Gul, F.A., Srinidhi, B., Ng, A.C., 2011. Does board gender diversity improve the informativeness of stock prices? J Acc Econ. 51, 314-338.

Hackbarth, D., 2008. Managerial traits and capital structure decisions. J Finan Quant Anal. 43, 843-881.

Hadlock, C.J., Pierce, J.R., 2010. New evidence on measuring financial constraints: Moving beyond the KZ index. Rev Financial Stud. 23, 1909-1940.

Harford, J., Mansi, S.A., Maxwell, W.F., 2008. Corporate governance and firm cash holdings in the US. J Finan Econ. 87, 535-555.

Heaton, J.B., 2002. Managerial optimism and corporate finance. Finan Manage. 1, 33-45.

Helland, E., Sykuta, M., 2004. Regulation and the evolution of corporate boards: Monitoring, advising, or window dressing? JL & Econ. 47, 167-193.

Hilary, G., Menzly, L., 2006. Does past success lead analysts to become overconfident? Manag Sci. 52, 489-500.

Hirshleifer, D., Low, A., Teoh, S.H., 2012. Are overconfident CEOs better innovators? J Financ. 67, 1457-1498.

Hoberg, G., Phillips, G., 2016. Text-based network industries and endogenous product differentiation. J Polit Economy. 124, 1423-1465.

Huang-Meier, W., Lambertides, N., Steeley, J.M., 2016. Motives for corporate cash holdings: the CEO optimism effect. Rev Quant Finance Acc. 47, 699-732.

Huang, W., Mazouz, K., 2018. Excess cash, trading continuity, and liquidity risk. J Corp Financ. 48, 275-291.

Isidro, H., Sobral, M., 2015. The effects of women on corporate boards on firm value, financial performance, and ethical and social compliance. J Bus Ethics. 132, 1-19.

Jensen, M.C., 1986. Agency cost of free cash flow, corporate finance, and takeovers. Amer Econ Rev. 76, 323-329.

Jiang, Z., Lie, E., 2016. Cash holding adjustments and managerial entrenchment. J Corp Financ. 36, 190-205.

Kanter, R.M., 1977. Some effects of proportions on group life: Skewed sex ratios and responses to token women. Am J Sociol. 82, 965-990.

Kind, A., Twardawski, T., 2016. Board overconfidence in mergers & acquisitions: A self-attribution bias. Acad Manag J. 2016, 1-40.

Kolasinski, A.C., Li, X., 2013. Can strong boards and trading their own firm's stock help CEOs make better decisions? Evidence from acquisitions by overconfident CEOs. J Finan Quant Anal. 48, 1173-1206.

Latané, B., 1981. The psychology of social impact. American Psychologist. 36, 343.

Levi, M., Li, K., Zhang, F., 2014. Director gender and mergers and acquisitions. J Corp Financ. 28, 185-200.

Liu, Y., Mauer, D.C., 2011. Corporate cash holdings and CEO compensation incentives. J Finan Econ. 102, 183-198.

Main, B., Gonzalez, A., Sila, V. Gender Equality and the Spillover Effects of Women on Boards. In: Academy of Management Proceedings, Academy of Management, 2018. vol 1. Academy of Management, pp 1-39

Malmendier, U., Tate, G., 2005. CEO overconfidence and corporate investment. J Financ. 60, 2661-2700.

Malmendier, U., Tate, G., 2008. Who makes acquisitions? CEO overconfidence and the market's reaction. J Finan Econ. 89, 20-43.

Malmendier, U., Tate, G., Yan, J., 2011. Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. J Financ. 66, 1687-1733.

Matsa, D.A., Miller, A.R., 2013. A female style in corporate leadership? Evidence from quotas. Am Econ J. 5, 136-169.

Meltzer, A.H., 1963. The demand for money: the evidence from the time series. J Polit Economy. 71, 219-246.

Miller, T., Triana, M.D.C., 2009. Demographic diversity in the boardroom: Mediators of the board diversity–firm performance relationship. J Manag Stud. 46, 755-786.

Niessen-Ruenzi, A., Ruenzi, S., 2018. Sex matters: Gender bias in the mutual fund industry. Manag Sci. 65, 2947-3448.

Opler, T., Pinkowitz, L., Stulz, R., Williamson, R., 1999. The determinants and implications of corporate cash holdings. J Finan Econ. 52, 3-46.

Roodman, D., 2009. How to do xtabond2: An introduction to difference and system GMM in Stata. The Stata Journal. 9, 86-136.

Schauten, M.B., Van Dijk, D., van der Waal, J.P., 2013. Corporate governance and the value of excess cash holdings of large European firms. Europ Finan Manage. 19, 991-1016.

Schrand, C.M., Zechman, S.L., 2010. Executive overconfidence and the slippery slope to fraud. Working Papep, University of Chicago.

Schwartz-Ziv, M., 2017. Gender and board activeness: the role of a critical mass. J Finan Quant Anal. 52, 751-780.

Schwartz-Ziv, M., Weisbach, M.S., 2013. What do boards really do? Evidence from minutes of board meetings. J Finan Econ. 108, 349-366.

Simon, M., Houghton, S.M., 2003. The relationship between overconfidence and the introduction of risky products: Evidence from a field study. Acad Manag J. 46, 139-149.

Simutin, M., 2010. Excess cash and stock returns. Finan Manage. 39, 1197-1222.

Terjesen, S., Aguilera, R.V., Lorenz, R., 2015. Legislating a woman's seat on the board: Institutional factors driving gender quotas for boards of directors. J Bus Ethics. 128, 233-251.

Wintoki, M.B., Linck, J.S., Netter, J.M., 2012. Endogeneity and the dynamics of internal corporate governance. J Finan Econ. 105, 581-606.

Zeng, S., Wang, L., 2015. CEO gender and corporate cash holdings. Are female CEOs more conservative? Asia-Pacific Journal of Accounting & Economics. 22, 449-474.

Tables and Figures

Table 1: Descriptive Statistics

This table provides descriptive statistics for the main variables. The time span for this study is between 2000 and 2017. There are 8,017 observations across 1,163 firms in this study. All variables are winsorized at the 1% and 99% levels. *ExCash* (in %) is the residual of a cross-sectional regression of cash holdings on firm characteristics (Eq. (1)). *Overconfidence* is a dummy that equals one if the average CEO option moneyness for the industry in that year (using the 2-digit SIC code) is greater than the median average CEO option moneyness across all industries. *FemaleRatio* is the number of female directors on the board scaled by the board size. *FIndepRatio* is the number of outsider female-directors on the board scaled by the number of all outsider directors on the board. *TWFemaleRatio* is the weighted fraction of female directors with the weights being the tenure of each female director relative to the total board tenure. *LnSales* is the natural logarithm of net sales. *Debt-to-Equity* is long-term debt plus debt in current liabilities scaled by the market value of equity. *ROA* is the return of assets calculated as earnings before interests and tax scaled by total assets. *ReturnVol* is the standard deviation of monthly equally weighted stock returns. *R&DDummy* is a dummy that is equal to one if a firm invests in R&D that year, and zero otherwise. *Dividend* is dividends scaled by the market value of equity. *IndepRatio* is the number of outsider directors on the board scaled by the board size. *Busy* is the number of directors on the board who also sit on the board of other firms scaled by the board size. *Inactive* is the number of directors on the board who attend less than 75% of the board meetings in that year scaled by the board size. *LnBoardSize* is the natural logarithm of total number of directors on the board. *CEOTenure* is the number of years the CEO has been in position. *CEOOwnership* is the fraction of total shares outstanding owned by the CEO. *Duality* is a dummy that is equal to one if the CEO is also the chairman of the board.

	Mean	**Std. Dev.**	**25th Percentile**	**Median**	**75th Percentile**
ExCash	0.035	9.158	-5.683	-0.903	4.751
Overconfidence	0.370	0.483	0.000	0.000	1.000
FemaleRatio	0.114	0.102	0.000	0.111	0.182
FIndepRatio	0.136	0.128	0.000	0.143	0.222
TWFemaleRatio	0.092	0.110	0.000	0.056	0.148
Sales (in $ Million)	6,177	14,106	629.1	1,624	4,803
Debt-to-Equity	0.349	0.568	0.036	0.171	0.397
ROA	0.098	0.086	0.057	0.096	0.143
ReturnVol	0.049	0.020	0.034	0.042	0.065
R&DDummy	0.534	0.499	0.000	1.000	1.000
Dividend	0.013	0.034	0.000	0.005	0.018
IndepRatio	0.722	0.163	0.625	0.750	0.857
Busy	0.484	0.245	0.300	0.500	0.667
Inactive	0.012	0.043	0.000	0.000	0.000
BoardSize	8.899	2.421	7.000	9.000	10.000
CEOTenure	8.518	7.551	3.000	6.000	11.000
CEOOwnership	0.022	0.057	0.001	0.003	0.012
Duality	0.431	0.495	0.000	0.000	1.000

Table 2: Effect of Female Board Representation on Excess Cash through CEO Overconfidence
This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with *LnSales, Debt-to-Equity*, *ROA, ReturnVol*, *R&DDummy*, *Dividend*, *IndepRatio*, *Busy*, *Inactive*, *LnBoardSize*, *CEOTenure*, *CEOOwnership*, and *Duality* as control variables. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**		
	I	**II**	**III**
FemaleRatio × Overconfidence	0.049***		
	(0.019)		
FemaleRatio	-0.004		
	(0.020)		
FIndepRatio × Overconfidence		0.044***	
		(0.017)	
FIndepRatio		-0.017	
		(0.015)	
TWFemaleRatio × Overconfidence			0.043**
			(0.021)
TWFemaleRatio			0.022
			(0.020)
Overconfidence	-0.017***	-0.018***	-0.016***
	(0.004)	(0.004)	(0.003)
LnSales	-0.009*	-0.009*	-0.009*
	(0.005)	(0.005)	(0.005)
Debt-to-Equity	0.005*	0.005*	0.005*
	(0.003)	(0.003)	(0.003)
ROA	0.152***	0.152***	0.153***
	(0.023)	(0.024)	(0.024)
ReturnVol	5.845	6.590	5.179
	(11.130)	(11.030)	(11.380)
R&DDummy	-0.006	-0.005	-0.005
	(0.009)	(0.009)	(0.009)
Dividend	0.022	0.024	0.021
	(0.023)	(0.023)	(0.023)
IndepRatio	0.012	0.013	0.011
	(0.015)	(0.014)	(0.014)
Busy	-0.002	-0.001	-0.002
	(0.008)	(0.008)	(0.008)
Inactive	0.021	0.022	0.021
	(0.025)	(0.025)	(0.025)
LnBoardSize	-0.006	-0.006	-0.005
	(0.010)	(0.010)	(0.010)
CEOTenure	-0.001	-0.001	-0.001
	(0.031)	(0.031)	(0.031)
CEOOwnership	0.003	0.004	0.002
	(0.060)	(0.060)	(0.061)
Duality	0.002	0.002	0.002
	(0.005)	(0.005)	(0.005)
Constant	-0.376	-0.433	-0.329
	(0.822)	(0.814)	(0.840)
Year and Firm Fixed Effects	YES	YES	YES
Observations	8,017	8,017	8,017
Adjusted R^2	0.027	0.027	0.028

Table 3: First Instrumental Variable (IV) Regression of Excess Cash on Female Board Representation and CEO Overconfidence

This table reports IV regression estimates for *Instrumented* (*FemaleRatio*, *FIndepRatio*, *TWFemaleRatio)*, *Instrumented* (*FemaleRatio* × *Overconfidence*, *FIndepRatio* × *Overconfidence*, *TWFemaleRatio* × *Overconfidence)*, and control variables. Columns I-VI present the first-stage regressions of "female board representation" variables and their interactions with *Overconfidence* on *FMRatio* and *FMRatio* × *Overconfidence* as their instruments, respectively. *FMRatio* is the female participation divided by the male participation in the state where the firm has the headquarter. Columns VII-IX present the second-stage regressions of *ExCash* on *Instrumented* (*FemaleRatio*, *FIndepRatio*, *TWFemaleRatio)* and *Instrumented* (*FemaleRatio* × *Overconfidence*, *FIndepRatio* × *Overconfidence*, *TWFemaleRatio* × *Overconfidence)* from the first-stage regression. All explanatory variables and controls are lagged by one year. Year and Firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. Test statistics for weak instruments, under- and over-identification are given. Variable definitions are given in Table A.1, Appendix. The *** indicates significance at the 1% level.

	First Stage Regressions						**Second Stage Regressions**		
	FemaleRatio	**FemaleRatio× Overconfidence**	**FIndepRatio**	**FIndepRatio× Overconfidence**	**TWFemaleRatio**	**TWFemaleRatio× Overconfidence**	**ExCash**	**ExCash**	**ExCash**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FMRatio × Overconfidence	-0.016	0.463***	0.026	0.581***	0.046	0.483***			
	(0.048)	(0.040)	(0.061)	(0.051)	(0.053)	(0.039)			
FMRatio	0.265***	-0.071***	0.367***	-0.065***	0.212***	-0.076***			
	(0.030)	(0.007)	(0.038)	(0.009)	(0.034)	(0.007)			
Inst(FemaleRatio × Overconfidence)							0.215*		
							(0.115)		
Inst(FemaleRatio)							0.087		
							(0.067)		
Inst(FIndepRatio × Overconfidence)								0.171*	
								(0.095)	
Inst(FIndepRatio)								0.067	
								(0.057)	
Inst(TWFemaleRatio × Overconfidence)									0.195*
									(0.116)
Inst(TWFemaleRatio)									0.302***
									(0.094)
Overconfidence	0.006	-0.266***	-0.030	-0.341***	-0.042	-0.308***	-0.034**	-0.033**	-0.026**
	(0.039)	(0.033)	(0.049)	(0.041)	(0.043)	(0.032)	(0.0144)	(0.013)	(0.011)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year & Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	12,645	12,645	12,645	12,645	12,645	12,645	7,616	7,616	7,616
Adjusted R^2	0.236	0.493	0.192	0.463	0.210	0.389	0.641	0.641	0.642
Weak Inst. Test	147.78	136.76	144.07	155.21	73.89	133.81			
Under-Ident. Test	290.61	269.32	283.44	304.93	146.69	263.60			
Over–Ident. Test							0.700	0.771	0.227

Table 4: Second Instrumental Variable (IV) Regression of Excess Cash on Female Board Representation and CEO Overconfidence

This table reports IV regression estimates for Instrumented (FemaleRatio, FIndepRatio, TWFemaleRatio), Instrumented (FemaleRatio × Overconfidence, FIndepRatio × Overconfidence, TWFemaleRatio × Overconfidence), and control variables. Columns I-VI present the first-stage regressions of "female board representation" variables and their interactions with Overconfidence on LinkedMRatio and LinkedMRatio × Overconfidence as their instruments, respectively. LinkedMRatio is the fraction of male directors on the board who sit on other boards with at least one female director. Columns VII-IX present the second-stage regressions of *ExCash* on *Instrumented* (*FemaleRatio*, *FIndepRatio*, *TWFemaleRatio)* and *Instrumented* (*FemaleRatio* × *Overconfidence*, *FIndepRatio* × *Overconfidence*, *TWFemaleRatio* × *Overconfidence)* from the first-stage regression. All explanatory variables and controls are lagged by one year. Year and Firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. Test statistics for weak instruments, under- and over-identification are given. Variable definitions are given in Table A.1, Appendix. The *** indicates significance at the 1% level.

	First Stage Regressions						**Second Stage Regressions**		
	FemaleRatio	**FemaleRatio× Overconfidence**	**FIndepRatio**	**FIndepRatio× Overconfidence**	**TWFemaleRatio**	**TWFemaleRatio× Overconfidence**	**ExCash**	**ExCash**	**ExCash**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
LinkedMRatio × Overconfidence	0.003	0.133***	0.007	0.150***	-0.017**	0.126***			
	(0.007)	(0.006)	(0.009)	(0.007)	(0.008)	(0.006)			
LinkedMRatio	0.067***	-0.022***	0.071***	-0.028***	0.072***	-0.029***			
	(0.006)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)			
Inst(FemaleRatio × Overconfidence)							0.099*		
							(0.056)		
Inst(FemaleRatio)							0.087*		
							(0.050)		
Inst(FIndepRatio × Overconfidence)								0.089*	
								(0.050)	
Inst(FIndepRatio)								0.066	
								(0.044)	
Inst(TWFemaleRatio × Overconfidence)									0.137***
									(0.053)
Inst(TWFemaleRatio)									0.173***
									(0.067)
Overconfidence	-0.009***	0.075***	-0.012***	0.091***	-0.001	0.051***	-0.020***	-0.021***	-0.021***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.007)	(0.008)	(0.006)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year & Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	12,118	12,118	12,112	12,112	12,114	12,114	7,352	7,352	7,352
Adjusted R^2	0.241	0.528	0.195	0.492	0.215	0.425	0.649	0.649	0.649
Weak Inst. Test	157.97	344.97	132.04	267.06	77.17	298.70			
Under-Ident. Test	310.04	660.92	260.03	516.75	153.09	575.65			
Over–Ident. Test							1.755	1.497	2.211

Table 5: Triple-Difference Analysis of Excess Cash on Female Board Representation and CEO Overconfidence

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* and *Post* along with control variables. *ExCash* represents the excess cash calculated using Eq. (1). The analysis is conducted using three different measures for female board representation: *FemaleRatio, FIndepRatio*, and *TWFemaleRatio. FemaleRatio* × *Overconfidence* × *Post, FIndepRatio* × *Overconfidence* × *Post, TWFemaleRatio* × *Overconfidence* × *Post, FemaleRatio* × *Post, FIndepRatio* × *Post, TWFemaleRatio* × *Post, Overconfidence* × *Post* are the interaction variables of *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio, Overconfidence* and *Post. Post* is a dummy that is equal to one for the years after the SEC regulations in 2003, and zero otherwise. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Timeline for this analysis is between 2000 and 2007. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**		
	I	**II**	**III**
FemaleRatio × Overconfidence × Post	0.082**		
	(0.040)		
FemaleRatio × Post	-0.095***		
	(0.029)		
FIndepRatio × Overconfidence × Post		0.063**	
		(0.031)	
FIndepRatio × Post		-0.065***	
		(0.022)	
TWFemaleRatio × Overconfidence × Post			0.111***
			(0.041)
TWFemaleRatio × Post			-0.079**
			(0.032)
Overconfidence × Post	-0.013	-0.012	-0.012*
	(0.008)	(0.008)	(0.007)
Overconfidence	-0.010**	-0.010**	-0.010**
	(0.004)	(0.004)	(0.004)
Constant	0.680**	0.681**	0.687**
	(0.333)	(0.331)	(0.330)
Control Variables	YES	YES	YES
Year and Firm Fixed Effects	YES	YES	YES
Observations	3,353	3,352	3,353
Adjusted R^2	0.020	0.019	0.020

Table 6: Propensity Score Matching Estimation of Excess Cash on Female Board Representation and CEO Overconfidence

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables using five matched samples. The first (second) matched sample is based on matching firms with more than two (three) female directors with firms having no female directors on board. The third, fourth, and fifth matched samples are based on matching firms which belong to the top 25th percentile of *FemaleRatio*, *FIndepRatio*, and *TWFemaleRatio* with firms belonging to the bottom 25th percentile, respectively. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	ExCash								
	Matched Sample 1			**Matched Sample 2**			**Matched Sample 3**	**Matched Sample 4**	**Matched Sample 5**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio × Overconfidence	0.070*			0.112**			0.105**		
	(0.041)			(0.049)			(0.052)		
FemaleRatio	0.008			0.015			-0.024		
	(0.035)			(0.064)			(0.044)		
FIndepRatio × Overconfidence		0.055*			0.094**			0.052	
		(0.03)			(0.048)			(0.033)	
FIndepRatio		0.0042			-0.063			-0.032	
		(0.029)			(0.048)			(0.035)	
TWFemaleRatio × Overconfidence			0.005			0.035			0.074***
			(0.032)			(0.051)			(0.028)
TWFemaleRatio			-0.008			0.038			0.016
			(0.031)			(0.053)			(0.037)
Overconfidence	-0.019**	-0.018**	-0.005	-0.038***	-0.036**	-0.016	-0.029**	-0.025**	-0.019***
	(0.009)	(0.01)	(0.007)	(0.012)	(0.015)	(0.013)	(0.012)	(0.01)	(0.006)
Constant	0.07	0.07	0.078	-0.062	0.002	-0.076	0.041	-0.044	0.165*
	(0.11)	(0.107)	(0.109)	(0.218)	(0.217)	(0.219)	(0.12)	(0.115)	(0.096)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,958	1,958	1,958	422	422	422	1,618	1,264	2,754
Adjusted R^2	0.046	0.047	0.043	0.094	0.095	0.090	0.054	0.101	0.036

Table 7: Dynamic Panel GMM Analysis of Excess Cash on Female Board Representation and CEO Overconfidence

This table presents the estimates from dynamic GMM regressions of excess cash measured by *ExCash* on *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables. All explanatory variables and controls are lagged by one year. The lags of *ExCash*, and control variables are included as a part of the dynamic GMM model. Year dummies are also included. Variable definitions are available in Table A.1, Appendix. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level. AR(1) and AR(2) are the tests for the first- and second-order serial correlations in the first-differenced residuals, under the null of no serial correlation. The Hansen test of over-identification is under the null that all instruments are valid. The Diff-in-Hansen test of exogeneity is under the null that instruments used for the equations in levels are exogenous. *p*-values of these tests are provided.

Variables:	**ExCash**		
	I	**II**	**III**
(FemaleRatio × Overconfidence) $_{t-1}$	0.346**		
	(0.169)		
FemaleRatio $_{t-1}$	-0.229		
	(0.162)		
(FIndepRatio × Overconfidence) $_{t-1}$		0.249*	
		(0.136)	
FIndepRatio $_{t-1}$		-0.152	
		(0.126)	
(TWFemaleRatio × Overconfidence) $_{t-1}$			0.305*
			(0.179)
TWFemaleRatio $_{t-1}$			-0.188
			(0.150)
Overconfidence $_{t-1}$	-0.059*	-0.043	-0.041
	(0.030)	(0.029)	(0.038)
Excash $_{t-1}$	0.146	0.254	0.175
	(0.176)	(0.186)	(0.210)
Excash $_{t-2}$	0.039	0.034	-0.008
	(0.128)	(0.131)	(0.159)
Constant	0.187	0.142	0.118
	(0.146)	(0.163)	(0.143)
Control Variables	YES	YES	YES
Year Dummies	YES	YES	YES
Observations	6,747	6,747	6,747
Lagging Period for Instruments	14 to 17 years	14 to 17 years	14 to 17 years
AR(1) Test (p-value)	0.013	0.014	0.016
AR(2) Test (p-value)	0.626	0.747	0.927
Hansen Over-Identification (p-value)	0.867	0.609	0.928
Diff-in-Hansen Exogeneity Test (p-value)	0.588	0.734	0.940

Table 8: The Effect of Female Directors and CEO Overconfidence on Value of Cash

This table presents results from OLS panel regressions with *ExcessRet* on the interaction of *FemaleRatio (FIndepRatio* or *TWFemaleRatio), Overconfidence,* and *ΔCashRatio* along with control variables. An intercept is included in the model, but is not reported in this table. Following Faulkender and Wang (2006) and Aktas et al. (2019), the dependent variable *ExcessRet* is a firm's excess return between the current and the previous year, which corresponds to the difference between the firm's stock return and the return of that firm's benchmark portfolio over the same period. Following Daniel and Titman (1997), the benchmark portfolios are the Fama and French (1993) 25 value-weighted portfolios constructed by independent sorting stocks on size and book-to-market characteristics. Control variables are the followings: *ΔCashRatio* is the change in cash holdings between the current and the previous year over market value of equity at the end of previous year. *ΔEarnings* is the change in earnings before extraordinary items over market value of equity. *ΔNetAssets* is the change in net assets over market value of equity. *ΔR&D* is the change in research and development expenses over market value of equity. *ΔInterest* is the change in interest expenses over market value of equity. *ΔDividend* is the change in common dividends over market value of equity. *NetFinancing* is total equity issuance minus repurchases plus debt issuance minus debt redemption, scaled by market value of equity. *CashRatio* is the cash holdings over market value of equity. *Leverage* is the sum of long-term debt and debt in current liabilities over the sum of long-term debt, debt in current liabilities, and market value of equity. Definitions for the remaining variables are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExcessRet**		
	I	**II**	**III**
FemaleRatio×Overconfidence×ΔCashRatio	0.407*		
	(0.238)		
FemaleRatio×Overconfidence	-0.031		
	(0.048)		
FemaleRatio	-0.018		
	(0.040)		
FindepRatio×Overconfidence×ΔCashRatio		0.380*	
		(0.204)	
FindepRatio×Overconfidence		0.016	
		(0.040)	
FindepRatio		-0.011	
		(0.033)	
TWfemaleRatio×Overconfidence×ΔCashRatio			0.384**
			(0.195)
TWfemaleRatio×Overconfidence			-0.011
			(0.037)
TWfemaleRatio			0.005
			(0.031)
Overconfidence	0.006	-0.001	0.003
	(0.009)	(0.009)	(0.007)
ΔCashRatio	-0.028	-0.029	-0.023
	(0.025)	(0.025)	(0.025)
ΔEarnings	0.137	0.136	0.244
	(1.022)	(1.022)	(1.055)
ΔNetAssets	2.958	3.281	2.926
	(10.750)	(10.750)	(10.910)
ΔR&D	3.386	3.591	5.525
	(9.233)	(9.129)	(8.867)
ΔInterest	2.502	2.351	2.666
	(1.612)	(1.605)	(1.630)
ΔDividend	2.999	2.556	3.334
	(6.656)	(6.635)	(6.677)
NetFinancing	0.032	0.033	0.034
	(0.023)	(0.023)	(0.024)
CashRatio	-0.018	-0.018	-0.019
	(0.044)	(0.043)	(0.044)
Leverage	-0.078**	-0.081**	-0.077**
	(0.033)	(0.033)	(0.033)
CashRatio x ΔCashRatio	-0.015	-0.012	-0.007
	(0.259)	(0.260)	(0.259)
Leverage x ΔCashRatio	-0.018	-0.019	-0.037
	(0.070)	(0.070)	(0.072)
Year and Firm FE	YES	YES	YES
Observations	2,765	2,765	2,765
Adjusted R^2	0.845	0.845	0.845

Table 9: Channels Explaining the Effect of Female Directors and CEO Overconfidence on Excess Cash

This table reports estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables. The analyses examine which potential channels to excess cash can explain the relation between female directors, CEO overconfidence and excess cash. We use the changes in operating margin (operating income after depreciation over total revenues), capital expenditures over total assets, and R&D expenditures over total revenues, in Panel A. Panel B includes changes in new financing (issuance of long-term debt plus sale of new stocks scaled by equity market value), dividends over last year's income, and repurchases (purchase of common and preferred stocks over last year's net income). The changes refer to the differences between the current and the next year. All explanatory variables and controls are lagged by one year. Remaining variable definitions are given in Table A.1, Appendix. Control variables, year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Panel A: Analyses Regarding Revenues and Investments

	Change in Operating Margin (ΔOpMargin)			**Change in Capital Expenditures (ΔCapEx)**			**Change in R&D Expenditures (ΔR&DEx)**		
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio×	0.049***			-0.010*			-0.016**		
Overconfidence	(0.016)			(0.006)			(0.007)		
FemaleRatio	0.001			0.003			0.006		
	(0.013)			(0.004)			(0.006)		
FIndepRatio×		0.033***			-0.008*			-0.010*	
Overconfidence		(0.012)			(0.004)			(0.006)	
FIndepRatio		0.003			0.003			0.005	
		(0.009)			(0.003)			(0.004)	
TWFemaleRatio×			0.039***			-0.013***			-0.005
Overconfidence			(0.015)			(0.005)			(0.006)
TWFemaleRatio			0.006			0.003			-0.001
			(0.012)			(0.004)			(0.004)
Overconfidence	-0.002	-0.001	0.001	0.004***	0.004***	0.005***	0.001	0.001	-0.001
	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year & Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	12,780	12,771	12,775	13,432	13,422	13,426	9,058	9,055	9,053
Adjusted R^2	0.189	0.189	0.189	0.051	0.040	0.051	0.082	0.082	0.082

Table 9: Channels Explaining the Effect of Female Directors and CEO Overconfidence on Excess Cash (continued)

Panel B: Analyses Regarding New Financing, Dividends and Share Repurchases Policies

	Change in New Financing (ΔNewFin)			Change in Dividends (ΔDividend)			Change in Repurchases (ΔRepurchase)		
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio×	0.016			-0.093			-0.378*		
Overconfidence	(0.054)			(0.104)			(0.228)		
FemaleRatio	-0.006			0.122			0.002		
	(0.048)			(0.098)			(0.181)		
FIndepRatio×		0.026			-0.045			-0.177	
Overconfidence		(0.043)			(0.077)			(0.173)	
FIndepRatio		0.005			0.080			-0.086	
		(0.037)			(0.076)			(0.134)	
TWFemaleRatio×			0.011			-0.008			-0.029
Overconfidence			(0.048)			(0.104)			(0.221)
TWFemaleRatio			-0.010			0.006			0.042
			(0.037)			(0.086)			(0.161)
Overconfidence	-0.018**	-0.020**	-0.018**	-0.010	-0.014	-0.020	0.037	0.017	-0.005
	(0.009)	(0.008)	(0.008)	(0.016)	(0.015)	(0.014)	(0.035)	(0.034)	(0.031)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year & Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	11,514	11,506	11,509	12,243	12,237	12,239	11,461	11,455	11,458
Adjusted R^2	0.074	0.074	0.074	0.018	0.018	0.018	0.033	0.033	0.033

Table 10: The Role of Cash Flow

This table provides estimates from a firm fixed-effect IV estimation of a regression model, which is estimated on the pooled data over the period 2000-2017. *CashFlow* $_{IV}$ equals the ratio of operating income before depreciation less interest expense less income taxes less common and preferred dividends to book value of net assets. *Growth* $_{IV}$ equals the ratio of the market value of assets to book value of net assets, where the market value of assets equals the market value of equity plus the book value of total liabilities. *Net Assets* $_{IV}$ equals the difference between total assets and cash & short-term investments. *Size* $_{IV}$ equals the natural logarithm of the book value of net assets. *CAPEX* $_{IV}$ equals the ratio of capital expenditures to net assets. *Acquisitions* $_{IV}$ equals the ratio of acquisitions to net assets. *ΔNWC* $_{IV}$ equals the change in net working capital (net of cash and short-term investments) over the fiscal year divided by net assets. *ΔShort-Term Debt* $_{IV}$ equals the change in debt in current liabilities over the fiscal year divided by net assets. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are based on the conventionally-derived variance estimator for generalized least-squares regression and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ΔExCash**		
	I	**II**	**III**
FemaleRatio×Overconfidence×CashFlow $_{IV}$	0.346*		
	(0.192)		
FemaleRatio×CashFlow $_{IV}$	-0.246***		
	(0.078)		
FemaleRatio×Overconfidence	-0.02		
	(0.03)		
FemaleRatio	0.027		
	(0.016)		
FindepRatio×Overconfidence×CashFlow $_{IV}$		0.265*	
		(0.155)	
FindepRatio×CashFlow $_{IV}$		-0.211***	
		(0.064)	
FindepRatio×Overconfidence		-0.005	
		(0.024)	
FindepRatio		0.022*	
		(0.013)	
TWfemaleRatio×Overconfidence×CashFlow $_{IV}$			0.415***
			(0.155)
TWfemaleRatio×CashFlow $_{IV}$			-0.232***
			(0.071)
TWfemaleRatio×Overconfidence			-0.036
			(0.026)
TWfemaleRatio			0.033**
			(0.014)
Overconfidence×CashFlow $_{IV}$	-0.03	-0.025	-0.026**
	(0.028)	(0.027)	(0.011)
Overconfidence	-0.002	-0.004	-0.001
	(0.005)	(0.005)	(0.003)
CashFlow $_{IV}$	0.119***	0.118***	0.114***
	(0.035)	(0.035)	(0.035)
Size $_{IV}$	-0.02***	-0.02***	-0.021***
	(0.003)	(0.003)	(0.003)
CAPEX $_{IV}$	-0.282	-0.240	-0.311
	(0.394)	(0.393)	(0.4)
Growth $_{IV}$	-0.009***	-0.009***	-0.009***
	(0.002)	(0.002)	(0.002)
Aquisitions $_{IV}$	0.086***	0.088***	0.085***
	(0.024)	(0.024)	(0.024)
ΔNWC $_{IV}$	0.282***	0.283***	0.282***
	(0.024)	(0.024)	(0.024)
ΔShort-Term Debt $_{IV}$	0.233***	0.232***	0.234***
	(0.023)	(0.022)	(0.023)
Year and Firm FE	YES	YES	YES
Observations	6,974	6,974	6,974
Adjusted R^2	0.334	0.340	0.331

Figure 1: Female Board Representation and Excess Cash

This figure shows the distribution of female board representation and excess cash levels across years. *FemaleRatio, FIndepRatio,* and *TWFemaleRatio* describe the fraction of female directors on the board in percentages. *ExCash* gives the level of excess cash holdings per year. Variable definitions are given in Table A.1, Appendix.

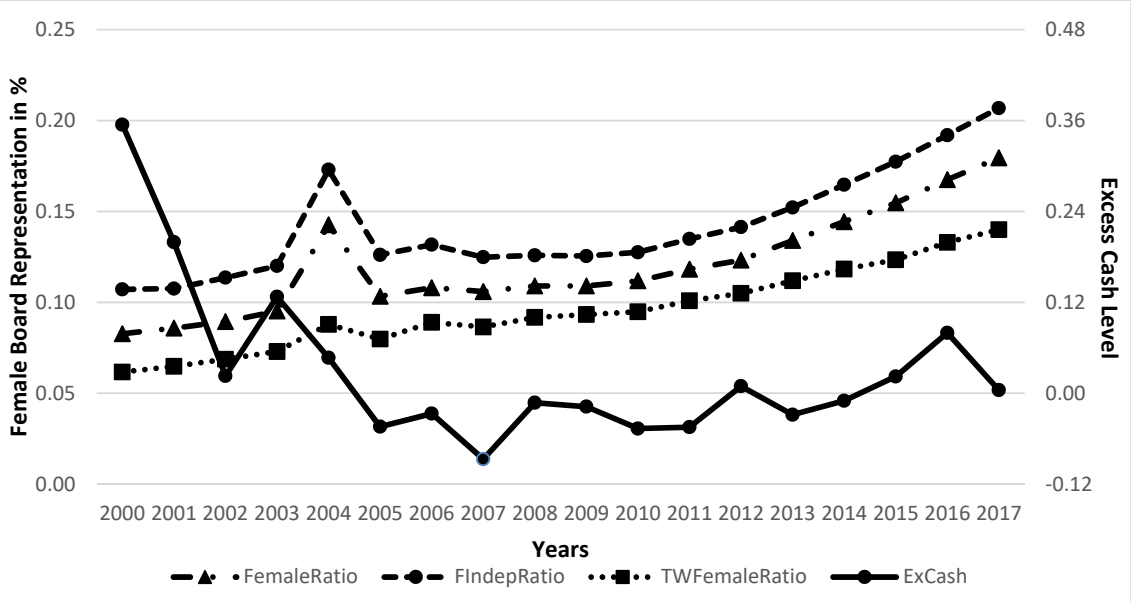
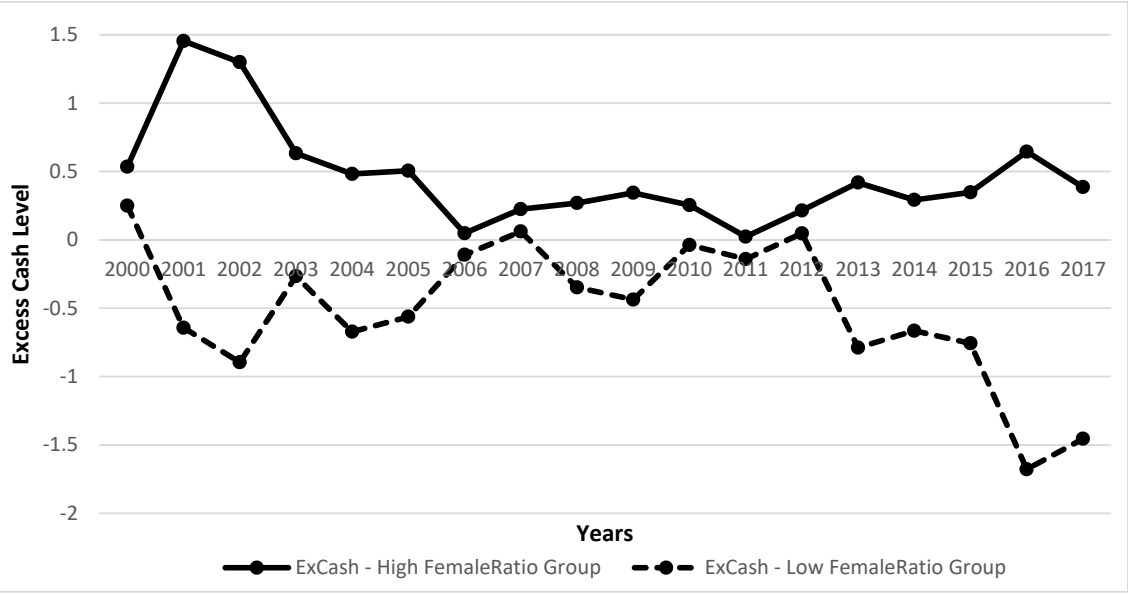


Figure 2: Excess Cash Level For Different Female Ratio Groups

This figure shows the distribution of excess cash across years for firms belonging to different *FemaleRatio* groups. A firm is in the high (low) female ratio group if the *FemaleRatio* of that firm is above (below) median value of *FemaleRatio* across all firms. Variable definitions are given in Table A.1, Appendix.



Appendix A

Table A.1: Definition of Variables

Variables	Description
ExCash	The residual of a cross-sectional regression of cash holdings on firm characteristics using the following equation: $Cash_i = \alpha + \beta_1 CF_i + \beta_2 Leverage_i + \beta_3 MTB_i + \beta_4 Size_i + \beta_5 NWC_i + \beta_6 CAPEX_i + \beta_7 Div_i + \beta_8 R\&D_i + \beta_9 IndustrySigma_i + \beta_{10} Aquisition_i + \beta_{11} Age_i + \varepsilon_i$ (1) The dependent variable $Cash_i$ is the cash and short-term investments scaled by total assets. The independent variables include CF_i earnings before interest, tax, depreciation and amortization plus current liabilities less current assets less capital expenditures scaled by net sales; $Leverage_i$ the long-term debt plus debt in current liabilities scaled by total assets; MTB_i the market value of equity plus total assets less common equity scaled by total assets; $Size_i$ natural logarithm of total assets; NWC_i working capital less cash less marketable security adjustments scaled by total assets; $CAPEX_i$ capital expenditures scaled by total assets; Div_i a dummy variable with a value of one if a firm pays dividends and zero, otherwise; $R\&D_i$ research and development expenses scaled by net sales; $IndustrySigma_i$ industry cash flow risk, defined as the mean of the ratio of the standard deviations of cash flows dividend by the total assets over 20 years for firms in the same industry (2-digit SIC code); $Aquisition_i$ the value of acquisitions; and Age_i the natural logarithm of firm age.
FemaleRatio	The number of female directors on the board scaled by the board size.
FIndepRatio	The number of outsider female-directors on the board scaled by the number of all outsider directors on the board.
TWFemaleRatio	The weighted fraction of female directors with the weights being the tenure of each female director relative to the total board tenure.
OptionMoneyness	Following Campbell et al. (2011), for each year, we calculate the realizable value per option as the ratio of the total realizable value of exercisable options to the number of exercisable options. Second, we subtract the realizable value per option from the fiscal-year-end stock price to obtain an estimate of the average exercise price of options. Finally, to compute the average percentage moneyness of the options, we divide the realizable value per option by the estimated average exercise price.
Overconfidence	A dummy that equals one if the average CEO option moneyness for the industry in that year (using the 2-digit SIC code) is greater than the median average CEO option moneyness across all industries.
LnSales	The natural logarithm of net sales.
ROA	Return on Assets is the earnings before interest and tax scaled by total assets.
Debt-to-Equity	Long-term debt plus debt in current liabilities scaled by the market value of equity.
ReturnVol	The standard deviation of monthly equally weighted stock returns.
R&DDummy	A dummy that is equal to one if a firm invests in R&D that year, and zero otherwise.
Dividend	Dividends scaled by the market value of equity.
IndepRatio	The number of outsider directors on the board scaled by the board size.
Busy	The number of directors on the board who also sit on the board of other firms scaled by the board size.
Inactive	The number of directors on the board who attend less than 75% of the board meetings in that year scaled by the board size.
LnBoardSize	The natural logarithm of total number of directors on the board.
CEOTenure	The number of years the CEO has been in position.
CEOOwnership	The fraction of total shares outstanding owned by the CEO.
Duality	A dummy that is equal to one if the CEO is also the chairman of the board.

Appendix B – Supplementary data

Table B.1: Individual Effect of CEO Overconfidence and Female Board Representation on Excess Cash

This table reports analysis estimates for *Overconfidence, FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* along with *LnSales, Debt-to-Equity*, *ROA, ReturnVol*, *R&DDummy*, *Dividend*, *IndepRatio*, *Busy*, *Inactive*, *LnBoardSize*, *CEOTenure*, *CEOOwnership*, and *Duality* as control variables. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**			
	I	**II**	**III**	**IV**
Overconfidence	-0.012***			
	(0.002)			
FemaleRatio		0.007		
		(0.018)		
FIndepRatio			-0.004	
			(0.014)	
TWFemaleRatio				0.034*
				(0.018)
LnSales	-0.009*	-0.011**	-0.011**	-0.012**
	(0.005)	(0.005)	(0.005)	(0.005)
Debt-to-Equity	0.005*	0.009***	0.009***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
ROA	0.153***	0.141***	0.141***	0.141***
	(0.024)	(0.024)	(0.024)	(0.024)
ReturnVol	5.793	2.124	2.232	1.344
	(11.050)	(8.066)	(8.051)	(8.147)
R&DDummy	-0.006	-0.004	-0.004	-0.003
	(0.009)	(0.007)	(0.007)	(0.007)
Dividend	0.023	0.028	0.029	0.027
	(0.023)	(0.030)	(0.030)	(0.030)
IndepRatio	0.013	0.007	0.008	0.005
	(0.014)	(0.014)	(0.014)	(0.014)
Busy	-0.001	0.001	0.001	-0.001
	(0.008)	(0.008)	(0.008)	(0.008)
Inactive	0.019	0.023	0.023	0.024
	(0.025)	(0.024)	(0.024)	(0.024)
LnBoardSize	-0.005	-0.007	-0.006	-0.005
	(0.0010)	(0.009)	(0.009)	(0.009)
CEOTenure	-0.001	-0.001	-0.001	-0.001
	(0.003)	(0.001)	(0.002)	(0.003)
CEOOwnership	0.009	0.018	0.019	0.017
	(0.060)	(0.043)	(0.043)	(0.043)
Duality	0.002	0.001	0.001	0.001
	(0.005)	(0.004)	(0.004)	(0.004)
Constant	-0.377	-0.089	-0.098	-0.031
	(0.816)	(0.597)	(0.596)	(0.603)
Year and Firm Fixed Effects	YES	YES	YES	YES
Observations	8,017	9,157	9,157	9,157
Adjusted R^2	0.026	0.019	0.019	0.020

Table B.2: Collinearity Analysis for the Triple-Difference Model

This table presents the results for measures of the strength of interrelationships among variables. Panel A gives the correlation matrix outcomes for the variables under investigation. Panels B and C show the results for multicollinearity analyses including and excluding *FemaleRatio* × *Overconfidence* and *FemaleRatio*, respectively. Variance Inflation Factor (VIF) is an indicator of how much inflation of the standard error can be caused by collinearity. Tolerance is an indicator of how much collinearity that a regression can tolerate. The tolerance for a particular variable is 1 minus the R^2 that results from the regression of the other variables on that variable. Variable definitions are available in Table A.1, Appendix.

Panel A: Correlation Matrix for Variables with *FemaleRatio*, *Overconfidence* and *Post*

		A	B	C	D	E	F
FemaleRatio × *Overconfidence* × *Post*	**A**	1					
FemaleRatio × *Post*	**B**	0.488	1				
Overconfidence × *Post*	**C**	0.723	0.220	1			
FemaleRatio × *Overconfidence*	**D**	0.836	0.322	0.576	1		
FemaleRatio	**E**	0.374	0.773	0.052	0.425	1	
Overconfidence	**F**	0.513	-0.039	0.710	0.648	-0.056	1

Panel B: Multicollinearity Analysis for the Model with *FemaleRatio* × *Overconfidence* and *FemaleRatio*

	VIF	Tolerance	R^2
FemaleRatio × *Overconfidence* × *Post*	8.01	0.125	0.875
FemaleRatio × *Post*	3.81	0.262	0.738
Overconfidence × *Post*	3.99	0.250	0.750
FemaleRatio × *Overconfidence*	7.77	0.129	0.871
FemaleRatio	3.92	0.255	0.745
Overconfidence	3.78	0.265	0.735
Mean VIF	5.21		

Panel C: Multicollinearity Analysis for the Model without *FemaleRatio* × *Overconfidence* and *FemaleRatio*

	VIF	Tolerance	R^2
FemaleRatio × *Overconfidence* × *Post*	2.83	0.353	0.647
FemaleRatio × *Post*	1.54	0.649	0.351
Overconfidence × *Post*	3.11	0.321	0.679
Overconfidence	2.25	0.444	0.556
Mean VIF	2.43		

Table B.3 : Analyses with High CEO Overconfidence Level

This table reports estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables using the group of firms with high CEO overconfidence level. Firms are assigned to high CEO overconfidence group if the CEOs' *moneyness* belongs to the top 15th percentile of that year. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Control variables, year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**		
	I	**II**	**III**
FemaleRatio ×	0.108**		
Overconfidence	(0.054)		
FemaleRatio	-0.047		
	(0.053)		
FIndepRatio ×		0.086**	
Overconfidence		(0.042)	
FIndepRatio		-0.040	
		(0.039)	
TWFemaleRatio ×			0.166***
Overconfidence			(0.060)
TWFemaleRatio			-0.012
			(0.053)
Overconfidence	-0.022***	-0.022***	-0.024***
	(0.008)	(0.008)	(0.007)
Constant	-2.205***	-2.339***	-2.149***
	(0.293)	(0.303)	(0.299)
Control Variables	YES	YES	YES
Year and Firm FE	YES	YES	YES
Observations	990	990	989
Adjusted R^2	0.08	0.08	0.082

Table B.4 : Analyses with Alternative CEO Overconfidence Definitions

This reports analysis estimates using alternative CEO overconfidence definitions. *ExCash* is regressed on *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* $_{FF48}$, *OverconfidenceRep* $_{FF48}$ along with control variables. *Overconfidence* $_{FF48}$ is a dummy that equals one if the average CEO option moneyness for the industry in that year (using the Fama-French industry classification) is greater than the median average CEO option moneyness across all industries. *OverconfidenceRep* $_{FF48}$ is a binary variable that equals one if the fraction of overconfident CEOs for an industry in that year is greater than the sample median across all industries, and zero otherwise, with overconfident CEOs being those who hold stock options that are more than 67% in the money. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	Overconfidence by FF48 Industries			**OverconfidenceRep by FF48 Industries**		
	ExCash			**ExCash**		
	I	**II**	**III**	**IV**	**V**	**VI**
FemaleRatio × Overconfidence $_{FF48}$	0.035*					
	(0.020)					
FIndepRatio × Overconfidence $_{FF48}$		0.026*				
		(0.015)				
TWFemaleRatio × Overconfidence $_{FF48}$			0.031*			
			(0.018)			
FemaleRatio × OverconfidenceRep $_{FF48}$				0.049**		
				(0.023)		
FIndepRatio × OverconfidenceRep $_{FF48}$					0.031*	
					(0.018)	
TWFemaleRatio × OverconfidenceRep $_{FF48}$						0.049**
						(0.023)
FemaleRatio	-0.007			-0.013		
	(0.019)			(0.022)		
FIndepRatio		-0.015			-0.016	
		(0.015)			(0.016)	
TWFemaleRatio			0.021			0.012
			(0.020)			(0.021)
Overconfidence $_{FF48}$	-0.010***	-0.010***	-0.009***			
	(0.003)	(0.003)	(0.003)			
OverconfidenceRep $_{FF48}$				-0.010**	-0.008**	-0.009**
				(0.004)	(0.004)	(0.004)
Constant	-0.074	-0.099	-0.009	-0.457	-0.476	-0.382
	(0.610)	(0.610)	(0.620)	(0.855)	(0.826)	(0.858)
Control Variables	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES
Observations	8,701	8,701	8,701	8,017	8,017	8,017
Adjusted R^2	0.021	0.021	0.022	0.021	0.021	0.022

Table B.5: Analyses with Additional CEO Overconfidence Measures

This table reports analysis estimates using additional CEO overconfidence measures. *ExCash* is regressed on *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *UEOptionPayRatio*, *LnUEOptionValue*, *ValueRatio* along with control variables. *UEOptionPayRatio* is the value of unexercised exercisable options scaled by the CEO total pay. *LnUEOptionValue* is the natural logarithm of the value of unexercised exercisable options. *ValueRatio* is the intrinsic value scaled by the strike price of the option, where the intrinsic value is calculated as the stock price at exercise minus the strike price. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	ExCash								
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio × UEOptionPayRatio	0.081***								
	(0.026)								
FIndepRatio × UEOptionPayRatio		0.016*							
		(0.009)							
TWFemaleRatio × UEOptionPayRatio			0.078***						
			(0.025)						
FemaleRatio × LnUEOptionValue				0.010*					
				(0.006)					
FIndepRatio × LnUEOptionValue					0.009*				
					(0.005)				
TWFemaleRatio × LnUEOptionValue						0.011**			
						(0.005)			
FemaleRatio × ValueRatio							0.068*		
							(0.041)		
FIndepRatio × ValueRatio								0.063*	
								(0.038)	
TWFemaleRatio × ValueRatio									0.060*
									(0.034)

Table B.5: Analyses with Additional CEO Overconfidence Measures (continued)

	ExCash								
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio	0.002			-0.074			0.013		
	(0.018)			(0.052)			(0.019)		
FIndepRatio		-0.006			-0.071*			-0.001	
		(0.014)			(0.041)			(0.014)	
TWFemaleRatio			0.032*			-0.042			0.044**
			(0.018)			(0.041)			(0.019)
UEOptionPayRatio	-0.160***	-0.147***	-0.155***						
	(0.041)	(0.040)	(0.041)						
LnUEOptionValue				-0.003***	-0.003***	-0.003***			
				(0.001)	(0.001)	(0.001)			
ValueRatio							-0.013*	-0.013*	-0.010**
							(0.007)	(0.007)	(0.005)
Constant	-0.104	-0.116	-0.045	-0.832	-0.843	-0.776	-0.405	-0.408	-0.350
	(0.599)	(0.595)	(0.602)	(0.890)	(0.858)	(0.868)	(0.708)	(0.706)	(0.710)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	9,139	9,136	9,135	7,080	7,078	7,078	7,322	7,321	7,318
Adjusted R^2	0.026	0.025	0.026	0.027	0.027	0.029	0.024	0.024	0.026

Table B.6: Further Analyses with Subsamples Regarding Different CEO Related Issues

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables. The analyses are conducted using three different subsamples: a) CEOs serving in the same firm for at least 4 years; b) No entrenchment: CEOs serving in the same firm with the tenure below 75th percentile of sample CEO tenure; c) Exclusion of the years when there is a CEO change in the firm. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	ExCash								
	The CEO Serves at least 4 Years			**No Entrenchment**			**No Years with CEO Change**		
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio × Overconfidence	0.052**			0.049*			0.047**		
	(0.022)			(0.026)			(0.021)		
FemaleRatio	-0.003			0.004			-0.001		
	(0.021)			(0.023)			(0.020)		
FIndepRatio × Overconfidence		0.045**			0.048**			0.038**	
		(0.019)			(0.021)			(0.017)	
FIndepRatio		-0.019			-0.001			-0.016	
		(0.016)			(0.019)			(0.015)	
TWFemaleRatio × Overconfidence			0.045**			0.038*			0.045**
			(0.022)			(0.023)			(0.021)
TWFemaleRatio			0.021			0.025			0.019
			(0.020)			(0.025)			(0.020)
Overconfidence	-0.019***	-0.019***	-0.017***	-0.014***	-0.015***	-0.012***	-0.018***	-0.018***	-0.017***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)
Constant	-2.129***	-2.172***	-2.066***	0.083*	0.082	0.079	-0.375	-0.427	-0.331
	(0.148)	(0.148)	(0.150)	(0.051)	(0.050)	(0.050)	(0.821)	(0.811)	(0.841)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	6,707	6,707	6,707	4,835	4,835	4,835	7,589	7,589	7,589
Adjusted R^2	0.034	0.034	0.035	0.018	0.019	0.019	0.029	0.029	0.030

Table B.7: Analyses Regarding Potential CFO and Board Influence

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence, CFOOverconfidence,* and *BoardOverconfidence* along with control variables. The model includes additional controls for CFO and the Board influence. *CFOOverconfidence* (*BoardOverconfidence)* is defined as a dummy that equals one if the average CFO (Board) option moneyness for the industry in that year using the 2-digit SIC code is greater than the median average CFO (Board) option moneyness across all industries. For Board option moneyness, the executive members of the Board are included. *CFOAge* is the age of CFO. *CFOOwnership* is number of shares owned by the CFO over the total number of shares outstanding. All explanatory variables and controls are lagged by one year. Remaining variable definitions are given in Table A.1, Appendix. Main control variables, year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Dependent Variable: Excash	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
FemaleRatio × Overconfidence	0.052*			0.045**			0.054**		
	(0.031)			(0.021)			(0.021)		
FemaleRatio	0.059*			-0.001			-0.006		
	(0.035)			(0.020)			(0.020)		
FIndepRatio × Overconfidence		0.054**			0.034**			0.046***	
		(0.026)			(0.017)			(0.017)	
FIndepRatio		0.041			-0.014			-0.018	
		(0.028)			(0.016)			(0.015)	
TWFemaleRatio × Overconfidence			0.088*			0.039*			0.049**
			(0.047)			(0.020)			(0.022)
TWFemaleRatio			0.051			0.025			0.019
			(0.034)			(0.021)			(0.020)
Overconfidence	-0.015***	-0.017***	-0.016***	-0.015***	-0.014***	-0.013***	-0.008	-0.011	-0.006
	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)	(0.011)	(0.012)	(0.012)
CFOOverconfidence	0.004	0.004	0.003						
	(0.004)	(0.004)	(0.003)						
CFOAge	0.001	0.001	0.001						
	(0.001)	(0.001)	(0.001)						
CFOOwnership	-0.001	-0.001	-0.001						
	(0.002)	(0.002)	(0.002)						
BoardOverconfidence				-0.001	-0.001	-0.001			
				(0.003)	(0.003)	(0.003)			
IndepRatio × Overconfidence							-0.013	-0.0010	-0.013
							(0.015)	(0.015)	(0.016)
Year and Firm FE, and Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2,299	2,299	2,299	7,578	7,578	7,578	8,017	8,017	8,017
Adjusted R^2	0.059	0.060	0.059	0.028	0.027	0.029	0.027	0.027	0.028

Table B.8: Placebo Tests by Replacing the CEO Overconfidence with the CFO and the Board Overconfidence

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *CFOOverconfidence* and *BoardOverconfidence,* respectively, along with control variables. *CFOOverconfidence* (*BoardOverconfidence)* is defined as a dummy that equals one if the average CFO (Board) option moneyness for the industry in that year using the 2-digit SIC code is greater than the median average CFO (Board) option moneyness across all industries. For Board option moneyness, the executive members of the Board are included. All explanatory variables and controls are lagged by one year. Remaining variable definitions are given in Table A.1, Appendix. Main control variables, year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	ExCash					
	I	**II**	**III**	**IV**	**V**	**VI**
FemaleRatio × CFOOverconfidence	0.052					
	(0.036)					
FemaleRatio	0.044					
	(0.036)					
FIndepRatio × CFOOverconfidence		0.044*				
		(0.026)				
FIndepRatio		0.032				
		(0.028)				
TWFemaleRatio × CFOOverconfidence			0.053*			
			(0.031)			
TWFemaleRatio			0.050			
			(0.034)			
CFOOverconfidence	-0.004	-0.004	-0.004			
	(0.006)	(0.006)	(0.005)			
FemaleRatio × BoardOverconfidence				0.035*		
				(0.020)		
FemaleRatio				0.0051		
				(0.020)		
FIndepRatio × BoardOverconfidence					0.024	
					(0.017)	
FIndepRatio					-0.008	
					(0.015)	
TWFemaleRatio × BoardOverconfidence						0.028
						(0.020)
TWFemaleRatio						0.029
						(0.021)
BoardOverconfidence				-0.013***	-0.013***	-0.012***
				(0.004)	(0.004)	(0.003)
Other Control Variables	YES	YES	YES	YES	YES	YES
Year and Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Observations	2,567	2,567	2,567	7,842	7,842	7,842
Adjusted R^2	0.047	0.047	0.048	0.026	0.025	0.027

Table B.9: Analysis Focusing on Non-Coopted Boards

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables. The analysis is conducted using new variables for female directors on the non-coopted board. Following Coles, Daniel, Naveen (2014), we reconstruct our main female director variables considering that the female director should be appointed before the current CEO assumes office. All explanatory variables and controls are lagged by one year. Remaining variable definitions are given in Table A.1, Appendix. Control variables, year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**		
	I	**II**	**III**
$FemaleRatio_{noncoopted}$ × Overconfidence	0.050*		
	(0.030)		
$FemaleRatio_{noncoopted}$	0.038**		
	(0.017)		
$FIndepRatio_{noncoopted}$ × Overconfidence		0.038**	
		(0.015)	
$FIndepRatio_{noncoopted}$		0.009	
		(0.007)	
$TWFemaleRatio_{noncoopted}$ × Overconfidence			0.050**
			(0.026)
$TWFemaleRatio_{noncoopted}$			0.032**
			(0.013)
Overconfidence	-0.013***	-0.013***	-0.013***
	(0.002)	(0.002)	(0.002)
Constant	-0.338	-0.346	-0.330
	(0.770)	(0.770)	(0.769)
Control Variables	YES	YES	YES
Year and Firm Fixed Effects	YES	YES	YES
Observations	8,017	8,017	8,017
Adjusted R^2	0.026	0.026	0.027

Table B.10: Analysis Excluding the IPO and Follow-up Years

This table reports analysis estimates for *FemaleRatio*, *FIndepRatio*, *TWFemaleRatio* and their interaction with *Overconfidence* along with control variables. The analysis is conducted by excluding the IPO and following three years. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

Variables:	**ExCash**		
	I	**II**	**III**
FemaleRatio × Overconfidence	0.057*		
	(0.031)		
FemaleRatio	0.023		
	(0.032)		
FIndepRatio × Overconfidence		0.052**	
		(0.024)	
FIndepRatio		0.004	
		(0.023)	
TWFemaleRatio × Overconfidence			0.063*
			(0.035)
TWFemaleRatio			0.039
			(0.042)
Overconfidence	-0.023***	-0.024***	-0.022***
	(0.005)	(0.005)	(0.005)
Constant	-1.318	-1.331	-1.238
	(1.241)	(1.247)	(1.222)
Control Variables	YES	YES	YES
Year and Firm Fixed Effects	YES	YES	YES
Observations	3,808	3,808	3,808
Adjusted R^2	0.038	0.039	0.039

Table B.11: Placebo Tests

This table reports estimates from analyses replacing variables of female board representation with other variables of female director, the board and the CEO characteristics. The analyses are conducted using the following placebo variables: *FemaleTenure* is the average tenure of female directors on the board; *FOwnership* is the fraction of shares owned by female directors on the board; *BoardTenure* is the average tenure of all directors on the board; *BEthnicity* is the fraction of directors on the board with "white" ethnicity; *BOwnership* is the fraction of shares owned by all directors on the board; *IndepRatio* is the number of outsider directors on the board scaled by the board size; *IOwnership* is the fraction of shares owned by institutional investors; *EIndex* is the Entrenchment Index (Gompers et al., 2003); *CEOChange* is a dummy that is equal to one for the years when the CEO of the firm changes, and zero otherwise; *CEOPay* is the CEO total pay in $Million. All explanatory variables and controls are lagged by one year. Variable definitions are in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors (in parentheses) are clustered by firms. The *** indicates statistical significance at the 1% level.

	ExCash									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**
FemaleTenure × Overconfidence	-0.056									
	(0.062)									
FemaleTenure	0.056									
	(0.044)									
FOwnership × Overconfidence		-0.236*								
		(0.131)								
FOwnership		0.033								
		(0.121)								
BoardTenure × Overconfidence			-0.036							
			(0.067)							
BoardTenure			0.021							
			(0.063)							
BEthnicity × Overconfidence				0.001						
				(0.006)						
BEthnicity				-0.001						
				(0.005)						
BOwnership × Overconfidence					-0.026					
					(0.020)					
BOwnership					0.009					
					(0.023)					
IndepRatio × Overconfidence						-0.004				
						(0.015)				
IndepRatio						0.014				
						(0.015)				

Table B.11: Placebo Tests (continued)

	ExCash									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**
IOwnership × Overconfidence							-0.005			
							(0.016)			
IOwnership							-0.015			
							(0.020)			
EIndex × Overconfidence								0.001		
								(0.002)		
EIndex								0.001		
								(0.002)		
CEOChange × Overconfidence									0.009	
									(0.008)	
CEOChange									0.008*	
									(0.004)	
CEOPay × Overconfidence										-0.068
										(0.203)
CEOPay										-0.240
										(0.218)
Overconfidence	-0.005	-0.008***	-0.008	-0.012***	-0.010***	-0.009	-0.006	-0.014**	-0.012***	-0.011***
	(0.004)	(0.002)	(0.006)	(0.005)	(0.003)	(0.012)	(0.014)	(0.006)	(0.002)	(0.003)
Constant	-0.672	-0.650	-0.389	-0.381	-0.360	-0.385	-0.945***	-2.181***	-0.381	-0.404
	(0.750)	(0.748)	(0.817)	(0.818)	(0.808)	(0.816)	(0.179)	(0.213)	(0.819)	(0.802)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,411	5,411	8,017	8,017	8,017	8,017	7,335	6,264	8,017	8,017
Adjusted R^2	0.041	0.043	0.026	0.026	0.026	0.026	0.030	0.036	0.027	0.027

Table B.12: The Role of Cash Flow for Financially Constrained Firms

This table provides estimates from a firm fixed-effect IV estimation of a regression model with financially constrained firms only. The model is estimated on the pooled data over the period 2000-2017. The analyses are conducted on three different subsamples of financially constrained firms depending on the definition of financial constraints. We define firms in a particular year as financially constrained if they: (i) fall in the top tertile value of the SA index, (ii) fall in the bottom tertile of the dividend ratio, (iii) and have no credit rating information on the debt or its long-term debt is associated with a speculative grade rating. All explanatory variables and controls are lagged by one year. Variable definitions are given in Table A.1, Appendix. Year and firm fixed effects are included. Standard errors are clustered by firms and given in parentheses. The *** indicates statistical significance at the 1% level.

	ExCash								
	SA index			Dividend Ratio			Credit Rating		
	I	II	III	IV	V	VI	VII	VIII	IX
FemaleRatio×Overconfidence×CashFlow $_{IV}$	1.057*			0.600***			0.629*		
	(0.611)			(0.205)			(0.346)		
FemaleRatio×CashFlow $_{IV}$	-0.223			-0.341**			-0.486**		
	(0.495)			(0.139)			(0.243)		
FemaleRatio×Overconfidence	-0.089			-0.054			-0.043		
	(0.084)			(0.048)			(0.044)		
FemaleRatio	0.032			0.046			0.059*		
	(0.052)			(0.04)			(0.031)		
FindepRatio×Overconfidence×CashFlow $_{IV}$		0.953**			0.526***			0.368*	
		(0.423)			(0.168)			(0.219)	
FindepRatio×CashFlow $_{IV}$		-0.082			-0.284***			-0.456**	
		(0.458)			(0.110)			(0.209)	
FindepRatio×Overconfidence		-0.064			-0.022			-0.014	
		(0.054)			(0.036)			(0.03)	
FindepRatio		0.036			0.013			0.046*	
		(0.045)			(0.028)			(0.025)	
TWfemaleRatio×Overconfidence×CashFlow $_{IV}$			0.574*			0.691**			0.780**
			(0.345)			(0.293)			(0.377)
TWfemaleRatio×CashFlow $_{IV}$			0.016			-0.298**			-0.432**
			(0.250)			(0.129)			(0.205)
TWfemaleRatio×Overconfidence			-0.029			-0.084			-0.071*
			(0.043)			(0.057)			(0.042)
TWfemaleRatio			0.002			0.057			0.076***
			(0.028)			(0.035)			(0.029)

Table B.12: The Role of Cash Flow Using Subsamples of Financially Constrained Firms (continued)

	ExCash								
	SA index			Dividend Ratio			Credit Rating		
	I	II	III	IV	V	VI	VII	VIII	IX
Overconfidence×CashFlow $_{IV}$	-0.130	-0.121	-0.023	-0.062**	-0.065**	-0.047***	-0.089*	-0.068	-0.101*
	(0.11)	(0.085)	(0.059)	(0.029)	(0.026)	(0.017)	(0.049)	(0.05)	(0.052)
Overconfidence	0.009	0.005	-0.003	0.003	0.0008	0.004	0.005	0.002	0.008
	(0.015)	(0.012)	(0.008)	(0.007)	(0.007)	(0.005)	(0.008)	(0.007)	(0.007)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year and Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	2,347	2,347	2,347	2,992	2,992	2,992	2,831	2,831	2,831
Adjusted R^2	0.059	0.037	0.247	0.035	0.047	0.030	0.296	0.306	0.296