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Board Gender Diversity and Corporate Cash Holdings¹

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Abstract This study investigates the relationship between boardroom gender diversity and corporate cash holdings (i.e., liquidity risk) and excess cash holdings (i.e., agency risk). Using a sample of French firms listed on the SBF 120 index over the period 1998 to 2015, we find a significant positive relation of board gender diversity for two measures of corporate cash holdings (i.e., corporate cash ratio and industry adjusted cash ratio) and a negative relation with excess cash holdings. These results support that feminized boards are associated with lower liquidity and agency risk implying that women directors engage in stricter monitoring and disallow stockpiling beyond the optimal cash level. The study provides significant intermediate results in relation to the Copé-Zimmermann gender quota law that are robust to alternate specifications and tests.

Keywords: Female Directors, Risk Propensity, Cash Holdings, Gender Quota

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Introduction

A significant and growing body of literature associates board gender diversity with notable corporate outcomes. We contribute to this literature by investigating how board gender diversity affects corporate cash holdings (i.e., liquidity risk) and excess cash holdings (i.e., agency risk). An important question that has arisen in view of the great recession of 2008 is whether the situation would have been different if more women directors were represented on corporate boards. In this context, Harriet Harman, while deputy leader of the UK Labour Party, blamed the financial crisis on the male domination of corporate boards in banks (Nigel, 2009). Minow (2008) also blames boards of directors for the financial disarray. In the aftermath of the financial crisis, many countries in the EU-28 have initiated reforms that specifically set a mandatory quota for women directors on corporate boards (Kirsch, 2018). Consequently, there has been a steady, albeit incremental, increase in the presence of women on corporate boards. For example, in the EU-28, women's representation on corporate boards rose to 27.8% compared to 11.9% in 2010⁵, yet the economic case of board gender quota law is unclear, while others believe that the primary motive of quota laws is not an economic case but to promote equality between men and women at board levels (Bertrand et al., 2019).

With the growing participation of women directors, the decisions of corporate boards are expected to differ for at least two reasons. First, based on critical mass theory, the influence of women directors on corporate board decisions increases with their number (Torchia et al., 2011). Second, based on social role theory (Eagly, 1987), there are fundamental differences between men and women. The contemporary literature mainly investigates how board gender diversity affects corporate performance and corporate governance. However, Kirsch, (2018) discuss that

⁵According to the European Union Gender statistics database: https://eige.europa.eu/gender-statistics/dgs/indicator/wmidm_bus_bus_wmid_comp_compbm/datatable

the economic case of board gender quota law is unclear, while others believe that the primary motive of quota laws is not an economic case but to promote equality between men and women at board levels (Bertrand et al., 2019). Our paper addresses this gap by examining how women directors affect liquidity risk and agency risk. Although psychology and economics studies report that the average woman has a lower risk appetite than the average man (Barber and Odean, 2001; Byrnes et al., 1999), whether firms with more female directors hold more cash that is, a lower liquidity risk is still unknown. We also focus on excess cash because free cash flow theory posits that managers are incentivized to hold excess cash, as this increases the assets under their control. Such excess cash is an amount that exceeds the need for day to day operations and precautionary measures, and therefore, likely to increase agency risk. The agency literature on corporate governance reports that women directors are very strict in the monitoring function and enhance board effectiveness. This increased board monitoring and board effectiveness is expected to ultimately curtail managerial discretion, and hence affect excess cash holdings. These relationships are significant as women with a seat on the board of directors are not ordinary women and, therefore, their risk behavior might differ. Further, as excessive risk-taking has been deemed a main cause of the financial crisis, board members now face heightened expectations concerning their role in risk oversight. Board gender diversity is a recent phenomenon and, thus far, no link has been established between women's representation on corporate boards and effective risk oversight.

We specifically consider corporate cash holdings and excess cash holdings as measures of liquidity risk and agency risk respectively. According to Gill and Shah (2012), corporate cash is the most liquid asset and a measure of a corporation's ability to pay its obligations on time. However, from an agency perspective, holding excess cash is also a source of agency cost since

cash leaves more discretionary power to top executives. Coinciding with the upward trend in board gender diversity, there is a worldwide positive trend in corporate cash holdings. A study by Iskandar-Datta and Jia (2012) covering seven industrialized countries finds the upward trend in cash holdings, with France showing a modest rise and Japan a significant decline. According to Moody's (2016), the cash holdings of non-financial rated firms in Europe, the Middle East, and Africa (EMEA) increased by 5% as of December 2015 compared to the previous year. Furthermore, the study shows that France, Germany, and the UK accounted for approximately 52% of total EMEA cash holdings, with France leading at 21%. These features make France an interesting case for studying corporate cash holdings. Standard financial theory refers to this upward trend of corporate cash holdings as a conundrum or a paradox, considering cash a source of agency costs (Jensen, 1986). In this regard, women directors may choose to hold more cash to avoid liquidity risk and defaulting if they are more risk-averse and experience greater anxiety in the anticipation of negative consequences. Furthermore, the questions as to what prompted the upward trend in corporate cash holdings and whether holding high levels of cash is justifiable are puzzling. Uyar and Kuzey (2014, p.1) state that cash is a "two-edged sword." The bright side is that by keeping idle cash, firms reduce their liquidity risk and the probability of financial distress; on the dark side, holding excess cash exacerbates the risk of misappropriation, invoking agency conflicts (Nikolov and Whited, 2014). In this perplexing situation, the present study also attempts to investigate how board gender diversity affects the liquidity risk measured by cash holdings and the agency risk measured by excess cash holdings.

We examine the relationship between board gender diversity on one hand and corporate cash holdings and excess cash holdings on another on a sample of the largest French listed companies from 1998 to 2015. There are specific reasons that make the French case unique and interesting

to investigate in relation to our research question. First, in 2011, French legislators passed the Copé-Zimmermann law, which mandated a quota for the representation of women on corporate boards in two phases: 20% by 2014 and 40% by 2017. Similarly, other European countries have also legally and voluntarily enacted quotas for women, but according to the (European Commission, 2016, 2012), the improvement of gender balance in France has been more drastic and swifter, the proportion of women on corporate boards having risen from 22% in 2012 to 37% in 2016. This relatively high change in board diversity in a short time makes the French case particularly interesting. Second, in France, non-financial companies distributed dividends, on average, approximately 10% of their EBITDA between 2001 and 2015 (data from Insee, the French national statistics agency). According to the Global Dividend Index published by Janus Henderson in 2016, 2017, and 2018, France is the highest dividend-paying economy in Europe.⁶ In a country where dividend payout is so important, holding cash is more challenging. Third, to our knowledge, while the topic of board gender diversity has been examined in depth in the US, UK, Spain, and Nordic countries (Kirsch, 2018), few results have been obtained from other countries.

orporate social responsibility ⁷Investigating the French listed companies, first, our results document a significant positive relationship between board gender diversity and liquidity risk (i.e., cash ratio and industry-adjusted cash ratio) and a negative relationship with agency risk (i.e. excess cash). These results support the notion that women directors have a lower liquidity risk-taking propensity than male directors and that they engage in stricter monitoring disallowing

⁶ The Global Dividend Index is published every year, and reports are downloadable at the following link: <https://www.janushenderson.com/frpi/documents-finder-eu>

⁷ PACTE stands for Plan d'Action pour la Croissance et la Transformation des Entreprises or Action Plan for Business Growth and Transformation. A presentation of the Law is available here : <https://www.gouvernement.fr/en/pacte-the-action-plan-for-business-growth-and-transformation>

stockpiling more than the optimal cash level. We also document that the effect of women directors is significant post gender quota law. These results are robust for several alternate specifications and tests.

The paper makes the following contributions to the literature. First, several studies have analyzed the determinants of cash holdings (Bates et al., 2009; Bigelli and Sánchez-Vidal, 2012; Atif et al., 2019) in mostly Anglo-Saxon common law countries but France is a continental European civil law country. Graff (2008) finds that investors are treated differently across legal systems. For instance, major differences exist between the Anglo-Saxon and Continental European countries. According to Rhodes and Apeldoorn (1997), in the Anglo-Saxon, ownership is diffused, the board structure is unitary, and control comes from the market. Shleifer and Vishny (1996) argue that, in Anglo-Saxon countries, the legal protection of investors is greater. Moreover, French civil law is more precarious in terms of protecting investors because it limits agency problems to a lesser degree (La Porta, 2000). Also, La Porta et al. (2008) discuss that, in comparison to French civil law, the common law countries provide greater protection to investors that leads to a developed financial system. Although France is a continental European country, Wirtz (2019) argues that French corporate governance has experienced substantial transformations since the middle 1980s. The country now shares most of the characteristics of a liberal market economy. However, the corporate governance legal differences still exist and limit the generalization of Anglo-Saxon findings over continental European civil law countries. In this context, the French case is particularly important, because France has also had a strong historical influence on the legal system in Western Europe. According to Belot et al. (2014), the legal codes of nine European countries are inherited from French civil law. Thus, the results can be better generalized to those countries (Belot et al. 2014). According to Adams and Ferreira (2009), female directors are stricter at monitoring than men, a characteristic that is important in countries where investors' legal protection is considered as low like France.

The remainder of the paper is structured as follows. Section 1 develops the French specific institutional context of the Copé-Zimmerman mandatory quotas law. Section 2 presents the literature review and hypothesis development with a focus on the relationship between board gender diversity and corporate cash holdings. Section 3 presents our empirical strategy. Section 4 reports and discusses the results and robustness analysis and their implications for future studies. Section 5 provides concluding remarks.

1 The impact of mandatory quotas: The case of the Copé-Zimmermann law in France

French legislators passed the Copé-Zimmermann law in 2011. It mandated a quota for the representation of women on corporate boards. In this regard, several impacts have been highlighted in the literature. First, French boards are more gender balanced as women must make up at least 40% of directors. This effect is sometimes labeled as the “lady-boom,” since many listed firms were seeking women candidates for director seats. For instance, The Financial Times (2016) reports that in 2016 women accounted for 28 of the 44 board appointments made by the CAC 40 index French firms. The article also states that the competition for appointing women directors is becoming intense and that the lack of qualified women is compelling multiple firms to appoint the same candidate. Some studies suggest that the quota laws and the fierce competition for women board members might force firms to hire directors because of their gender rather than their skills, leading to a reduction in the level of human capital on boards (Ahern and Dittmar, 2012). However, Allemand et al. (2016) report that French firms have managed to find suitable women candidates who meet the usual selection criteria for the position of director. Also, Benkraiem (2017) concludes that the Copé-Zimmermann law is more likely to

enhance the effectiveness of board decisions as these women are introduced onto boards as independent directors.

Another consequence has been to push more women to become or to be hired as executive managers, since many directors are chosen from among the corporate elite (Dang and Nguyen, 2016). The literature is sparse in the French context, but some authors underline that the presence of female directors exhibits various impacts on board dynamics, board performance, risk-taking, and financial policies (Allemand et al., 2016; Allemand and Brullebaut, 2014; Rebérioux and Roudaut, 2018). In the context of the Copé-Zimmermann law in France, Rosenblum and Daria (2015) interviewed 24 French board members, concluding that the quota laws have impacted boards' decision-making processes because some of the newly appointed women are from outside France and some are expert in a wider range of areas. The study reports that board gender diversity in France has affected the tone of board interactions. One participant noted that after her first meeting – the board's first with a woman present – the men had said to her (p.25), “That was the best meeting we ever had as we clashed about nothing and discussed things peacefully.” Another participant noted that, compared to men, women tend to ask questions designed to elicit additional information. Moreover, the study also finds that women played some role in risk aversion and were more insistent on precise measurement of risk.

2 Literature review and hypotheses development

Our research examines how board gender diversity affects corporate cash holdings. We present the academic literature investigating this question and then develop our hypotheses.

2.1 Corporate cash holdings

We investigate the association of board gender diversity with two main focuses of the academic literature on the determinants of cash holdings: liquidity risk and agency risk. Corporate cash holdings is the main way to insure corporate liquidity. In a survey on corporate liquidity management, Almeida et al. (2014; p. 135) conclude that: “While there are alternatives to cash holdings such as hedging or lines of credit, cash remains “king”, in that it still is the predominate way in which firms ensure future liquidity for future investments. Traditionally, two main theoretical models explain corporate cash holdings through the determinants of capital structure (i.e., the debt to equity ratio) with the agency theory being predominant. Since increasing cash decreases net debt, any decision about cash holdings automatically affects capital structure. First, owing to information asymmetry and based on pecking order theory, Myers and Majluf (1984) conclude that firms do not maintain target cash holdings, but rely primarily on internal funds and then on external funds. Therefore, firms prefer to hold as much cash as possible. Second, contrary to pecking order theory, trade-off theory predicts that firms prefer to hold an optimal amount of cash through a trade-off between tax benefits and the bankruptcy costs associated with debt (Al-Najjar and Belghitar, 2011). Apart from these two traditional theories, free cash flow agency theory (Jensen, 1986) posits that managers hold excess cash to increase their discretionary power. Excess cash may be squandered on negative net present value projects. Under this view, holding excess cash exacerbates the risk of misappropriation resulting from agency conflicts. Empirical studies also support the propositions of this theory. Based on a sample of 45 countries, Dittmar et al. (2003) report that firms hold up to twice as much cash in countries where shareholders are not well protected by law compared to countries where they

are. Nikolov and Whited (2014) conclude that, due to agency problems, cash holdings are estimated as being 20% higher, resulting in a 6% drop in shareholder value.

2.2 Board gender diversity

Since the introduction of quotas for female directors in different countries, more women have seats on the board. This increased representation of women on boards implies they are likely to have more influence on corporate decisions. Relying on critical mass theory, Konrad et al., (2008) and Torchia et al., (2011) report that women's influence on corporate board decisions increases with their number. The decisions of corporate boards are also expected to differ as more women become involved, as according to social role theory Eagly (1987), there are fundamental differences between men and women. This theory posits that women are expected to be ascribed to roles with a more communal focus, such as being helpful and kind and seeking security and safety. By contrast, men are expected to be assertive, dominant, and willing to take risks. Due to these perceived fundamental differences between men and women, and as a consequence of the growing presence of women directors on corporate boards, a large body of contemporary research primarily investigates how women affect firm performance and corporate governance.

To understand the relationship between board gender diversity and firm performance, the literature mainly focuses on agency theory (Carter et al., 2003, 2010; Terjesen et al., 2016). These studies report that women directors on corporate boards may increase board effectiveness through a monitoring and control function, resolving agency conflicts and aligning the interests of managers and shareholders (Fama and Jensen, 1983). In the agency theory context, Carter et al. (2003) argue that a more diverse board may be able to better monitor managers, as board gender diversity increases board independence. Furthermore, the authors state that, while agency

theory does not suggest a clear link between board diversity and financial performance, the possibility that board diversity is beneficial is not ruled out. Based on the agency theory rationale, Francoeur et al. (2008) report that women – like external stakeholders, ethnic minorities, or non-nationals – often bring a fresh perspective to intricate issues that may help to correct informational bias in strategy formulation and problem-solving. Relying on this theory, Dang and Vo (2012) argue that women on corporate boards increase the effectiveness of board monitoring.

Resting on this theory and other conceptual frameworks, empirical studies on the impact of board gender diversity on firm performance report conflicting results. Several studies state a positive relationship (Carter et al., 2003; Terjesen et al., 2016), providing three explanations. First, Kim and Starks (2016) conclude that women directors bring unique skills to corporate boards, which result in enhanced board advisory effectiveness. In addition, they report that women directors diversify boards' expertise more than their male counterparts. Enhanced advisory effectiveness leads to better decisions and, thus, better firm performance.

Second, studies of corporate governance report that women directors improve monitoring effectiveness (Carter et al., 2010, 2003; Erhardt et al., 2003). Compared to their male counterparts, female directors are more likely to have active functions on corporate boards (Virtanen, 2012). Empirical studies also suggest that women directors outperform men in terms of monitoring. One argument pertaining to this relates to inside directors versus outside directors. Studies report that women are more likely than men to be outside directors (Adams and Ferreira, 2009; Carter et al., 2010). Compared to inside directors, outside directors experience fewer conflicts of interest and are, therefore, more likely to play a greater role in monitoring efforts. Adams and Ferreira (2009) report that the presence of women directors is associated with

increased board meeting attendance and that they prefer to be part of monitoring committees. Furthermore, female directors face difficulties in establishing credibility and influence. To preempt this, they tend to be more thoroughly prepared for meetings (Singh et al., 2002), showing increased monitoring activity. More effective monitoring prevents agents from wasting valuable resources, thus leading to better performance. Levi et al. (2014) conclude that firms with more male directors are more likely to participate in merger and acquisition activities, paying higher acquisition premia.

Third, gender diversity on corporate boards enhances governance quality, as a heterogeneous group is more likely to address concerns than one that is homogeneous (Ely and Thomas, 2001). Other studies find a negative effect. Adams and Ferreira (2009) report that, on average, gender diversity has a negative impact on firm performance in the US. Yet, other studies report no significant effect (Erhardt et al., 2003). These inconclusive empirical results can be attributed to differences across studies in terms of performance measures, methodologies, omitted variable biases, time horizons, and other contextual issues (Adams et al., 2015).

Finally, another limited strand of literature looks at how women directors affect risk patterns. Research in economics and psychology indicates that, in general, women tend to be more risk-averse than men. A meta-analysis of 150 studies on risk-taking behavior (Byrnes et al., 1999) finds that women are less likely than men to be involved in “intellectual risk taking”, “risky experiments”, and “gambling.” Other authors argue that women have a lower appetite than men for risk (Barber and Odean, 2001). These findings on risk aversion are consistent with the psychology literature. For instance, a first possible explanation for gender differences in risk-taking is based on interpretation of risk. Arch (1993) states that men are more likely to interpret risk as a challenging situation that requires participation, while women consider it a threat that

encourages avoidance. Another possible explanation is that emotions might explain women's risk aversion. Fujita et al. (1991) note argue that women experience greater anxiety and fear than men in anticipation of negative consequences. Therefore, if women have experienced undesirable consequences, they are more likely to become risk-averse.

Sensation seeking theory also attempts to explain gender differences in risk aversion. Sensation seeking is a preference for diverse, new, and complex sensations, typically entailing a risk factor, which may be physical, social, legal, or financial. Men score significantly higher than women for this personality trait (Zuckerman and Kuhlman, 2000), implying that this may have an effect on gender attitudes to risk aversion. Byrnes et al. (1999) also argue that sensation seeking explains risk aversion by women. Relying on this theory, the authors suggest that men would always take more risks than women and that the gap would remain relatively the same across contexts. Finally, Eagly's (1987) gender role theory may also be used to explain differences in attitudes to risk aversion between men and women. Research based on this conceptual framework shows that men and women differ psychologically in meaningful ways. The theory posits that women are ascribed more feminine characteristics, such as being helpful, kind, sympathetic, and safety and security seeking. By contrast, the male role is characterized by other qualities including a willingness to take risks (Eagly and Crowley, 1986). Research on personality traits suggests that willingness to take risks is a component of masculinity (Bem, 1974). If willingness to take risks is perceived to be part of the male role and a need for security and risk aversion is viewed as part of the female role, there is reason to expect gender differences in attitudes and behaviors associated with decisions that involve risks. Jadack et al. (1995), relying on social role theory, argue that men are more suited to risk-taking than women, as women seek safety and security and have a greater tendency to avoid harm. Applying this conceptual framework to health risk,

the authors claim that gender roles strongly explain women's greater risk aversion. Davidson and Freudenburg (1996) also argue that social roles explain women's risk aversion, and Thom (2003) reports clear evidence of gender role differences in response to risk-taking.

Women who break the glass ceiling and reach director positions may be expected to act differently to other women. To reach such positions, females in predominantly male environments may adapt their behavior so that gender differences become narrow and disappear. However, in the risk management domain, there is literature, albeit limited, that documents a negative relationship between women directors and insolvency risk (Wilson and Altanlar, 2009).

2.3 Hypotheses development

Based on the literature discussed above, we expect women directors to affect corporate cash holdings. Trade-off theory predicts that firms prefer holding optimal amounts of cash through a trade-off between the additional benefits and costs associated with holding cash. Studies in psychology and economics on the risk-taking behavior of women argue that they have a lower risk appetite and lower sensation seeking scores than men. Perception of gender roles also associate women with risk avoidance and, furthermore, some researchers claim that women experience more anxiety and fear than men in anticipation of negative consequences. Thus, in the trade-off between the benefits and costs of holding cash, we may expect women directors to give greater consideration to risk. Cash is the main proxy of liquidity risk (Gill and Shah, 2012) and the “king” of liquidity management tools (Almeida et al., 2014). Holding more cash can prevent firms from defaulting, and women directors may be expected to hold higher amounts of cash. Thus, our first hypothesis is:

H1: Corporate cash holdings are higher for firms with more gender-diverse boards.

The second argument and hypothesis is based on excess corporate cash. Agency theory posits that managers are incentivized to hold excess cash, as this increases the assets under their control. Such excess cash is an amount that exceeds the need for day to day operations and precautionary measures. However, as discussed above, agency literature and empirical studies on corporate governance report that women directors are very strict in the monitoring function and enhance board effectiveness. Board dynamic literature reports that women directors are more likely to raise questions, debate issues, and are more dogged than men in pursuing answers to difficult questions. This increased board monitoring and board effectiveness ultimately curtails managerial discretion, and hence lower excess cash holdings are expected in the presence of more women directors. Hence our second hypothesis:

H2: Excess cash holdings are lower in firms with more gender diversified boards.

3 Empirical strategy

Here, we present the data and develop our empirical strategy to deal with endogeneity issues and the model specification. First, we discuss why the relationship between corporate cash holdings and explanatory variables is endogenous and then specify the model which addresses two specific sources of endogeneity that are of high concern in board and risk studies – omitted variable and simultaneity biases. We then present the empirical model specification, including the variables. The data sources for this study are the Thomson Reuters Worldscope database and the INSEAD OEE Data Services (IODS) Corporate Governance database. Worldscope is the premier source of detailed financial statement data of public companies. We retrieved the

governance data from the IODS database, which comprehensively covers French companies listed on the SBF 120 index. Based on general industry classification we removed the financial and the utilities firms. These sectors have very specific characteristics, as their cash holdings and liquidity are governed by specific regulations and removing them is quite common. We have 27 companies in these sectors. We have 4 companies that cannot be included because of missing data. After excluding these firms, the total sample includes 89 French firms in the period between 1998 and 2015.

3.1 Endogeneity issues in the relationship between board gender diversity and cash holdings

Empirical research in corporate finance and corporate governance is often plagued by endogeneity issues (Adams, 2016; Jurkus et al., 2011; Roberts and Whited, 2012). The problem of endogeneity is also expected to be inherent in relation to corporate cash holdings and board gender diversity, as there is a broad consensus that board characteristics are not exogenous; rather, they are endogenously chosen to suit the firm's environment (Adams, 2016; Jurkus et al., 2011). In relation to women directors, (Jurkus et al., 2011) find that the choice to appoint female directors is not independent from characteristics of firms that board gender diversity is meant to influence. Adams, (2016) also argues that board gender diversity is not independent of other factors. The view that the appointment of women directors is a choice that firms make must be taken into consideration when estimating the gender–liquidity risk relationship. In particular, two sources of endogeneity are likely to bias our estimates: omitted variables bias and reverse causality (Adams, 2016; Sila et al., 2016). To accurately test whether women directors affect cash holdings, these two concerns must be addressed.

Regarding omitted variable bias, some variables that are difficult to observe and are not considered in various cases may affect both the liquidity risk and the appointment of a director. The inability to consider these as explanatory factors creates unobservable heterogeneity. For instance, one omitted variable in the risk equation and director appointment can be managerial ability. According to Hermalin and Weisbach, (1988), highly skilled CEOs are more effective in managing risk and, at the same time, have considerable influence over appointment of directors. The study reports that CEOs with high ability may select directors who are less likely to hold them accountable. Concerning women directors, as we have seen, the literature documents that they are more likely to be effective monitors of CEOs (Adams and Ferreira, 2009); thus, it is expected that unobserved CEO ability and CEO preferences for a less strict board might be correlated with the extent of gender diversity. However, the ability of CEOs is difficult to observe or measure. A second possibility is that, in the case of liquidity shortage, firms may appoint particular board members who have a good reputation in the financial sector – also difficult to observe or measure. The unobservable heterogeneity created by an inability to consider these factors means that these omitted variables appear in the error term. If these factors are, in fact, correlated with explanatory variables, there is an endogeneity problem that causes inference to break down.

As for reverse causality, or simultaneity bias, the observed relationship between cash and its explanatory variables, such as director appointment, growth rate, and dividend policy, may reflect the impact of the former on the latter, therefore creating a simultaneity problem. For instance, if women directors are risk-averse, they may self-select into lower-risk firms (Farrell and Hersch, 2005). A second example is that we expect an inverse relationship between corporate cash holdings and dividends as, with dividend payments, firms' distribution of cash

ultimately reduces the balance. On the other hand, corporations announce their dividend policy based on their cash position and, therefore, both are expected to impact each other. The same behavior may also be expected for capital expenditures. Thus, in either case, simultaneity is expected.

Considering the endogeneity problems, the common strategy is to identify an external instrumental variable that explains representation of women directors on the board and should be exogenous to the firm outcomes under consideration (i.e., cash holdings) (Jurkus et al., 2011). However, (Adams, 2016; Sila et al., 2016) discuss that it is challenging to find an exogenous instrumental variable for women directors. Sila et al., (2016) provide evidence that the variables employed in previous studies as a source of exogenous variation in board gender diversity are not truly exogenous. Considering these limitations, we employ a dynamic model using the generalized method of moments (GMM) techniques (Arellano and Bover, 1995; Blundell and Bond, 1998). These techniques are based on the internal instrumental variables estimation method, whereby the internally generated lagged dependent variables and explanatory regressors are used as estimators. In their studies on cash holdings (Al-Najjar and Belghitar, 2011; Bigelli and Sánchez-Vidal, 2012; Ozkan and Ozkan, 2004; Uyar and Kuzey, 2014), risk and board gender diversity (Sila et al., 2016) also employed this method.

We consider this dynamic model to be appropriate because static models implicitly assume that firms can quickly adjust to a target level of cash following random shocks or changes in firm-specific characteristics. However, cash is a dynamic variable as the adjustment process takes time because of transaction costs, causing the cash policy not to be immediately adjusted to a more desirable one. As firms set a target level of cash (Opler et al., 1999), the decisions made in previous periods explain the level achieved over time (Ozkan and Ozkan, 2004). Furthermore,

based on the insight of Wintoki et al., (2012), we argue that the reverse causality problem also has a dynamic nature – which means that the representation of women directors in the boardroom is influenced by the past risk of the firm. This is because the appointment of a director is made before the next risk realization becomes observable. Therefore, only past risk would be included in the information set considered when appointing a new female director.

3.2 Model specification

The basic model specification to be tested is:

$$\text{Corporate_Cash}_{i,t} = \beta_0 + \beta_1 \text{CASH}_{i,t-1} + \beta_2 \text{WDIR}_{i,t} + \beta_3 \text{BIND}_{i,t} + \beta_4 \text{CEODUAL}_{i,t} + \beta_5 \text{BSIZE}_{i,t} + \beta_6 \text{CFO}_{i,t} + \beta_7 \text{DEBT}_{i,t} + \beta_8 \text{FSIZE}_{i,t} + \beta_9 \text{M_B}_{i,t} + \beta_{10} \text{CFO_Vol}_{i,t} + \beta_{11} \text{CAPEXP}_{i,t} + \beta_{12} \text{DIV}_{i,t} + \beta_{13} \text{Cop_Effect} + \varepsilon_{i,t}$$

The definitions of the variables included in our analyses is presented in the appendix A.

We consider corporate cash holdings as a measure of liquidity risk and excess cash as a proxy of agency costs. The liquidity risk captured by corporate cash holdings is measured using two different variables: cash ratio (CASH) and industry-adjusted cash ratio (Ind_Adj_Cash). Following Uyar and Kuzey (2014), we CASH is computed as cash and cash equivalent to total assets. The second proxy, Ind_Adj_Cash, is a measure of cash adjusted for industry effect. We consider Ind_Adj_Cash since, according to Harford et al. (2008), corporate cash holdings are strongly dependent on a firm's industry. Following Boubaker et al. (2015), and using Campbell's (1996) industry classification, we measure Ind_Adj_Cash by calculating the yearly median level of cash held by all firms within the industry. Adjusted cash is then computed as the difference between the firm's ratio of cash to net assets and the median level of this ratio for the given industry, where net assets are measured as total assets minus cash and cash equivalents.

In order to investigate how board gender diversity is related to agency costs, we measure excess cash (E_cash) defined as the difference between actual cash and the explained value of cash predicted or explained by our econometric model. Following Belkhir, Boubaker, and Derouiche (2014); Dittmar and Mahrt-Smith (2007); Opler et al. (1999), we first measure the optimal cash that firms should hold predicted or explained by the model, and then calculate the excess cash as a difference between actual cash and our predicted value; in other words, the residual of a corporate cash level regression. The detailed methodology for measuring excess cash is described in the Appendix B.

Our main independent variable of interest is the board gender diversity. Following, Abad et al., (2017) we compute board gender diversity (WDIR) as the number of women directors divided by the total number of directors on corporate boards. We consider the alternate specifications of board gender diversity in the robustness section.

The literature underlines the need to include other board composition variables in considering the link between board gender diversity and corporate cash holdings. We include board independence, CEO duality, and board size. Board independence, referred to as BIND, is calculated as the ratio of independent board members to the total number of directors. We include CEO duality, denoted as CEODUAL, which is a dummy variable that takes the value of 1 if the CEO is also the chairperson of the board, and 0 otherwise. Third, we consider board size, referred to as BSIZE, derived from the natural logarithm of board members.

Following Boubaker et al. (2015) and Uyar and Kuzey (2014), we include a number of financial control variables. Specifically, cash flows (CFO) are earnings before interest and taxes plus depreciation and amortization, divided by total assets. We include the debt ratio (DEBT), measured as total debt divided by total assets. Then we consider the net working capital ratio

(NWC), computed as current assets minus current liabilities and cash and cash equivalents, divided by total assets. We also include firm size (FSIZE), derived from the natural logarithm of total assets. We include cash flow volatility (CFO_Vol), measured by the standard deviation of cash flows. We also add a proxy for capital expenditure (CAPEXP), calculated as the ratio of capital expenditures to total assets. CWe also control for dividends (DIV), measured as the ratio of dividends to total assets. And finally, we consider the proxy of firm growth market to book value (M_B), computed as the sum of the book value of liabilities and market value of equity, divided by the book value of total assets. Cop_Effect is a dummy variable that takes the value of 1 for the year greater than 2011 inclusive, and 0 otherwise. Following Boubaker et al. (2015), all the financial variables are Winsorized at 1% and 99% to eliminate the effect of outliers.

4 Results

4.1 Descriptive analysis

The descriptive statistics for our sampled companies from the period 1998–2015 are presented in Table 1. On average, the corporate cash holdings of French companies represent 6% of assets over the period. Among the board composition variables, the average representation of women directors on corporate boards is 13.7%, indicating that French corporate boards are dominated by male directors. The independence of corporate boards is high in France, and the average representation of independent directors remains at 47.1% over the sampled period. On average, in 58% of cases, the CEO is also the chairperson of the board. Table 1 also provides detailed information on financial variables. The mean value of cash flow is 10.9%. Furthermore, net working capital over the period is 2.7%, showing that working assets are higher than working liabilities.

(Insert Table 1 about here)

In Table 2, we present the results of the mean difference tests between the governance and financial variables over two interval periods, 1998–2010 and 2011–2015. We split the sample into these two intervals because in 2011 French legislators passed the Copé-Zimmermann law that required women representation on corporate boards in two phases: 20% by 2014 and 40% by 2017. Due to the implementation of the law, changes may be expected in board composition and financial variables; splitting the sample into pre- and post-implementation periods allows comparison between the two. The results in Table 2 show that there is a considerable difference in mean values at the 1% significance level for the corporate cash variable over the two intervals. Cash holdings were 5.4%, on average, over the period 1998–2010 and significantly increased to 7.6% over the period 2011–2015. Thus, on average, cash holdings increased by 2.2% after the implementation of the Copé-Zimmermann law. We also observe that board gender diversity has significantly increased as, on average, the representation of women over the period 1998–2010 was 8.5%, growing to 26.1% over the period 2011–2015. This upward trend shows that firms have adhered to the Copé-Zimmermann law. The representation of women directors on corporate boards is expected to increase further, as the law mandated 40% female representation on corporate boards by 2017.

(Insert Table 2 about here)

Table 3 presents correlations among the variables. As shown in Table 3 the correlation among variables is mainly below 0.5, and the variance inflation factors (VIF) value measuring multicollinearity is also less than the critical value of 10 suggested by O'Brien (2007).

(Insert Table 3 about here)

4.2 Results and discussion

The results of the GMM system regression analyses are presented in Table 4. These results are based on unbalanced panel data for the period 1998–2015. The findings in columns 1 and 2 of (Table 4) show a positive effect of WDIR on CASH and Ind_Adj_Cash. In terms of economic significance, all else being equal, when board gender diversity increases by one standard deviation, the ratio of CASH and Ind_Adj_Cash increases, on average, by 0.33% and 0.46% respectively, with a standard deviation of WDIR 13.7% (Table 1).

(Insert Table 4 about here)

The above findings corroborate Hypothesis 1 and validate the notion that women directors contribute to reducing liquidity risk. In the risk management domain, there is literature, albeit limited, that focuses on the effect of women directors on risk (Levi et al., 2014; Sila et al., 2016; Wilson and Altanlar, 2009). These studies document conflicting results. Sila et al., 2016) find no significant effect of women director on risk. This study focuses on equity risk in the US and is based on a time horizon of 1996–2010. During this period, the representation of women directors on corporate boards was largely symbolic. Other studies report a negative relationship between women directors and risk. For example, Wilson and Altanlar (2009) find a negative relationship between women directors and insolvency risk. Levi et al. (2014) conclude that firms with more male directors are more likely to participate in riskier activities such as merger and acquisition. In this strand of the literature, we focus on alternate definitions of risk, that is, liquidity risk, and

document a negative relationship between board gender diversity and liquidity risk. Our results document a positive relationship between women directors and cash holdings, supporting the notion that women directors have a lower liquidity risk-taking propensity than male directors.

Our results on the effect of board gender diversity on liquidity risk are consistent with the broad psychology literature on women's risk aversion. For instance, according to Arch (1993), men are more likely to interpret risk as a challenging situation requiring participation, while women are more likely to consider it as a threat that encourages avoidance. The results are in line with several other studies in the economics and psychology domain (Barber and Odean, 2001; Byrnes et al., 1999), documenting that women have a lower risk appetite than men. In addition, our results are consistent with gender role theory. In the context of this theory, Jadack et al. (1995) argue that men are more suited to risk-taking than women. This theory argues that women seek safety and security and have a greater tendency to avoid harm. The authors applied this theory to health risk, claiming that gender roles strongly explain why women may be risk averse. In the present study, we extend the scope of this theory and apply it to liquidity risk, finding that women are risk averse.

Cash holdings reduce the liquidity risk but are also a two-edged sword. Indeed, excess cash can be squandered by managers on negative return projects. Agency theory posits that holding excess cash exacerbates the risk of misappropriation of these funds, invoking agency problems between shareholders and managers. Dittmar et al. (2003) document that agency costs are correlated with excess corporate cash holdings. To check how women directors, affect excess cash holdings, we included the variable excess cash in column 3 of Table 4. Our findings report a significant negative effect of board gender diversity on excess cash holdings. In terms of economic significance, all else being equal, when board gender diversity increases by one standard

deviation, the ratio of ECASH decreases, on average, by 0.84%, with a standard deviation of WDIR 13.7% (Table 1). These findings corroborate Hypothesis 2 and validate the notion that women directors are stricter at monitoring, and they tend to prevent managers from holding excess liquid resources that can be readily converted into private benefits or used for negative return projects. The results are in line with agency theory in corporate governance literature (Adams and Ferreira, 2009; Carter et al., 2003, 2010; Erhardt et al., 2003; Terjesen et al., 2016; Virtanen, 2012) associating women directors with strict and effective monitoring. Consistent with this literature, our results related to the excess cash variable measuring agency costs imply that women directors do not allow managers to hold excess cash beyond the requirements of day to day operations and precautionary measures. These results indicate that women directors not only reduce the liquidity risk but also contribute to better corporate governance by reducing the risk of the misappropriation of liquid assets on negative return projects.

We also discuss the critical mass theory effects on cash holdings. The theory posits that the influence of women directors becomes more prominent when the size of the female group reaches a critical mass or a minimum threshold (Konrad et al., 2008; Torchia et al., 2011). Relying on critical mass theory, the authors find that women's influence on corporate board decisions increases with their number because relatively high numbers of women can form a block, expand their influence and affect the decision-making culture of the board. Also, increasing the number of women directors reduces their sense of isolation and allows their voices to be heard, and they no longer report being ignored or isolated. To examine the effect of the critical mass theory, we use three dummy variable WDIR1 coded as 1 if firms have 1 women on board and 0 otherwise, WDIR2 coded as 1 if firms have two women on board and 0 otherwise, and WDIR3, dummy variable coded as 1 if firms have at least three women on board and 0 otherwise. The results are presented in Table 5.

The results show that only WDIR3 have significant and robust effect on all three dependent variables.

The results of critical mass theory are in line with the study of Konrad et al. (2008) who interviewed female CEOs, women directors, and corporate secretaries at Fortune 1000 companies. The authors quoted that, “One male CEO noticed that as more women directors were added to the board, the original female directors became more active: more willing to push their issues and were more vocal”. Further, the study documents that solo woman on corporate board are often marginalized and isolated. Adding up a second woman director to corporate boards though help lessen the sense of isolation but may not always cause change. A visible shift happens when boards have three or more women directors. At this number, their voice is heard, and they don’t report being ignored or isolated. At the critical mass of three, women directors are considered by other board members as directors not as “female directors”. Consistently, Torchia et al. (2011) also report that one or two women directors has no significant impact on firm’s innovation, while three women directors significantly increase firm’s innovations.

(Insert Table 5 about here)

4.3 Robustness analysis

In this section, we perform several robustness tests to re-examine the validity of our results. First, the basic equation is rerun using different proxies of the dependent variable. Different measures of cash allow us to avoid biases of each measure. Following Gill and Shah (2012), we use other proxies of liquidity risk; namely, current ratio (CR) and cash by net assets (N_Cash). The estimates shown in column 1 and 2 of Table 6, demonstrate that the results shown in Table 4 are

not sensitive to other proxies of liquidity risk. In column 3 of Table 6, following Boubaker, Derouiche, and Lasfer (2015) we consider the logarithmic transformation of the cash ratio, and document a positive relationship of women on cash holdings. These estimates also demonstrate that women directors have a significant negative effect on risk.

(Insert Table 6 about here)

In Table 7, following Abad et al. (2017), we use two indices of board gender diversity: the BLAU_INDEX and the SHANON_INDEX. These indices consider the number of gender categories of male and female directors, also called variety and evenness of the distribution of corporate board members, or balance. Both indices are qualitatively similar, but the SHANON_INDEX is a logarithmic measure of diversity and, therefore, more sensitive to minor differences in corporate gender diversity. The BLAU_INDEX value for the two categories of gender diversity ranges from 0 (when the corporate board is dominated by one category, either male or female) to a maximum of 0.5 (when both categories have equal representation). The results of indices are reported in Table 7. We find that the basic results reported in Table 4 are not sensitive to indices of board gender proxies.

(Insert Table 7 about here)

We also address endogeneity concerns with alternate methodologies. First, following Al-Najjar and Belghitar (2011), Ozkan and Ozkan (2004), and Uyar and Kuzey (2014), we use the GMM difference techniques developed by Arellano and Bover (1995). These techniques are based on

the internal instrumental variables estimation method, whereby the internally generated lagged dependent variables and explanatory regressors are used as estimators. In addition, the first difference of endogeneity is taken into account to eliminate the endogeneity concerns. The estimates of GMM difference in Table 8 confirm that our main results in Table 4 are not sensitive to the alternate method of controlling endogeneity.

(Insert Table 8 about here)

It can also be argued that the significant impact of gender diversity on liquidity risk is due to firm-specific factors that may simultaneously affect both gender diversity and cash holdings. In this set-up, due to differences in firm-specific characteristics, the direct analysis of all firms might not be appropriate. To eliminate such concerns, following Sila et al. (2016), we use propensity score matching. This method serves to match gender-diverse and non-gender-diverse firms with very similar characteristics. To operationalize the propensity method, following Gull et al. (2018), we defined the treatment group as a set of firms having at least one women director and matched it with the control group of firms having no women directors but almost identical firm-specific characteristics. Bad matching occurs if the nearest neighbor is distant. In order, to decrease the probability of bad matching, following, Gull et al. (2018) we use a calliper distance of 1% without replacement⁸. We estimate the results using the system GMM technique to the matched sample to correct for endogeneity bias.

⁸ Matching without replacement means that the same gender-diverse firm can be matched to only one non-gender-diverse firm.

(Insert Table 9 about here)

Our results of matching sample in Table 9 columns 1 and 2, demonstrate a positive association between the presence of at least one woman on the board and cash holdings and a negative relation of at least one woman on board and excess cash in column 3. The estimates of propensity score demonstrate that our previous results in Table 4 are not sensitive to the alternate method of controlling endogeneity. We then also employ difference-in-difference-estimator (DID) on matched sample. DID covers the 'parallel trends' assumption; implying that two same organizations are expected to follow the same change without any treatment. Roberts and Whited (2012) discuss that if the treatment has any effect on the outcome, the effect is likely to be observed in the difference between the changes of the two firms. The DID estimator is computed as:

$$\text{Corporate_Cash}_{i,t} = \beta_0 + (\text{WDIR1})_{i,t} + (\text{Cop_Effect})_{i,t} + (\text{WDIR1} \times \text{Cop_Effect})_{i,t} + \text{control variables} + \epsilon_{i,t}$$

The variable WDIR1 as defined above is a treatment group, coded as 1 if firms have at least 1 woman on board and 0 otherwise. Cop_Effect is a post treatment period, that takes the value of 1 for post quota period and, and 0 otherwise. The results in columns 4 and 5, demonstrate a positive association between the DID and cash holdings but no significant effect on excess cash in column 6.

4.4 Implications for future studies

In summary, our results document a positive relationship between women directors and cash holdings, implying that women contribute to reducing firms' liquidity risk. Our results highlighting a negative relation between board gender diversity and excess cash also document that women directors are strict in monitoring and effective at resolving the agency costs of cash hoarding. Women directors not only contribute positively to corporate governance but also tend to reduce the risk of misappropriation of liquid assets. These results have several implications for stakeholders. First, diverse boards bring varied perspectives and a more balanced risk management approach. The results show that encouraging more women directors on corporate boards and giving them more voice in corporate governance and decision-making may lead to the avoidance of excessive risk-taking. The lower liquidity risk-taking behavior of women directors might justify their presence on corporate boards. Ozkan and Ozkan (2004) note that high liquidity risk increases the probability of default, but women directors significantly reduce such risk. Therefore, lower risk-taking could be one of the underlying motivations of policymakers in promoting gender diversity on corporate boards after the financial crisis.

Another important implication is for corporate governance consulting firms. These advisory firms that are specialized in organizational design may encourage and advice firms to appoint women at top positions, particularly in the industries and the firms that are involved in the management of risky assets and where the capital structure is riskier. These firms may encourage the appointment of women directors because they reduce risk and they are strict at monitoring the executives and therefore, the likelihood of agency problems and squandering of firm resources are expected to be lower in the presence of diverse boards. Moreover, to benefit from board gender diversity, it is important to have a significant representation of women on

corporate boards, as their symbolic representation shows that they do not have a significant and robust impact in small numbers. However, the results of DID suggest that the liquidity risk was taken more into account after the quota law, that is, when gender diversity became higher. The implications are consistent with the extant literature on the effect of gender quota law in France (Houanti et al., 2018; Allemand et al., 2016; Benkraiem, 2017; Rosenblum and Roithmayr, 2015). These studies underline that the presence of female directors after the implementation of the Copé-Zimmermann law exhibits various impacts on board dynamics, board performance, and other strategic policies.

The above implications of our study are not without limitations. Future research could also investigate further the concept of board diversity. The board can be diverse in terms of nationality, gender, demographic attributes, or industry experience. In this paper, we focus on gender diversity for two main reasons. First, the extant literature documents that this diversity has a broad impact on corporate governance (Harjoto et al., 2015; Terjesen et al., 2015) and risk management (Levi et al., 2014; Sila et al., 2016; Wilson and Altanlar, 2009). Second, the French Copé-Zimmermann law, required that French listed companies must exhibit at least 40% of female directors by 2017. However, as other details (e.g., nationality, demographic attributes, and industry experience) were not compulsory for listed firms, we were not able to clearly identify such variables. It would be interesting to consider these other details in future studies in a country setting where law does not mandate gender diversity on corporate boards. In addition, demographic factors may also be considered (Gull et al., 2018).

Moreover, to estimate the results we relied on archival information at the aggregate board level. This approach lessens concerns about common source bias. Keeping in mind conflicting results in the risk domain (Adams and Funk, 2011; Levi et al., 2014; Sila et al., 2016; Wilson and

Altanlar, 2009), the use of additional measures of risk based on alternate methods of data collection (e.g., analysis of board minutes, observations of board meetings, qualitative studies, and peer ratings of directors) would further strengthen our confidence in these results. Future research may also benefit from evaluating individual female director involvement from board minutes or observational studies. This could lead the research into a previously untouched, but critically significant, field of investigation. However, given the difficulty of gaining access to board members and board meeting minutes, this would be a serious challenge for corporate governance scholars. Another important limitation of our study is that we consider the sample of SBF 120 index because the targeted companies or the obligation to implement gender diversity imposed by the law applies to boards of directors of: 1) listed companies; and 2) unlisted *sociétés anonymes* (joint stock corporations) and *sociétés en commandite par actions* (limited partnerships) (i) employing an average of at least 500 people, and (ii) with revenues or total assets over 50 million euros, for the last three financial years. Since SBF companies are listed thus they fit with the context of Copé-Zimmerman law, and therefore, we consider them. These companies are large in size, have a large float and are more likely to be followed by financial analysts and rating agencies, under media limelight, etc. Therefore, the results might not be generalized to small and unlisted firms.

5 Conclusion

After the financial crisis of 2008, many countries have introduced corporate governance reforms that specifically set a mandatory quota for women directors on corporate boards. Consequently, there has been an increase in the presence of women directors on these boards. However,

contemporary literature provides limited and inconsistent evidence regarding the economic effect that increased participation of women might bring to a firm.

Drawing on the largest listed French firms over an 18-year period, the present study contributes to this intense debate by examining the relationship between board gender diversity and cash holdings. We find that board gender diversity significantly increases corporate cash holdings and industry-adjusted cash. In terms of economic significance, when board gender diversity increases by one standard deviation, the ratio of corporate cash and industry-adjusted cash increases, on average, by 0.6% and 0.16% respectively. Then, we document a significant negative effect of board gender diversity on agency costs proxied by excess cash. We also document that the effect of women directors on cash holdings is significant post gender quota law.

Based on these results, we conclude that boards with a higher representation of women directors tend to reduce liquidity risk. We also conclude that women directors are stricter at monitoring as they do not allow managers to stockpile more than optimal cash. A key implication of our paper is that one of the cases for more gender diversity on corporate boards could rest upon perceptions of men being risk-prone and women being risk-averse.

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Table 1 Descriptive analysis of the variables included in the baseline model

Variable	Mean	Standard Deviation	Minimum	Maximum
CASH	0.0608	0.0528	0.0019	0.3252
WDIR	0.1370	0.1327	0.0000	0.6666
BIND	0.4710	0.2083	0.0000	1.0000
CEODUAL	0.5808	0.4935	0.0000	1.0000
BSIZE	11.180	3.6260	3.0000	22.000
CAPEXP	4.7189	3.9863	0.2300	25.700
FSIZE	15.253	1.6164	11.419	18.224
DIV	0.0152	0.0161	0.0000	0.0833
CFO	0.1094	0.0655	-0.0973	0.3472
DEBT	0.2457	0.1453	0.0024	0.6917
CFO_Vol	0.0199	0.0274	0.0002	0.1743
M_B	2.4730	2.7952	0.2300	36.800

Definitions of the variables are explained in Table A.2
Table 2 Univariate analysis: difference of mean test

Variable	Mean 1998 – 2010	Mean 2011 – 2015	Mean Difference	T-Test Equal Variance
CASH	0.054	0.076	0.022	7.61***
WDIR	0.085	0.261	0.175	29.2***
BIND	0.447	0.515	0.068	5.57***
CEODUAL	0.576	0.590	0.015	0.55
BSIZE	10.90	11.85	-0.953	4.67***
CAPEXP	5.130	3.640	-1.488	-6.71***
FSIZE	15.10	15.60	0.500	6.08***
DIV	0.014	0.016	0.002	2.63***
CFO	0.113	0.097	-0.015	4.11***
DEBT	0.248	0.239	-0.008	-1.00
M_B	2.722	1.882	-0.839	-5.35***
CFO_Vol	0.021	0.016	-0.004	-2.77***

*** p<0.01, ** p<0.05, * p<0.1.

Table 3 Correlation analysis and variance inflation factors

Variable	CASH	WDIR	BIND	CEODUAL	BSIZE	CFO	M_B	DEBT	CAPEXP	FSIZE	DIV	CFO_Vol	VIF
CASH	1												1
WDIR	0.0947	1											.081
BIND	0.1082	0.0237	1										.191
CEODUAL	0.0167	0.0362	0.2147	1									.092
BSIZE	0.0803	0.0642	0.1645	-0.0226	1								.111
CFO	0.1166	0.0432	0.0092	-0.0040	0.1061	1							.451
M_B	0.0630	0.0154	0.1711	0.0213	0.1250	0.2648	1						.17
DEBT	0.0608	0.0502	0.0731	0.1017	0.0328	0.2159	0.0801	1					1.14
CAPEXP	0.1063	0.1383	0.0967	0.0200	0.0414	0.2502	0.1462	0.0708	1				1.15
FSIZE	0.1136	0.0300	0.2628	-0.1109	0.6651	0.1947	0.0800	0.1248	0.0360	1			2.09
DIV	0.0775	0.0958	0.0582	-0.0907	0.1384	0.4181	0.2028	-0.2835	0.0079	-0.0206	1		1.42
CFO_Vol	0.1309	0.1180	0.0077	0.0363	0.1865	0.0966	0.0350	0.0376	0.066	-0.2037	0.0995	1	1.10

Mean VIF	1	1.35
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Definitions of the variables are explained in Table A.2

Table 4 The relationship between board gender diversity and corporate cash holdings (1998–2015), GMM system

	(1)	(2)	(3)	E C A S H
	CASH		Ind_Adj	
L.CASH	0.4950*** (0.0179)			
L.Ind_Adj			0.4520*** (0.0370)	
L.ECASH			0.5300*** (0.0222)	
WDIR				- 0 . 0 6 8 8 * * *
	0.0247*** (0.0072)	0.0341*** (0.0094)	(0.0136)	- 0 . 0 0 2 3
BIND		-0.0133**	-0.0081	
CEODUAL	(0.0052) 0.0010 (0.0010)	(0.0109) -0.0003 (0.0039)	(0.0069) 0.0076** (0.0015)	
BSIZE	-0.0003 (0.0026)	0.0304*** (0.0092)	0.0047 (0.0056)	
CFO	0.0548*** (0.0149)	0.0363 (0.0278)	0.0615*** (0.0147)	
FSIZE	-0.0014* (0.0008)	-0.0123** (0.0055)	0.0147*** (0.0019)	
DIV	-0.1570** (0.0786)	-0.2250* (0.1290)	-0.0668 (0.1370)	
CAPEXP	-0.0006*** (0.0000)	-0.0005*** (0.0000)	0.0003*** (0.0000)	
M_B	-0.0001**	0.0001	-0.0002	

		(0.0000)	(0.0003)	(0 . 0 0 4)
CFO_Vol	0.1430*** (0.0125)	0.1460** (0.0624)	0.0633*** (0.0164)	
DEBT	0.0149 (0.0108)	-0.0225 (0.0164)	-0.0056 (0.0118)	
Cop_Effect	0.0111*** (0.0010)	0.0019 (0.0014)	0.0002 (0.0014)	
Constant	0.0456*** (0.0123)	0.1290 (0.0799)	-0.2410*** (0.0200)	
Observations	1,145	1,057	866	
AR(1)	0.0000	0.0000	0.0000	
AR(2)	0.0731	0.1456	0.1647	
Sargan Test	1	1	1	

Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5 The relationship between board gender diversity and corporate cash holdings (The critical mass WDIR1, WDIR2, and WDIR 3), GMM System

	(1) CASH	(2) Ind_Adj	(3) ECASH	(4) CASH	(5) Ind_Adj	(6) ECASH	(7) CASH	(8) Ind_Adj	(9) ECASH
L.CASH	0.5170*** (0.0228)			0.5220*** (0.0233)			0.4780*** (0.0305)		
L.Ind_Adj		0.4340*** (0.0370)			0.4110*** (0.0423)			0.3980*** (0.0397)	
L.ECASH			0.5200*** (0.0348)			0.5180*** (0.0431)			0.5500*** (0.0227)
WDIR1	0.0029 (0.0042)	-0.0061 (0.0040)	-0.0081** (0.0040)						
WDIR2				0.0065** (0.0028)	0.0011 (0.0017)	-0.0105** (0.0047)			
WDIR3							0.0092*** (0.0032)	0.0046* (0.0025)	-0.0090** (0.0036)
BIND	-0.0148* (0.0084)	-0.0148 (0.0146)	-0.0004 (0.0179)	-0.0247*** (0.0082)	-0.0299* (0.0157)	-0.0107 (0.0162)	-0.0053 (0.0090)	-0.0121 (0.0110)	-0.0053 (0.0067)
CFO	0.0577*** (0.0180)	0.1120** (0.0473)	0.0823*** (0.0318)	0.0684*** (0.0196)	0.0732* (0.0374)	0.0221 (0.0260)	0.1090*** (0.0186)	0.0668** (0.0339)	0.0571*** (0.0152)
M_B	0.0001 (0.0000)	-0.0002 (0.0004)	-0.0004 (0.0003)	0.0002* (0.0001)	-0.0005 (0.0003)	-0.0007* (0.0003)	0.0003*** (0.0001)	-0.0003 (0.0004)	-0.0000 (0.0004)
DEBT	0.0066 (0.0120)	0.0029 (0.0201)	0.0057 (0.0206)	0.0257** (0.0127)	-0.0062 (0.0208)	-0.0171 (0.0192)	0.0227 (0.0147)	0.0078 (0.0205)	-0.0034 (0.0087)
FSIZE	-0.0025 (0.0029)	0.0008 (0.0051)	0.0147*** (0.0031)	-0.00134 (0.0030)	-0.0010 (0.0064)	0.0071 (0.0054)	-0.0007 (0.0025)	-0.0052 (0.0056)	0.0154*** (0.0021)
CAPEXP	-0.0003*** (0.0000)	-0.0003*** (0.0001)	0.0006*** (0.0001)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0006*** (0.0000)	0.0003*** (0.0000)
CFO_Vol	0.1640*** (0.0423)	0.1200** (0.0543)	0.0424 (0.0429)	0.0854* (0.0473)	0.1320** (0.0564)	0.0517 (0.0365)	0.1350*** (0.0503)	0.1970*** (0.0572)	0.0724*** (0.0186)
CEODUAL	-0.0025 (0.0027)	0.0015 (0.0053)	-0.0011 (0.0067)	0.0000 (0.00267)	-0.0018 (0.0031)	0.0068 (0.0061)	-0.0048 (0.0033)	0.0024 (0.0038)	0.0049*** (0.0013)
BSIZE	0.0061 (0.0045)	0.0229*** (0.0086)	0.0150 (0.0093)	-0.0021 (0.0073)	0.0023 (0.0084)	0.0147** (0.0071)	0.0105 (0.0066)	0.0172** (0.0076)	0.0074 (0.0058)
DIV	-0.0151 (0.0914)	-0.2830** (0.1440)	-0.5190*** (0.1110)	-0.0745 (0.1050)	-0.2610* (0.1440)	-0.2370** (0.1120)	-0.1340 (0.0975)	-0.2760* (0.1440)	-0.3170*** (0.1220)
Cop_Effect	0.0134*** (0.0012)	0.0049*** (0.0014)	-0.0053*** (0.0018)	0.0117*** (0.0014)	0.0069*** (0.0012)	-0.0019 (0.0022)	0.0094*** (0.0017)	0.0032** (0.0015)	-0.0031* (0.0017)
Constant	0.0475 (0.0397)	-0.0587 (0.0714)	-0.2620*** (0.0459)	0.0478 (0.0548)	0.0291 (0.0933)	-0.1360* (0.0776)	0.0028 (0.0343)	0.0455 (0.0832)	-0.2590*** (0.0208)
Observations	1,145	1,057	866	1,145	1,057	866	1,145	1,057	866
AR(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR(2)	0.0728	0.1520	0.1575	0.0658	0.1315	0.1117	0.0604	0.1315	0.1687
Sargan Test	1	1	1	1	1	1	1	1	1

Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 6 Sensitivity analysis for cash proxy (1998- 2015); GMM System

	(1) CR	(2) NCASH	(3) LNCASH
L.CR	0.4500*** (0.0218)		
L.NCASH		0.4940*** (0.0124)	
L.LNCASH			0.4780*** (0.0268)
WDIR	0.0882** (0.0447)	0.0381*** (0.0071)	0.2580** (0.1310)
BIND	-0.1950*** (0.0407)	-0.0229*** (0.0044)	-0.0354 (0.0967)
BSIZE	0.0993*** (0.0378)	-0.0049 (0.0031)	0.0074 (0.0777)
CEODUAL	-0.0257 (0.0171)	-0.0000 (0.0013)	0.0551*** (0.0209)
CFO	0.8700*** (0.0996)	0.0762*** (0.0106)	0.9290*** (0.2620)
M_B	-0.0047*** (0.0008)	-0.0004*** (0.0000)	0.0144*** (0.0016)
DEBT	-0.1840*** (0.0607)	0.0203** (0.0101)	0.1320 (0.2840)
CAPEXP	-0.0064*** (0.0005)	-0.0006*** (0.0000)	-0.0103*** (0.0017)
FSIZE	-0.0312*** (0.0110)	-0.0007 (0.0011)	-0.0289* (0.0157)
DIV	-0.4620 (0.5160)	-0.1710* (0.0901)	-8.1650*** (1.6990)
CFO_Vol	-0.0047 (0.1060)	0.1970*** (0.0188)	2.2430*** (0.8580)
Cop_Effect	0.0201*** (0.0064)	0.0139*** (0.0009)	0.2030*** (0.0224)
Constant	1.0370*** (0.1620)	0.0481*** (0.0156)	-1.2970*** (0.281)
Observations	1,151	1,145	1,145
AR(1)	0.0000	0.0000	0.0000
AR(2)	0.4816	0.0976	0.0696
Sargan Test	1	1	1

Definitions of the variables are explained in Table A.2. Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 7 Sensitivity analysis using alternate measure of board gender diversity Blau and Shanon Index (1998- 2015); GMM System

	(1) CASH	(2) Ind_Adj	(3) ECASH	(4) CASH	(5) Ind_Adj	(6) ECASH
L.CASH	0.4810*** (0.0173)			0.4970*** (0.0162)		
L.Ind_Adj		0.4410*** (0.0159)			0.4590*** (0.0421)	
L.ECASH			0.5440*** (0.0187)			0.5430*** (0.0185)
BLAU_INDEX	0.0169*** (0.0055)	0.0159** (0.0074)	-0.0307*** (0.0080)			
SHANON_INDEX				0.0121*** (0.0042)	0.0111** (0.0048)	-0.0237*** (0.0062)
BIND	-0.0150*** (0.0055)	-0.0218*** (0.0062)	0.0038 (0.0059)	-0.0199*** (0.0056)	-0.0277*** (0.0082)	0.0045 (0.0058)
CEODUAL	0.0010 (0.0010)	0.0035** (0.0014)	0.0042** (0.0018)	0.0013 (0.0012)	0.0026 (0.0039)	0.0044** (0.0018)
BSIZE	-0.0028 (0.0033)	0.0061 (0.0044)	-0.0011 (0.0057)	0.0004 (0.0023)	0.0205*** (0.0075)	-0.0015 (0.0057)
CFO	0.0487*** (0.0144)	0.0704*** (0.0206)	0.0583*** (0.0161)	0.0502*** (0.0142)	0.0450 (0.0429)	0.0579*** (0.0160)
M_B	-0.0001** (0.0000)	0.0012*** (0.0003)	0.0001 (0.0003)	-0.0002** (0.0000)	0.0002 (0.0003)	0.0001 (0.0003)
CAPEXP	-0.0005*** (0.0000)	-0.0010*** (0.0000)	0.0001*** (0.0000)	-0.0005*** (0.0000)	-0.0006*** (0.0000)	0.0002*** (0.0000)
FSIZE	-0.0006 (0.0010)	-0.0010 (0.0010)	0.0157*** (0.0016)	-0.0009 (0.0008)	0.0000 (0.0041)	0.0157*** (0.0016)
DIV	-0.1870** (0.0815)	-0.3650*** (0.0932)	-0.1880 (0.1340)	-0.1280 (0.0830)	-0.3470** (0.1440)	-0.1870 (0.1330)
CFO_Vol	0.1540*** (0.0115)	0.1940*** (0.0227)	0.0543*** (0.0208)	0.1640*** (0.0163)	0.1860*** (0.0665)	0.0527** (0.0207)
DEBT	0.0141 (0.0121)	0.0166 (0.0199)	-0.0015 (0.0121)	0.0201* (0.0103)	-0.0062 (0.0247)	0.0002 (0.0122)
Cop_Effect	0.0118*** (0.0009)	0.0038*** (0.0011)	-0.0015 (0.0014)	0.0122*** (0.0011)	0.0020* (0.0011)	-0.0013 (0.0015)
Constant	0.0420*** (0.0122)	0.0044 (0.0116)	-0.2440*** (0.0159)	0.0362*** (0.0135)	-0.0322 (0.0605)	-0.2450*** (0.0158)
Observations	1,145	1,057	866	1,145	1,057	866
AR(1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR(2)	0.0706	0.1532	0.1780	0.0756	0.1751	0.1597
Sargan Test	1	1	1	1	1	1

Definitions of the variables are explained in Table A.2. Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.

Table 8 Dynamic panel data GMM difference estimation results

	(1) CASH	(2) Ind_Adj	(3) ECASH
L.CASH	0.4340*** (0.0234)		
L.Ind_Adj		0.3940*** (0.0395)	
L.ECASH			0.1990*** (0.0302)
WDIR	0.0173** (0.0084)	0.0350*** (0.0073)	-0.0346** (0.0162)
BIND	-0.0056 (0.0080)	-0.0031 (0.0085)	0.0000 (0.0090)
CEODUAL	-0.0021 (0.0027)	-0.0025 (0.0045)	0.0072*** (0.0017)
BSIZE	0.0106* (0.0063)	0.0216** (0.0100)	0.0081 (0.0070)
CFO	-0.0011 (0.0157)	0.0024 (0.0355)	0.0991*** (0.0240)
M_B	0.0003*** (0.0000)	-0.0000 (0.0002)	-0.0010** (0.0004)
CAPEXP	-0.0004*** (0.0000)	-0.0003*** (0.0000)	0.0011*** (0.0000)
FSIZE	-0.0014 (0.0037)	-0.0045 (0.0039)	0.0020 (0.0021)
DIV	-0.0288 (0.1190)	-0.1280 (0.1060)	-0.0873 (0.1020)
CFO_Vol	0.0386 (0.0406)	0.0996** (0.0438)	0.0580** (0.0226)
DEBT	-0.0130 (0.0149)	-0.0115 (0.0151)	0.0325* (0.0169)
Cop_Effect	0.0079*** (0.0012)	-0.0031** (0.0015)	-0.0022 (0.0016)
Constant	0.0358 (0.0543)	0.0308 (0.0622)	
Observations	1,035	953	736
AR (1)	0.0000	0.0000	0.0000
AR (2)	0.0504	0.1268	0.0692
Sargan Test	1	1	1

Definitions of the variables are explained in Table A.2. Standard errors are in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table:9 Effect of board gender diversity on corporate cash, Propensity Score Matching and Difference in Difference

	(1) CASH	(2) Ind_Adj	(3) ECASH	(4) CASH	(5) Ind_Adj	(6) ECASH
L.CASH	0.4580*** (0.0107)			0.4790*** (0.0236)		
L.Ind_Adj		0.3750*** (0.0194)			0.3340*** (0.0220)	
L.ECASH			0.5640*** (0.0343)			0.5840*** (0.0304)
WDIR1	0.0035*** (0.0009)	0.0056** (0.0025)	-0.0099*** (0.0027)	-0.0015 (0.0011)	0.0058* (0.0030)	-0.0051** (0.0022)
BIND	-0.0189*** (0.0052)	-0.0215*** (0.0071)	-0.0096 (0.0078)	-0.0169*** (0.0050)	-0.0173** (0.0069)	-0.0050 (0.0126)
CEODUAL	-0.0020** (0.0008)	-0.0041 (0.0033)	0.0002 (0.0040)	-0.0024** (0.0011)	0.0017 (0.0057)	-0.0015 (0.0040)
BSIZE	-0.0023 (0.0016)	0.0046 (0.0040)	0.0026 (0.0052)	0.0002 (0.0033)	0.0057 (0.0043)	-0.0059 (0.0064)
CFO	0.1060*** (0.0085)	0.0593*** (0.0171)	0.1000*** (0.0148)	0.1300*** (0.0124)	0.0566*** (0.0162)	0.0776*** (0.0198)
M_B	0.0002*** (0.0000)	0.0006* (0.0003)	-0.0002 (0.0004)	0.0000 (0.0000)	0.0007*** (0.0002)	0.0001 (0.0005)
CAPEXP	-0.0006*** (0.0001)	-0.0008*** (0.0000)	0.0001*** (0.0000)	-0.0003*** (0.0000)	-0.0009*** (0.0000)	0.0002** (0.0000)
FSIZE	-0.0005 (0.0010)	-0.0017 (0.0013)	0.0193*** (0.0022)	-0.0023** (0.0010)	0.0010 (0.0013)	0.0190*** (0.0025)
DIV	-0.0865 (0.0713)	-0.4850*** (0.0727)	-0.5150*** (0.1330)	-0.0866 (0.0740)	-0.4550*** (0.0845)	-0.6760*** (0.1590)
DEBT	-0.0240*** (0.0054)	-0.0278** (0.0134)	0.0242*** (0.0086)	0.0197** (0.0097)	-0.0187* (0.0109)	0.0301 (0.0189)
CFO_Vol	0.0896*** (0.0224)	0.1570*** (0.0304)	0.0493 (0.0316)	0.1200*** (0.0085)	0.1130*** (0.0342)	0.0866*** (0.0237)
Cop_Effect	0.0136*** (0.0010)	0.0128*** (0.0019)	-0.0043*** (0.0015)	0.0126*** (0.0029)	0.0021 (0.0063)	-0.0110 (0.0068)
DID				0.0081** (0.0032)	0.0154* (0.0087)	0.0056 (0.0084)
Constant	0.0485*** (0.0150)	0.0400 (0.0252)	-0.3060*** (0.0345)	0.0553*** (0.0114)	-0.0103 (0.0242)	-0.2800*** (0.0354)
Observations	569	528	470	569	528	458
AR(1)	0.0143	0.0022	0.0098	0.0122	0.0040	0.0059
AR(2)	0.2363	0.0754	0.0572	0.2533	0.0697	0.0196
Sargan Test	1	1	1	1	1	1

Appendix A: Variable definitions and measures

Variable	Definition	Measure
Dependent Variable		
CASH	Cash ratio	Cash divided by total assets
Ind_Adj_Cash	Industry-adjusted cash	Firm's ratio of cash to net assets and the median level of this ratio for the given industry
N_CASH	Net cash ratio	Cash divided by net assets
CR	Current ratio	Current assets divided by current liabilities
Independent Variable		
WDIR	Percentage of women directors	Ratio of total women directors to total number of directors
BLAU_INDEX	Women on board index	$1 - \sum_{r=1}^n P_r^2$ where n is the number of categories of male and female directors and P_r is the percentage of each category of male and female directors.
SHANON_INDEX	Women on board index	$-\sum_{r=1}^n P_r \ln P_r$ where n is the number of categories of male and female directors and P_r is the percentage of each category of male and female directors.
WDIR1	Women directors on	Dummy variable coded 1 if firms have at least one female on the board, 0 otherwise.
WDIR2	Women directors	Dummy variable coded 1 if firms have at least two female on the board, 0 otherwise.
WDIR3	Women directors	Dummy variable coded 1 if firms have at least three female on the board, 0 otherwise
BIND	Board independence	Ratio of independent directors to total number of directors
BSIZE	Board size	Natural logarithm of total board members on corporate board
CEODUAL	CEO duality	Dummy variable, coded 1 if the CEO is also chair of the corporate board, 0 otherwise
CFO	Operating cash flows	Pre-tax profits plus depreciation and amortization, divided by total assets
DEBT	Debt ratio	Total debt divided by total assets
FSIZE	Firm size	Natural logarithm of total assets
NWC	Net working capital	Current assets minus current liabilities and cash holdings, divided by total assets
CAPEXP	Capital expenditure	Capital expenditure to total assets
DIV	Dividends	Dividends to total assets
CF_Vol	Cash flow volatility	Standard deviation of cash flows from operations to total assets
M_B	Firms' growth	The sum of the book value of liabilities and market value of equity divided by the book value of total assets.

Appendix B: Measuring Excess Cash E_Cash

To measure E_cash, following Dittmar and Mahrt-Smith (2007), we first estimate a regression to determine the optimal cash, and excess cash is then defined as the difference between actual cash and predicted optimal cash that firms should hold. In other words, the residual of a corporate cash level regression. The main idea of the literature on optimal cash is that firms do not need to hold cash, provided that financial markets are perfect. However, due to market imperfections, cash cannot be raised instantaneously, and therefore, firms stockpile it. The equation and the definition of variables for measuring optimal cash in the regression equation are mainly based on the work of (Dittmar and Mahrt-Smith 2007) and are discussed below:

$$\ln (Cash/TNA)_{i,t} = \beta_0 + \beta_1 \ln(TNA)_{i,t} + \beta_2 (NWC/TNA)_{i,t} + \beta_3 (FCF/TNA)_{i,t} + \beta_4 (R_D/TNA)_{i,t} + \beta_5 (MV/TNA)_{i,t} + \beta_6 (Industry_Vol)_{i,t} + \varepsilon_{i,t}.$$

Where Cash is cash and equivalents, TNA is total net assets and equal to total assets minus cash and equivalents. NWC is the difference of current assets and current liabilities. The variable FCF is free cash flows; MV is market value measured as price times shares plus total liabilities. R_D are research and development expenditures, set to zero if missing. Finally, the variable industry sigma is measured as a standard deviation of FCF of the prior 10 years.