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Innovative boards: Exploring the curvilinear relationship of firm innovation with information diversity, dynamic capability diversity and governance diversity of the board of directors, and understanding the critical moderating effect of board size on this relationship

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I hereby declare that this Doctor of Business Administration (Innovation) dissertation is my original work and it has been written by me in its entirety.

I have duly acknowledged all the sources of information

which have been used in this dissertation.

This Doctor of Business Administration (Innovation) dissertation has

also not been submitted for any degree in any university previously.

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Abstract:

The role and effectiveness of Board of directors in fostering innovation is an area of keen interest for both academics and professionals. Heterogeneity research suggests that diverse groups consider a broader range of perspectives and hence are able to foster creativity and drive innovation. The focus of most prior research on board diversity has largely been on gender, and the outcomes have been generally inconclusive. In addition, previous research efforts have focused on the RBV (Resource based view) in terms of the board role and also in explaining the diversity relationship with innovation. This study extends the diversity, governance and innovation literature , beyond generic gender diversity, and beyond the RBV view by examining the relationship of organizational innovation with newly introduced experience based diversity constructs like “Dynamic Capability Diversity” , “Information diversity”, and “Governance diversity” at the board level. The longitudinal study, used a sample of data consisting of 209 unique and global firms, spanning over an eight-year period, and the results demonstrate that the innovation outcomes of an organization have a curvilinear relationship with Dynamic capability diversity and Information diversity. The study results also indicate support for the “contingency view” by showing that the influence of the diversity elements is contingent upon the firm’s board size. This study also brings forth the

importance of understanding the interactions between the different diversities. This study extends the understanding of the challenges around board composition, board diversity and board governance with respect to innovation as we discuss the implications for both practice and academic research.

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SECTION 1 INTRODUCTION

The secret of change is to focus all of your energy, not on fighting the old, but building on the new.“

Socrates (470-399 BC), Philosopher

In today’s world, the economic perspectives are increasing the focus on the capabilities of firms to be able to consistently and constantly innovate and derive incremental financial value. Interest in the role of executive diversity increased dramatically after Hambrick and Mason postulated their Upper Echelon Theory and many studies have since examined the effects of demographic components of diversity like age, gender, race of the top management teams on firm performance. With the increasing focus of corporate governance and the emerging importance of the role of the board of directors, researchers have looked at similar effects of diversity on firm performance beyond the TMT and extended it to diversity among board members. However the studies that have focused on relationship between diversity and innovation are still quite limited (Van der Vegt & Janssen, 2003) (Ostergaard, Timmermans, & Kristinsson, 2011). The first purpose of this research was to make a theoretical and empirical examination of the linkage between diversity of the and firm innovation. We extend the work in these areas by going beyond the TMT diversity and firm wide diversity to specifically examine the issue from the perspective of diversity of Board of directors. While the diversity issue has generally been looked at from “surface level diversity” or “deep level diversity”, we specifically examine diversity

through multiple constructs – demographic construct, information /cognitive construct, dynamic capability construct and the governance construct with respect to their relationship with innovation. Previous studies on the relationships of diversity and creativity and team performance have given mixed and inconsistent empirical results with some studies supporting the positive relationship as proposed by Bentel and Jackson (Bantel & Jackson, 1989) and some reflecting negative relationships (O'Reilly, Snyder, & Boothe, 1993) 1993 (Miller, Burke, & Glick, 1998). We believe that this is driven by a few reasons. First, most of such research is done on a cross-sectional basis and that approach has limitations in terms of causality determination, and hence we have taken a longitudinal approach in this study. In addition, many of the previous studies look at the relationship from the perspective of a single theoretical construct which could be Resource based view, the Agency theoretical view, or the Communication and social interaction view or the Social identity theoretical view. We have looked at the diversity and innovation relationship through a multiple theoretical perspective wherein we indicate how different theoretical constructs involving resource based view, dynamic capability view, agency view, cognitive diversity view, social identity view and the corporate governance theories all fit in one multi theoretical approach and their interactions and inter relationships define the relationship of diversity with firm innovation. In addition, this study posits the structural contingency approach and provides the analysis of the moderating effects of board size on the diversity – innovation relationship.

1.1 Innovation

In every field of economic activity, businesses are facing new and complex challenges requiring continuous improvements in performance. Firms today are facing multiple challenges driven by changes that are extremely fast paced. In the uncertainty driven ecosystem of business, every organization is constantly looking for potentially radical ways to create a sustainable differentiation with its competitors. Innovation plays a very important role in determining firm performance (Torchia, Calabro, & Huse, 2011) . Innovation has now not only become the central strategic element for business strategy but is considered critical for organization's current and future existence (Zahra & George, 2002) (Mayer, Salovey, & Caruso, 2004) . Firms are being forced to focus on innovation because of the dynamically changing competitive strengths of the industry (Porter, 1985) and by the changes that are happening outside the industry (Goffin & Mitchell, 2010).

"Innovation is the adoption of any idea, process or behavior, which is new for the organization" (Daft, 1978), (Damanpour & Evan, 1984) (Damanpour, 2010) , and at the same time it is also seen as a recombination or an improvement of old ideas into something that is perceived as something new or improved (Van de Ven, 1986). As innovation is the key antecedent to the firm's success (Covin & Slevin, 1991), it becomes imperative that we study the antecedents of firm innovation to allow us to develop a deeper understanding of the critical

conditions that are necessary in driving organizational success (Zona, Zattoni, & Minichilli, 2013).

1.2 Leadership

Another issue which has fostered great debate among and management theorists is the issue of the importance of the **role of Leaders** in an organization and the manner in which the firm's leadership engages with its different stakeholders. (Covin & Slevin, 1991) (Bantel & Jackson, 1989). While there has been a minority view that leaders in an organization have limited powers and they do not have the ability to control the systemic and environmental factors that impact organizational direction (Aldrich, 1979), it is also widely believed that the leaders of an organization do hold strong decision making powers, and hence it is the leaders of the firm who determine the success and failure of the organization (Weiner & Mahoney, 1981). Management research on leadership has focused on the role of CEO in driving firm performance and innovation. We believe that the Board of directors, which has legal responsibilities for the management of the firm, plays a vital role in establishing a "connect" between the firm and its external operating environment, and has an overall strategic responsibility for the firm. The Board of directors is today essentially seen as the strategic leadership of the firm. Therefore it is critical that firms need to understand how boards play a key role in driving organizational innovation.

Fundamentally, the boards are effectively a group of "individual" decision makers who are thus tasked with the responsibility of making collective decisions with respect to the organization. This concept then throws up the key question that how do the individual characteristics of the different board members impact their thinking and analysis of a situation as they make their individual choices that contribute to the board decisions and firm innovation?

1.3 Heterogeneity

Heterogeneity of the organization is therefore another facet of increasing relevance for organizational innovation and firm performance. Both academic researchers and management practitioners have demonstrated interest in finding the characteristics of team members that have an influence on the team's performance (Carpenter, Geletkanycz, & Sanders, 2004). Higher levels of heterogeneity are understood to help increase the differences in the perspectives of the working groups within the firm and allow the groups to consider multiple approaches to the group activity. This heterogeneity view, when observed from the Resource Based theory lens, looks at firms and businesses (especially large firms) as open systems which use the processes of information and resource exchange with the environment to create sustainable competitive advantage through innovation in product and processes. In any group, the cognitive conflict (which arises from the difference in thoughts, opinions, ideas, beliefs of the group with respect to the group tasks), is a key driver of the quality of the decisions

made by the group (Ding & Yang, 2014). The core belief is that a broader resource pool for the group leads to higher cognitive conflict and more effective analysis and decision making by the group.

In the context of the board of directors of a firm, the same philosophy reflects that higher diversity among the board members breeds higher cognitive conflict contributing to a variety of opinions and views amongst the board members leading to better understanding of the business and environmental complexities (Cox, Lobel, & McLeod, 1991). Over the years, therefore many organizations have incorporated diversity in their workforce with a view to augmenting the problem solving processes (Chatman & Flynn, 2001).

The results of such attempts have only achieved a mixed bag of outcomes because research on group and team interactions has also shown that there are other potentially challenging effects of incorporating heterogeneity. The heterogenous groups in many studies experience issues in coordination, cohesion and team work ,especially when they are handling complex activities (Zeigler, Dielh, & Zijlstra, 2000) .The board of directors as a group are generally tasked with intricate decision making activities. The complicated strategic decisions required of them become more complex because the boards usually don't meet very often, and generally have to make decisions while operating with difficult time constraints. The challenges at the board become even more labyrinthine, when the board members' interactions are looked at from

the Social identity and Social categorisation theory perspective. Individual board members tend to associate themselves with a “specific identity”, based on certain real or perceived group memberships (Tajfel, 1978). Such identification and categorization leads to sub-group formation and inter-group biases, which create barriers and boundaries of thought as well as minority-majority levels and power-status differentiation among members (Tajfel & Turner, 1985). This culminates in dysfunctional group-interactions, with reduced level of questioning, incomplete and biased analysis and lack of resource sharing. Therefore heterogeneity can drive poor board cohesion , create challenges in terms of identifying the problem, understanding the issues, and analysing the potential solutions leading to poor creativity and reduced innovation for the firm.

1.4 Corporate Governance

The innovation complexity hence extends beyond the resource-pool dynamics of the board of directors. Less than one fifth of new product innovations succeed (Crawford, 1987). Innovation as a strategy remains fraught with risk (Lumpkin & Dess, 1996) and it remains difficult to execute, needs resource alignment, adaptation to constant change and has a long term time frame of reference (Lee & O'Neill, 2003). It is important therefore to also understand as to how the board members visualize their role in such context. Analysing the issue from the **corporate governance perspective**, the Agency theory reflects that the interests of the management/ executives of the firm and of the

shareholders are not necessarily aligned all the time (Eisenhardt, 1989). Also, the results of investments in innovation are generally long term in orientation. These time frames may not align with executive objectives and hence the board is tasked with ensuring that the shareholder interest is protected against any managerial opportunism (Lee & O'Neill, 2003). This determines the board members' role as focused on risk management and control.

At the same time when the board role in corporate governance is viewed through the resource perspective, the board is expected to provide a wide range of capabilities, knowledge and networks to allow it to perform its strategic and advisory role and help in value creation.

The Board of directors thereby plays a multi-dimensional and crucial role for the firm:

a. by providing resources and pools of information, networks, skills, and experiences to increase the knowledge base, the cognitive quotient and broaden the perspective of intellectual capital of the firm and the absorptive capacity of the organization.
b. by ensuring that it manages to synergize the organizational interest and protect shareholder interest by monitoring the management effectively.
c. by ensuring that it reviews the inputs from management, overlays it with its own information from its networks, and through its own consultative review and engagement, decide on the resource allocation to manage current and future R&D and innovative initiatives (Wincent, Anokhin, & Boter, 2009).

d. by managing its decision-making processes to ensure that the personal values, beliefs and attitudes of the individual members and their differing backgrounds, and experiences do not create social categories and stereotype led biases causing group think which would reduce solution orientation and weaken creativity and cohesive execution resulting in poor innovation.

To summarize, we see that innovation is a key driver for the long term strategy, value creation and success of the firm; that the board of directors is the key strategic leadership team of the firm playing a crucial role in managing the firm; and that board activities and decisions (like of any other team) have a strong dependence on board composition and diversity. Therefore it is no surprise that board level diversity is one of the most critical governance issues faced by modern corporations (Milliken & Martins, 1996).

1.5 Approaches to diversity: Surface level diversity, deep level diversity, job related diversity

Though the importance of diversity, board and corporate governance is well established, there is no clear consensus among academics and social scientists in terms of the definition of innovation and the approach that should be applied for establishing the appropriate framework. This is largely because academics have made efforts to “oversimplify” the construct of team diversity (Bell, Villado, Lukasic, & Belau, 2011). For a

very long time, diversity was either viewed as surface level diversity (generally observable differences like gender, age, race), or as deep level diversity (which largely refers to attributes that are more difficult to observe like socio-economic background, values, beliefs etc.) (Milliken & Martins, 1996), (Torchia, Calabro, & Morner, 2015). Pelled (Pelled, 1996), then extended the argument that the diversity of a team should be studied with respect to function and job related differences defined on the basis of job-related attributes (Educational and functional backgrounds) or "less job-related" attributes (gender, sex, race etc.) (Bell, Villado, Lukasic, & Belau, 2011).

1.6 The merit principle & representation principle of board composition

While the Board is responsible to make decisions that have a role in determining the firm's current business and financial performance and in determining its future strategies to maximize the interest of the shareholders (Carver, On Board Leadership, 2002), the board is also responsible for the societal engagement of the firm ((Keasey, Thompson, & Wright, 1997) and organizations are generally expected to reflect the values of the society in which they operate.

Based on the above, there are two core principles related to diversity that matter in the context of the board - The merit principle and the representation principle (van der Walt & Ingley, 2003). The representation principle is based on the social responsibility theory / stakeholder view wherein the board composition should reflect the composition of the society at large and ensure social justice. The merit principle is based on the shareholder view that the board composition should reflect the distribution that brings individuals with certain characteristics which will be of value to the firm especially in resolving issues and challenges of policy (Burton, 1991).

1.7 The "experiential" orientation in our study

While most existing studies on diversity look at observable/demographic and non-observable (cognitive diversity) characteristics (Milliken & Martins, 1996), we posit that it is important to delve deeper into the composition of the board and antecedents of the diversity elements to build a framework that allows us to explore the relationship between diversity and innovation.

We especially extend the thinking of the merit and the representation principle in our research whereby we indicate that it is these special experiences which drive the skill / merit of the board members with respect to their ability to drive innovation. We focus on developing a deeper understanding these "merit experiences" by classifying them as

cognition driven Information experiences, Dynamic capability experiences , and Governance Experiences and we also explore the different nature of their relationships with firm innovation through the lens of board diversities with respect of each of such special experiences .

We also in parallel explore the effect of representation principle – which is largely governed by gender etc. as drivers of social composition and the effect of board diversity on such demographic (representation) diversities on firm innovation.

1.8 The Classification of the Key experiences of the Board members

The experiences and backgrounds that have generally been considered in most research efforts have been focused on functional backgrounds (e.g. marketing, operations, sales, finance, etc.) and industrial backgrounds (e.g. consumer, technology, manufacturing, commodities etc) (Torchia, Calabro, & Morner, 2015). While there has been some prior support to these vectors as part of background diversity of board members , there is also the important question regarding the difference in role of management (TMT) and the role of the board. As we have articulated earlier, the role of the board is at the strategy and resource allocation level and the board is generally not supposed to find solutions to operational problems and not to solve functional and departmental issues or to build operational and functional synergies.

Therefore it is critical that the board and the management should not reflect the same set of skills and backgrounds because such a scenario will be ineffective and dysfunctional.

We therefore believe that while it is important for the TMT to focus on functional background and industrial background diversity, the board needs to look at a different set of experiences.

1.8.1 Information experiences:

The resource based view of board governance and the resource based view of diversity / heterogeneity both highlight the criticality of wide pool of “information” availability for board effectiveness.

1.8.1(a). Higher education:

Higher education reflects higher human capital through knowledge, skills and expertise (Brandenburg, Gunther, & Schneider, 2007).The human capital perspective indicates that better educated people are more competent in the use and exploitation of new technologies (Nelson & Phelps, 1966). Not only do higher educated graduates operate as strong basic innovators themselves, they can also perform as effective second stage innovators who have better abilities to exploit technological progress. (Lundvall & Johnson, 1994). A diverse team with high qualifications therefore deepens information and expertise in a group to help drive creativity and innovation.

1.8.1 (b). Educational Institutional backgrounds:

It is well recognized that Institutions of learning are responsible for developing knowledge, skills and competencies amongst their students. Institutions also recognize that a significant part of education is outside the structure of the classroom. The external interactions with the institutional environment influences the thinking and learning of the students (Gurin, 1999). The curriculum and specific pedagogical interventions have a positive impact on the critical thinking capabilities (Macphee, Kreutzer, & Fritz, 1994). Having a variety of such experiences enhances the information/ knowledge pools built from exposure to multiple institutions. This will build a resource pool that will add strongly to the analytical and the creative capacity of the board and foster innovation.

1.8.1 (c). Networks:

It is also well established that human capital is rooted in social networks (Nahapiet & Ghoshal, 1998). The capabilities of the board members in terms of knowledge and information are acquired through their internal and external network i.e. their social capital (Tsai & Ghoshal, 1998). The board enhances the organizational cognitive quotient and absorptive capacity by the extent of networks and potential interactions of the board members, thereby impacting firm innovation.

We therefore postulate that "**Information experience**" – driven by higher education, multiplicity of institutional exposure and professional

networks should have a significant relationship with the ability of the organization to drive innovation.

1.8.2 Dynamic Capability Experiences

Dynamic capability view is an extension of the Resource based view of the firm, wherein it is believed that it is not just the availability of the resources but the ability of the firm to “integrate, build and reconfigure internal and external competencies/capabilities “ that allows the firm to successfully innovate and address the rapidly changing environment. (Teece, Pisano, & Shuen, 1997). The capability of the firm to be able to continuously alter its resource base allows it to continuously change, adapt and hence innovate. It has been established that for firms to be able to achieve breakthrough innovation, they need to focus on the development of the firm’s dynamic capabilities (Michailova & Zhan, 2015).

Classification of dynamic capabilities

The dynamic capabilities have a set of key components that allow them to:

> “(1) **Sense** and shape opportunities and threats
>
> (2) **Seize** the opportunities and
>
> (3) **Transform** i.e. reconfiguring the business enterprise’s intangible and tangible assets” (Teece, 2007) (Diaz-Fernandez, Bornay-Barrachina, & Lopez-Cabrales, 2015).

The dynamic capabilities of the firm also reflect in the form certain identifiable and specific routines which include:

a. Capabilities to integrate resources including human resources from varied skills and backgrounds (Eisenhardt & Martin, 2000)
b. Capabilities to make analytical choices and strategic decisions (Eisenhardt, 1989)
c. Capabilities to reconfigure the firm's resources through replication and brokering (Hansen, 1999).
d. Capability to re-allocate the firm resources (Eisenhardt & Brown, 1999)(
e. Knowledge creation routines that allow the firm to develop its key dynamic capability of building new thinking (Helfat , 1997) (Eisenhardt & Martin, 2000)
f. Capabilities to build alliances and partnerships (Eisenhardt & Martin, 2000)
g. Capabilities to forge mergers and acquisitions (Eisenhardt & Martin, 2000)
h. Capabilities to manage exit strategies allowing firm to abandon and reject unsuccessful and/or unnecessary resources or combinations of resources (Sull, 1999) (Eisenhardt & Martin, 2000).

Dynamic capabilities and innovation

We take the view that the dynamic capabilities of the firm are an asset of the firm which allow the firm to have the capability to adapt to change through innovation (Hill & Rothaermel, 2003). Firm innovation relies on its knowledge, attitude and creativity and "this view is in line with the asset position of dynamic capability" (Parashar & Singh, 2005). Dynamic capability has been accepted to be seen as a pre-condition for the innovation capability of the firm (Bresnik & Hisrich, 2014). Fundamentally, the most significant aspect of the dynamic capabilities is the higher order capability of being able to learn how-to-learn, and that then allows the firm to be able to innovate more effectively (Collis, 1994) (Bresnik & Hisrich, 2014).

Since the Board of directors of the firm is the strategic decision making body, we believe it is the "dynamic capabilities of the board" that allow the firm to sense new opportunities and challenges, seize these opportunities and then reconfigure the firm's business to innovate and transform itself continuously. While dynamic capabilities are very difficult to observe in an organization (Diaz-Fernandez, Bornay-Barrachina, & Lopez-Cabrales, 2015), there are certain experiences of the board members , which we classify as **Dynamic capability experiences** , which are a set of specific and identifiable experiences – Entrepreneurship, Leadership and Research, which are idiosyncratic in themselves but have commonalities in mechanism based on the

dynamic capability view, through which they operate and drive firm innovation.

1.8.2 (a) Entrepreneurship

The entrepreneurial activities of a firm are those that focus on "identifying and exploiting" the potential opportunities (Zahra, Sapienza, & Davidsson, 2006). Reconfiguration of resources, reallocation of resources, developing alliances, building acquisition and exit routines are among the key dynamic capabilities (Eisenhardt & Martin, 2000) and they have a close association with Entrepreneurship. "Sensing" is one of the critical components of the dynamic capabilities and an entrepreneur has to be agile in his/ her capability to be able to continuously scan and identify market opportunities. Entrepreneurs become successful because they are able to seize the opportunities that come their way. Furthermore, entrepreneurs have to be able to pivot in terms of products, processes or business models to be successful. Successful entrepreneurs challenge the status quo, look for new opportunities, take risk and build new businesses through finding new solutions, build critical partnerships to solve current problems or create new opportunities by continuously innovating at every step.

1.8.2 (b) Leadership

Key leadership positions in an organization e.g. the CEO, are recognized as critical factors regarding the firm's ability to recognize opportunities & challenges, and to make decisions that impact organizational processes

(Ling et al., 2008). While it is important for organizations to have the required technological knowledge, R&D capabilities as well as the necessary skills in marketing and distribution, they also must have the right leadership to drive the innovation process. (Oke, Munshi, & Walumbwa, 2009). Leaders embrace change and transformational leaders create an environment supportive of disruption and accepting failure. Transformational CEOs/ Leaders track and filter information and build hypothesis with reference to market trends, review ongoing and expected competitive behaviours and they therefore exhibit the sensing capability that drives firm dynamic capabilities. CEOs and business leaders also make business decisions that require unbiased strategic and analytical analysis on the challenges and opportunities facing them and thereby they reflect the "seizing element" of firm dynamic capability. In addition, CEOs are able to marshal the resources that they have to be able to reorient the firm towards the revised strategic goals thereby reflecting the "transformational element" of firm dynamic capability. Transformational leaders therefore reflect a style that has a positive relationship with the firm dynamic capability (Diaz-Fernandez, Bornay-Barrachina, & Lopez-Cabrales, 2015).

1.8.2 (c) Research

The process of innovation is intricately linked to the ability to not only use existing knowledge, but also requires the capability to generate and acquire new knowledge (Mukherjee, Dey, Guin, & Sinha, 2005) through research. Extraordinary research is based on quest for knowledge which

is exploratory in nature and pushes the boundaries of normal science (Kuhn, 1970) and such thinking and research leads to formation of new paradigms which plays a crucial role in innovation. The knowledge creation routines which allow the creation of new knowledge and a new way of thinking develop a vital dynamic capability in a firm. (Helfat , 1997) (Eisenhardt & Martin, 2000). Academics and researchers bring this critical experience for the firm which allows for the improvement of the learning process for the firm and an increment to the overall knowledge base of the firm thereby enhancing firm dynamic capabilities and improving firm innovation. A key factor in the knowledge creation process for the firm is also the ability to keep strong information flow by maintaining active linkages with the external knowledge ecosystem. Active and direct research experience at the board allows the development and maintenance of a robust knowledge network and thereby providing a strong support to the sensing element of the firm dynamic capabilities.

We thereby believe a diverse composition of "Dynamic capability experiences" of entrepreneurship, leadership and research should have a significant relationship with the ability of the organization to drive innovation.

1.8.3 Governance experience:

1.8.3 (a). Board vintage:

Two factors that have a strong impact on the innovation outcome of an organization are “uncertainty” (this is dependent on the pace at which technology is changing , the dynamics of the market are evolving etc.) and “complexity” (which is a reflection of the level of organizational interdependency) (Tidd, 2001; Drucker, 1985). Longer term for members on the board of directors also adds to board cohesion, prevents the firm from making resource allocation errors and improves board effectiveness (Nutt, 2002). It is also important that Innovation be seen as a process that has to be highly managed for success rather than simply looking at it as an outcome that is driven by acts of personal / individual excellence or in response to random / sporadic brilliance (Drucker, 1985). In any team, the depth of specific knowledge builds with vintage of the team members, and so board members with longer specific board experience should have a deeper understanding of the issues and challenges and hence contribute to firm innovation.

1.8.3 (b). Other Board experiences:

Effective boards are able to develop skills and capabilities which are above the base level of expectation. (Klearner, Yoshikawa, & Hitt, 2018). Board members from adjacent spaces and/ or from related experiences can add valuable perspective both from knowledge base and from their experience of understanding the board decision making processes.

Hence we postulate that **Governance Experience** which is a combination of

a. the depth of current board experience and
b. the width of understanding of managing board challenges across multiple organizations

should be a key driver of innovation.

1.8.4 The Demographic Composition Effect

1.8.4 (a) Gender

Going beyond the agency theory and the resource based theory view about the role of the board , there is developing view around the ability of the board to provide advice and counsel to the CEO and the TMT (van der Walt & Ingley, 2003). This advice and counsel is largely based on the different perspectives that the different members of the board bring to the table, which is supposedly going beyond the direct skill and resource based view about the capabilities of the board and its individual members. Men and women have differences with respect to their ethical behaviours (Kray, Reb, & Galinsky, 2004). There is difference in terms of corporate social view between the different genders (Bear, Rahman, & Post, 2010). Women provide a broader view to any problem and gender therefore has a significant support in theoretical basis for providing perspective led differentiated input .

1.8.4 (b) Age

The concept of age and its role in teams and boards has not received much attention though there are some attempts in literature that examine the effect of age. Younger board members are generally associated with higher energy and enthusiasm and openness to risk and change (Ararat, Aksu, & Cetin, 2015), and provide a vastly different perspective from established team members and hence they help in fostering innovation.

At the same time , age and gender are generally considered to be amongst the most easily observable personal criteria. Most social psychology academic research postulates that people in general tend to form first impressions about other people and do tend to categorize them on the basis of generally observable physical characteristics like gender, age etc. (Fiske & Neuberg, 1990). It is also seen that such categorization is generally consistent, and moreover is able to sustain itself in spite of interventions that are introduced to reduce social categorizations (Hewstone, Hantzi, & Johnston, 1991). Surface level demographic observations clearly lead to categorization (Bell, Villado, & Lukasik, 2010). Clearly such categorization based on age and gender could also lead to board inefficiencies and hence impact its decisions related to firm innovation.

We therefore postulate that the "**Demographic composition**" – driven by generally observable factors like age and gender should have a

significant relationship with the ability of the organization to drive innovation.

1.9 The contingency perspective: Interaction of diversity with board size

Structural contingency thinking posits that suitability of any structure depends upon the situational /environmental factors (Zona, Zattoni, & Minichilli, 2013) (Burns & Stalker, 1961). Hence, while there is no perfect or best way to organize, it is many times the contextual factors which end up being the key determining factors in understanding the effectiveness of the structure in question (Birkinshaw, Nobel, & Ridderstale, 2002). Research on the board of directors indicates that, the Contingency perspective is the right approach to analyse board effectiveness as there are many key factors impacting board composition, characteristics and interactions . (Boyd, Haynes, & Zona, 2011). Each board member brings to the table a certain “unique” set of knowledge, skills, experiences , capabilities, networks, information, and individual set of beliefs, values, attitudes. The board works as a team where these individual factors determine the thought process of the member as an individual and the board also operates as a strategic team wherein multiple individuals and group interactions occur which have a strong bearing on the overall outcome of the decisions of the board.

The board composition reflects the critical board diversities and these have a strong interplay within the **context of the board size**. The size

of the board has a strong influence on the capabilities, knowledge and resource pool that is available. The size of the board of directors also has significant effect on how the group dynamics change the group cohesion and impact group decisions, because any group decision is finally a compromise on the different views of group members (Sah & Stiglitz, 1986) (Sah & Stiglitz, 1991). The size of the Board of directors is a thereby a key determinant of corporate performance and innovation as the board size determines the board operating frameworks and also provides context for the behaviour of board members which shape the decision making of the board.

Some academic literature supports the view that large size board is more effective due to improved monitoring capability because larger boards have ability to create work teams that can provide more focus (Anderson & Tushman, 2004). This is supposed to be more so in case of more complex firms (Coles, Daniel, & Naveen, 2008), as the monitoring task is even more difficult in such firms. Members of larger boards tend to feel that their perceived risk of a decision is lower and that allows them to calibrate more aggressively for investment and innovation decisions (Damanpour, 2010). Large boards have better information processing capabilities in comparison to small boards (Haleblian & Finklestein, 2017) (Haleblian & Finklestein, 1993). In addition, larger size of the board can also help the company to forge external connections with its market and its competitive and regulatory environment thereby

enhancing the firms' ability to make strategic competitive analysis and improve the quality of its innovative decisions.

At the same time , it has also been shown that large size of the board is likely to create more challenges in the level of communication (Cheng, 2008) and this can also affect exchange of information with the management, thus impacting quality of decision making (Zahra , Neubaum, & Huse, 2000). Smaller boards are able to reduce the opportunity of managerial opportunism because they have stronger cohesion and hence control over CEO and management. (Yermack, 1996). In addition, the size of the board also has a motivational impact on each board member as some members feel less important in large boards. (Zona , Zattoni, & Minichilli, 2013), (Latane, Williams, & Harkins, 1979). Large boards also provide many board members the ability to enjoy the ability to "free ride" and enjoy social loafing (Lipton & Lorsch, 1992) and enjoy the benefits of reduced participation efforts.

Therefore the size of the board impacts innovation due to its effect on the information capability of the board, the governance modality of the board , the perspectives of the board, the individual motivations of the board members and the dynamic capabilities of the board .Hence, the board size should become a significant contingency factor for analysis as to how it has a moderating role in shaping the effects of board diversity in determining the innovation outcome of the firm.

1.10 Dimensions of our study

The core of our analysis is the research question exploring "What is the effect of the different constituents of diversity of the board of directors on the innovation of the firm? What is the nature of these relationships?.

a. The primary interest of our investigation was hence to understand the extent to which diversity of such experiential merit variables (information, dynamic capabilities and governance) and diversity of representation (demographic) variables are related to firm innovation.

b. Secondly , within the context of the conceptualization of these specific experiential variables, we also investigated the moderators of the relationship of these experiential diversities and firm innovation by specifically examining the effect of the board size.

c. In addition, previous studies have proposed that there is a possibility of significant impact of " setting of the study" while executing studies that explore composition of teams and team outcomes (Bell S. T., Villado, Lukasic, & Belau, 2011; Bell, Villado, & Lukasik, 2010). We thereby, also examine the results in different study settings (industry sector and geographic analysis).

SECTION 2 : DETAILED THEORETICAL BACKGROUND AND LITERATURE REVIEW

The theory of innovation, the theory of diversity and homogeneity, the theory of corporate governance and the theory of dynamic capabilities of a firm are the primary theories that provide the contextual background for this study. In this section we review these diverse theories from a prior research and understanding perspective and that helped us to identify specific gaps in the existing literature which then led us to the key research question that we address in our thesis paper.

2.1 Diversity

In the modern world, Diversity is not just relevant in the social and political context but it has a cultural, behavioural and economic milieu too. As business organizations have grown and become more complex- both structurally and environmentally, the diversity in the composition of its constituent groups has become of significant importance (Milliken & Martins, 1996) (Torchia, Calabro, & Huse, 2011). As people travelled, educated, lived and settled across continents and as the economic activity of corporations started to traverse national boundaries , the emerging MNCs (Multi-National Corporations) also had a MNC (Multi National Cultural) effect and it became imperative for corporations to understand the effect of organizational and team diversity (Milliken & Martins, 1996). Researchers and management practitioners have all been deeply interested in understanding the influence of characteristics

of team members on its performance. (Carpenter, Geletkanycz, & Sanders, 2004).

Penrose (Penrose, 1959) was among the earliest academics to address the important relationship of the diversity in the workforce with the performance of the organization as she highlighted that a firm reflects its "unique character" which is dependent upon the heterogeneity of the resources that are available to the firm. The Individual and his/ her importance as a particular member of a team/ group / is itself a very critical input for the success of the outcomes of the group / team. The Human Capital Theory (Becker, 1964) highlights the importance of the cognitive and productive capabilities of the individual as provided by the concerned individual's education levels, skills and experience. This cognitive perspective expounds the necessity of multiple resources to create the competitive advantage for firms on a sustainable basis. Collectively, the combination of such capabilities and competencies form the human social capital of the company (Carpenter & Westphal, 2001). At the same time, the individual members of a team carry a particular perceived status along a multiple set of attributes (gender, race, education, family background etc.) as per the Status Characteristic theory . This status has a significant bearing on the group interactions / group dynamics and these different standards possibly help create insider/ outsider scenarios (Terjesen, Sealy, & Singh, 2009).

2.2 The double sword effect of heterogeneity

While there is large amount of research reflecting that the demographic differences among the team members have a relationship with team performance, it is not conclusive as to what the nature of that relationship is and this relationship could be both positive or negative, (Tsui & Gutek) (van Kippenberg, De Dreu, & Homan, 2004).

2.2 (a) The Positive Effect of diversity in a team: The Cognitive Resource Perspective:

The cognitive resource perspective is largely based on the concept of knowledge and postulates that the "differences in the distribution of demographic factors is a reflection of the wider knowledge base and allows for availability of broader and different perspectives, and hence improves the team performance" (Williams & O'Reilly, 1998), (Cox & Blake, 1991). When there are different views causing disagreements with respect to opportunities and/ or threats facing an organization, the strategic decision making groups (comprising of upper echelon group members as individuals and as a group) thereby are aware of more issues, more ways of looking at the issue and can explore more alternative action steps (Bantel & Jackson, 1989) (Wiersema & Bantel, 1992). Ethnically heterogenous groups produce better ideas (McLeod & Lobel, 1992). Disagreements thereby allow improved learning opportunities for the group (board) and reduce the probability of group think. (Lant, Milliken , & Batra, 1992). Research also indicates that

diverse views and disagreements also force the upper echelon group , namely the board to spend firm resources to getting more information, specialist analysis etc. and that improves the board's comprehensiveness and extensiveness of analysis (Miller, Burke, & Glick, 1998). A team that is composed of members who provide a more diverse and hence unique demographic distribution is likely to be more successful than a homogenous team because the diverse team has access to a resource pool that has a broader base of information and knowledge and a wider base of available perspectives of different types (Bell, Villado, Lukasic, & Belau, 2011) . Board members who like each other tend to increase board "cohesion" (liking and sticking up for each other) (OReilly III, Caldwell , & Barnett, 1989). Based on the concept of inferred evaluation, individual board members tend to think that agreement on an issue reflects liking of the person (and not just the view). Cohesion therefore tends to reduce the comprehensive and extensiveness of analysis as ideas and issues go unchallenged, and diversity and disagreement on the board therefore improves quality of analysis and innovation by reducing 'cohesion" (Miller, Burke, & Glick, 1998).

2.2 (b) The Negative Effect of diversity:

While academic research provides strong support to the cognitive perspective, there are also a few academic arguments that suggest the opposite relationship.

The Co-operation Perspective – There are multiple theories that postulate that increase in intra-group diversity leads to reduced performance because coordination and cooperation among group members is reduced and hence the group work is no longer synergistic and positive (Milliken & Martins, 1996).

Communication failure – Because of diversity of cognitive thought or due of diversity driven by backgrounds, individuals end up using means of communication whether in terms of language, image, body language, mannerism, etc. which have different meaning for different individuals and this creates communication challenges (Daft & Lengel, 1986), and impact board and firm strategic analysis and innovation.

The Social Identity/ Categorization Theory (Tajfel, 1981) (Tajfel, 1978), (Tajfel & Turner, 1985) explores the inter personal interactions based on principle of attraction-selection-attrition amongst people, wherein individuals are believed to seek out and group-in with "similar" (homophilic) members. This further impacts the manner and the extent of exchange and communication within the group. Diversity among a group / team leads team members to categorize "other" members into clusters / sub-groups, leading to creation of "in-group" or "out-group" biases. Furthermore, members in a diverse team tend to make certain assumptions about the social status of other members, largely based on visible / demographic characteristics and hence their engagement with other members is driven by their "expectation" of the assumption based status/ position. The Expectation model hence further leads to a

negative effect on team performance (Bell, Villado, Lukasic, & Belau, 2011).

The Similarity Attraction Paradigm postulates that members with similar demographic/ sociographic similarities have a natural mutual attraction with each other because of commonality of their shared attributes (Byrne, 1971). Given this mutual attraction, the members have respect of others' views (in group), are able to communicate better with each other and work more cohesively and hence homogenous groups have a better performance than heterogenous teams (Wiersema & Bantel, 1992).

2.3 Different conceptualizations of diversity

The diversity of a group can therefore be viewed in multiple ways and has multiple definitions, and thereby there are various frameworks for defining and conceptualizing group diversity. Harrison and Klien, in their highly regarded study in 2007 have focused on developing a clear definition of diversity and a strong framework for diversity constituents wherein they define diversity as "**a unit level compositional construct",** which basically describes "the distribution of differences among the members of a unit with respect to a common attribute" (Harrison & Klein, 2007).

The key facet of the nature of diversity of a particular unit/group could be seen as indicative of the differences in the underlying factor in terms of

the nature or substance of the factor, or it could be as a result of the range of nature of arrangement of the differences, or it could arise from differences in the engagement and effects arising from different types of engagement of the underlying facets. These can be operationalised in terms of categories as defined by Harrison and Klein as:

a. Separation

This refers to the differences amongst the team constituents with respect to their values, opinions, beliefs, attitudes in terms of lateral differences on a continuum scale (Harrison & Klein, 2007). Among two teams A & B, wherein A has all members with attribute X and B has all members with attribute Y, the two teams will effectively have the same level of homogeneity because there is no “separation” amongst its members with respect to the particular attribute . Therefore the social theories of group and team interaction based on similarity attraction, social categorization etc. tend to look at diversity as a values/ beliefs / opinions based separation across a lateral continuum (Bell, Villado, Lukasic, & Belau, 2011).

b. Variety

The variety construct refers to the differences with respect to categories among the members of the team. The diversity is contributed by the different categories i.e. number of different categories. (Harrison & Klein, 2007) The variety construct associates closely with the Cognitive

Resource Perspective. Highers number of categories (higher variety) driving higher diversity in team improves availability of information pools and knowledge resources and this difference in information, experience and knowledge of members contributes to higher & broader level of perspectives, better discussion/ debate/ analysis of the tasks and challenges/ opportunities and hence increased level of team performance (Bell, Villado, Lukasic, & Belau, 2011). We derived almost all of our operational diversity constructs on this principle.

c. Disparity

The construct of disparity refers to the differences in resource concentration amongst members. (Harrison & Klein, 2007). The diversity construct has its essence in the "inequality" levels amongst the team constituents with respect to availability of resources /special privileges. (Harrison & Klein, 2007). Unlike the separation construct, the Disparity construct reflects the differences among team constituents on a vertical scale of high and low resource availability (unlike "Separation" which has a lateral disposition with opposite values/beliefs etc.).

Therefore, in developing any understanding of the diversity , it becomes imperative to look at each element of diversity as a description of specific pattern of effects arising out of individual element or a combination of Separation, Variety or Disparity . For any particular diversity construct one could view the impact arising out of a different perspective of the construct itself. We could consider a construct as providing variety, because it contributes to providing a higher availability of perspectives

and a higher availability of relevant information, which based on the cognitive resource theory lead such diversity construct to contributing positively to the performance of the team (Harrison & Klein, 2007). At the same time if we conceptualize the same diversity variable as a separation construct, then it could lead to creation of groups/sub groups (based on similarity attraction theory) , create group alignments and biases(social identity theory) and bring about a reduced level of cohesion in the team dynamics, poor team execution and overall reduced team performance (Harrison & Klein, 2007). Therefore it is important to have a clear understanding of the underlying diversity construct in developing the theoretical model of diversity and its relationship with innovation.

We have taken support of this seminal conceptualization by Harrison and Klein's to specifically define the relevant construct for each of our diversity elements while postulating our hypothesis.

2.4 The Resource Based View and the Dynamic Capability View:

The view of a firm that went beyond looking at it as an administrative unit and brought to fore the perspective that the firm could derive value from its resources was highlighted by Penrose (Penrose, 1959). Rubin (Rubin, 1973) then added the perspective that a firm uses the resources in different combinations for certain activities. Identification and deployment of critical resources by the firm can become a critical driver

of the firm's capability of generating superior performance (Wernerfelt, 1984). This set the ground for the emerging resource based view wherein it was the ability of the firm to identify, procure, utilize the relevant and critical resources that would drive its competitive advantage. (Porter, 1985) (Barney J. , 1991) (Wernerfelt, 1984). It was important for the firm to thereby focus on the knowledge, skills and technologies that it used and the routines that reflect the behaviour patterns of the deployment and the usage of the resources (Prahalad & Hamel, 1990) (Nelson & Winter, 1982).

According to this RBV view, a firm that has access to resources that are classified as valuable, rare, inimitable and non- substitutable (VRIN resources), can achieve SCA (sustainable competitive advantage through its innovative and value creating strategies (Barney J. , 1991), (Nelson R. , 1991), (Conner & Prahalad, 1997). Firms are always trying to understand their operating conditions and look for opportunities within their environment, so that they can innovate and are able to frame new value and gain competitive advantage (Porter, 1985) (Porter M. , 1996) (Damanpour & Schneider, 2009).

The extension of the RBV to take it beyond its static view of the resource capabilities was enumerated in the Dynamic capability view where in it is believed that it is the ability of the firm to "integrate, build and reconfigure internal and external competencies/capabilities " that allow the firm to successfully innovate and address the rapidly changing

environment. (Teece, Pisano, & Shuen, 1997). Dynamic capabilities of the firm are therefore seen as the organizational routines which allow the leaders and managers of the firm to be able to combine and integrate resources, shed or acquire resources with the objective to create value for the firm (Grant, 1996) (Teece, Pisano, & Shuen, 1997). Dynamic capabilities are "organizational routines" – i.e. a set of processes that "use, integrate, reconfigure, gain and release resources depending upon the needs of the environment or for the needs that may cause a change in the environment (Eisenhardt & Martin, 2000) (Bresnik & Hisrich, 2014). The dynamic capabilities are also seen as "change oriented capabilities for reallocation / redeployment of firm's resources (Zahra & George, 2002). The dynamic capabilities can be therefore looked at as a combination of

i) strategic processes as well as

ii) operational processes.

In the dynamic operating environment, the strategic processes and routines are largely focused around

a) "sensing" i.e. identifying the opportunities and

b) "seizing" i.e. deciding to act upon the opportunities, and the operational processes focus on re-calibrating and "Reconfiguring" the firm resources to achieve the desired objectives for the opportunities that have been sensed and seized (Jurksiene & Giniuniene, 2015).

2.4.1 Dynamic capabilities, Organizational learning and innovation

Innovation has been considered both as an outcome and as a process. It can be considered as an outcome or a result of responding to deepening or emerging competition, that may necessitate changes in products, services or business models. It can also be seen as a process that involves many activities i.e. improving existing products and services, and responding to dynamic changes in the environment etc. Innovation is achieved as a result of the learning process wherein knowledge is acquired, shared, developed and transformed (Huber, 1991). Therefore organizational learning is an antecedent of firm innovation (Jiminez-Jiminez & Sanz-Valle, 2011) (Bresnik & Hisrich, 2014). The dynamic capabilities of the firm help to create a culture and environment that is positively oriented towards knowledge and increase organizational learning. (Jurksiene & Giniuniene, 2015). It has been established that for firms to be able to achieve innovation, they need to focus on the development of the firm's dynamic capabilities (Zollo & Winter, 2002)

Table: Widely accepted Definitions of Dynamic Capability

Teece, Pisano, and Shuen (1997): "We define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions." (Teece, Pisano, & Shuen, Dynamic capabilities and strategic management, 1997)
Eisenhardt and Martin (2000): "Dynamic capabilities include well-known organizational and strategic processes like alliancing and product development whose strategic value lies in their ability to manipulate resources into value-creating strategies. Although idiosyncratic, they exhibit commonalities or 'best practice' across firms….They evolve via well-known learning mechanisms." (Eisenhardt & Martin, 2000)

2.5 Innovation

The innovation literature offers multiple perspectives on the subject and the different conceptualizations of innovation define it in both generic and specific manner. Innovation “means different things to different people” (King, 2000). Innovation strategies are generally defined as the corporate strategies that help the firm create new strategic opportunities (Miller & Trianna, 2009). Innovation is now widely accepted to be a key strategy for any firm in its quest to gain sustainable competitive advantage (Hitt M. A., Hoskisson, Johnson, & Moesel, 1996). It is not only considered important for competitive advantage but is also seen as vital for improving the overall firm performance ((Moreby, 1988). It is also well established in academic literature that innovation level in an organization can be a key predictor of future performance (Hitt M. A., Hoskisson, Johnson, & Moesel, 1996).

As innovation is the key antecedent to the firm’s success (Covin & Slevin, 1991), the study of the antecedents of firm innovation allows researchers to further explore the critical conditions that are necessary in driving organizational success (Zona, Zattoni, & Minichilli, 2013). In modern and large organizations, the real benefits of strategies and executions that drive innovation are only realizable over an extended period of time and hence such strategies need to be designed for a long term (Lippman & Rumelt, 1982) (Lee & O'Neill, 2003). However, with all this focus there is yet to be complete agreement on developing a common and accepted definition of innovation (Bantel & Jackson, 1989).

Conceptually, innovation has been described by (Kimberley, 1981) as either

a. an overall attribute of the firm, or
b. simply as a process or
c. as a set of discrete items.

In management strategy literature, disruption is considered as a key component of the innovation cycle. Disruption is “an interruption to the well-established processes and practices which are then dismantled / destroyed / redesigned in order to make way for innovation” (Schumpeter, 1962). The concept of disruptive innovation, which today has become one of the most researched areas of management study can be traced back to the seminal work of Abernathy and Clark 1985 (Abernathy & Clark, 1985) (Wan , Williamson, & Yin, 2015) who had postulated the idea that disruptive innovations had a negative effect on the value of existing businesses and technologies.

Christensen , in his seminal book “ The Innovators Dilemma” then articulated the modern understanding of disruptive innovation where he defines it as technologies “that provide value from sources that are different from the standard /mainstream technologies” (Christensen C. , 1997). Such disruptive technologies are initially considered supposedly inferior to the well-established technologies, especially on parameters which are of critical importance for the current primary customers. Therefore, the new technology is purportedly having significance and

relevance only for a small “niche” segment of the market. However over a period of time, with the customers reflecting the new shifts in need, and with the availability of technology driven enhancements, the markets go through disruptive change (Christensen, Raynor, & McDonald, 2015). Christensen and Raynor then expanded the term “disruptive technologies” to “disruptive innovation” by extending the concept beyond manufacturing (products) to services and to business model changes and innovations (Christensen, Raynor, & McDonald, 2015). It is now believed that it is not necessary for a business to undergo a technology change or functionality change for disruptive innovation and that any change which can challenge the existing “value proposition” is considered disruptive innovative change (Markides, 2006).

There is also a notable amount of research that focuses on the enablers of organizational innovation. The Resource dependence view of innovation elaborates on the proposition that the availability and allocation of an organization’s resources is a critical input for the organization’s ability to innovate (Wan , Williamson, & Yin, 2015). The Board of directors is by itself a key source of direct resources and also through its network a key provider of intellectual, financial and regulatory resources for the large firms. The board of directors which is effectively a decision making body (Forbes & Milliken, 1999) (Zona , Zattoni, & Minichilli, 2013), through its decision making efforts can definitely effect corporate innovation by being able to set the overarching context under which the firm executives operate and pursuit innovation (Stiles, 2001).

2.6 Board of Directors & Corporate Governance

There have been a large number of studies that have attempted to examine the impact of the demographic composition of TMT (top management team) on organizational performance. Drawing largely from strategic management literature, the focus is on the Upper Echelon Theory, which postulates that it is the structure, composition and compilation (diversity) of the Upper echelons (TMT) of any organization that performs a critical and important role in the strategy formulation , the strategy implementation and hence in the performance of the organization (Finkelstein & Hambrick, 1990), (Hambrick & Mason, 1984).

The Board of Directors' role is broadly defined with responsibilities to manage and oversee a firm's activities which allow it to set a strategic vision, framework & direction for the enterprise, ensure the monitoring & supervising of the firm and its management, and develop a strong governance structure to ensure that the organization's objectives are being effectively achieved while protecting the interests of all relevant stakeholders of the enterprise. In essence, the Board of Directors' key responsibility is to optimize the performance of the enterprise as per the directives and desires of the owners of the firm (Bainbridge, 2002).

2.7 Board Governance and its complexity

Academic literature review on corporate governance does tend to have consonance on the view that the Board of Directors play a critical,

significant and complex role (Torchia, Calabro, & Morner, 2015). Governance research has over the years been quite extensive and has employed both quantitative and qualitative approaches. Qualitative researchers have identified , a set of key variables (Boone, Casares, Karpoff, & Raheja, 2007). Different researchers have analysed multiple aspects of the board, in terms of the board structure, the board composition, the board interactions, the board responsibilities and the board behaviour, and have found that governance is a highly complex and a very dynamic phenomenon (Sargot & Rita, 2011).

The core of modern governance is built around the stakeholder theory , wherein the key stakeholders in any firm/ organization were seen to be " any group or individuals who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984). Freeman postulated the term stakeholder as a broad categorical group. This included management, shareholders, employees, consumers, external suppliers/creditors, regulators, etc. (Freeman, 1984). The stakeholder and the upper echelon perspective are driven on the central thought that the "cognitive differences" among the members of this stakeholder group/ upper echelons affect the strategic decisions.

At the board, the governance role is largely focused around the three key roles and tasks of the board namely :

a. Resource provision (Hillman, Cannella, & Paetzold, 2000),

b. Monitoring Management (Baysinger & Hoskisson, 1990) and

c. Advisory (Andrews, 1971).

2.7.1 Resource Dependency

Viewed from the lens of resource dependence, a firm, in order to survive, tends to acquire and exchange resources wherein it creates a dependency with these resource providers, and hence it is critical for the firm to build linkages that promote the creation of such resource pools (Terjesen, Sealy, & Singh, 2009). This theory argues that the leadership (which could be both the TMT or the board of directors of the company) through its linkages is able to

a. provide the firm with resources of information, knowledge, skills, external connections and communication channels, and
b. provide its insights and counsel which help the company/ firm to survive and succeed (Pfeffer & Salanick, 1978).

In the context of board composition, the resource dependency construct builds the argument that the members of the board of the company / firm should be individuals who have the capability to provide such range (width and depth) of resources that include functional / geographic knowledge, expertise in financing and other critical expertise, legitimacy and reputation which all put together provide the Human Capital and also provide the Relational Capital (through network ties with appropriate stakeholders) (Hillman & Dalziel, 2003).

2.7.2 The Agency Theory / Approach

However, corporate governance also relies on the Agency theory which revolves around the conflict in the relationship between the Principal (Shareholder/Owner) and the Agent of the Principal (Executive Management), focusing on the inherent issues of differing interests and conflicting alignments between the principal and the agents (Fama & Jensen, 1983). The Board of directors is assumed to be the independent arbitrator of protecting the interests of the principal (i.e. shareholders), and hence securing the long term survival of the firm by ensuring that through effective monitoring and control the conflicts are minimized and managed (Terjesen, Sealy, & Singh, 2009) (Fama & Jensen, 1983). The board is hence focused on controlling and managing issues arising out management opportunism (Huse & Zattoni, 2008).

2.7.3 The Strategy / Advisory view:

The managerial hegemony theories and the strategic view theories prescribe to the board a largely advisory oriented role where the board is focused more on giving strategic inputs but is not directly engaged in monitoring, controlling, directing the management performance (Andrews, 1971).

2.7.4 The moral and social view of the board responsibility

The moral perspective of the board responsibility is architected in the idea that the board has social responsibility and carries certain moral obligations under its stewardship role (Van der Welt & Ingley, 2003). The board is expected to govern not just for shareholder maximization but also expected to undertake ethical and moral responsibility for all

stakeholders (Keasey, Thompson, & Wright, Corporate Governance, 1997). The board of the firm is therefore supposed to represent the social balances (Carver, 2002). This ultimately underpins the representative view for diversity in the board.

2.7.5 Management and Customer Relationships

Large firms also face the challenges of perpetuity management wherein the management of the firms get bonded to large customers (especially those that provide perpetuity of revenues and enjoy relationship vintage) because the management is “vested” in such relationships as they determine firm performance especially in the short term. In such a scenario, the management provides overdue weightage to feedback and needs of the existing customers and tends to overlook / avoid need for change and innovation. (Christensen C. , 2006).

2.8 Decision Making:

The board at the end of the day is a decision making body. Decision-making as a process has two core elements – Decision and Behaviour (Oliveira, 2007). The Rational (normative) decision making process focuses on identifying a set of potential alternatives that would allow us to reach a solution to the problem (Goodwin & Wright), (Hoch, Kunreuther, & Gunther). The rational model of decision making is based upon getting information from various sources and then analysing the potential possible alternative solutions and then making an informed choice (Hoch, Kunreuther, & Gunther).

On the other hand, the Descriptive (Psychological) decision making processes rely upon the cognitive process of understanding and upon the basic principles that are utilized to make the decision, by processing information through a set of simplifying mechanisms and filters based upon contextual experiences (Oliveira, 2007). Decision making is effectively a process of responding to the various types of stimulus from the external world and the society at large and therefore it is important to understand the role of beliefs, values etc. and their relationship with cultural / social aspects of decision making (Oliveira, 2007). It is hence imperative to understand the theoretical processes of decision making to be able to architect the processes that are involved in the relationship and contextual environment of board diversity and firm innovation.

2.9 Diversity , Decision Making, Governance , Innovation and the Dynamic Capability at the Board – The interrelationship and our study objectives

From the above we clearly see that existing academic literature on the relationship between board diversity and innovation is related to a multitude of conceptual theories around decision making, resource-based and dynamic capability-based firm strategies, social interactions, governance and heterogeneity. Resource based theories suggest that bringing together diverse stake holders allows the firm to acquire critical resources ((Pfeffer, 1972) (Goodstein, Gautam, & Boeker, 1994). The Dynamic capability theories suggest that it is not just the static resources but the dynamic capability of the firm (and its strategic decision makers)

that drives innovation and competitive advantage. Heterogeneity research suggests that more diverse groups consider a broader range of perspectives and drive creativity and innovation ((Hoffman & Maier, 1961) (Wagner, Pfeffer, & O'Reilly ,III, 1984). Clearly, there is a strong relationship between a firms' diversity and its knowledge base and hence with its innovation and creativity capabilities (Ostergaard, Timmermans, & Kristinsson, 2011). Agency theory proposes that the board's role is to do a collective monitoring of management / CEO (Garrat, 1997). Heterogeneity of views amongst board members would result in a reduction in idiosyncratic decisions by the board and would lead to a higher level of scrutiny within the board (Bernile, Bhagwat, & Yonker, 2018) and this would result in higher innovation by the firm. At the same time, while there have been many studies that also show that heterogenous groups lead to a reduction in the cohesion and the integration of the group (Wagner, Pfeffer, & O'Reilly ,III, 1984). With a high level of diversity at the board, the decision making process would be disrupted, a higher level of conflicts will occur, communication will be impacted and these issues will increase the difficulty for the board to attain and maintain consensus (Arrow, 1951) and this would clearly lead to reduced innovation by the firm.

Hence , given the multiplicity of factors involved and the multitude of theoretical constructs that provide a different theoretical basis for the relationships between each factor and firm innovation, this research was

focused on determining the **nature of the relationship between the diversity constructs of the board composition and firm innovation**.

SECTION 3: THE STUDY CONSTRUCTS, DEFINITIONS AND HYPOTHESES

3.1 Our diversity constructs as "Variety"

As we have seen earlier, the seminal effort of Harrison and Klein enumerated the criticality of developing a clear view of diversity along separation, variety or disparity. It is critical that the each conceptualization of diversity should be matched with the specific operationalization mechanism (Harrison & Klein, 2007).

Our constructs of demographic, dynamic capability, information and governance diversity at the board of large organizations reflect the differences i.e. variances between the board members, primarily in terms of information, knowledge or experience. We believe that the most significant aspect of the heterogeneity in a group is not driven by the polarity and the degree of polarity of the views (i.e. separation). The decisions that board members take are largely not bi-polar in nature, and the impact of the decisions of the board of directors is also not generally bi-polar. We also believe that at the level of the board of directors, diversity effects are not primarily reflected through the eminence of power distance between members (disparity) because the board members are almost always individuals with distinguished track records and high levels of achievement, and so the concept of superiority-inferiority is not very prevalent. The difference of expertise and

experience/ backgrounds/ knowledge rather tends to reflect in mutual respect.

Hence in our definition of the various diversity constructs, we chose to focus on "variety" as the driver of diversity at the board level. This aspect allows us to view distribution of diversity almost as a "uniform distribution" and not as a continuum, thereby reflecting an almost even spread of constituents across different categories when the diversity is at the maximum (Harrison & Klein, 2007). We believe that within the unit, i.e. the board of directors, each board member differs from the other board member on the specific diversity attribute that we have defined. We therefore developed our theoretical constructs by defining diversity as "a variety in the composition of the board of directors", in line with some of the recent research on board of directors. (Galia, Zenou, & Ingham, 2015).

The key associative aspect of diversity as a variety is the change in the cognitive capability and the impact on the behavioural aspects of the board. So when boards have all members belong to the same category of the concerned attribute, the variety is minimum and so the board does not add any incremental information, knowledge or capability by adding another member of the same category or replacing one member with another of the same category (Shannon, 1948) (Harrison & Klein, 2007). At the same time if each board member represents a "unique" or different category, the distribution and hence the diversity of the attribute is the maximum possible. The underpinning of conceptualizing diversity as a

"variety" for board of directors is also supported by the cybernetic principles that teams have the capability to utilize a higher level/quality of information to make better decisions (Finkelstein & Hambrick, 1990) (Harrison & Klein, 2007). As the "variety" of board members increases, each board member is effectively getting differentiated more and more from each other because they each represent a different category and thereby reflect a different position of thought, experience and perspective.

3.2 The Individual diversity constructs

3.2.1 Demographic Diversity

We define board demographic diversity as a combination of the diversity of gender and diversity of age composition of the board members. We look at demographic diversity as a "variety" construct based on the conceptual belief that women and men, and the young and the old, have qualitative differences in their knowledge and information pool and that these differences can be categorized (Wood, 1987).

3.2.1 (a) Demographic diversity and Innovation

The Resource based view of board governance postulates that Demography based differences in views, in perspective and in styles of different board members will foster a higher level of creativity among the

board members leading to improved innovation for the organization. Women contribute to the boards by providing a different set of perspectives and styles of working compared to the male board members (Daily & Dalton, 2003). The age diversity on the board allows a board to examine issues from perspectives of different age groups which fosters improved learning for the board and a more effective analysis of the strategic elements of the business leading to improved creativity. (Kang, Cheng, & Gray, 2007) (Mahadeo, Soobaroyen, & Hanuman, 2012).

Demographic Diversity therefore leads to a differentiated level of information amongst different members leading to higher cognitive capabilities of the board which as a consequence help improve the process of

a) choice evaluation ,

b) the opportunity and threat analysis and

c) resource allocation in board decision making,

leading to higher innovation for the organization. The diverse board demography in terms of gender and age also allows the board to have different viewpoints on certain issues given that demographic differences driven by gender and age lead to variance in thought process, attitudes and belief systems. This helps to thereby improve the process of decision making at the board level especially related to strategy, competition and resource allocation. For example, women and younger board members are generally more sensitive when the issues

in front of the board of directors relate to the environment (Post, Rahman, & McQuillen, 2015) (Hafsi & Turgut, 2013) or are issues related to values and ethics (Selby, 2000) and (Hafsi & Turgut, 2013).

However there is strong support in academic research that demographic differences of gender and age lead to early stage crystallization of personal and group/sub group identities. The formation of such groups leads to inter group disassociation and intra group association, which in a board creates strong prejudices amongst group members and such prejudices lead to reducing the board ideation capability and the quality of analysis. In such situations, board members tend to associate with and support intra group analysis and reject inter group ideation leading to a drop in the effectiveness of decision making and innovation. The social identity theories do suggest that gender based approach could lead to "sorting and psychological belonging" (Kanter, 1977) (Pelled, 1996), which at the board level leads to increasing conflict and reduces board decision effectiveness and hence impacts the organizational innovation. The majority gender in the board (generally males) tend to perceive that the female board representation is a reflection of affirmative action and not justified on merit and this causes male cohort formation which has a poor view of other gender ideation and inputs. This also leads to female gender dissatisfaction which causes reduced group association and increases suppression of voice. Similarly age heterogeneity leads to formation of age cohorts which contribute to formation of inter group biases and even temporal caps at the board.

This has a significant impact on the quality of board processes and board cohesion and reduces overall innovation at the firm.

We are arguing that demographic diversity has a **curvilinear relationship** with innovation . When the demographic diversity is low, the board tends to take a benign view of the inputs of the minority demographic members. This allows for a positive and nurturing operating environment, where multiple perspectives are shared, discussed and hence organization is able to derive the positive benefit on innovation. In a board where the demographic diversity is relatively low, it is highly likely that it is being nurtured by the Chairman/CEO as a quasi- affirmative action and the differing view from women / younger members are encouraged by the leadership which allow them to question status quo scenarios and suggest new alternatives as problem solutions and effective and efficient implementation. Hence at relatively low levels of such diversity, the challenges posed by reduced availability of resource based cognitive inputs are overcome by the positive operating board environment where low levels of social identity and social categorization allow for higher overall innovation for the firm.

When the demographic diversity is moderate in a board of directors setting, that the broader issues of social identity and social categorization take hold, i.e. the smaller gender & age groups tend to have high in-group association and the imbalanced diverse groups tend to have strong in-group and out-group biases. Strong power distance

issues emerge wherein the minority members need to jostle for space, there is distrust among in-group and out-group members and board members of gender and age minority need to seek comfort against the biased conversations and discussions which tend to reduce the overall cognitive effectiveness of the board and reduce the creativity and innovation of the firm. The minority diversities at moderate level then tend to experience lower satisfaction with their role (Ostergaard, Timmermans, & Kristinsson, 2011) and demographic diversity then tends to cause emotional conflict at the board (Pelled, 1996) . Demographic diversity , especially driven by age/ gender can also lead to differences along not some but across a wide range of issues (Golden & Zajac, 2001) (Zajac, Golden, & Shortell, 1991), and this has negative consequences for innovation of the firm.

We believe that when the demographic diversity tends to get to a higher level, then the board is able to derive strong benefits from the broader and wider cognitive information pool of board members who are able to look at strategic choice decisions with a broader, deeper and wider perspective. In a highly diverse board, the minority/ smaller demographic groups (gender and age based) tend to have “representative size” and in the smaller group/ sub groups do not face power distance challenges and are able to share perspectives, beliefs on issues facing the firm in an open and transparent manner. Clearly , highly diverse boards only become such because they have the support of the leadership and the

shareholders . This leads to overall confident sub groups, with improved problem assessment and opportunity analysis.

Hypothesis 1: **There is a curvilinear relationship between demographic diversity of the board and the firm's innovation and this should be reflected in a U shaped relationship**.

3.2.2 Dynamic Capability Diversity:

Extant literature on diversity suggests that dynamic capabilities are a key driver of firm innovation (Zollo & Winter, 2002) and its competitive edge. In the volatile and fast changing environment, the dynamic capability view was therefore seen to extend the RBV(resource based view) and views the dynamic capabilities as "the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base (Barreto, 2010). Dynamic capabilities of the firm are therefore seen as the organizational routines which allow the leaders and managers of the firm to be able to combine and integrate resources, shed or acquire resources with the objective to create value for the firm. (Grant, 1996) (Teece, Pisano, & Shuen, 1997) . It has been established that for firms to be able to achieve breakthrough innovation, they need to focus on the development of the firm's dynamic capabilities (Michailova & Zhan, 2015).

We extend the concept of the dynamic capabilities of the firm to the board of directors of the firm. The Upper echelon research postulates that organizational outcomes reflect the “values and the cognitive bases of the powerful actors in the organization (Hambrick & Mason, 1984). The board of directors has typically a strong decision making role and can affect organizational outcomes. Senior leadership of a firm also face the challenges of information overload, unclear and ambiguous information inputs, time constraints and prioritization and allocation challenges , the decisions that they make are therefore driven by their personalities (Carpenter, Geletkanycz, & Sanders, 2004) and by their experiences. Therefore we postulate that it is the dynamic capability experiences of the board that reflect their abilities to sense and seize the opportunities and then and reallocate and transform the organizational capabilities and resources to drive firm innovation.

3.2.2 (a) Dynamic capability experiences and positive association with innovation.

It has been asserted in academic literature, most notably by (Miles & Snow, 1978) in the adaptive innovation theory , that organizations that are oriented to innovation need to focus on finding the solution to three key managerial problems- the entrepreneurial problem, the engineering problem and the administrative problem. The entrepreneurial problem is solved by focusing on new business ideas, new business segments and new products. The administrative problem is solved by having leadership

capability to manage risk and uncertainty and to be able to manage organization structure to execute. The engineering problem is solved by focusing on developing the highest levels of knowledge and understanding and through a highly analytical approach built on meticulous , methodological and systematic approach.

Hence we consider Entrepreneurial Experience of founding and building a firm, Leadership experience of being CEO/Chairman of a firm, and Research experience from an academic doctoral program as key Dynamic capability experiences, i.e. experiences which are vital resources for a board and that such experiences drive the firm dynamic capability which has a significant relationship with firm innovation.

Leadership experience: Leaders (i.e. board members with prior leadership experiences as CEO/Chairman) enhance the firm dynamic capability by providing the ability to integrate firm's disparate resources. Such board members because of their prior experience will also provide the board and hence the firm strategic and analytical decision making dynamic capability. In addition, having prior experiences as leaders allows the board members to provide the firm with improved resource allocation and alliance making/ acquisition oriented dynamic capabilities too. Boards with leaders, will provide the capability to solve the administrative problem as identified by Miles and Snow, and support disruptive thinking environment which promotes innovation (Miles & Snow, 1978). Leadership experience thereby would enhance the firm

dynamic experiences and provide stronger support to innovation routines in the firm.

Every social exchange has an underlying background which is based on the cognitive aspects which is related to the shared mental models and shared narrative that exists around the exchange participants and the ecosystem (Arrow, 1951) (Arrow, 1970), (Orr, 1974). Board members who identify themselves with a CEO role (current or previous), feel higher trust with the CEO and the TMT because they relate to the narratives, the scenarios that the CEO/TMT provide to the board (Hillman, Nicholson, & Shropshire, 2008). Increase in this trust level leads to improvement in the quality of the advice from the board member and also increases the risk calibration of board decisions and hence nurtures a positive association with innovation.

Research experience: Board members with research oriented qualification such as PhD/ Doctoral Studies, will enhance the overall competency matrix of board skills and board dynamic capability that would normally help in executing the governance function (Carpenter & Westphal, 2001)((Ujunwa, 2012) (Boyd B. K., 1995). Such board members will enhance the knowledge creation routines and build the thinking capability within the firm. Research & Development activities of the firms have a well stablished relationship with innovation. “Research and development has a positive correlation with all measures of

innovation output" (Mairesee & Mohnen, 2004). R&D has been seen to be clearly useful not only for development of new products and new processes but also helps in supporting a firms' ability to maintain and to improve on its competencies, especially in terms of business intelligence (Karlsson & Olsson, 1998). Moreover, the mere fact that the firm has R&D activities, nurtures an organizational climate that fosters questioning and critical analysis and enhances the organizational capability to orient and adapt to change (Freel, 2000). The ability to create such a climate of appreciating and imbibing knowledge is a critical knowledge routine and an important dynamic capability for the organization. In addition, the cumulative knowledge accretion from historical R&D activities over a period of time helps nurture innovation in the firm (Brouwer & Kleinknecht, 1996). The ability of the board to review and assess R&D activities of a firm improves with board members who have Doctoral degrees (Dalziel, Gentry, & Bowerman, 2010).

Entrepreneurship experience: Having entrepreneurs on the board of directors allows businesses to think beyond their existing customers and current products and provide support to ideas that nurture innovation in the firm (Yu & Hang, 2010). Entrepreneurs contribute positively to the board and firm dynamic capabilities by helping the formation of routines that improve resource allocation, risk-opportunity assessment and alliance building as these are key components of an entrepreneurial process. Entrepreneurs know how to make difficult but necessary pivoting decisions and have the necessary skills to make the complex exit decisions relating to products, segments, partners, vendors, and

processes etc. and therefore presence of entrepreneurs on the board enhances the firm overall dynamic capability.

Board members with founder experience will have a strong relationship with idea generation, idea modulation and idea execution processes, all of which are key to the Innovation Process. Start-up businesses are generally accepted to be more effective in producing disruptive innovation. (Wan , Williamson, & Yin, 2015)**. "**It is the entrepreneurs who experiment and are able to develop and adopt innovations" (Yoav & Schori-Bachrach, 1973).

Hence, exposure to such "Dynamic capability experiences" will have a strong relationship with questioning, ideation, review and execution processes, all of which are key to Innovation. These experiences significantly impact the capability to think differently and disruptively, and, reflect critical analytical thinking which all together lead to higher creativity and superior analysis, improve resource allocation and more effective decision making, all of which are critical to drive Innovation. Therefore, the number of directors with Dynamic capability experiences should be positively associated with firm innovation.

3.2.2 (b) Dynamic capability experiences and negative association with innovation

Behavioural decision theory indicates that "managerial hubris" creates cognitive bias due to which the decision maker tends to "overestimate" their personal capabilities and skills to solve the problems (Camerer & Lovallo, 1999). This management overconfidence also leads to underestimation of risk and business uncertainty (Shane & Stuart, 2002), (Kahneman & Lovallo, 1993). As a combination of these effects, hubris leads to a negative impact on organizations' ability to make appropriate decisions, solve problems, and hence impacts its ability to drive innovation. Presence of multiple directors with current and/or prior leadership experience leads to enhancement of the cognitive bias due to the potential hubris issue and this has a detrimental impact on organization's innovation performance. There is also support from both the agency theory and the stewardship theory to the view that directors who exhibit strong CEO identity (because of their current CEO role with another firm) tend to reflect a high level of empathy with the CEO (Finklestein & Hambrick, 1989), and they tend to reflect a lower level of monitoring (Zajac & Westphal, 1995), and are more amenable to managerial discretion (Stiles, 2001). The board members then develop some sort of hesitancy and reluctance to have a critical view of the management (Lawler , 1990), (Mace, 1971) which reduces the board oversight quality and lowers the level of examination and inquiry leading to reduced innovation.

Specialists with academic research orientation tend to succumb to "early group" formation which causes teams and boards to suffer from out-group bias and out group derision and reduce debate and points of view in an analysis.

Entrepreneurs tend to underestimate the risk and it has been seen in studies that over-optimistic entrepreneurs are more likely to be associated with negative firm performance (Lowe & Ziedonis, 2006) (Li & Tanh, 2010). In addition, entrepreneurs in a group suffer from early-norm issues and reflect out-group derision especially with professional career executives.

We also understand from past research that when such Dynamic capability experiences are present in a group, the overall cohesion of the group is not very effective. This lack of cohesion within the group when seen at the board level impacts the board decision making on issues of understanding of problems, identification of risk, analysis of solutions and organizational resource allocations which all impact firm innovation. All these tend to reduce the innovation driving benefit of diversity of Dynamic capability experiences.

3.2.2.1.Possible relationships between interaction effects of Dynamic capability diversity and Innovation:

3.2.2.1 a When the dynamic capability diversity of the board is low, the cohesion/ communication challenge is low, and the uniqueness of Dynamic capability experiences is respected, views are nurtured thereby providing support for innovation. As the dynamic capability diversity of the board tends to reach moderate levels, the cohesion challenge becomes significant, the team dynamics and group formation reduce the quality of analysis and debate. Group formation tends to happen with board members (who have similarities of clearly distinguishing experiences like research or corporate leadership or founding businesses) starting to coalesce together and the members with non-dynamic capability experience forming their own groups. This leads to problems of "unshared information" (Stasser G., Vaughan, & Stewart, 2000). The board governance processes get challenged, in a manner that the benefits of firm's dynamic capabilities, diverse thinking and wider cognitive capabilities are matched off with the board cohesion issues and the firm innovation is not able to derive the complete benefit of the wide resource of experiences in its decision-making process. As the dynamic capability diversity of the board increases to higher levels, the resource pool of experiences significantly improves the absorptive capacity of the firm and the cognitive benefits will drive strong innovation. When the dynamic capability , has maximum variety, board members would be seeing each other as "almost everyone being different from everyone else" and hence respect each-others' views and observations (Vermeulen, 2013). They will also not have high association/

categorization with each other and this will also lead to lower groupism and bias.

Therefore, we propose that Dynamic capability diversity in a board has a curvilinear relationship with Innovation.

Hypothesis 2(a): **There is a curvilinear relationship between Dynamic capability diversity of the board and the firm's innovation, and this should be reflected in a U-shaped relationship.**

3.2.2.1b . Given the multiple levels of interactions possible between the resource-based view, the agency view, the dynamic capability view , the stewardship view of the nature of governance role of the board members and the multiple implications of the identity and social identity theories impacting the board processes, there is theoretical support for the alternate hypothesis too. When a board has low levels of dynamic capability diversity, the overall cognitive strength of the board is low, the firm's standard capabilities are nurtured but the board is unable to provide experiential inputs or establish higher level routines that would help it analyse the management inputs regarding entrepreneurial, administrative and process problems, thereby impacting the quality of analysis. The board then is also unable to provide direct solutions, and is unable to sense or seize the opportunities before it thereby reducing creativity and innovative opportunities for the firm. As the board of a firm improves the dynamic capability diversity of its board members, it improves the routines regarding sensing and seizing opportunities and

the higher level capabilities to reconfigure firm resources through analytical decision routines and hence the firm should see a positive curve for innovation. However, as the organizational governance theories have suggested, while such cognitive benefit starts to accrue, but high levels of heterogeneity on dynamic capability experiences amongst the board also leads to group formation, fosters inter-group and intra-group biases, and impacts the quality of enquiry at the board. This negatively impacts the firm's capability to get the best analysis of the challenges and the solutions presented by the management and leads to inefficient resource allocations and thereby brings a negative slope effect on innovation.

Hypothesis 2(b): **There is a curvilinear relationship between Dynamic capability diversity of the board and firm innovation, and this should be reflected in an inverse-U shaped relationship.**

3.2.3 Information Diversity

As per the theoretical literature on role and responsibilities of the board, one of the key activities is allocation of resources and making investment decisions on behalf of the shareholders of the firm with the objective to maintaining sustainable competitive advantage. The board effectively acts upon the management inputs as a filtering mechanism, and it reviews the information provided by the management by interpreting that data based upon their cognitive capability. Therefore, the educational qualifications attained by the board members are of vital importance and

are seen as a precedent to the cognitive value and the human capital of the board (Hambrick & Mason, 1984) (Dallenbach, McCarthy, & Schoenecker, 1999).

Higher education not only provides deeper information but also tends to build a more "receptive attitude" towards innovation, because higher education helps to improve "paradigmatic perspectives" and helps to manage complex situations (Hoskisson, Hitt, Johnson, & Moesel, 1993). Higher educational qualifications have a strong relationship with cognitive ability and the level of education has been seen to have a positive relationship with the openness and commitment to innovation (Hambrick & Mason, 1984).

In addition to the highest qualification, we strongly express the view that exposure to multiple educational institutions, is a way of providing a broader perspective of values and beliefs. This multiple institutional experience also provides a wider exposure to differing methodologies of analysis. It is well established that each institution has its own institutional logic and that exposure to each such institution logic allows the person to internalize it, not just as entity schemas like people, places etc., but also as event schemas like implicit theories (Glaser, Fast, & Harmon, 2016). The individual then develops a cognitive frame based on such associative network of schemas, to determine his/ her decisions and actions in different contextual situations (Glaser, Fast, & Harmon, 2016). Alma matter congruence thereby brings about a reduction in overall cognitive quality of the board. In addition, the alma mater

similarity led attraction causes cliques & groups to form. This then introduces biases in the group analyses, reduces the efficacy of group participation and increases intra-group derision , which all contribute to negative impact on innovation.

Similarly, exposure to large networks in industry and socio-economic environment adds to the absorptive capacity, (Zahra & Pearce, 1989)) (Hitt M. , Hoskisson, Johnson, & Moesel, 1996). Each member of the Board of directors has his/ her own external network and that contributes to the information pool of the individual and hence the board. The Resource based view considers this resourcing ability as a strong determinant of the information and cognitive capability of the board which allows it to effectively analyse strategic problems and identify solutions, thereby increasing organizations' chances to innovate.

Information diversity of the board (which we define as a combination of higher education diversity, educational institute diversity and network diversity) therefore like most other diversities has dual effect on the innovation.

Hence we posit that when Information diversity in a board tends to increase, the board will start to derive strong benefits in innovation from its improved resource pool of cognitive information but at some stage the cognitive overload will lead to scenarios where the board tend to lose focus on key issue. It will also lead to increase in group biases which

cause delays in quality and timeliness of analysis, reduces communication and negatively impact cohesion in execution which will all together then lead to reduced firm innovation. Moreover, the negative relationship of high information diversity with firm and team performance which has a lot of theoretical support for team dynamics is even more relevant in a setting like the board of directors of a firm, as they make complex investment and prioritization decisions, within a limited time frame (as boards meet less frequently and operate with tight schedules for their meetings).

H3: There is a curvilinear relationship between Information Diversity of the board and the firm's innovation and this should be reflected in an inverse U shaped relationship.

3.2.4 Governance Experience Diversity

The tenure i.e. the time period of association (of key decision makers) with the firm affects the strategic decisions made by the firm (Hoskisson, Hitt, Johnson, & Moesel, 1993). Research has shown that the monitoring role of a board member as per the agency theory improves with a deeper understanding of the situation, as it improves the cognitive knowledge of the group/ board. Also, the wider is the experience of board members across other boards, the larger is the network of connections, which provides the opportunity for higher absorptive capacity for the firm and improve firm innovation. Similarly, deeper and wider understanding and experience of board dynamics allows for more effective cohesion of

decision making at the board and hence drive innovation in an effective manner.

At the same time research also indicates that higher vintage in the organization's board leads to entrenchment , conformity and inertia in thinking (Vance, 1983) which lead to reduced risk taking in terms of allocation of resources for challenging ideas and projects. Generally such boards will respond to challenges with traditional patterns of action and ideation (Kiesler & Sproul, 1982) and lead to reduced innovation. Entrenchment in a board and presence in multiple boards also leads to "prestige association" , perceived seniority which through power distance causes suppression of voice in the group and reduces the level of debate and scrutiny thereby having a negative impact on organizational innovation.

In our view , the Governance Experience diversity (BED) of a board (defined as a combination of diversity of current board vintage and diversity of other board experiences) has a combined effect of the cognitive benefits and entrenchment/ conformity challenges. We consider Governance experience diversity as a variety construct as the board is thereby composed of members who have effectively belong to different cohorts and bring a different set of experiences to the table (Anacona & Caldwell, 1992). At low levels of GED, the overall cohesion in the board is high, allowing for quick and efficient decision-making at the board and there is board support for views of smaller minority/ different voice groups, leading to high innovation. But at moderate levels of GED, the board entrenchment issues start to effect the decision

making quality and the bureaucratic board processes and group biases have a negative effect on firm's ability to innovate. However when we have larger levels of GED, the board allegiances are difficult to maintain (Hoskisson, Hitt, Johnson, & Moesel, 1993), the benefits of higher absorptive capacity and wider information and perspective (Wiersema & Bantel, 1992) will lead to high level of innovative decision making.

H4: There is a curvilinear relationship between governance experience diversity of the board and the firm's innovation in an U shaped relationship.

3.3 The Moderating effect of Board size:

A review of extant literature on board governance suggests that the size of board is viewed by many researchers from a resource dependency perspective (Pfeffer & Salanick, 1978) in terms of the fact that boards are able to provide access to resources that are vital for the success of the firm. Large boards are expected to have higher cognitive levels from their within-board membership access to large pool of information (Burt, 1997). They also have larger interlocking ties which allow for improved resource pool and hence improved absorptive capacity of the organization. Larger boards are also expected to have a higher competency range. These cognitive advantage allow larger boards to have a sharper analysis of the situation, a higher level of debate and

improved problem analysis and solution orientation which should all promote innovation.

From an agency perspective, larger boards are expected to have a more effective command over the senior management leadership of the firm because larger boards are able to establish more structured board-management review processes through specialized committees, and can distribute oversight responsibilities more efficiently((Zahra & Pearce, 1989), (Hitt M. , Hoskisson, Johnson, & Moesel, 1996). This allows boards to undertake complex decisions of innovation like R&D, capital allocation and risk etc. more efficiently. (Wincent, Anokhin, & Boter, 2009). Large boards also have the ability to create stronger confidence in the management (which feel more comfortable working with structured boards than with direct relationships) and this promotes TMT's ability to undertake risky innovative strategies. In addition, larger boards lead to reduced perceived risk for an individual board member due to decision-diffusion and this builds board confidence in taking longer term and higher uncertainty/ higher volatility decisions.

Simultaneously, we also come across a body of research that suggests a negative impacting relationship between board size and organization performance and organizational innovation. Larger networks have worse control outcomes (Human & Provan, 1997). Large boards have difficulty to maintain strategic focus, and are unable to have sustained active and participative discussions , given that boards normally meet sporadically

and have high levels of time constraints. Larger boards have a challenge in terms of factions, groups and coalitions that form based on social identity and social integration phenomenon (OReilly III, Caldwell , & Barnett, 1989). Board decisions in large boards then tend to be taken on the basis of inter-group compromise rather than of transparent dialogue, efficient and effective cognitive analysis, and that tends to reduce firm innovation. In large boards there is a challenge of board member motivation because the impact of individual contribution is not perceived by the board member to be high , which leads to ideation restriction, reduced participation and social loafing , thereby reducing board effectiveness on complex decisions driving innovation (Latane, Williams, & Harkins, 1979). Large boards also are exposed to the challenges of communication and coordination which create issues of cohesion and reduce comprehensive decision quality (Hackman & Morris, 1975). It is difficult to build and maintain trust in large teams (Burt, 1997), which along with the challenge of in group- out group formation in large groups tends to reduce risk taking (which is key for innovation) because larger groups have a tendency to reject risk (Cheng, 2008). Smaller boards are more effective and faster in decision making which is key advantage when speed to market is key and hence smaller sized boards can be more effective in driving innovation.

We suggest that the relationships between the board diversity elements and innovation as stated in hypothesis 1-4, do not render a complete view on an independent basis and that the size of the board has a key

moderating role on the strength of the diversity relationships with firm innovation and that the effect of board size interaction with each diversity construct (i.e. demographic, dynamic capability, information or governance) is different given the multiple interlinkages of the interacting dimensions that are involved.

3.3 (a) Demographic diversity and Board size

In small boards the cognitive benefit from multiple perspectives of demographic diversity will not be leveraged as smaller boards members have a high perceived risk on an individual basis , which reduces analysis, investment and support for innovative projects and R&D in firms. Small boards generally tend to avoid risk, focus less on long term investments and longer payoff decisions . Smaller boards also tend to see themselves from an agency perspective and assume the role of risk managers holding shareholder responsibility and when demographic diversity of gender and age is increasing in smaller boards, the risk avoidance approach of diverse board members moderates negatively the effect of multiple perspectives that the board should have been able to operate with. Hence the higher demographic diversity is not able to drive stronger innovation outcomes in smaller boards. As the board size becomes large, the individual perceived board member risk orientation is reduced, the larger boards are more structured in terms of management supervision processes and therefore the significant cognitive resource augmentation with increased demographic diversity

has a stronger positive impact on debate, analysis, choice and hence creativity and innovation.

H5: Board size will moderate the curvilinear relationship between Demographic diversity and innovation such that the relationship will be stronger in larger boards.

3.3 (b) Information experience diversity and board size

Larger boards have higher probability of group formation while in small boards board members feel confident to engage on an individual basis and they do not feel the need to protect themselves from “others” by joining certain “in groups”. Therefore the large boards have very strong in-group / out-group bias which tends to overshadow the, multi-institution, higher education and network driven advantage of broader perspective and cognitive strength which drives innovation. When we have large boards with high diversity driving multiple such views, cohesion becomes a significant challenge and the board effectiveness falls. Therefore we believe that the curvilinear relationship between information diversity and innovation is stronger for smaller boards and less reflective in larger boards.

H6: Board size will moderate the curvilinear relationship between Information experience diversity and innovation such that the relationship will be stronger in smaller boards.

3.3 (c) Dynamic capability diversity and Board size:

In small boards the cognitive benefit of Dynamic capability experiences will not be leveraged as smaller boards have perceived personal association challenges for board members for high risk innovation and R&D type decisions. Small boards generally tend to avoid risk, focus more on short term decisions. Smaller boards also tend to see themselves from an agency perspective and assume the role of risk managers holding shareholder responsibility and hence the higher Dynamic capability diversity is not able to drive stronger innovation outcomes in smaller boards. As the board size becomes large, the board members are less risk oriented and their personal perceived risk association goes down, the boards are more structured in terms of TMT supervision processes and therefore the significant cognitive resource augmentation with increased dynamic capability diversity is able to manifest more effectively. The challenge of coordination and cohesion problems will also get mitigated in large boards since larger boards will have more well defined and structured processes.

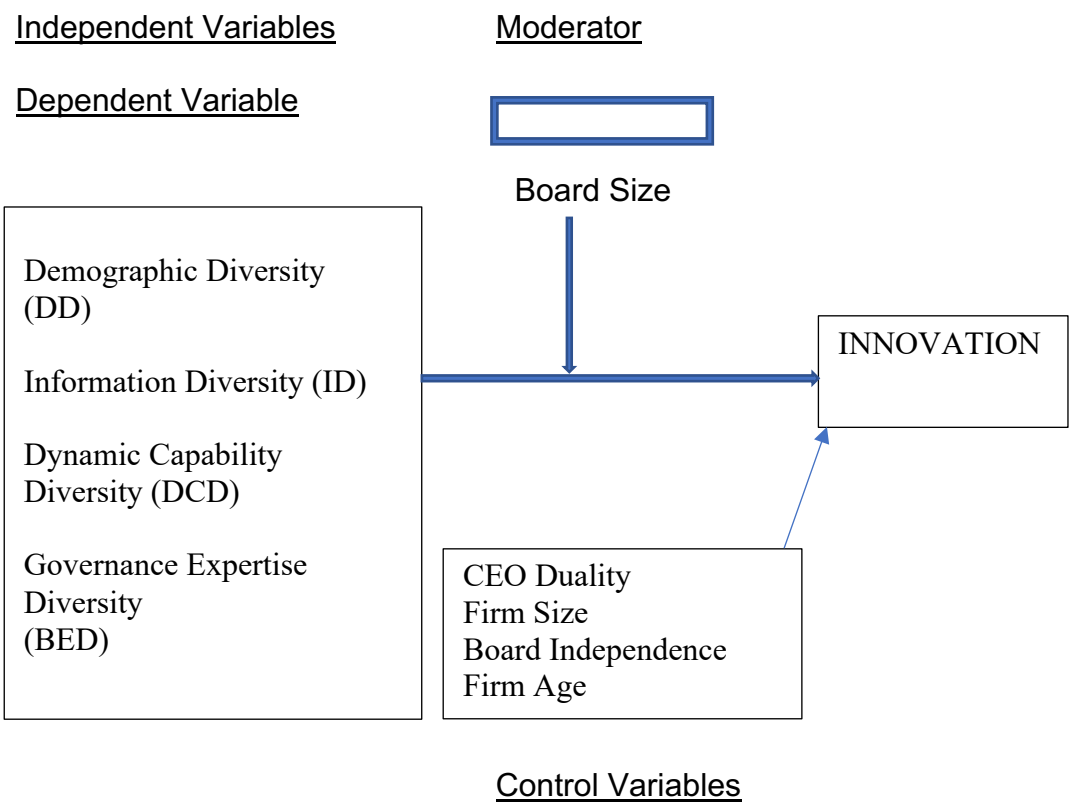
H7: Board size will moderate the curvilinear relationship between Dynamic capability diversity and innovation such that the relationship will be stronger in larger boards.

3.3 (d) Governance experience diversity and board size

In small boards the challenges of entrenchment, status-quo, comfort and risk avoidance are very strong, given the smaller number of board members. Hence the firm is unable to draw benefits of improving governance expertise because the small boards are generally more execution focused, have stronger communication and therefore there is not significant leverage of the cognitive strength of network and perspectives which is derived from such diversity. However when the board is large, the effect of governance diversity gets amplified because in large boards the network benefit of size is more effective, and the structured approach of large board processes leverages on the cognitive strength derived from governance experience diversity and this structured approach overcomes the issues of communication, improves risk taking capacity of board members and hence promotes overall firm innovation.

H8: Board size will moderate the curvilinear relationship between Governance Experience diversity and innovation such that the relationship will be stronger in larger boards.

SECTION 4 :THE THEORETICAL MODEL



SECTION 5 : DATA SOURCES

In our research, we used the following different sources of data.

5.1 Innovation Data: Forbes WMI

The Innovation outcome of the organization will be defined as the Innovation Premium that has been developed by Forbes™, for each organization as a part of its annual World's Most Innovative™ (WMI) companies list. The Forbes WMI list is a reliable, established industry standard and a consistent index listing the world's top 100 most innovative companies for almost a decade. Each company in the Forbes WMI List is ranked based on the calculation of the Innovation Premium (detailed in section on Variables). The innovation premium is calculated by making future projections of a firm's cash flow and its income and the model then derives a future NPV, based on business anticipated growth rates. This value when compared with market value gives a premium/ discount value which is called the Innovation Premium. (Dyer & Gregersen, 2018).

5.2 Board Diversity Data: Boardex

To identify the different measures of diversity of the members of the board of directors, we have collected data of the various characteristics of members of the board of directors of 209 companies spanning across 702 company years from Boardex™. We have embellished the data where required (missing from Boardex™) from manual efforts through

annual reports, **Orbis, Bloomberg and Reuters**. For the list of companies in our reference point we have taken the historical revenue data from Orbis.

We have used the Boardex data on excel spreadsheet for the following

a. Data for European exchange
b. Data for North America exchange
c. Data for rest of the world

For each of the geographies, we have the following data files –

a. Board Summary
b. Committee Details
c. Director Profile- Characteristics
d. Director Profile- Employment Current Board
e. Director profile- current Non Board
f. Director Profile- Employment History Board
g. Director profile – Employment history- Non Board
h. Director profile- Others
i. Organization Analysis

5.3 Data Fields:

We have collected the following fields of data from the above-mentioned files of Boardex^{TM}, which will be utilized to derive the relevant measures of diversity (as explained later) for each board member:

a. Age of Board Member
b. Gender of Board Member
c. Director type- ED/SD/ID (Executive Director, Standard director, Independent director)
d. Time in Role in Organization
e. Time on Board
f. Total no of Quoted Boards to date
g. Total no of other boards to date
h. Total no of Other Boards- Current
i. Average years on other Quoted Boards
j. Total Directors on Board
k. No of Independent NED on board
l. CEO Duality
m. Qualification Degree 1- Qualification Degree 6
n. Different educational institutions of undergraduate or higher study
o. Different roles in current organization
p. Different roles in other organizations

We have also used data from ORBIS and Capital IQ to supplement the corporate financial and executive information wherever the core data sources needed further information. Orbis is one of the world's most powerful corporate databases, holding information on more than 365 million companies and is provided by Bureau Van Dijk, a Moody's analytics company. Capital IQ is also a world leader in corporate information databases, (Winner of the best data analytics provider – Waters Ranking 2019) and is a part of S&P Global Market intelligence. We have also update the information wherever possible and necessary through corporate annual shareholder reports.

SECTION 6: THE VARIABLES

6.1 The Dependent Variable:

While innovation has been quite a widely studied topic among researchers in different forms of academic research- social sciences, governance, policy, management strategy, one of the biggest challenges that has been faced by academics and researchers has been the inherent subjective nature of the concept of innovation and hence the inability to measure innovation with a high level of accuracy and strong levels of confidence. Given that the definition of innovation has seen wide interpretation, it is not strange that the measurement of innovation also has seen may different approaches with no real consensus and hence multiple proxies have been used across different research fields (Jensen & Webster, 2009).

The major proxies that have been used are :

a. **R&D Expenditure:** In academic literature, one common way of measuring innovation is based on the "investment" view of innovation. The R&D view is based on the concept that "innovation in a firm has a connection with the expense that the firm makes in developing new products, processes or services, with a supposition that this investment will yield positive results over time" (Webster, 1999) (Brown, Fazzari, & Petersen, 2009).

With this definition, the most appropriate way for us to measure the investment metric would be to find the specific investment in innovation related to products, services and processes, but it is extremely difficult to do so given the intangible nature and lack of consistency in defining these items. In addition, there are no standardized guidelines in the financial regulatory environment for the corporate world to track and report these in their financial reports. Therefore, academic researchers have done the logical adjustment and accepted the most relevant proxy – the R&D expenditure of the firm and have used R&D investments as an "indicator of firm's ability, capability and propensity to innovate" (Qian & Li, 2003); (Wolff & Pett, 2006) .

b. **Patents:** Innovation has also been closely linked to specifically the new product development by the firm and therefore it has been strongly believed that any tangible measure which has close association with the new product development capability, will be a good measure for innovation at the firm. (Jensen & Webster, 2009). The count of patents and trademarks has also been considered in academic literature as a possible measure of firm innovation (Greenhalgh & Longland, 2001). While patents can be seen as an objective measure of new knowledge but using plain patent count does have the limitation of ignoring the weightage of the value of the patent given the inability to capture the qualitative difference in the output derived from different patents. It is

important to note that patent-count should not be confused with Trademarks as the latter is not reflective of knowledge, but a mechanism that provides protection for words, phrases, images, logos, symbols etc.

c. **New product launches:** Since innovation is closely linked to new products (as was generally defined in the earlier definitions of innovation), the new product count has been also considered in the past as a measure of innovation (Brouwer & Kleinknecht, 1996).

However, many of these methodologies have since lost relevance with the modern definition of innovation as espoused by Christensen which has looked at innovation beyond just new products and new technology, but into business model too.

6.2 The Innovation Premium

It is Christensen's theory of disruptive innovation, where the core of the innovation premium as a viable measure of innovation lies (Christensen C. , 1997) (Christensen C. , Raynor, Dyer, & Gregerson, 2012). Change through product improvements renders older products obsolete and in the same way disruptive innovation renders obsolete the market advantage of an incumbent. Therefore it is the market value and market premium of a firm that could be seen as a measure of innovation

premium. The innovation premium is based on the core mantra that it is the "market" that is most capable to value and judge the firm's innovation. It is the financial and monetary investment methodologies that can consistently value a firm, and the capital investment in the identified firms reflects what the market believes will be the firms who through their innovative strategies will create long term shareholder value. (Jensen & Webster, 2009)."The innovation premium of any company is thereby defined as the difference between the market capitalization of the company and the net present value (NPV) of the cash flows of the existing businesses based on the expected growth rates in these businesses". (Christensen, Gregersen, & Dyer, The Innovators DNA, 2011).

Forbes prepares the world's most innovative companies list in partnership with Credit Suisse by calculating the various cash flows of the different businesses based on the proprietary algorithm – HOLT ™ (developed by Credit Suisse). The Forbes method is based on the concept of the wisdom of the crowds and conceptually it relies on the belief that the global investor community is fundamentally capable of identifying firms which they see as innovative today AND they believe will be able to continue to remain innovative in the future (Dyer & Gregersen, 2018). We have captured data from the WMI list from 2011 till 2018 giving us a list of 245 * unique companies and 702* company-year data for our analysis. When we collated the Boardex data for the companies as per the Innovation premium data from Forbes, we had to

exclude from the sample certain observations for lack of complete information about the individual directors .That finally reduced our analysis sample size to 209 companies with 595 company year data against 702 company year observations in the Forbes data (reflecting a loss of 15.24%) of possible data observations. The mean observation of the Innovation premium is 19.1, with a standard deviation of 12.8 and the range of 595 observations is 19.10 - 89.22.

6.2.1 The validation of Innovation Premium:

It is now well-established that over the last decade , there is a high level of global acceptability of the Forbes Innovation Premium and Forbes Innovation Index as one of the foremost measures of innovation for large companies. This is reflected in its widespread use in the industry as a measure of innovation and innovative performance, with firms using this index to benchmark their innovative performance.

The innovation premium as a metric of innovation has been further analysed by some academics and it was found that the companies on the Innovation Premium list generally outperformed the firms that were in a control group in terms of measures that define both stock performance and market capitalization, over a period of time (Pryzant, 2014). Innovation premium effectively measures the expectations of the market with reference to the company's capability to innovate in the

future and reflects confidence in the “wisdom of the markets” in valuing innovation.

The relationship between different proxies of innovation has been looked at in some previous studies. Most such research has come to the conclusion that there is a high level of variance and that the inter-relationships between the proxies are inconsistent. The choice of the innovation proxy is thereby an important factor for firm level analysis (Jensen & Webster, 2009). Notwithstanding the fact that the Innovation Premium as a measure has been well established as highlighted earlier , we also did a further examination of the relationship between Innovation premium and R&D expenditure(the most widely used proxy for innovation).

The actual measure used was R&D expense as a percentage of firm revenue. We used the data over the same period for the same set of firms that have been used for the hypothesis testing. Against a total of 595 data points (firm – year information) , we were able to get data for 394 data points (firm year information) where R&D level information was available. This corresponds to a total of 142 companies against the original analysis for 209 companies.

The correlates are presented in Table 1 below.

Table 1 : Correlation Table – Innovation premium & R&D expense (as percentage of revenue).

Regression Statistics									
Multiple R	0.473326634								
R Square	0.224038102								
Adjusted R S	0.222058608								
Standard Err	14.372048								
Observations	394								
ANOVA									
	df		*SS*	*MS*	*F*	*Significance F*			
Regression	1		23377.8665	23377.8665	113.179444	2.16E-23			
Residual	392		80969.8594	206.555764					
Total	393		104347.726						
	Coefficients		*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-13.51488569		2.36245199	-5.7207028	2.11E-08	-18.159547	-8.8702245	-18.159547	-8.8702245
X Variable 1	0.541060387		0.05085831	10.6385828	2.16E-23	0.44107121	0.64104957	0.44107121	0.64104957

The Innovation Premium reflects a correlation 0.473, with a very high degree of significance (2.1619E-23) (as per the above Table) . In most inter-relations studies, the correlations range between 0.1-0.6 and so our result is giving support to the strength of Innovation premium as a measure of the firm innovation.

6.3 The Independent Variables:

6.3.1 Demographic Diversity (DD): We have defined demographic diversity as a combined factor of the constituent factors – Gender diversity and Age diversity of the board members.

6.3.1(a) - Gender Diversity: We collected data on each board member for the firms for the board composition that was adjusted by 3 years from the year of innovation premium. From the board composition data, we classified the gender (Male=1, female=0) and we calculated the Blau's

Index (1- $\sum i^2$) where i was the proportion of board members who were male. This gave us the measure for gender diversity of the board as per methodology suggested by (Mahadeo, Soobaroyen, & Hanuman, 2012);(Galia, Zenou, & Ingham, 2015). The calculated scores of Gender diversity observations had a mean of 0.225, a standard deviation of 0.146 and a range of 0.0-0.5.

6.3.1(b) – Age Diversity: based on the same data source as above, we also collected the age data for the board members. This was available for the respective years for which the innovation premium adjustment by three years for the board composition was done. We then classified the age on the basis of many previous studies that have used age diversity as a measure (Kang, Cheng, & Gray, 2007); (Mahadeo, Soobaroyen, & Hanuman, 2012) (Galia, Zenou, & Ingham, 2015) . The classifications were 0-<40, 41-<50, 51-<60, 61-<70 and Above 70. We then we calculated the Blau's index (1- $\sum i^2$), where i = proportion of board members in each age category) to derive the Age diversity of the board of directors. The calculated scores of Age diversity had a mean of 0.590, a standard deviation of 0.125 and a range of 0.0-0.792.

Based on the approach followed by (Chatman & Flynn, 2001), (Randel & Jaussi, 2003) and (Wayne & Liden, 1995), we used the amalgamation approach to then sum and average these two individual scores for each board to create the overall measure of Demographic diversity. This approach is supported by the formative indicator argument (Bollen &

Lennox, 1991) and hence we have applied it to measure demographic diversity. The overall measure of demographic diversity (DD) had a mean of 0.407 with a standard deviation of 0.104 and a range of 0.0-0.631

6.3.2 Information Diversity (ID): We have defined Information diversity as a combined factor of the constituent factors –Higher Education diversity, Educational institutional diversity and Professional network diversity of the board members.

6.3.2 (a) - Higher education Diversity: For each of the board members we took from Boardex the respective level of different qualifications of each of the board members. Then we classified for each board member the highest qualification that he/ she had acquired. We created the diversity measure through the Blau's index by calculating the percentage of composition of each board into different categories of highest qualification – Doctoral, Post-Graduate/Masters, Undergraduate, No degree. $(1- \sum i^2)$, where i = proportion of board members in each highest education category). Our observations for higher education diversity had a mean of 0.559, with a standard deviation of 0.132 and a range of 0.0-0.743.

6.3.2 (b) - Educational institutional diversity: We also collected information for each director (from Boardex) on the different educational institutions that they studied at. We then calculated the number of educational overlaps for each director (if the director had one or more

overlaps with another) and then classified the for each board the percentage of directors who had any overlap with another director, and percentage of directors who had no overlap with any director. We then calculated the Blau's Index for educational institutional diversity based on $(1- \sum i^2)$, where i = proportion of board members in the overlap category. Our observations for educational institutional diversity had a mean of 0.334 with a standard deviation of 0.184 and a range of 0.0-0.5.

6.3.2 (c) - Network diversity: We took the number of professional networks that each board member has as per the data given in Boardex. We then classified the data into the following categories based on the number of people in their professional network- 0-100, 101-1000, 1001-2000, 2001-3000, Above 3000. Then we calculated the Blau's index for network diversity based on $(1- \sum i^2)$, where i = proportion of board members in each of the network size category. The network diversity observations then had a mean of 0.557 with a standard deviation of 0.169 and a range between 0.0-0.79

Again, based on the amalgamation approach that has been earlier followed by (Chatman & Flynn, 2001), (Randel & Jaussi, 2003) and (Wayne & Liden, 1995), and the support of the causal / formative indicator argument (Bollen & Lennox, 1991) we sum and average these three individual diversity scores for each board to create the overall measure of Information diversity (ID) for the board. The combined

variable of Information diversity had a mean of 0.484 with a standard deviation of 0.101 and a range between 0.0-0.643

6.3.3 Dynamic capability diversity (DCD): We have defined Dynamic capability diversity as an average of the constituent factors – Entrepreneurship experience diversity, Leadership experience diversity and Research experience diversity, of the board members.

6.3.3 (a) Entrepreneurship Experience diversity is calculated by the measure of proportion of board members on every board who have an entrepreneurial experience defined by the following categories- Founder, Co-founder, Founding Member, Founding Partner, and Founding Director. Then using the Blau's index ($1- \sum i^2$), where i = proportion of board members within each category – with and without founders' experience) we derived entrepreneurship experience diversity. The Entrepreneurial experience diversity observations had a mean of 0.178 with a standard deviation of 0.168 and a range of 0.0-0.5

6.3.3 (b) Leadership Experience Diversity: We again use the Blau's index to calculate the leadership experience diversity. Leadership experience is defined as the experience acquired by having the position of CEO and/or Chairman of a firm. We looked at each individual board members' past experience from Boardex and classified them as either having or not having leadership experience. We focused on the attributes where the ultimate decision-making responsibility and the

responsibility for strategy formulation and execution across the firm is seen as the critical attribute that allows leaders to develop their decision making and disruptive thinking and disruptive analysis skills. The categories used for our data were CEO/Deputy CEO/ Regional CEO/ MD/ President/ Chairman/ Dy Chairman/ Group General Manager. Then using the Blau's index ($1- \sum i^2$) where i = proportion of board members within each category – with and without leadership experience, we derived Leadership experience diversity. The leadership experience diversity had a mean of 0.394 with a standard deviation of 0.138 and a range between 0.0 and 0.5.

6.3.3 (c) Research Skill Diversity: We developed this measure by classifying each board member as having the particular skill of academic research which is linked to their having achieved a doctoral degree in their educational or work background. As noted earlier, the experience of conducting research with academic rigor develops critical analytical skills, problem identification and solution orientation skills and theory building and logical thinking skills that are critical inputs for disruptive thinking. Then using the Blau's index ($1- \sum i^2$), where i = proportion of board members within each category – with and without academic research experience) we derived Research experience diversity. The Research skill diversity had a mean of 0.205 with a standard deviation of 0.171 and a range between 0.0 and 0.5.

Again, based on the amalgamation approach and the support of the causal / formative indicator argument we sum and average these three individual diversity scores for each board to create the overall measure of Dynamic capability diversity (DCD) diversity for the board. The combined variable of Dynamic capability diversity had a mean of 0.259 with a standard deviation of 0.097 and a range between 0.0 and 0.479

6.3.4 Governance Experience Diversity (GED): We have defined Governance experience diversity as an average of the constituent factors – Current board experience diversity and Other board experience diversity of the board members.

6.3.4 (a) Current Board experience Diversity- The experience on the current board is measured for each member of the board for every year and we then classified them according to the board experience categories as per the following distribution: 0-<3 years,3-<6 years, 6-<9 years, 9<12 years and Above 12 years. This has been used to largely reflect number of board terms (since most board memberships are for a period of 3 years). Then using the Blau's index ($1- \sum i^2$), where i = proportion of board members within each category of current board vintage experience, we derived Current Board vintage diversity. The board vintage diversity had a mean of 0.613 with a standard deviation of 0.173 and a range between 0.0 and 0.791.

6.3.4 (b) Other Board experience Diversity – The experience on other corporate boards was measured for each member of the board for every

year and we then classified them according to the other corporate board experience categories as per the following distribution 0-<3 years,3-<6 years, 6-<9 years, 9<12 years and Above 12 years. This has again been used to largely reflect number of board terms (since most board memberships are for a period of 3 years). Then using the Blau's index ($1- \sum i^2$), where i = proportion of board members within each category of other corporate board vintage experience) we derived Other Board experience diversity. The other board experience diversity measure had a mean of 0.543 with a standard deviation of 0.179 and a range between 0.0 and 0.792.

Again, as we have done for our other diversity measures, we sum and average the two individual diversity scores based on the amalgamation approach and the causal / formative indicator argument to create the overall measure of Governance Diversity (BED) diversity for the board. The combined variable of Governance experience diversity had a mean of 0.580 with a standard deviation of 0.129 and a range between 0.0 and 0.765.

6.4 The Control Variables

Given the fact that the relationship between board composition and firm innovation is multi-dimensional, our intent in this study was to focus only on the diversity elements of the board. We have in our study captured data on certain other critical variables too because we acknowledge that

there are other variables over and above the independent variables that we are studying, which have an impact on firm innovation.

6.4(a) CEO Duality

Board power structure and Board-TMT interaction has been viewed as a key driver of organization decision making, risk assessment, long term goal setting and organization investment appetite for R&D and innovation investments. The organizations potentially manage the agency risk of duality by segregating the task of CEO and Chairman i.e. the task of managing decision making and task of managing decision control (Boyd 1995). However, at the same time, CEO duality provides a management process that provides the clarity in direction because of single leadership and improves on the organization's response to external information (Boyd B. , 1995). This improved information communication and decision making impact board capability to drive innovation. We measured CEO duality through a dummy variable: 0,1(for duality not present or for duality present). The variable CEO duality had a mean of 0.584 with a standard deviation of 0.493 and a range between 0.0 and 1.0.

6.4(b) Board Independence

There is a large body of governance research which reflects the well-established relationship of board independence and firm performance. Independent / Outside members of the board are more effective in TMT monitoring, giving a strong support to the agency theory. (Westphal &

Zajac, 1997). Also, independent directors add to the external linkages of the firm and improve firm absorptive capacity and foster innovation. We measured board independence as a ratio of independent directors on the board. The mean of the observations was 0.643 with a standard deviation of 0.265 and a minimum – maximum range of 0-1.0.

6.4(c) Firm Size

We also control for firm size, because there is significant extant research which postulates that the size of firm has strong bearing on the firm innovation . Firm size has generally been accepted to have a positive relationship with firm innovation (Cohen, Wesley, Levin, & Mowery, 1987). Large firms have stronger resource pool in terms of financial capabilities, higher risk tolerance, superior employee and technological skills, the ability to raise capital and more efficient management processes , which all help in managing the innovation cycle more effectively (Damanpour, 2010). Another theoretical explanation is that large firms generally have to face higher set of competitive challenges, increased amount of risk, uncertainty and volatility and this scenario necessitates that innovation is critical for large firms to be able to cope with such an operating environment. We consider firm revenue (US $ millions) as a measure of the firm size.

6.4(d) Firm Age

The age of the firm has also been considered in governance research as a relevant factor on driving firm performance and innovation. Firms that are old are expected to have strong bureaucratic processes and generally have higher resistance to change (Zona, Zattoni, & Minichilli, 2013).They have a longer process to determine the need to change, a more bureaucratic process for analysing the potential alternatives and then a more complex process for resource allocation, execution and monitoring, all of which have a strong negative bearing on firm innovation.

Recent research however has also indicated that firms that are well established have the benefit of well-established technical capabilities, managerial processes, longer standing financial relationships , core financial strength and also the ability to assess and manage risk based on prior experiences. They also have the capability to assess the risk of investments especially those related to innovation because these extend over a longer period of time. Hence there is a strong case for a positive relationship between firm vintage and firm innovation. We measured firm age based on the number of years the firm has been in existence and the observations had a mean age of 46.32 years with a standard deviation of 38.64 .

6.5 The "Time-deferred" impact of Board composition on Innovation

A key component of the analysis was to define the time-deferred relationship of team decisions and the innovation outcomes. Innovation is a complex process and decisions that impact innovation need quite a bit of time for their implementation to be able to demonstrate their impact and reflect in desirable outcomes (Mairesee & Mohnen, 2004). Clearly decisions that a board takes generally involve more complexity than normal team decisions, and innovation decisions involve higher risk, therefore the time frame for consideration has to be beyond the simple quarterly cycle of financial reporting and even beyond the annual cycle of performance review. Galia et al in their study considered board composition of 2006 to have had an impact over the period 2006-2008 (Galia, Zenou, & Ingham, 2015). In their study of demographic diversities, Ostergaard et al , used board composition of 2002 and developed their understanding of its relationship with the firm innovation probability over the period of 2003-2005 (Ostergaard, Timmermans, & Kristinsson, 2011).

We believe that given the nature of our sample firms in terms of scale of revenues and size of their operations, and hence the implication on complexity of innovation involved, the impact of the decisions by the board will take 2-3 years to reflect . A board member has a term of generally 3 years and so it is natural that they would like to see the

benefits of the decisions reflected during their normal tenure (unless extended). Therefore , in line with the previous studies we have used board composition data for a firm on a three year reported difference from the reported Innovation premium for the firm.

7. OBSERVATIONS & RESULTS

7.1 Descriptive Statistics: Table 2 displays the means, standard deviations and the range for the variables in our research.

Table 2 : Mean, SD and range of observations

	count	mean	sd	min	max
premium	595	44.99784	12.80299	19.1	89.22
demo_div	595	0.4076622	0.1043216	0	0.6319444
demo_div_sq	595	0.1770531	0.0763152	0	0.3993538
info_div	595	0.484036	0.1010031	0	0.6435185
info_div_sq	595	0.2444753	0.0833437	0	0.4141161
dynamic_capab_div	595	0.2596268	0.0979465	0	0.4791667
dynamic_capab_div_sq	595	0.0769835	0.0498848	0	0.2296007
governance_div	595	0.5808529	0.129291	0	0.765625
governance_div_sq	595	0.3540782	0.1333998	0	0.5861816
board_size	595	10.51765	2.706323	5	22
ceo_duality	595	0.5848739	0.4931584	0	1
independentdirectors	595	0.6430688	0.26598	0	1
revenue	595	11556.28	24517.66	138.2165	421849
firm_vintage	595	46.32773	38.64004	2	219
N	595				

a. Board Size- The average size of the board of directors was 10.5, with the range being a low of 5 to a maximum of 22 and a SD of 2.7215.

b. Independence- On an average 64% of the directors were independent and there were firms which had zero independent directors and also firms which had 100 % independent directors on their board. The SD of director independence was .265

c. Revenue- The average revenue of the firm was 11.53 Billion USD with a range of 0 and 421.84 Billion US dollars and a SD of 24.501 Bn USD

d. Vintage- The companies had an average vintage of 46 years with a SD of 38.6 years and these firms were as young as 2 years old and the oldest being 219 years old.

e. The Education levels- The data pool has a total of 6258 directors. Of these 916 (14.66%) had no formal qualification, 1478(23.61%) had undergraduate degree, 2983(47.66%) had a master's or a post graduate degree and 881 (14.07%) had a doctoral or post-doctoral degree.

7.2 The Regression Methodology- Fixed Effects

The analyses was conducted by using the fixed effects regression model. The fixed effects regression model allowed us to control for stable characteristics and hence was useful in reducing large sources of bias. This method allowed us to make comparisons within an entity and then across all the entities in the sample, wherein the differences were averaged to get the "fixed effects" regression. So when we measured our dependent variable y (innovation premium), which has a relationship with independent variables (x1…xn) over a period of time, the fixed effects regression focused on the variation in x over time for the same entity and ignored the variation in x between different entities.

This gets done because "*the between entity variation could possibly be contaminated by certain characteristics that are corelated with the dependent variable y and this allows us to hence get much more unbiased estimates for the regression analysis*". (Allison, 1978). We used the **panel data** for our research , which allowed us to control for certain variables like corporate culture and corporate business practices, which vary across companies and might have an impact on innovation. We could also control thereby for issues like regulatory policies which change over time and impact board decisions concerning innovation.

Table 3 : The correlation of variables

	premium	demo_div	demo_div_sq	info_div	info_div_sq	dynamic_capab_div	dynamic_capab_div_sq	governance_div	governance_div_sq	board_size	ceo_duality	independentdirectors	revenue	firm_vintage
premium	1													
demo_div	-0.0568	1												
demo_div_sq	-0.0364	0.967***	1											
info_div	-0.00595	0.218***	0.219***	1										
info_div_sq	-0.0147	0.203***	0.201***	0.975***	1									
dynamic_capab_div	0.265***	0.0807*	0.0832*	0.394***	0.344***	1								
dynamic_capab_div_sq	0.289***	0.0381	0.0381	0.294***	0.272***	0.962***	1							
governance_div	-0.191***	0.362***	0.342***	0.232***	0.195***	0.169***	0.103*	1						
governance_div_sq	-0.183***	0.356***	0.340***	0.241***	0.205***	0.172***	0.104*	0.984***	1					
board_size	-0.262***	0.323***	0.296***	0.112**	0.132**	-0.0803	-0.108**	0.167***	0.161***	1				
ceo_duality	-0.0360	0.0288	0.0485	0.114**	0.0977*	0.0348	0.000232	0.0439	0.0763	-0.00522	1			
independentdirectors	0.0538	0.297***	0.274***	0.236***	0.169***	0.337***	0.276***	0.437***	0.461***	-0.179***	0.116**	1		
revenue	-0.0993*	0.108**	0.123**	0.0891*	0.0939*	0.0348	0.0277	0.169***	0.183***	0.145***	0.0590	0.107**	1	
firm_vintage	-0.315***	0.00928	0.00225	0.00536	0.0105	-0.252***	-0.281***	0.123**	0.117**	0.199***	0.0810*	-0.0885*	0.0425	1
="* p<0.05	** p<0.01	*** p<0.001"												

Table 4 : Regression of Primary variables and second order of primary variables

	premium		premium	
demo_div	-7.94	(5.83)	-12.0	(17.40)
info_div	-7.58	(8.12)	115.2**	(52.88)
dynamic_capab_div	-0.11	(8.65)	-55.2**	(25.40)
governance_div	-4.74	(5.04)	-29.9	(19.20)
board_size	0.21	(0.32)	0.38	(0.33)
ceo_duality	1.31	(1.52)	0.97	(1.53)
independentdirectors	-2.03	(5.99)	-1.68	(5.96)
revenue	0.000091**	(0.00)	0.000089**	(0.00)
firm_vintage	1.06***	(0.19)	0.91***	(0.20)
c.demo_div#c.demo_div			10.4	(23.10)
c.info_div#c.info_div			-129.4**	(56.05)
c.dynamic_capab_div#c.dynamic_capab_div			104.8**	(47.68)
c.governance_div#c.governance_div			25.1	(18.91)
_cons	2.69	(8.50)	-8.27	(14.19)
r2	0.14		0.17	
F	7.03		5.79	
sigma_u	50.0		44.0	
sigma_e	5.35		5.30	
rho	0.99		0.99	
p	2.1e-09		9.9e-10	
N	595		595	
groups	209		209	
Standard errors in parentheses				
="* p<.10	** p<.05	*** p<.01"		

Table 5 : Regression of primary variables second order AND interaction with Moderating Variable

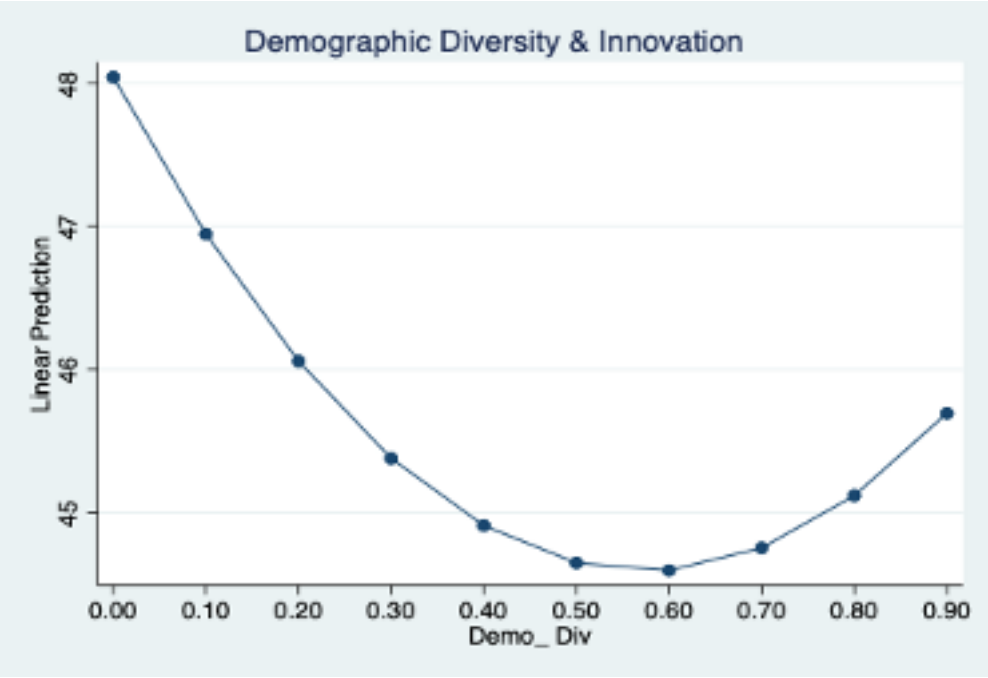
	(1)		(2)		(3)		(4)		(5)	
	premium		premium		premium		premium		premium	
demo_div	-12.0	(17.40)	2.50	(51.71)	-6.12	(17.31)	-10.1	(17.32)	-15.4	(17.42)
c.demo_div#c.demo_div	10.4	(23.10)	3.11	(71.48)	4.50	(22.92)	7.78	(22.99)	15.6	(23.15)
info_div	115.2**	(52.88)	118.2**	(53.88)	629.4***	(169.80)	178.9***	(59.10)	107.5**	(52.87)
c.info_div#c.info_div	-129.4**	(56.05)	-132.7**	(57.14)	-692.0***	(188.76)	-196.9***	(62.46)	-120.7**	(56.04)
dynamic_capab_div	-55.2**	(25.40)	-52.8**	(25.91)	-36.2	(25.89)	156.0*	(90.54)	-57.6**	(25.34)
c.dynamic_capab_div#c.dynamic_capab_div	104.8**	(47.68)	100.3**	(48.54)	69.6	(48.54)	-313.8*	(173.96)	107.4**	(47.53)
governance_div	-29.9	(19.20)	-30.5	(19.27)	-37.4*	(19.16)	-30.1	(19.12)	99.1	(70.62)
c.governance_div#c.governance_div	25.1	(18.91)	25.4	(18.98)	31.5*	(18.82)	24.4	(18.85)	-110.3	(68.39)
board_size	0.38	(0.33)	1.07	(1.48)	9.30***	(2.82)	2.43**	(1.00)	3.56*	(2.12)
ceo_duality	0.97	(1.53)	0.98	(1.53)	1.48	(1.52)	0.83	(1.52)	0.94	(1.53)
independentdirectors	-1.68	(5.96)	-1.55	(5.98)	-2.08	(5.94)	-0.75	(5.94)	-1.45	(5.94)
revenue	0.000089**	(0.00)	0.000090**	(0.00)	0.000091**	(0.00)	0.000081*	(0.00)	0.000090**	(0.00)
firm_vintage	0.91***	(0.20)	0.93***	(0.20)	0.94***	(0.20)	0.96***	(0.20)	0.88***	(0.20)
c.demo_div#c.board_size			-2.47	(6.83)						
c.demo_div#c.demo_div#c.board_size			1.85	(8.46)						
c.info_div#c.board_size					-42.4***	(13.36)				
c.info_div#c.info_div#c.board_size					47.0***	(15.27)				
c.dynamic_capab_div#c.board_size							-20.1**	(8.17)		
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size							40.8**	(16.45)		
c.governance_div#c.board_size									-14.6*	(8.06)
c.governance_div#c.governance_div#c.board_size									15.1**	(7.58)
_cons	-8.27	(14.19)	-14.2	(18.04)	-121.4***	(38.42)	-47.3**	(22.27)	-31.3	(21.47)
r2	0.17		0.17		0.19		0.18		0.18	
F	5.79		5.01		5.80		5.49		5.36	
sigma_u	44.0		44.5		45.2		45.8		42.5	
sigma_e	5.30		5.31		5.24		5.27		5.28	
rho	0.99		0.99		0.99		0.99		0.98	
p	9.9e-10		5.2e-09		8.5e-11		4.3e-10		8.6e-10	
N	595		595		595		595		595	
groups	209		209		209		209		209	
Standard errors in parentheses										
="* p<.10	** p<.05	*** p<.01"								

7.3 Observations from Model 1 (Table 5) :

Model 1 presents the results of the second order relationship between the four dependent variables and the independent variable. The model 1 includes the control variables – CEO duality, Independent Board directors , Revenue year and Company vintage. Of these only the Revenue(.000089, **) and Company vintage(0.91 , ***) reflect coefficients with significant values.

7.3.1 Observation 1

This model shows the curvilinear relationship between demographic diversity (DD) and Innovation, but the relationship is not reflecting any significance in testing.



Observation 1

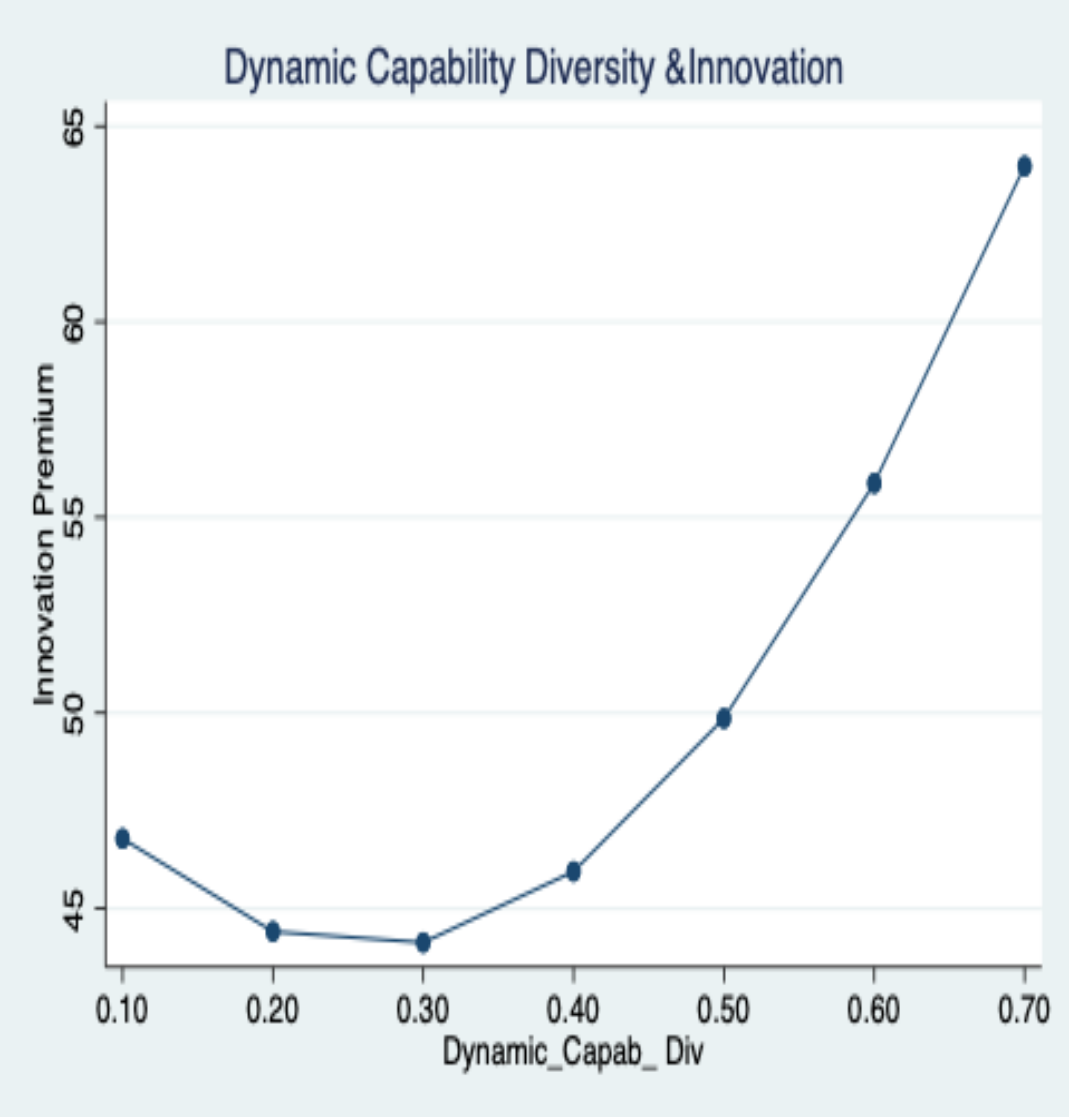
This result is in **dissonance with our Hypothesis 1** on effect of demographic diversity on innovation and the expectation of a curvilinear relationship based on extant theory driven by a combination of resource based view and the social identity view. Clearly our results are also not showing any significance in a direct effect of demographic diversity on firm innovation. While there have been previous studies that have associated gender diversity with improved firm financial/ stock performance, our study is highlighting that there is no discernible relationship between demographic diversity (as a combined effect of gender and age) and innovation. The key driver of the theoretical positive impact of diversity on demographic factors has been the " visibility" of the difference and the inherent difference in perspective between men and women and between the young and the old. The lack of significant relationship could be driven by the fact that we are looking at a sample of large global firms, where the membership of the board is achieved by a select few through a comprehensive and difficult process. The women who make it to the board of such firms do not think of themselves as "gender' selection or "regulatory primed" selection. They believe that they are there "solely" on merit and on " equal" basis with every other male board member. The engagement of female board members is then reflective of the " reverse bias" i.e. women board members think, behave and engage like a man and that they possibly hold back their natural difference in view and perspective so that the rest of the board perceives their appointment on "skill and capability" and not as " regulatory/ CSR " action. This self-restraint then thereby reduces

the resource quality as per the Resource based theory. The demographic diversity of the board could be seen as a " proxy for two different constructs- experience (from a resource based view) and risk aversion (from an agency view), (Johnson, Schnatterly, & Hill, 2013). At the same time , given the quality of the experience of the younger and/ or the female members of the board, these members are "unlikely" to form cohorts and groups based on visible and discernible differences like age and gender , and hence the negative effects of the social identity theoretical perspective are also unlikely to be strong in boards. Both these views have been supported through the sample of interviews with global CEOs and board members (summary enclosed in Annexure).

Therefore , our observations that reflect a curvilinear relationship between demographic diversity and firm innovation but are not seeing statistical significance can be possibly looked at in line with some of the emerging and recent academic views like (Chapple & Humphrey, 2014) where gender heterogeneity at the board is not seen as having any impact on firm innovation (Nielsen & Huse, 2010) also proposed that under the aegis of the agency theory, gender has no role to play in board tasks.

7.3.2 Observation 2

The data reflects that there is a statistically significant curvilinear relationship between Innovation and Dynamic capability diversity (DCD).



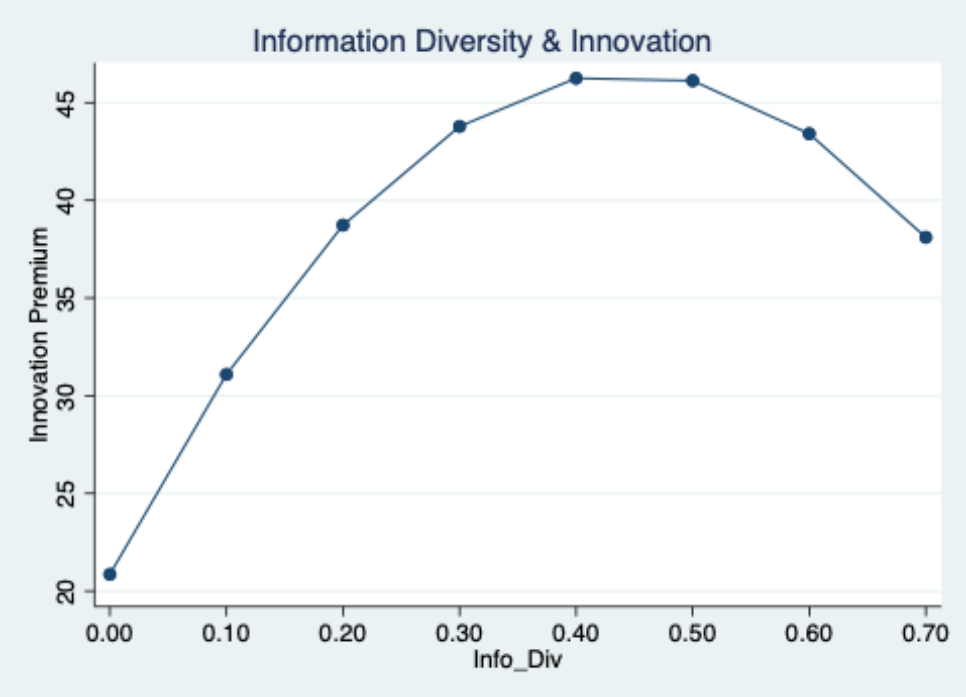
Observation 2

Model 1 gives evidence to a strong U shaped curvilinear relationship between Dynamic capability diversity and Innovation premium , thereby giving strong **support to Hypothesis 2b**. This gives strong support to the Dynamic capability view (DCV) and to the theoretical concept of adaptive innovation of Miles and Snow , who identified the need of the firm to solve the three key problems- the entrepreneurial problem, the engineering problem and the process problem in order to drive innovation. The board needs to develop the diversity on experiences related to these facets in the form of entrepreneurial experience diversity, research experience diversity and leadership experience diversity which through a combined perspective of building up firm dynamic capabilities diversity clearly reflect a highly significant U shaped curvilinear relationship with firm innovation. The curvilinear relationship reflects the need for firms to build a higher level of such diversity to be able to get the desired positive outcome differential for firm innovation. As we see from the enclosed output chart, as dynamic capability diversity increases 0.2 to 0.3 , the firm innovation premium falls by 0.2799 to its lowest value of 44.1332. However, the rate of increase of firm innovation for every increase of 0.1 in dynamic capability diversity is highly positive after that – 1.8167 (from 03.to 04) and 8.106 (from 0.6 to 0.7).

DCD	Premium	Std error	z	P>z	95% conf interval		
0.1	46.78938	1.542157	30.34	0	43.76681	_	49.81195
0.2	44.4131	0.6610178	67.19	0	43.11753	_	45.70867
0.3	44.1328	0.5378528	82.05	0	43.07911	_	45.18745
0.4	45.94991	1.39064	33.04	0	43.22432	_	48.67552
0.5	49.863	3.290199	15.16	0	43.41433	_	56.31167
0.6	55.87254	6.154239	9.08	0	43.81045	_	67.93463
0.7	63.97853	9.97853	6.42	0	43.43302	_	83.52404

7.3.3 Observation 3

The data reflects that there is a statistically significant curvilinear relationship between Information Diversity (ID) and Innovation – with coefficient of -129.4 , a standard error of 56.05 and a p value of 0.021.)



Observation 3

This observation **gives support to our hypothesis 3** and as predicted reflects an inverse U shaped relationship between the firm innovation and information diversity. This gives support to previous research where the resource based view propagates a positive effect because with higher firm information diversity, the overall cognitive quotient of the board improves its capabilities to analyse , review, monitor and make resource allocations. The outcome also gives support to the view of the social integration theorists that challenges do arise in the quality of the board processes, in the engagement of board members, and in the power of the inter and intra group biases that take shape when the information diversity reaches higher levels . These effects tend to first balance out the benefits as we see in the graph and then at some stage start to reduce the advantages of multiplicity of thinking.

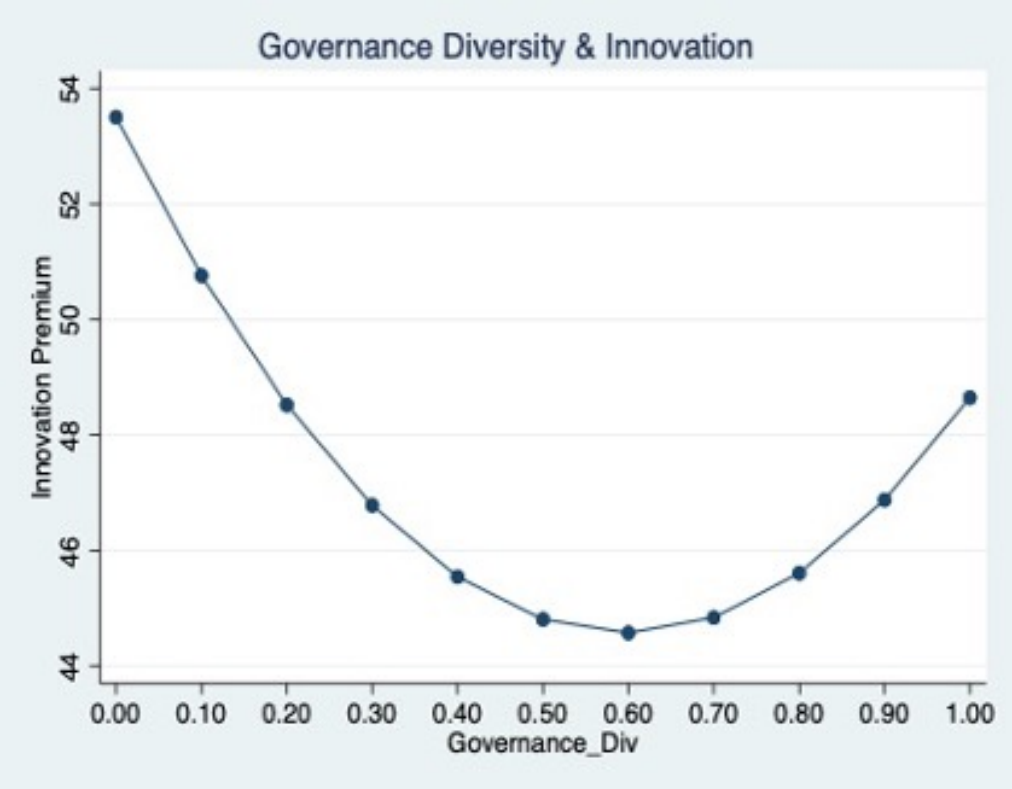
As we notice (in the table below) from a zero base to 0.2 level of information diversity, the firm innovation goes up by almost 17.87 points. However from 0.2 to 0.5 , the innovation tends to stabilize and peak at 46.4 and at levels of 0.7 tends to fall to 38.106. This clearly reflects that, the multiplicity of information, perspectives and analysis driven by diverse views that were contributed by the board members due to their Information diversity provides the firm opportunities to create innovation. Our results also show that the negative slope effect from social identity and group biases is clearly not as strong as the strong and robust

positive effect of improved cognition, super analysis and higher creativity.

Info Diversity	Premium	Std error	z	P>z	95% conf interval		
0	20.85879	12.24436	1.7	0.088	-3.139721	_	44.8573
0.1	31.08911	7.60326	4.09	0.000	16.18699	_	45.99122
0.2	38.73064	4.105303	9.43	0.000	30.68439	_	46.77689
0.3	43.78339	1.796192	24.38	0.000	40.26292	_	47.30386
0.4	46.24735	70.7988064	57.9	0.000	44.68172	_	47.81299
0.5	46.12254	0.5824032	79.19	0.000	44.98105	_	47.26402
0.6	43.40893	1.058346	41.02	0.000	41.33461	_	45.48325
0.7	38.10655	3.051466	12.49	0.000	32.12579	_	44.08731

7.3.4 Observation 4

This model shows that the curvilinear relationship between Innovation and Governance Experience Diversity with IP (25.1) , however the relationship is not reflecting any significance in testing and hence **we cannot see support for our hypothesis no 4.**



Observation 4

7.4 Model 1 and observations on the control variables

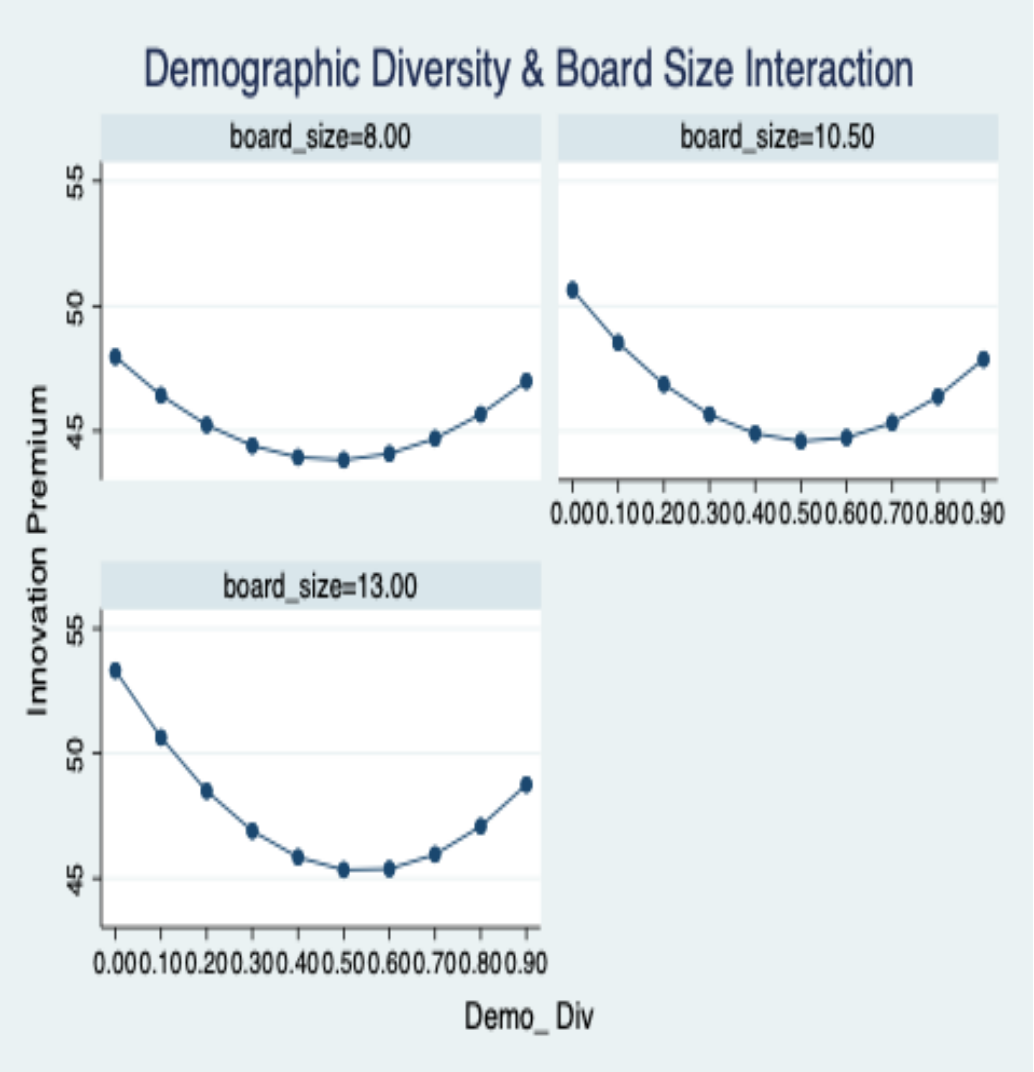
In model 1 (Table 5) we also observe the relationships of the our main control variables with the independent variables before we introduce the effects of the moderating variable. We see that the sample data reflects a strong support to the fact that firm innovation has a positive and highly significant relationship with both firm vintage and with firm revenue (firm size) . These observations are in line with similar studies on board diversities (Zona, Zattoni, & Minichilli, 2013).

7.5 The Observations on the Interaction Effects of Board Size

Models 2-5 are testing the moderating effect of board size on the curvilinear relationship between innovation and the different types of diversities . In these models we ran the fixed effects regression on our panel data by introducing the interaction of board size with our independent variables and the second order of the independent variables. In our observations we have taken the approach which was used by (Stewart & Barrick, 2000)and by (Hitt M. A., Hoskisson, Johnson, & Moesel, 1996) to represent graphically the effects of board size on firm innovation – with the graphs reflecting board size in a range of minus two times standard deviation from the mean board size to plus two times the standard deviation from the mean board size.

7.5.1 Observation 5

The model 2 tests the moderating effect of board size on the curvilinear relationship between demographic diversity and innovation and found no significance. The Model 2 regression statistics for the interaction of board size with squared value of demographic diversity show the value of the coefficient b= 1.855 and but the p value at 0.827 make the relationship with the dependent variable not significant and hence **do not support hypothesis 5**

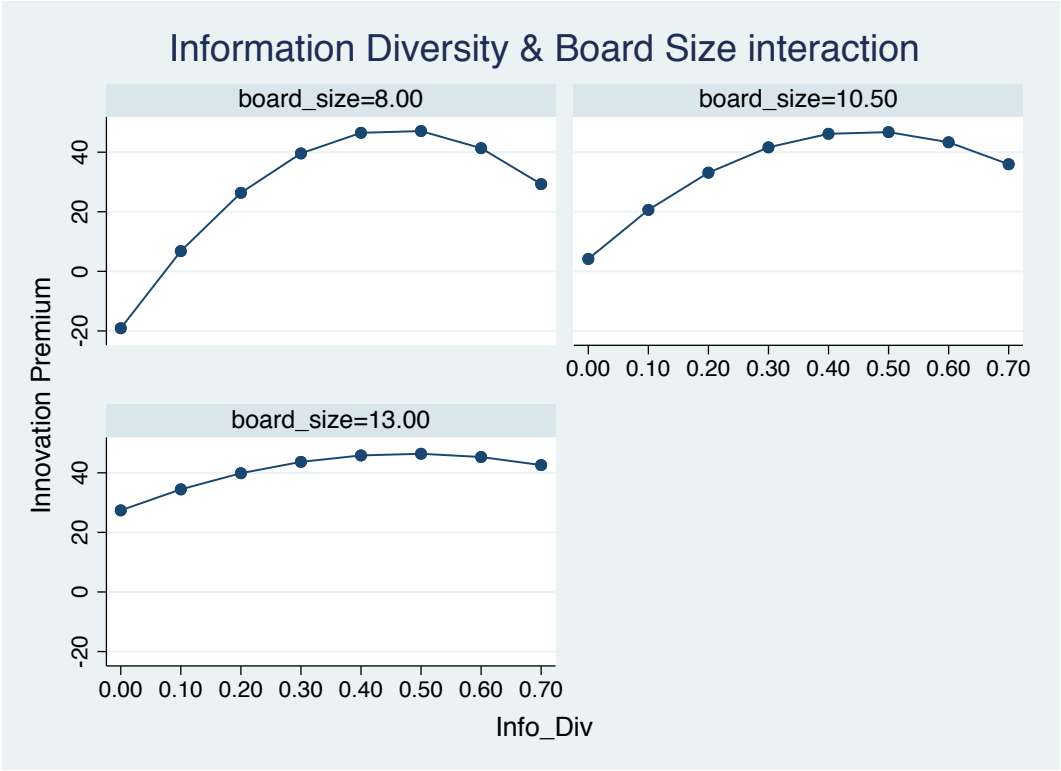


Model 2 : Graphical description at Mean and at +/-1 Std Deviation

7.5.2 Observation 6

Model 3, tests the moderating effect of board size on the curvilinear relationship between Information diversity and innovation and finds the effect to be significant. The interaction of board size with the second order of information diversity has a positive coefficient of 46.978 and a p

value of 0.002 . This observation **provides strong support to our Hypothesis 6** that the relationship of information diversity and firm innovation is stronger for smaller boards.



Model 3: Graphical description at Mean and at +/-1 Std Deviation

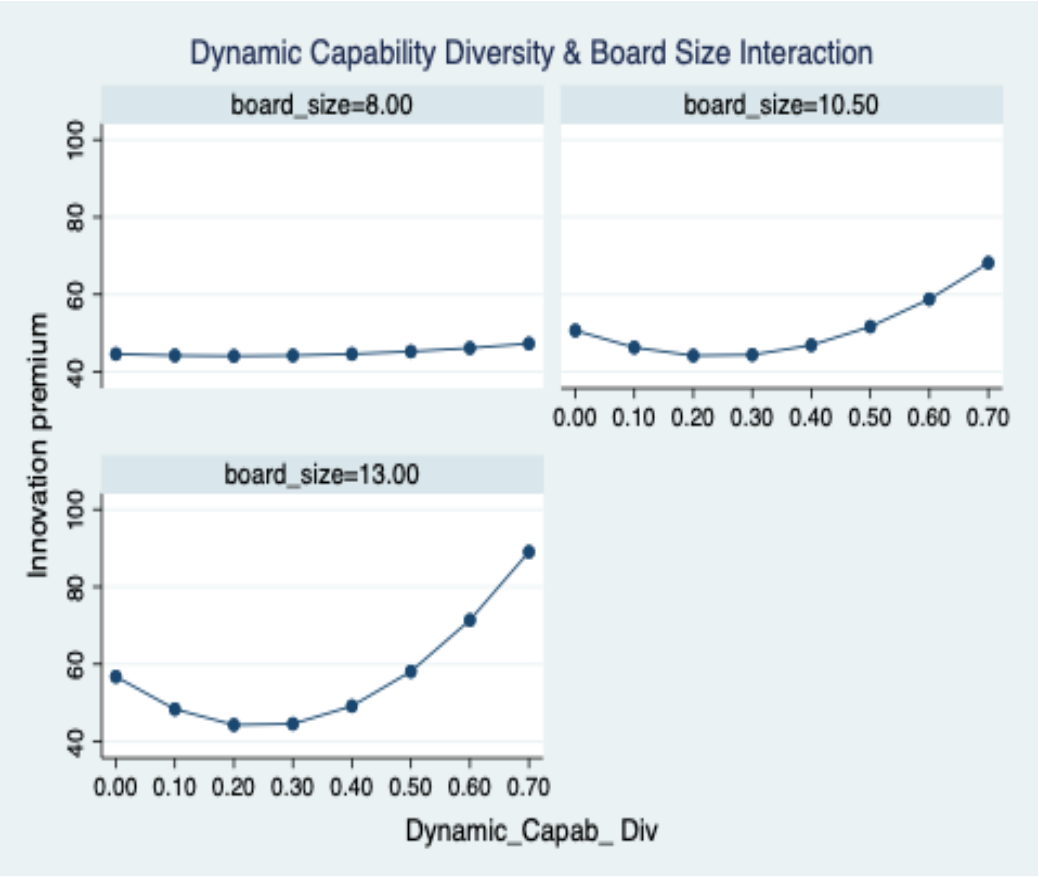
As we observe in the graphs above, the relationship effect of information diversity is much stronger when the board size is one or two standard deviations smaller than the mean board size in our sample (10.5). At the same time , we see that as the board size goes much bigger , i.e. one / two standard deviations larger than the mean, the shape of the relationship curve tends to flatten out. This is in line with our hypothesis

that when the board size in the firm is small , the firm generally struggles to deliver innovation because the cognitive quotient is on an overall basis impacted as its resource pool is small. In such small boards, as soon as we can improve the composition to reflect heterogeneity in terms of choosing members who are reflecting diversity of information due to their educational qualification , information networks and their educational institutional variety, the firm sees dramatic improvement in innovation outcomes as seen by the steepness of the curve. In large boards, the size itself contributes to providing variety of information sources and backgrounds (since the modern firm is no longer a “cookie cutter” club), the resource pool augmentation benefit from specifically choosing members who provide information diversity tends to get balanced out by the challenges of social integration and operational biases in larger boards and hence we see in very large boards the graph showing a flat outcome.

7.5.3 Observation 7

Model 4 tests the moderating effect of board size on the curvilinear relationship between dynamic capability diversity and innovation and finds the effect to be significant. The interaction of board size with the second order of dynamic capability diversity has a positive coefficient of 40.823 and a p value of 0.014 . This observation **provides strong**

support to our Hypothesis 7 that the relationship of dynamic capability diversity and firm innovation is stronger for larger boards.



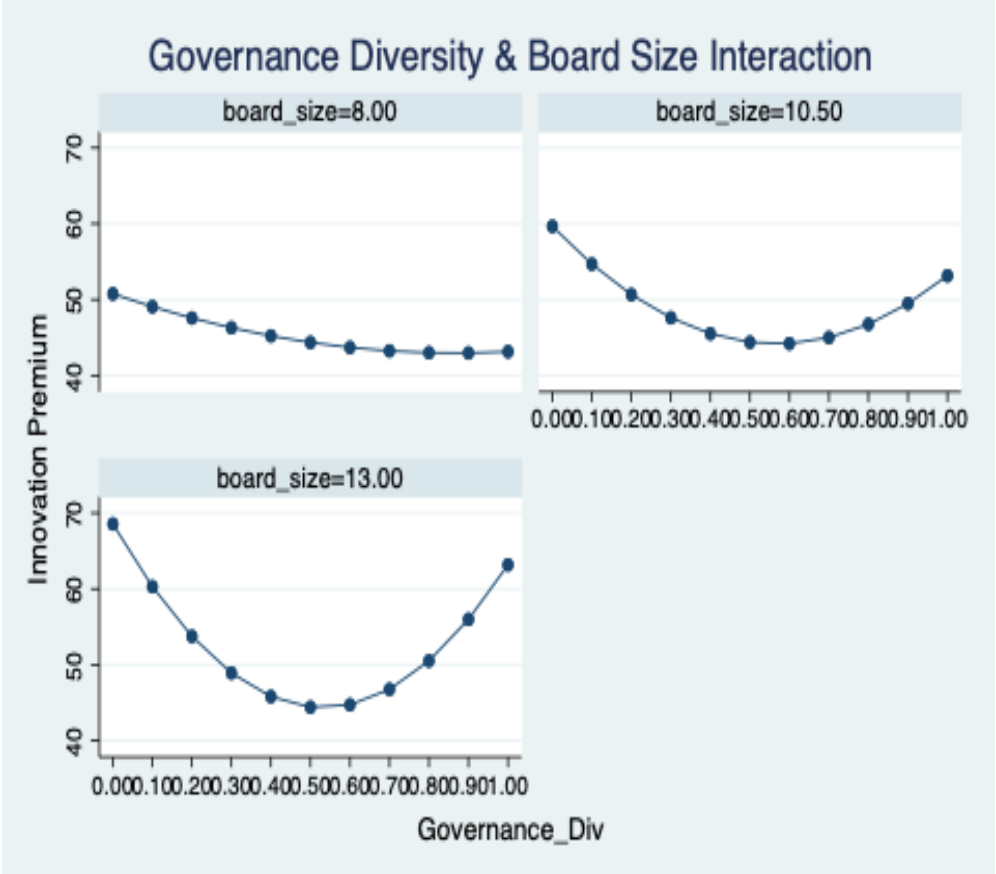
Model 4: Graphical description at Mean and at +/-1 Std Deviation

As we observe in the figure above, for smaller boards , the relationship of innovation and dynamic capability diversity is almost flat and for large board sizes (as seen for one SD and 2 SD away from the mean board size) , the U shaped curvilinear effect is well established. Larger boards are less risk averse and less agency-oriented than small boards where the personal risk perception of board members is high and that leads to

lower level of participation. Also most modern large boards are able to overcome challenges of coordination with well-organized committee structures which reduce the negative effects of social integration.

7.5.4 Observation 8

The model 5 tests the moderating effect of board size on the curvilinear relationship between governance experience diversity and innovation and finds the effect to be significant. The interaction of board size with the second order of governance diversity has a positive coefficient of 15.086 and a p value of 0.047. This observation **provides support to our Hypothesis 8** that the relationship of dynamic capability diversity and firm innovation is stronger for larger boards .



Model 5: Graphical description at Mean and at +/-1 Std Deviation

7.6 SUMMARY TABLE OF HYPOTHESIS VALIDATION

	Hypothesis	Outcome
1	**There is a curvilinear relationship between demographic diversity of the board and the firm's innovation and this should be reflected in a U shaped relationship**	Not Supported
2	**There is a curvilinear relationship between Dynamic capability diversity of the board and the firm's innovation, and this should be reflected in a U-shaped relationship**	Supported
3	**There is a curvilinear relationship between Information Diversity of the board and the firm's innovation and this should be reflected in an inverse U shaped relationship**	Supported
4	**There is a curvilinear relationship between governance experience diversity of the board and the firm's innovation in an U shaped relationship.**	Not Supported
5	**Board size will moderate the curvilinear relationship between Demographic diversity and innovation such that the relationship will be stronger in larger boards**	Not Supported
6	**Board size will moderate the curvilinear relationship between Information experience diversity and innovation such that the relationship will be stronger in smaller boards.**	Supported
7	**Board size will moderate the curvilinear relationship between Dynamic capability diversity and innovation such that the relationship will be stronger in larger boards.**	Supported

8	**Board size will moderate the curvilinear relationship between Governance Experience diversity and innovation such that the relationship will be stronger in larger boards.**	Supported

7.7 Additional Regressions and Observations-

7.7 a Geographic Analysis

While there has been a lot of attention from researchers on board diversity, most of the research, especially empirical efforts have been focused on the firms that are in the developed world. (Darmadi, 2011). This has largely been due to the higher quality of data and ease of data availability in the developed geographies. There has been prior academic effort which has indicated that diversity and heterogeneity effects are different across teams depending upon the geographic distribution (Kagzi & Guha, 2018). Some meta- analytic studies have shown that differences in regulatory environment, variances in policy frameworks and the differences in socio-cultural contexts lead to different outcomes. (Post & Byron, 2015). Different societies and differing environments have different outlook towards diversity. We therefore executed a set of regression analysis on the same models for different geographical dimensions (EMEA, North America, Asia, South Asia and LATAM). The results for the different geographies are enclosed in the following tables. The data for LATAM and South Asia cannot be effectively interpreted as the sample sizes are extremely

small. The residual data indicates that the information diversity and the dynamic capability diversity indicate the curvilinear relationship in Asia but the other main geographic clusters – North America and EMEA show no significant relationship with any of the diversity dimensions either direct or in second order. However, the North American firms show significant relationship between CEO duality and firm innovation. This clearly shows that in the American large firms, innovation is largely being led from the top and it is the confluence of decision making at the top of the organization that allows the board to operate with high degree of cohesion and reduced effects of social categorization. This could also be as a result of legitimacy enhancement of the board decisions and the effectiveness of signals with a clear direction to management (Galia, Zenou, & Ingham, 2015). However, we do want to observe caution on the interpretation of geographical results because the very small sample of the data as is reduced to only 60, 105 and 28 groups for EMEA, North America and Asia respectively.

EMEA

	(1)		(2)		(3)		(4)		(5)	
	premium		premium		premium		premium		premium	
demo_div	25.2	(32.58)	-156.5	(95.42)	29.3	(35.74)	39.0	(33.21)	21.5	(34.42)
c.demo_div#c.demo_div	-44.6	(45.08)	194.5	(120.89)	-52.1	(48.48)	-59.6	(45.70)	-40.4	(47.40)
info_div	104.8	(143.32)	159.1	(144.13)	482.3	(726.67)	135.4	(144.13)	121.6	(145.66)
c.info_div#c.info_div	-127.5	(147.99)	-185.2	(149.06)	-598.2	(765.50)	-162.0	(149.14)	-143.9	(150.24)
dynamic_capab_div	-89.4	(67.85)	-106.5	(67.35)	-80.7	(68.58)	542.3	(461.23)	-83.9	(68.69)
c.dynamic_capab_div#c.dynamic_capab_div	208.1	(139.56)	234.2*	(138.38)	196.9	(140.55)	-1224.2	(948.49)	197.4	(141.19)
governance_div	-95.8	(58.04)	-110.7*	(58.37)	-116.5*	(62.28)	-107.1*	(58.68)	77.3	(204.72)
c.governance_div#c.governance_div	95.0*	(54.31)	104.1*	(54.28)	113.9*	(57.96)	102.5*	(55.13)	-77.8	(203.54)
board_size	0.60	(0.78)	-5.04	(3.83)	5.75	(16.21)	6.05	(4.42)	4.41	(4.68)
ceo_duality	-3.15	(4.88)	0.74	(5.17)	-2.01	(5.06)	-3.65	(5.07)	-3.47	(4.95)
independentdirectors	3.32	(10.80)	5.51	(10.70)	3.02	(10.85)	4.98	(10.75)	4.89	(11.21)
revenue	0.00017**	(0.00)	0.00018**	(0.00)	0.00018**	(0.00)	0.00016*	(0.00)	0.00017*	(0.00)
firm_vintage	1.66***	(0.44)	1.82***	(0.45)	1.68***	(0.45)	1.76***	(0.45)	1.66***	(0.45)
c.demo_div#c.board_size			30.0*	(15.92)						
c.demo_div#c.demo_div#c.board_size			-36.9**	(17.81)						
c.info_div#c.board_size					-29.4	(67.11)				
c.info_div#c.info_div#c.board_size					37.1	(69.30)				
c.dynamic_capab_div#c.board_size							-57.4	(40.29)		
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size							134.0	(84.88)		
c.governance_div#c.board_size									-16.7	(19.08)
c.governance_div#c.governance_div#c.board_size									16.4	(18.56)
_cons	-60.4	(40.58)	-47.9	(46.34)	-126.2	(168.48)	-134.9*	(73.52)	-103.4	(65.30)
r2	0.34		0.37		0.35		0.36		0.34	
F	3.18		3.15		2.82		3.04		2.77	
sigma_u	87.5		94.9		88.1		92.2		87.1	
sigma_e	5.38		5.30		5.40		5.33		5.42	
rho	1.00		1.00		1.00		1.00		1.00	
p	0.00067		0.00046		0.0015		0.00068		0.0017	
N	155		155		155		155		155	
groups	60		60		60		60		60	
Standard errors in parentheses										
="* p<.10	** p<.05	*** p<.01"								

North America

	(1)		(2)		(3)		(4)		(5)	
	premium		premium		premium		premium		premium	
demo_div	-10.9	(28.60)	20.6	(189.57)	-8.39	(28.59)	-9.63	(28.55)	-14.3	(29.02)
c.demo_div#c.demo_div	1.07	(37.20)	-72.0	(209.65)	-0.81	(37.14)	-2.66	(37.18)	8.50	(37.64)
info_div	132.9	(87.62)	132.1	(87.89)	771.5	(475.85)	125.8	(87.63)	127.8	(88.22)
c.info_div#c.info_div	-132.5	(93.37)	-131.7	(93.66)	-850.2*	(500.33)	-125.2	(93.30)	-127.1	(93.92)
dynamic_capab_div	-25.5	(37.94)	-27.3	(38.53)	-32.7	(38.09)	157.1	(261.00)	-34.8	(38.18)
c.dynamic_capab_div#c.dynamic_capab_div	34.9	(66.21)	38.2	(67.00)	46.7	(66.45)	-364.0	(415.13)	45.1	(66.26)
governance_div	-43.6	(27.00)	-44.3	(27.14)	-46.0*	(27.02)	-41.9	(26.97)	40.5	(137.48)
c.governance_div#c.governance_div	32.9	(25.46)	34.6	(25.63)	34.8	(25.47)	30.1	(25.47)	-82.5	(119.52)
board_size	0.24	(0.49)	0.11	(5.96)	12.9	(10.61)	2.12	(3.78)	0.81	(4.74)
ceo_duality	3.77*	(1.95)	3.81*	(1.95)	4.02**	(1.95)	3.58*	(1.95)	3.73*	(1.96)
independentdirectors	4.57	(10.49)	3.45	(10.65)	7.94	(10.71)	4.97	(10.47)	0.17	(10.83)
revenue	0.000062	(0.00)	0.000061	(0.00)	0.000065	(0.00)	0.000041	(0.00)	0.000060	(0.00)
firm_vintage	0.93***	(0.26)	0.90***	(0.26)	0.93***	(0.26)	0.97***	(0.26)	0.87***	(0.26)
c.demo_div#c.board_size			-2.83	(25.30)						
c.demo_div#c.demo_div#c.board_size			6.98	(27.29)						
c.info_div#c.board_size					-60.5	(45.38)				
c.info_div#c.info_div#c.board_size					68.5	(47.72)				
c.dynamic_capab_div#c.board_size							-19.3	(25.26)		
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size							42.5	(40.92)		
c.governance_div#c.board_size									-8.92	(15.67)
c.governance_div#c.governance_div#c.board_size									12.4	(13.49)
_cons	-9.64	(24.26)	-6.96	(49.82)	-146.6	(113.24)	-26.9	(46.31)	-6.62	(42.60)
r2	0.19		0.19		0.20		0.20		0.20	
F	3.64		3.18		3.36		3.36		3.38	
sigma_u	42.5		41.4		42.6		43.4		40.4	
sigma_e	5.25		5.26		5.23		5.23		5.23	
rho	0.98		0.98		0.99		0.99		0.98	
p	0.000036		0.00010		0.000046		0.000046		0.000042	
N	320		320		320		320		320	
groups	105		105		105		105		105	
Standard errors in parentheses										
="* p<.10	** p<.05	*** p<.01"								

ASIA

	(1)		(2)		(3)		(4)		(5)	
	premium		premium		premium		premium		premium	
demo_div	-21.8	(54.38)	147.2	(157.10)	23.1	(57.19)	45.8	(66.81)	-21.0	(57.48)
c.demo_div#c.demo_div	90.3	(113.11)	-275.1	(323.94)	30.7	(113.79)	-21.6	(135.32)	89.2	(122.96)
info_div	283.0**	(122.98)	173.8	(163.37)	567.9*	(329.21)	639.5***	(202.33)	284.3**	(127.01)
c.info_div#c.info_div	-320.7**	(138.91)	-206.0	(178.75)	-496.7	(400.88)	-671.1***	(214.86)	-320.9**	(143.59)
dynamic_capab_div	-113.6*	(59.51)	-114.9*	(62.56)	-89.2	(59.89)	187.4	(213.95)	-116.7*	(64.08)
c.dynamic_capab_div#c.dynamic_capab_div	254.3*	(126.17)	282.6**	(133.72)	184.8	(129.01)	-158.8	(469.30)	261.5*	(137.71)
governance_div	31.4	(40.46)	13.9	(44.44)	27.5	(39.37)	37.7	(41.87)	57.7	(158.14)
c.governance_div#c.governance_div	-18.8	(45.55)	2.73	(49.82)	-19.3	(44.28)	-24.8	(45.82)	-46.0	(162.40)
board_size	1.20	(0.89)	3.18	(2.55)	5.70	(4.58)	5.13**	(2.06)	2.09	(5.46)
ceo_duality	-6.90	(4.49)	-6.68	(4.63)	-7.15	(4.64)	-5.52	(4.51)	-6.90	(4.61)
independentdirectors	0.029	(18.99)	3.56	(19.35)	-3.61	(19.12)	1.57	(19.11)	-0.22	(19.90)
revenue	-0.00058	(0.00)	-0.00076	(0.00)	-0.00075	(0.00)	0.00038	(0.00)	-0.00055	(0.00)
firm_vintage	-0.35	(0.82)	0.022	(0.93)	0.12	(0.85)	-0.57	(0.88)	-0.38	(0.86)
c.demo_div#c.board_size			-24.3	(22.31)						
c.demo_div#c.demo_div#c.board_size			50.6	(42.64)						
c.info_div#c.board_size					-11.5	(27.87)				
c.info_div#c.info_div#c.board_size					-3.61	(38.89)				
c.dynamic_capab_div#c.board_size							-33.6	(22.06)		
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size							37.4	(49.59)		
c.governance_div#c.board_size									-3.89	(22.73)
c.governance_div#c.governance_div#c.board_size									4.00	(22.88)
_cons	1.86	(30.57)	-1.17	(32.52)	-96.0	(74.60)	-109.3*	(60.69)	-3.34	(45.53)
r2	0.43		0.45		0.49		0.50		0.43	
F	2.22		1.99		2.32		2.41		1.82	
sigma_u	24.6		26.0		31.4		41.2		24.7	
sigma_e	4.68		4.72		4.55		4.51		4.81	
rho	0.97		0.97		0.98		0.99		0.96	
p	0.028		0.046		0.020		0.016		0.070	
N	79		79		79		79		79	
groups	28		28		28		28		28	
Standard errors in parentheses										
="* p<.10	** p<.05	*** p<.01"								

7.7 (b) Does Regulatory focus on diversity make a difference?

There has been regulatory focus across the world in terms of promoting diversity at the board and this has been driven by multiple rationales. There is the view that there exists a moral and social obligation of the board such that the ownership structure should reflect the emerging distribution and the heterogeneity of the society (Carver, 2002). There is the belief that firms have responsibilities beyond just the shareholder, and this wider stakeholder view proposes that the board and the firm are responsible to the community and the society as it is the broader society that gives the firms the right to exist and operate (Van der Welt & Ingley, 2003). Over the years, across many countries politicians and regulators have instituted quotas and / or guidelines for different types of criteria for board composition (Hillman A. , 2015). These include gender and racial

quotas, independent director quotas , small share-holder representation quotas etc. To understand whether these factors make a difference in the relationship of board diversities with firm innovation, we controlled for the countries that are having well defined regulations and guidelines to better understand the impact. The countries that we controlled for were:

Countries
Germany
Finland
Denmark
Netherlands
Sweden
Luxembourg

The results are in the following table.

Models for Regulatory Guided Countries

	(1)		(2)		(3)		(4)		(5)		(6)	
	premium		premium		premium		premium		premium		premium	
demo_div	304.3	(589.70)	1998.5	(2669.46)	633.8	(868.20)	305.0	(529.80)	519.1	(426.89)	3414.1**	(1240.79)
c.demo_div#c.demo_div	-379.9	(627.51)	-2556.9	(2826.71)	-779.1	(902.12)	-320.4	(564.79)	-561.6	(453.06)	-4070.8**	(1381.91)
info_div	-171.7	(418.03)	-169.3	(401.82)	-5679.4*	(3152.10)	-218.8	(364.82)	-354.1	(292.37)	7358.2	(4028.80)
c.info_div#c.info_div	203.5	(442.06)	194.5	(426.90)	5838.7*	(3285.05)	196.9	(385.33)	392.9	(308.13)	-7898.9*	(4142.98)
dynamic_capab_div	-434.1	(278.50)	-788.8**	(332.39)	-348.7	(274.41)	-6101.1*	(2913.73)	-849.2***	(214.09)	4896.8	(3478.39)
c.dynamic_capab_div#c.dynamic_capab_div	1021.3*	(548.59)	1778.8**	(675.72)	746.6	(559.59)	11252.0*	(5712.77)	1880.6***	(422.94)	-11225.1	(7050.24)
governance_div	-84.9	(193.75)	5.38	(216.57)	-131.1	(196.48)	168.1	(196.71)	2379.7**	(829.48)	1340.8	(760.14)
c.governance_div#c.governance_div	111.0	(174.84)	59.8	(188.38)	146.2	(174.36)	-67.1	(168.13)	-2576.6***	(787.27)	-1879.6**	(614.08)
board_size	0.98	(2.53)	37.6	(50.18)	-139.7	(79.16)	-56.0*	(27.77)	50.7**	(17.74)	315.5**	(129.29)
ceo_duality	0	(.)	0	(.)	0	(.)	0	(.)	0	(.)	0	(.)
independentdirectors	-2.14	(48.69)	6.23	(51.82)	12.8	(49.98)	-37.9	(44.68)	15.6	(34.38)	35.4	(24.81)
revenue	0.00021	(0.00)	0.000076	(0.00)	0.000096	(0.00)	0.00012	(0.00)	0.00011	(0.00)	-0.000081	(0.00)
firm_vintage	2.29	(1.66)	2.33	(1.60)	3.11	(2.03)	3.45**	(1.55)	3.21**	(1.21)	4.04**	(1.18)
c.demo_div#c.board_size			-198.9	(220.25)							-326.7**	(108.10)
c.demo_div#c.demo_div#c.board_size			247.0	(237.18)							392.8**	(123.62)
c.info_div#c.board_size					584.5*	(327.64)					-786.5	(439.97)
c.info_div#c.info_div#c.board_size					-597.0*	(336.02)					836.9	(448.69)
c.dynamic_capab_div#c.board_size							447.6*	(236.65)			-548.8	(308.63)
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size							-797.2	(464.84)			1261.3*	(639.66)
c.governance_div#c.board_size									-246.5***	(73.29)	-160.0**	(62.61)
c.governance_div#c.governance_div#c.board_size									269.9***	(72.57)	216.1***	(54.14)
board_size											0	(.)
board_size											0	(.)
board_size											0	(.)
_cons	-61.2	(172.94)	-353.1	(610.54)	1162.3	(721.13)	538.2	(361.46)	-579.1**	(210.73)	-3127.3**	(1235.60)
r2	0.58		0.66		0.66		0.72		0.83		0.97	
F	1.71		1.82		1.81		2.41		4.56		11.4	
sigma_u	126.9		124.4		172.2		200.6		167.8		250.8	
sigma_e	8.24		7.92		7.93		7.18		5.60		5.20	
rho	1.00		1.00		1.00		1.00		1.00		1.00	
p	0.16		0.15		0.15		0.061		0.0047		0.0015	
N	48		48		48		48		48		48	
groups	21		21		21		21		21		21	
Standard errors in parentheses												
="* p<.10	** p<.05	*** p<.01"										

These results moderately reflect the overall results of the analysis and support the hypothesis 3,6, and 8 , giving support to the curvilinear relationship of dynamic capability diversity with innovation and also supporting the moderating effect of board size interaction with information diversity and governance diversity. We do not wish to however base any significant analysis based on these results since the sample size was very small and included only 21 firms and 48 observations (less than 10 percent of our overall panel data).

7.7 (c) Sectoral Analysis

Another factor that could have an effect on the relationship of diversity elements and innovation is the industry sector. Firms go through strong phases of innovation depending upon the competition and also regulatory policies and macro trends which are reflective of the sector that they operate in. We used the GICS classification to first identify each firm into the 11 sectoral definitions as per S&P/ MSCI GICS categories. These are :

1. Energy
2. Materials
3. Industrials
4. Consumer Discretionary
5. Consumer Staples

6. Healthcare
7. IT
8. Communication
9. Real Estate

We further classified these into combined comprehensive categories :

1. Commodities/Industrials = Energy+ Materials+ Industrials+ Real Estate = 108 observations
2. Consumer= Consumer Discretionary + Consumer Staples = 242 observations
3. Health/Pharma = Health care = 106 observations
4. Technology = IT + Communication = 139 observations

Sectoral Analysis- Primary interaction

	-1		-2		-3		-4	
	premium		premium		premium		premium	
demo_div	22.3	-36.92	3.1	-17.58	70.1	-104.23	-76.4	-64.38
c.demo_div#c.demo_div	-5.57	-59.65	-13.9	-23.25	-169.5	-131.46	134.0*	-79.61
info_div	64.2	-142.41	-55.8	-69.46	376.6	-277.38	231.2	-156.27
c.info_div#c.info_div	-112.8	-155.76	49.5	-72.78	-346.7	-271.94	-221	-168.01
dynamic_capab_div	-98.1	-91.38	-15.8	-25.3	-117	-102.47	-210.7*	-126.56
c.dynamic_capab_div#c.dynamic_capab_div	186.8	-180.18	46.3	-55.82	195	-151.73	447.0*	-248.63
governance_div	85.3	-114.53	-48.2**	-22.77	-118.2	-96.63	-26.6	-43.99
c.governance_div#c.governance_div	-84.4	-99	46.7**	-20.68	110	-82.49	16.6	-47.76
board_size	-0.6	-0.74	-0.27	-0.35	1.38	-1.4	0.61	-1.01
ceo_duality	4.28	-6.67	0.31	-1.65	8.53*	-4.26	3.41	-4.32
independentdirectors	-18.6	-19.67	-4.83	-6.94	40.3*	-21.44	11.9	-14.96
revenue	0.0008	0	0.00014***	0	0.00011	0	-0.00037**	0
firm_vintage	1.32**	-0.65	1.39***	-0.19	0.69	-0.63	1.24**	-0.52
_cons	-40.7	-42.8	-4.23	-18.43	-77.9	-83.06	-22.2	-48.61
r2	0.29		0.44		0.31		0.29	
F	1.38		9.43		1.94		2.56	
sigma_u	70.7		64.7		28		37.4	
sigma_e	4.72		3.49		6.76		6.02	
rho	1		1		0.94		0.97	
p	0.21		3.50E-14		0.044		0.0052	
N	108		242		106		139	
groups								
Standard errors in parentheses								
="* p<.10	** p<.05	*** p<.01"						

The most notable observation from the results indicates that demographic diversity has a moderately significant curvilinear relationship with firm innovation for the Information technology sector. We see that the demographic diversity has no significance for innovation in other sectors or in the overall analysis.

The dawn of the internet and the new century has forced a view that modern digital technologies have blurred the boundaries between males and females and unlike the patriarchal nature of industrial technologies they have changed the locus from social hierarchy to knowledge, allowing the woman the ability to bring the female difference to the fore (Wajcman, 2007). The impact of age with respect to technology has to be viewed from the TPB (Theory of planned behaviour) (Morris & Venkatesh, 2000). As the psychological processes decline with increasing age, the ability to handle complex information and technology is negatively impacted, the performance on fluid intelligence task is reduced with age (Morris & Venkatesh, 2000) and thereby age is supposed to have a negative impact on use and attitude towards new technology. Therefore, when the board of directors has higher age diversity, the younger board members provide the stronger orientation, attitude and understanding of the strategic issues. Therefore, we believe that as a combined effect, the demographic diversity has a significance for technology sector.

7.7 d Sectoral analysis – Secondary interaction for each diversity and board size

We also proceeded to review the board size interaction with each of the diversity and innovation relationships for different sectors , to better understand whether the industry/ sector had specific differences in the core relationships.

Sectoral analysis on board size interaction with demographic diversity

	(1)		(2)		(3)		(4)	
	premium		premium		premium		premium	
demo_div	-87.7	(113.88)	-24.8	(61.83)	-443.6	(685.46)	-337.0*	(184.77)
c.demo_div#c.demo_div	140.5	(202.18)	-8.73	(80.20)	170.8	(803.70)	660.9**	(283.57)
board_size	-4.00	(3.87)	-1.88	(1.89)	-17.6	(16.26)	-1.64	(3.46)
c.demo_div#c.board_size	19.4	(18.28)	5.20	(8.29)	68.1	(75.86)	31.6	(20.34)
c.demo_div#c.demo_div#c.board_size	-25.3	(26.53)	-3.31	(9.54)	-52.2	(87.01)	-60.2*	(31.02)
info_div	123.6	(157.21)	-61.1	(69.86)	472.6*	(278.83)	227.7	(153.76)
c.info_div#c.info_div	-178.1	(172.47)	55.8	(73.25)	-441.2	(273.46)	-209.8	(165.40)
dynamic_capab_div	-138.7	(128.50)	-16.7	(25.36)	-140.8	(101.02)	-255.4**	(126.18)
c.dynamic_capab_div#c.dynamic_capab_div	236.0	(249.98)	51.5	(56.18)	233.4	(150.88)	532.5**	(247.71)
governance_div	89.6	(116.53)	-43.3*	(23.23)	-123.1	(96.06)	-33.2	(43.36)
c.governance_div#c.governance_div	-87.2	(100.71)	44.1**	(20.94)	120.3	(81.44)	21.5	(47.04)
board_size	0	(.)	0	(.)	0	(.)	0	(.)
ceo_duality	1.33	(7.60)	0.44	(1.67)	8.05*	(4.16)	3.43	(4.29)
independentdirectors	-11.7	(20.92)	-4.80	(7.15)	39.6*	(21.16)	26.5	(16.16)
revenue	0.00092	(0.00)	0.00014***	(0.00)	0.000047	(0.00)	-0.00027*	(0.00)
firm_vintage	1.20*	(0.68)	1.34***	(0.20)	0.95	(0.63)	1.17**	(0.52)
_cons	-28.6	(51.82)	8.66	(22.35)	44.6	(149.71)	-10.3	(56.03)
r2	0.31		0.45		0.37		0.33	
F	1.25		8.24		2.10		2.62	
sigma_u	65.9		62.4		34.6		37.1	
sigma_e	4.76		3.50		6.59		5.92	
rho	0.99		1.00		0.96		0.98	
p	0.28		1.8e-13		0.024		0.0030	
N	108		242		106		139	
groups								
Standard errors in parentheses								
="* p<.10	** p<.05	*** p<.01"						

Sectoral analysis of board size interaction with information diversity

	(1)		(2)		(3)		(4)	
	premium		premium		premium		premium	
demo_div	2.95	(35.76)	2.03	(17.63)	75.4	(104.93)	-10.1	(63.26)
c.demo_div#c.demo_div	14.5	(56.90)	-12.0	(23.32)	-173.8	(132.08)	49.9	(78.11)
info_div	722.1	(754.37)	-60.2	(189.55)	-1115.2	(1229.49)	1851.1***	(450.90)
c.info_div#c.info_div	-701.8	(856.77)	5.61	(209.87)	1209.5	(1275.75)	-2018.0***	(496.58)
board_size	14.8	(13.58)	-1.55	(3.28)	-35.7	(31.14)	34.2***	(9.16)
c.info_div#c.board_size	-58.9	(64.35)	0.95	(14.40)	157.2	(126.92)	-158.0***	(41.66)
c.info_div#c.info_div#c.board_size	50.4	(72.88)	3.14	(16.03)	-163.1	(130.44)	176.5***	(46.30)
dynamic_capab_div	207.6	(195.09)	-14.3	(25.40)	-163.5	(109.42)	-117.7	(124.77)
c.dynamic_capab_div#c.dynamic_capab_div	-374.8	(355.12)	42.0	(56.06)	256.1	(160.30)	260.2	(244.42)
governance_div	57.4	(110.80)	-45.9**	(22.89)	-43.7	(119.97)	-84.8*	(44.02)
c.governance_div#c.governance_div	-64.6	(95.33)	45.9**	(20.73)	53.5	(99.86)	73.4	(47.28)
board_size	0	(.)	0	(.)	0	(.)	0	(.)
ceo_duality	-2.49	(6.88)	0.35	(1.66)	8.19*	(4.36)	2.16	(4.04)
independentdirectors	-4.20	(19.90)	-5.92	(7.01)	38.5*	(21.71)	6.58	(14.19)
revenue	0.0014*	(0.00)	0.00015***	(0.00)	0.000091	(0.00)	-0.00031**	(0.00)
firm_vintage	1.00	(0.64)	1.37***	(0.19)	0.68	(0.64)	1.16**	(0.50)
_cons	-226.4	(168.07)	9.85	(44.17)	256.3	(293.44)	-372.2***	(105.12)
r2	0.39		0.45		0.33		0.40	
F	1.82		8.27		1.78		3.54	
sigma_u	59.0		63.8		27.8		39.2	
sigma_e	4.46		3.49		6.78		5.60	
rho	0.99		1.00		0.94		0.98	
p	0.064		1.6e-13		0.063		0.00012	
N	108		242		106		139	
groups								
Standard errors in parentheses								
="* p<.10	** p<.05	*** p<.01"						

Sectoral analysis of board size interaction with dynamic capability diversity

	(1)		(2)		(3)		(4)	
	premium		premium		premium		premium	
demo_div	21.8	(37.64)	3.12	(17.67)	51.3	(105.35)	-65.3	(63.88)
c.demo_div#c.demo_div	-8.55	(60.87)	-12.6	(23.41)	-136.4	(133.50)	120.6	(78.96)
info_div	91.6	(178.44)	-58.1	(70.12)	333.4	(278.70)	355.5**	(168.34)
c.info_div#c.info_div	-146.8	(194.49)	52.1	(73.39)	-313.8	(272.65)	-350.3*	(179.52)
dynamic_capab_div	155.5	(702.74)	-57.1	(131.05)	406.1	(505.14)	273.2	(269.09)
c.dynamic_capab_div#c.dynamic_capab_div	-166.1	(1417.55)	81.3	(264.83)	-742.6	(782.87)	-466.3	(520.11)
board_size	1.71	(5.30)	-1.02	(1.58)	7.00	(6.71)	6.28*	(3.19)
c.dynamic_capab_div#c.board_size	-14.6	(48.71)	4.02	(12.73)	-51.4	(46.12)	-54.9**	(27.05)
c.dynamic_capab_div#c.dynamic_capab_div#c.board_size	16.7	(104.73)	-3.48	(25.80)	94.1	(73.55)	103.4*	(52.23)
governance_div	87.2	(118.31)	-48.8**	(22.96)	-69.4	(102.53)	-45.9	(45.40)
c.governance_div#c.governance_div	-85.6	(101.69)	47.5**	(20.81)	65.1	(88.13)	37.4	(49.08)
board_size	0	(.)	0	(.)	0	(.)	0	(.)
ceo_duality	2.85	(7.46)	0.55	(1.70)	8.46*	(4.33)	3.60	(4.28)
independentdirectors	-18.7	(21.44)	-4.43	(7.03)	36.2	(22.06)	19.5	(15.28)
revenue	0.00074	(0.00)	0.00013***	(0.00)	0.00014	(0.00)	-0.00045***	(0.00)
firm_vintage	1.28*	(0.70)	1.38***	(0.20)	0.63	(0.65)	1.49***	(0.53)
_cons	-79.7	(98.27)	4.40	(24.35)	-129.5	(112.89)	-110.3*	(66.19)
r2	0.30		0.45		0.34		0.33	
F	1.19		8.15		1.83		2.55	
sigma_u	68.5		64.0		25.4		43.7	
sigma_e	4.80		3.50		6.75		5.94	
rho	1.00		1.00		0.93		0.98	
p	0.31		2.5e-13		0.054		0.0038	
N	108		242		106		139	
groups								
Standard errors in parentheses								
="* p<.10	** p<.05	*** p<.01"						

Sectoral Analysis of board size interaction with governance diversity

	(1)		(2)		(3)		(4)	
	premium		premium		premium		premium	
demo_div	24.3	(39.73)	-0.93	(17.87)	72.0	(104.59)	-87.2	(63.34)
c.demo_div#c.demo_div	-8.66	(64.40)	-11.3	(23.35)	-167.0	(132.03)	149.9*	(77.57)
info_div	65.5	(146.07)	-50.0	(69.58)	463.4	(285.70)	268.0*	(151.92)
c.info_div#c.info_div	-115.0	(160.18)	42.6	(72.94)	-425.7	(279.04)	-246.8	(162.63)
dynamic_capab_div	-92.9	(102.23)	-19.4	(25.53)	-134.9	(105.62)	-221.2*	(122.14)
c.dynamic_capab_div#c.dynamic_capab_div	177.4	(198.47)	55.4	(56.40)	216.1	(155.69)	458.2*	(239.63)
governance_div	137.6	(300.05)	44.1	(76.45)	-83.8	(524.07)	356.4**	(155.21)
c.governance_div#c.governance_div	-125.3	(283.40)	-28.7	(71.72)	-12.0	(473.78)	-431.8**	(167.77)
board_size	1.20	(7.61)	3.04	(2.43)	-4.60	(17.73)	8.05**	(4.00)
c.governance_div#c.board_size	-5.83	(29.67)	-11.4	(8.88)	5.28	(62.41)	-44.1**	(17.79)
c.governance_div#c.governance_div#c.board_size	4.58	(27.95)	9.49	(8.09)	6.21	(55.17)	51.6***	(18.98)
board_size	0	(.)	0	(.)	0	(.)	0	(.)
ceo_duality	3.34	(7.57)	0.36	(1.65)	10.2**	(4.45)	4.75	(4.19)
independentdirectors	-17.6	(20.49)	-5.14	(6.97)	44.2*	(22.10)	8.72	(15.21)
revenue	0.00077	(0.00)	0.00015***	(0.00)	0.000078	(0.00)	-0.00025*	(0.00)
firm_vintage	1.33*	(0.67)	1.37***	(0.20)	0.84	(0.65)	1.03**	(0.51)
_cons	-58.7	(83.78)	-29.4	(25.78)	-79.1	(162.20)	-87.4	(61.57)
r2	0.29		0.45		0.33		0.36	
F	1.15		8.31		1.80		2.95	
sigma_u	71.2		63.6		31.4		32.3	
sigma_e	4.82		3.49		6.77		5.80	
rho	1.00		1.00		0.96		0.97	
p	0.35		1.4e-13		0.060		0.00094	
N	108		242		106		139	
groups								
Standard errors in parentheses								
="* p<.10	** p<.05	*** p<.01"						

The second order- board size interactions also indicate that it is only the technology sector, where the moderating effect of the board size is significant across all diversity and board size interactions.

7.8 Inter diversity interaction:

We also reviewed the interaction effect of the various diversity elements (our independent variables) with each other. It was important to better understand the interactions given the multiplicity of various forces at play given the board dynamics and the complexity of the decision making.

7.8 a – Demographic Diversity Interactions with other diversities –

	(1)		(2)		(3)		(4)		(5)		(6)	
	premium		premium		premium		premium		premium		premium	
demo_div	3.07	(29.82)	-16.8	(99.61)	6.66	(15.57)	77.0	(62.06)	-22.2	(15.44)	20.9	(40.56)
info_div	1.35	(25.08)	0.63	(40.64)	-7.66	(8.12)	-8.31	(8.13)	-7.55	(8.12)	-7.89	(8.13)
c.demo_div#c.info_div	-22.1	(58.67)	-4.96	(208.45)								
dynamic_capab_div	-0.48	(8.71)	-0.54	(8.73)	19.9	(21.55)	63.4*	(38.40)	0.46	(8.67)	1.68	(8.73)
governance_div	-4.68	(5.05)	-4.81	(5.06)	-4.92	(5.04)	-4.91	(5.04)	-13.9	(10.46)	-3.20	(13.82)
board_size	0.22	(0.33)	0.25	(0.33)	0.24	(0.33)	0.23	(0.33)	0.21	(0.32)	0.28	(0.33)
ceo_duality	1.27	(1.52)	1.31	(1.53)	1.22	(1.52)	1.40	(1.52)	1.23	(1.52)	1.17	(1.52)
independentdirectors	-1.99	(6.00)	-1.95	(6.02)	-2.47	(6.01)	2.87	(6.01)	-1.90	(5.99)	-1.20	(6.02)
revenue	0.000092**	(0.00)	0.000092**	(0.00)	0.000097**	(0.00)	0.000086**	(0.00)	0.000091**	(0.00)	0.000092**	(0.00)
firm_vintage	1.07***	(0.19)	1.03***	(0.19)	1.05***	(0.19)	1.05***	(0.19)	1.05***	(0.19)	1.02***	(0.19)
c.demo_div#c.demo_div			34.4	(138.46)			-96.5	(81.99)			-80.6	(72.75)
c.demo_div#c.demo_div#c.info_div			-36.4	(284.61)								
c.demo_div#c.dynamic_capab_div					-51.9	(51.35)	-323.1	(202.80)				
c.demo_div#c.demo_div#c.dynamic_capab_div							376.5	(270.34)				
c.demo_div#c.governance_div									25.1	(25.17)	-68.1	(77.25)
c.demo_div#c.demo_div#c.governance_div											156.6	(124.15)
_cons	-1.88	(14.83)	1.46	(20.66)	-2.14	(9.75)	-12.8	(14.50)	8.31	(10.20)	4.72	(10.89)
r2	0.14		0.15		0.15		0.15		0.15		0.15	
F	6.32		5.29		6.43		5.55		6.42		5.48	
sigma_u	50.1		48.8		49.4		49.3		49.3		48.2	
sigma_e	5.35		5.36		5.35		5.35		5.35		5.35	
rho	0.99		0.99		0.99		0.99		0.99		0.99	
p	5.5e-09		0.000000029		3.7e-09		9.5e-09		3.7e-09		0.000000012	
N	595		595		595		595		595		595	
groups	209		209		209		209		209		209	
Standard errors in parentheses												
="* p<.10	** p<.05	*** p<.01"										

Model 1 Demographic Diversity * Information Diversity

Model 2 Demog Div * Demog Div* Info Div

Model 3 Demog Div * Dynamic capability Div

Model 4 Demog Div * Demog Div* Dynamic capability Div

Model 5	Demog Div* Governance Div
Model 6	Demog Div* Demog Div* Governance Diversity

Models 1-6 indicate that there is no interaction effect of demographic diversity with other diversities.

7.8 b Interaction of Dynamic capability diversity with other diversities

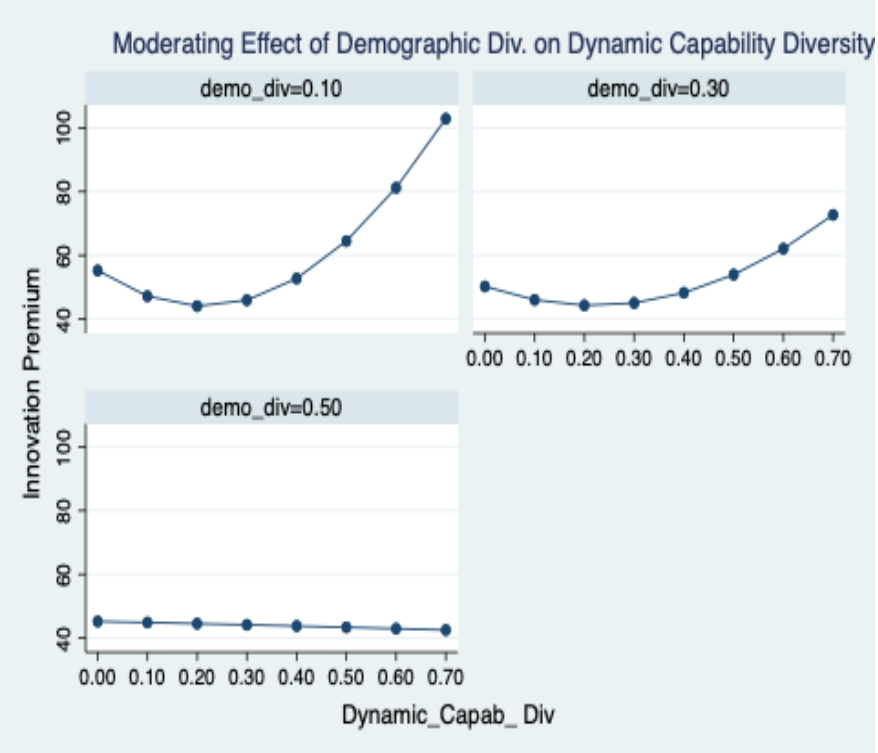
The results are as follows:

	(1) premium		(2) premium		(3) premium		(4) premium		(5) premium		(6) premium	
dynamic_capab_div	19.9	(21.55)	-130.9*	(72.90)	-33.6	(29.11)	-111.7	(79.75)	11.8	(24.00)	-104.1	(68.39)
demo_div	6.66	(15.57)	-25.1	(26.58)	-8.80	(5.87)	-7.76	(5.91)	-8.06	(5.84)	-7.46	(5.83)
c.dynamic_capab_div#c.demo_div	-51.9	(51.35)	255.2	(196.01)								
info_div	-7.66	(8.12)	-2.53	(8.33)	-26.6	(17.72)	-28.2	(22.79)	-8.18	(8.21)	-6.92	(8.31)
governance_div	-4.92	(5.04)	-4.50	(5.06)	-4.42	(5.04)	-5.31	(5.08)	0.55	(11.13)	-10.7	(15.12)
board_size	0.24	(0.33)	0.090	(0.33)	0.10	(0.34)	0.052	(0.34)	0.21	(0.32)	0.16	(0.32)
ceo_duality	1.22	(1.52)	1.79	(1.53)	1.47	(1.52)	1.79	(1.54)	1.26	(1.52)	1.73	(1.53)
independentdirectors	-2.47	(6.01)	-2.62	(5.97)	-2.00	(5.99)	-2.11	(5.99)	-2.15	(6.00)	-2.22	(5.98)
revenue	0.000097**	(0.00)	0.00010**	(0.00)	0.000085**	(0.00)	0.000087**	(0.00)	0.000092**	(0.00)	0.000089**	(0.00)
firm_vintage	1.05***	(0.19)	1.06***	(0.19)	1.12***	(0.19)	1.11***	(0.19)	1.07***	(0.19)	1.12***	(0.19)
c.dynamic_capab_div#c.dynamic_capab_div			310.0**	(139.34)			196.4	(174.36)			270.1*	(148.12)
c.dynamic_capab_div#c.dynamic_capab_div#c.demo_div			-621.5*	(366.07)								
c.dynamic_capab_div#c.info_div					71.2	(59.08)	178.4	(181.44)				
c.dynamic_capab_div#c.dynamic_capab_div#c.info_div							-291.9	(381.63)				
c.dynamic_capab_div#c.governance_div									-20.4	(38.29)	126.0	(124.76)
c.dynamic_capab_div#c.dynamic_capab_div#c.governance_div											-344.5	(260.42)
_cons	-2.14	(9.75)	11.1	(11.97)	9.96	(10.42)	14.2	(11.99)	-0.42	(10.32)	6.21	(11.14)
r2	0.15		0.16		0.15		0.15		0.14		0.16	
F	6.43		5.94		6.48		5.62		6.34		5.74	
sigma_u	49.4		49.6		52.3		51.8		50.4		52.0	
sigma_e	5.35		5.32		5.34		5.34		5.35		5.33	
rho	0.99		0.99		0.99		0.99		0.99		0.99	
p	3.7e-09		1.7e-09		3.1e-09		6.9e-09		5.1e-09		4.1e-09	
N	595		595		595		595		595		595	
groups	209		209		209		209		209		209	
Standard errors in parentheses												
="* p<.10	** p<.05	*** p<.01"										

Model 1	Dynamic capability Diversity * Demographic Diversity
Model 2	Dynamic capability Div * Dynamic capability Div* Demo Div
Model 3	Dynamic capability Div * Info Div

Model 4	Dynamic capability Div * Dynamic capability Div* Info Div
Model 5	Dynamic capability Div* Governance Div
Model 6	Dynamic capability Div*Dynamic capability Div* Governance Diversity

Models 1-6 indicate that there is no interaction effect of dynamic capability diversity with other diversities, except that demographic diversity has a significant moderating effect on the curvilinear relationship of dynamic capability diversity and firm innovation. This probably reflects the effect of social integration theory where in a higher demographic diversity leads to formation of groups (based on gender and age) and these groups cause strong biases in terms of views and opinions, reduce group participation, risk orientation and cognitive quotient, and also lead to poor harmony at the board leading to inefficient execution of board policies that would be driving the innovation on a positive curvilinear basis with increased dynamic capability diversity. Therefore, demographic diversity creates a reverse effect on the relationship of dynamic capability diversity with firm innovation.

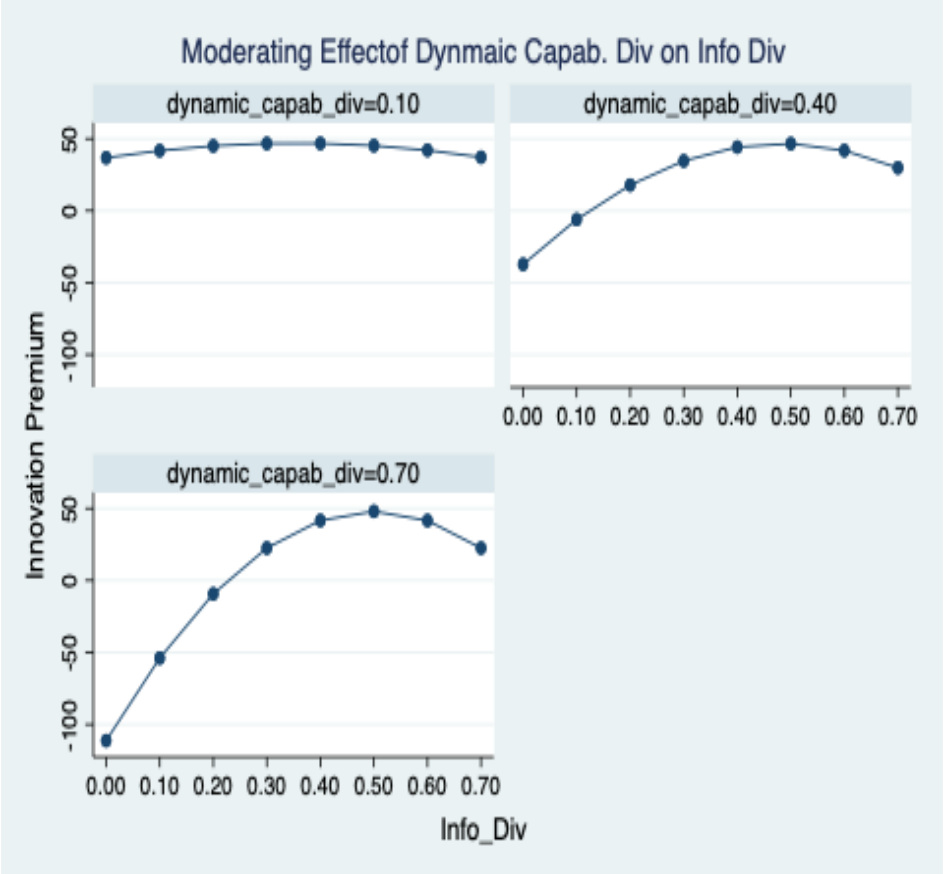


7.8 c Interaction of Information diversity with other diversities

	(1)		(2)		(3)		(4)		(5)		(6)	
	premium		premium		premium		premium		premium		premium	
info_div	1.35	(25.08)	-15.4	(123.38)	-26.6	(17.72)	-39.2	(80.17)	2.34	(23.58)	220.6	(144.89)
demo_div	3.07	(29.82)	-72.4	(71.46)	-8.80	(5.87)	-5.41	(5.85)	-7.85	(5.84)	-6.04	(5.88)
c.info_div#c.demo_div	-22.1	(58.67)	301.7	(313.25)								
dynamic_capab_div	-0.48	(8.71)	-2.71	(8.86)	-33.6	(29.11)	-246.7***	(74.69)	0.063	(8.67)	-5.61	(9.15)
governance_div	-4.68	(5.05)	-4.03	(5.08)	-4.42	(5.04)	-4.87	(4.98)	3.67	(19.41)	45.8	(52.45)
board_size	0.22	(0.33)	0.33	(0.34)	0.10	(0.34)	0.10	(0.34)	0.22	(0.33)	0.39	(0.33)
ceo_duality	1.27	(1.52)	0.86	(1.53)	1.47	(1.52)	1.41	(1.52)	1.32	(1.52)	0.84	(1.53)
independentdirectors	-1.99	(6.00)	-1.93	(6.00)	-2.00	(5.99)	-2.73	(5.89)	-1.77	(6.03)	-2.59	(6.03)
revenue	0.000092**	(0.00)	0.000093**	(0.00)	0.000085**	(0.00)	0.000085**	(0.00)	0.000092**	(0.00)	0.000092**	(0.00)
firm_vintage	1.07***	(0.19)	0.97***	(0.19)	1.12***	(0.19)	1.00***	(0.19)	1.07***	(0.19)	0.97***	(0.19)
c.info_div#c.info_div			13.4	(142.01)			11.4	(97.21)			-247.0	(163.49)
c.info_div#c.info_div#c.demo_div			-333.0	(350.12)								
c.info_div#c.dynamic_capab_div					71.2	(59.08)	966.1***	(332.12)				
c.info_div#c.info_div#c.dynamic_capab_div							-926.5**	(373.73)				
c.info_div#c.governance_div									-17.7	(39.50)	-230.8	(242.75)
c.info_div#c.info_div#c.governance_div											250.1	(274.80)
_cons	-1.88	(14.83)	6.69	(27.30)	9.96	(10.42)	19.0	(17.57)	-2.47	(14.31)	-43.3	(31.17)
r2	0.14		0.15		0.15		0.18		0.14		0.15	
F	6.32		5.70		6.48		6.79		6.33		5.70	
sigma_u	50.1		46.2		52.3		47.7		50.1		46.3	
sigma_e	5.35		5.33		5.34		5.26		5.35		5.33	
rho	0.99		0.99		0.99		0.99		0.99		0.99	
p	5.5e-09		4.9e-09		3.1e-09		4.3e-11		5.3e-09		4.9e-09	
N	595		595		595		595		595		595	
groups	209		209		209		209		209		209	
Standard errors in parentheses												
="* p<.10	** p<.05	*** p<.01"										

Model 1	Information Diversity * Demographic Diversity
Model 2	Info Div * Info Div * Demo Div
Model 3	Info Div * Dynamic capability Div
Model 4	Info Div * info Div* Dynamic capability Div
Model 5	Info Div* Governance Div
Model 6	Info Div* Info Div* Governance Diversity

The dynamic capability diversity moderates significantly the curvilinear relationship between information diversity and innovation.



7.8 d Interaction of Governance diversity with others

	(1)		(2)		(3)		(4)		(5)		(6)	
	premium		premium		premium		premium		premium		premium	
governance_div	-13.9	(10.46)	42.6	(39.96)	3.67	(19.41)	49.7	(67.99)	0.55	(11.13)	-32.1	(41.71)
demo_div	-22.2	(15.44)	20.5	(23.17)	-7.85	(5.84)	-6.96	(5.85)	-8.06	(5.84)	-7.65	(5.86)
c.governance_div#c.demo_div	25.1	(25.17)	-200.5**	(101.69)								
info_div	-7.55	(8.12)	-8.02	(8.08)	2.34	(23.58)	37.3	(35.18)	-8.18	(8.21)	-8.64	(8.21)
dynamic_capab_div	0.46	(8.67)	2.23	(8.65)	0.063	(8.67)	-0.24	(8.71)	11.8	(24.00)	12.3	(37.51)
board_size	0.21	(0.32)	0.29	(0.32)	0.22	(0.33)	0.21	(0.33)	0.21	(0.32)	0.23	(0.33)
ceo_duality	1.23	(1.52)	0.95	(1.52)	1.32	(1.52)	1.14	(1.52)	1.26	(1.52)	0.97	(1.53)
independentdirectors	-1.90	(5.99)	-1.12	(5.98)	-1.77	(6.03)	-0.38	(6.05)	-2.15	(6.00)	-1.46	(6.02)
revenue	0.000091**	(0.00)	0.000099**	(0.00)	0.000092**	(0.00)	0.000093**	(0.00)	0.000092**	(0.00)	0.000094**	(0.00)
firm_vintage	1.05***	(0.19)	0.98***	(0.19)	1.07***	(0.19)	1.03***	(0.19)	1.07***	(0.19)	1.05***	(0.19)
c.governance_div#c.governance_div			-65.1	(45.98)			-49.5	(74.20)			35.4	(43.56)
c.governance_div#c.governance_div#c.demo_div			243.7**	(112.05)								
c.governance_div#c.info_div					-17.7	(39.50)	-178.5	(139.58)				
c.governance_div#c.governance_div#c.info_div							167.7	(149.97)				
c.governance_div#c.dynamic_capab_div									-20.4	(38.29)	-7.13	(144.46)
c.governance_div#c.governance_div#c.dynamic_capab_div											-21.6	(148.93)
_cons	8.31	(10.20)	0.62	(11.58)	-2.47	(14.31)	-11.6	(18.69)	-0.42	(10.32)	6.62	(12.93)
r2	0.15		0.16		0.14		0.15		0.14		0.15	
F	6.42		5.93		6.33		5.62		6.34		5.50	
sigma_u	49.3		46.8		50.1		48.7		50.4		49.4	
sigma_e	5.35		5.32		5.35		5.34		5.35		5.35	
rho	0.99		0.99		0.99		0.99		0.99		0.99	
p	3.7e-09		1.8e-09		5.3e-09		6.9e-09		5.1e-09		0.000000012	
N	595		595		595		595		595		595	
groups	209		209		209		209		209		209	
Standard errors in parentheses												
="* p<.10	** p<.05	*** p<.01"										

Model 1 Gov Diversity * Demographic Diversity

Model 2 Gov Div * Gov Div * Demo Div

Model 3 Gov Div *Info Div

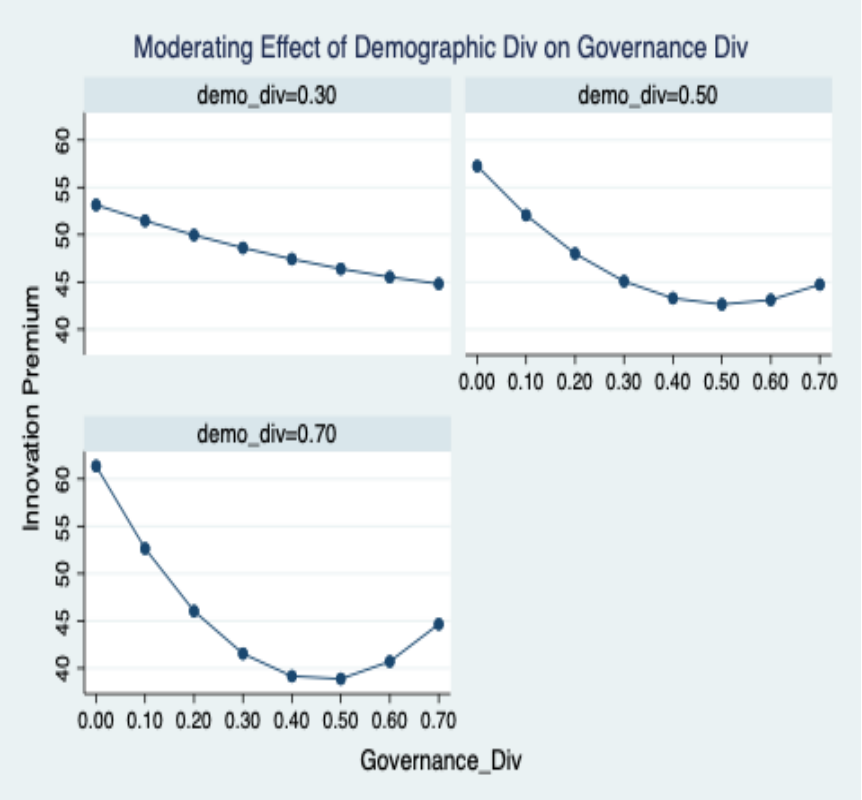
Model 4 Gov Div * Gov Div* Info Div

Model 5 Gov Div* Dynamic capability Div

Model 6 Gov Div* Gov Div* Dynamic capability Div

The demographic diversity has a moderating effect on the curvilinear relationship between governance diversity and innovation. Gender diversity specially has been shown to have a strong role in promoting improved corporate governance. It has also been seen that younger board members are more oriented towards environment and corporate social responsibility. The governance diversity has a U-shaped curvilinear relationship with firm innovation as we have seen from our earlier results (though not significant), but we see here that as the

demographic diversity of the board increases, the U-shaped relationship of the governance diversity finds statistical significance too.



SECTION 8 SUMMARY OF RESULTS AND THEORETICAL ANALYSIS

In our study we have looked at effect of board diversity on firm innovation. We have reviewed the nebulous construct of diversity not just through the lens of surface level and deep level diversity, but through the perspective of the combined experiences of the board members by introducing new constructs of Dynamic capability diversity, Information diversity and Governance diversity.

We looked at eight different hypothesis each one of which examined a different aspect of the relationship between a specific diversity element and firm innovation and we also explored the effect of a key moderator i.e. board size, on the relationship.

Our results tend to support the theoretical understanding that there is a strong basis for board composition as a precursor to firm innovation. They also support the thinking that the board interactions and effects are multi-faceted and complex and that these involve theories which overlap behavioral science, political science and social science. The U shaped and inverse U- shaped relationships also give support to the fact that the boards diversity operates through multiple mechanisms while impacting firm innovation. They demonstrate that diversity of the board reflects a strong resource-based perspective by providing cognitive inputs to the management process. The results also reflect that board diversity also

provides a strong support to the agency-based perspective which is based on the need to control and direct the management in line with the shareholder requirement and that boards operate at times beyond the shareholder view to encapsulate the stakeholder perspective. Our results also indicate that the board diversity also operates through the lens of social integration and social identification and board members' groups and biases reflect in their decisions and hence impact firm innovation.

The results support the resource based, cognition based, multiplicity view and heterogeneity-based perspective of group dynamics, problem solving, creativity and board functioning. It supports the view that a high level of homogeneity in the views and perspectives of board members could lead to reduced level of board-enquiry and that could result in idiosyncratic decisions causing reduction in firm innovation (Bernile, Bhagwat, & Yonker, 2018). The results also support the arguments based on the information perspective which as per the demographic literature show that the heterogeneity of a team has a negative effect because of the dysfunctional biases and poor communication in a board. We are clearly able to see the differing and opposing effects of cognitive resource-based perspective AND the social integration and communication-based issues arising from the diversity and heterogeneity. We are also able to show that these effects while generally opposing in nature, are driven in their intensity (and hence the

differences in shapes and slopes of the U), by the core underlying nature of the specific diversity.

8.1 Key Insights

8.1.1 One of the most significant outcomes of our research is the **introduction of the underlying diversity in the form of Dynamic capability view of diversity** at the level of Board of directors of a firm. It is the unique experiences of the board members that reflect their dynamic capabilities and hence the dynamic capabilities of the board of directors in terms of being able to reconfigure, align, allocate, resources available to the firm in order to create innovation outcomes. It extends the thinking of the Resource based view of diversity (which focuses on the access and availability of special and different types of resources), and postulates that it is these Dynamic capabilities to reconfigure and realign that are more critical than just access and availability of the resources. This research then goes on to define these through the lens of leadership, entrepreneurship and academic exposure and then not only provides empirical support to the existence of this important new relationship, but also provides support to the existence of the curvilinear (U) shape of the relationship.

8.1.2 Another significant outcome of this research is the **introduction of the underlying diversity in the form of Information Diversity at the board of directors.** The information diversity is based on the resource based view but provides a uniquely different compositional

dimension to the factors that drive the cognitive vector by not focusing on the traditional functional backgrounds or experiential backgrounds of board members but by laying the emphasis on the information and thinking capability construct driven by heterogeneity of education level, the variety of educational institutional backgrounds and the width of networks of board members. Once again this research successfully demonstrates the strength to our view that the individual members bring the cognitive strength of their "informational experiences", which operate in the board environment that allows the individuals to operate with natural and group biases, and thereby these have a curvilinear (Inverse U) relationship with firm innovation.

8.1.3 Quite surprisingly, our results do not support the arguments that differences in views and perspectives based on surface-level heterogeneity drivers, like gender and age (demographic diversity) should have a bearing on firm innovation. While there have been many studies that have been conducted on gender and surface level diversities, it is also true that studies have been unable to establish a clear relationship between firm performance and gender diversity. The lack of support for our hypothesis could be because the potential differences arising from surface level diversity of gender and age may not reflect itself, as the members providing such diversity would want to avoid conflict based on such issues, and would like to behave like the majority so as to disprove the tokenism and affirmative action label. The results of the study also fail to provide support to the relevance of

governance diversity of board members within and across firms. This could be because the board members especially in large global firms would be having exposure to board processes due to their previous executive roles, and also because the regulatory oversight requirements could be standardizing the board experiences. Hence diversity of such experiences may not be contributing to cognitive and reflective capabilities.

8.1.4 The other key finding of the study was the strong effect of the moderating role of the size of the board in terms of the relationship between board diversities and firm innovation. The study indicates support to the views that the right approach to analyse the effects of board diversity on firm outcomes like innovation should take a contingency-view, and therefore such results should also be evaluated with respect to organizational contingent parameters (Zona , Zattoni, & Minichilli, 2013). In our study the key contingency factor was the size of the board, and the results show that larger boards magnify the effect of dynamic capability diversity and the effect of governance diversity on innovation. It also shows that smaller boards magnify the effect of the information diversity on firm innovation. This particular aspect of our study further enriches the body of recent research efforts that focus on the moderating effects on team diversity (Bell et al 2011) and extends the efforts of studying the moderating effects of firm size for board diversity (Zona , Zattoni, & Minichilli, 2013).

8.1.5 Interaction effects of diversities: Our results also indicate that it is important that each of the board diversities should not be looked at in isolation in terms of their relationship with firm innovation and that combined presence of certain types of diversities can have a significant bearing on the individual diversity and firm innovation relationship. It was therefore pertinent to examine the interaction effects of the two key board diversities in our study- Dynamic capability diversity and the Information diversity.

8.2 Strong supplementary effect of dynamic capability diversity on the relationship between information diversity and firm innovation.

Our results clearly demonstrate that when firms have low levels of dynamic capability diversity, the information diversity and firm innovation relationship is largely flat and the expected curvilinear relationship opportunities tends to be lost, but when the dynamic capability diversity of the firm becomes stronger, the information diversity and firm innovation relationship tends to become much more effectively defined as shown in section 7.8c. This clearly indicates that firms that have strong information diversity can enhance or negate the beneficial implications of the information diversity and firm innovation relationship by ignoring the dynamic capability diversity of its board members.

SECTION 9 ANALYSIS OF OVERALL RESULTS WITH RESPECT TO INSIGHTS FROM CEO INTERVIEWS

It is quite interesting to note that while there is unanimity amongst the board members with respect to the key importance and high weightage expectation of the "monitoring role" , the board members in general did indicate that innovation is a key part of the "strategy" role for the board members.

Board members do believe that there is merit to the overarching concept of diversity at the board. However in line with the multiplicity of definitions of diversity in the academic world, the board members/ CEOs also had widely differing definitions and understanding of diversity, with some having a generic view focused on gender/race , some focused on cognition and a few who looked at diversity in terms of the "differential experiences and thinking" .

CEO/BOD QUOTES- SUPPORT FOR HYPOTHESIS / OBSERVATIONS

Key Quotes	Underlying Concept	Hypothesis positive/negative
1."Don't care about where you came from and what you look but important is what you know", 2.a. "A South Asian origin, Western Passport, Woman, in her early forties, PhD, was added to board- Got the person with right skills matrix who was also a woman" 2 b. "Traditionally ethnicity and gender was first pillar of choice but now Skills matrix is first supported by gender/ethnicity" 2c." Personally I have not felt different because I am a woman. Looking for diversity of experiences and knowledge and not just gender diversity" (Quote by a women Board Member) 3." Diversity of thought is important to get different Points of View on the table" 4. "No direct correlation between board size and innovation but through governance process that becomes difficult"	Information diversity Demographic/ gender diversity Resource based view	This observation provides support to the RBV view and to the hypothesis regarding relationship of information diversity & firm innovation. The focus is on the multiple sources of information and knowledge. These observations support the observations that demographic diversity does not have a significant relationship with firm innovation. Difference of thought , view and experiences are key , and they may come from gender, but the core issue is differences of thinking/ perspective from knowledge and experiences and capabilities. This observation provides support to the RBV view and to the hypothesis regarding relationship of information diversity & firm innovation. Supports view that Board size should have a moderating effect and not direct effect on innovation

Cognitive diversity was clearly seen as positive for the board effectiveness and for fostering information. Practitioner view was that boards with diverse backgrounds lead to improved engagement with management, better monitoring of management, and also makes boards analyse problems from multiple perspectives. Board members also indicated that they do believe that at times the discussions and debates do lose focus because of multiplicity of views and while that does get resolved generally to arrive at consensus solutions, valuable resources and time does get wasted in the process of arriving at this consensus. This is generally in line with our results (H2).

Board members felt that softer skills of forging alliances, building consensus, aligning risk and reward scenarios, and the ability to pivot and extend strategies are important skills. Board members indicated that special experiences like high technology, deep academic research are generally positive for board knowledge and firm innovation. They also had the view that deep specialist expertise/ research expertise on board also led to reduction in level of debate as board tends to respect and accept “specialist” view rather than challenge it. Board members had strong positive views that support the dynamic capability view of diversity wherein they felt that board members with prior CEO leadership experience, entrepreneurial experience enhanced risk taking capability of the board to drive innovation. These observations give partial support to our validated hypothesis H3.

Key Quotes	Underlying Concept	Hypothesis positive/negative
5." Board members with similar backgrounds hangout together, encourage groupism and become counterproductive , raise same points"	Information diversity is reduced, diminishes POV in debate, reduces innovation	Provides support to the social identity theory and supports the curvilinear nature of the relationship between information diversity and firm innovation.
6 a. "You cannot supervise yourself, thereby if you can't ask right tough questions , there is impact on innovation .But we have examples of both types succeeding" b. " Never take a guy who has just been CEO and make him Chairman"	CEO Duality and its effect on innovation	The organizations potentially manage the agency risk of duality by segregating the task of CEO and Chairman and at the same time single leadership improves communication and decision making (Boyd 1995). Supports the fact that CEO duality is an important control factor for our analysis.
7. "I just bring a perspective that is different- , unique combination of banking, Venture investor and academic."	Dynamic Capability View- Entrepreneurial(venture) , Academic experiences .	Provides support that Dynamic capability experiences as per our hypothesis have an impact on firm innovation.

Board members generally felt that having multiple board experiences is beneficial as members can cross-pollinate best practices and share networks (largely anecdotal observations). Board members generally believed that vintage on board is not a critical issue as it is the cognitive value that drives the input and analysis .They however indicated an inverse U relationship (with anecdotal observations of 3 terms , i.e. 9 years as optimum) with observations that beyond three terms, the board members then tend to protect their position and reduce their monitoring role and risk role. This observation is only partially in line with our hypothesis (H4).

Most interestingly, all board members indicated that gender (demographic) diversity allows the board to function with broader perspectives and improve overall team participation and engagement.

They all felt that while such benefits of diversity are important, however the cognitive capability element has to be priority in selection. From their perspective demography is positive as a supportive condition while cognitive aspect is the necessary condition. Even more interestingly, the women directors on our panel tended to see themselves as “non-gender” representatives who are there only on the basis of their “cognitive” or “special” experiences. This is partially in sync with our observation of the moderating effect of demographic diversity on dynamic capabilities. We believe that this relationship has interesting ramifications for gender-based board regulatory policies and this will have to be explored in more detail with larger data sets and a deeper empirical focus on this aspect alone.

Key Quotes	Underlying Concept	Hypothesis positive/negative
8 “The person who is the domain / subject matter expert, tends to drive more of the conversation, and views and opinions get more weightage- “Who know the area better”	Information Diversity	Provides support to our hypothesis wrt the curvilinear relationship of information diversity and innovation. Subject matter expertise provides specialist view and better analysis (positive) but also reduces debate (negative).
9. “One person ticks more than one box- international diversity, global experience AND female !!!”	Demographic diversity	Demographic diversity by itself is not seen as key driver but as support , as our observations are showing.
10. “Diversity is not just about gender or race.. It is about diversity of thinking and diversity of knowledge/ information and connectivity –e.g. public policy”	Information diversity / networking	Provides support to our hypothesis that diversity of information and networking has key relationship with firm innovation.
11. Entrepreneurs have different capacity to take risk, willingness to take a shot goes up viz a viz people who have always been in a secure job environment, and this willingness and appetite for risk taking is a key attribute for innovation.	Entrepreneurship / Dynamic Capability View	Provides support that Dynamic capability experiences (Entrepreneurship component) as per our hypothesis have an impact on firm innovation
12. “CEO presence is helpful as they understand the context of the issues “	Leadership/ Dynamic Capability View	Provides support that Dynamic capability experiences (Leadership component) as per our hypothesis have an impact on firm
13. Have a Board member with PhD but also has entrepreneurial and VC experience. Difficult to break up individual effect but his combined effect is excellent’	Dynamic capability View	Provides support that Dynamic capability experiences across multiple components as per our hypothesis have an impact on firm innovation.

With respect to the moderating effect of board size, the view among the interviewed board members was that a moderate board size of around 10 members was optimal, and board size moderating effects would depend upon the nature of the challenges being faced by the board and the nature of board composition. This observation gives strong validation to our moderating role hypothesis.

Key Quotes	Underlying Concept	Hypothesis positive/negative
14.a. Duality is a challenge to innovation if board sees role as corporate policeman, and it is positive if board sees role as value creation . 14 b. Management is normally vested into all proposal it makes to board and in case of differences, duality opens ground for discussion and allows multiple POV even though efficiency and speed of decision/ execution is other way around"	CEO Duality	The organizations potentially manage the agency risk of duality by segregating the task of CEO and Chairman and at the same time single leadership improves communication and decision making (Boyd 1995). Supports the fact that CEO duality is an important control factor for our analysis

In relation to control factors, the interviewed panel was largely in strong agreement on reflecting their opposition to the concept of CEO-duality. They felt that CEO duality reduces level of debate, has a negative effect on monitoring and hence affects performance and innovation. Only in rare anecdotal instances wherein the dual-role performing executive is a uniquely skilled individual, does the concentration of power lead to high risk taking, faster and effective resource allocation, supported by effective management execution to bring about innovative organizational success.

SECTION 10 MANAGERIAL IMPLICATIONS

The observations from this study can help us further improve the understanding of the influence of the characteristics of board members on the innovative performance of the firm and hence can have interesting managerial implications.

10.1 Our empirical results are suggesting that firms should endeavour to build a board that comprises of members that provide it a higher level of dynamic capability diversity and of information diversity. It is important therefore for firms to invite people who have strong dynamic capability oriented experiences i.e. founders and entrepreneurs, leaders and CEOs and academics and researchers to join their board. They should also ensure that the board is not an “old school” club, and board members must provide backgrounds across multiple educational institutions and provide different levels of educational experiences and identify board members who have strong external networks.

10.2 However, it is very critical that firms must keep the U shaped curvilinear relationships and the contingency view in mind and should try and optimize their operational diversities – dynamic capability diversity and informational diversity in that context rather than simply increasing their diversity elements.

10.3 It is also important that firms should keep the board size as a key operating variable given the important moderating role of the board size as demonstrated by this research and forms should manage the size of the board depending upon their dynamic capability diversity and their information diversity and their ongoing innovation objectives.

10.4 We also see empirically that it is important that the firm must look at the inter-relationships of the different diversity elements. So while demographic diversity may not have a key primary effect on firm innovation, but for firms that have high elements of dynamic capability diversity, firms should keep a low level on demographic diversity to maximize the innovation opportunity because for large demographic diversity, the dynamic capability diversity relationship with firm innovation tends to be flat in nature.

10.5 Our research also provides some empirical evidence that there are certain complimentary interactions possible between the presence of different types of diversities . For example, we see the significant interplay of the moderating effect of demographic diversity on dynamic capability diversity and governance diversity.

Therefore, it is vital to understand that there we need to consider the different types of diversities at the board to comprehend the effect of

board composition on firm innovation AND that the board should be composed in a manner that encapsulates the fact that a change in one particular characteristic and diversity could and will in all probability necessitate reviewing many other board characteristics.

SECTION 11 IMPLICATIONS FOR RESEARCH

Our findings have several implications for research. One such implication is related to the perspective on gender and demographic diversity. There has been influential research that has indicated in the past that “in spite of the popularity of demographic heterogeneity as a topic there is little consensus about how it affects performance”. Our research supports a review and adjustment to the gender and demographic diversity (of the board of directors) relationship with firm innovation (and thereby firm performance). Furthermore, given that many prior studies of such relationship have been based on cross sectional analysis, our results implore a deeper look at the issue of gender and demographic diversity which is currently gaining popular traction due to its political dimension.

There have been many studies that built linkage between diversity of cognitive knowledge and innovation capability but these generally overlooked the value of the “intangible assets” of a firm (Teece, Pisano, & Shuen, Dynamic capabilities and strategic management, 1997) (Ostergaard, Timmermans, & Kristinsson, 2011). Our research is bringing to focus these intangible assets, i.e. the “dynamic capabilities”, specifically with respect to the board of directors and introduces the importance of the diversity of dynamic capabilities of the board in driving innovation. This relationship needs to be explored further to provide solid validation.

SECTION 12 LIMITATIONS OF THE STUDY AND DIRECTIONS FOR FUTURE RESEARCH

While our study gives some interesting insights and strong empirical support for a complex issue such as board diversity, it does leave certain interesting questions unanswered.

One of the issues with our study is that is has been limited to large multi-national firms and so it does not allow the results to be generalized across a large cross-section of firms. It would enhance our confidence in the robustness of our results if we could extend this study to medium-sized firms.

Also, while we did a set of extended interviews with global CEOs to validate some of the key underlying effects and the causal relationships of the effects of the diversity constructs that we have identified, we believe that a few intensive organizational case studies by embedding with the boards may be required to inform us of the processes that are involved in the board interactions.

We have used the approach of aggregation of diversity elements to define our diversity constructs. However, there is lack of consensus on the best way to look at the issue of compositional elements. We have considered each dimension to carry equal weight, while the impact of the individual elements could be different in strength.

While we have taken into account many factors that define heterogeneity of the board and characteristics of the board and the firm, we have not taken into consideration the specific issues of personal incentives which could have an effect on the level and quality of individual board member participation in board decision making and hence on firm innovation. In addition we have not factored in the longevity of the CEO and of the board chairman, both of which could have potential effect on board dynamics. We would appreciate if this study is extended to better understand this impact.

SECTION 13: CONCLUSIONS

This research has examined the complexity and dynamic nature of the diversity of the firm's board of directors and its ability to achieve innovation. Our research examined the issue of board diversity beyond the traditional approach of surface level and deep level diversity and has introduced the concepts of dynamic capability diversity and information diversity of the board.

The theoretical development and the empirical evidence in this research provide evidence through its findings that the dynamic capability diversity and the information diversity of the board of directors have a significant relationship with firm innovation. This research also examined the two opposing effects of diversity namely the positive effect of the resource/ multiple-perspective view and the negative effect of the Social identity led view. The research thereby goes on to provide evidence of the curvilinear nature of these diversity and innovation relationships.

The findings of this research also provide support to the moderating role of the size of the board of directors on these relationships. In addition the research also demonstrates that the interactions of these board diversities amongst each other, play a key role in determining the nature of diversity-innovation relationships.

The research findings contribute to improving the understanding of the effect of board composition from a firm innovation perspective and provide insights on diversity interactions.

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ANNEXURES:

Annexure 1: Hypothesis validation- Observations from external interview

Annexure 2: Observation from 9 CEO/Board member interviews

Annexure 3: Interview Transcript (Sample).

Annexure 4: **FORBES LIST OF COMPANIES ON WMI – 2011-2018**

Annexure 1

Hypothesis validation : One external in depth interview

Key Observations from Interview 1

1. Board's key role is to choose management, monitor management and do resource allocation.
2. Difference in experiences for BMs is vital.
3. Discussions happen more at committee level than at Board level.
4. Social engagement amongst board members helps to build trust. Trust helps to get sharing of views
5. Key attributes in selection of BMs- Skills, Stature, Chemistry and style of working
6. Same background/ Known people – Lopsided discussions
7. Relative Power of board members and also viz management matters. "Asian Board members avoid conflict"
8. Differences in backgrounds cause conflict- PE vs Govt background. But same is not the best.

9. Gender is important but not at cost of quality
10. Large boards – less ideas as reduced participation, lower quality of discussion
11. Small Boards – Not enough experiences, views. So, there is a diminishing return of size
12. International exposure is good for diversity/innovation-multicultural approach
13. Entrepreneurship is useful (Though limited)
14. CEO Duality – inhibits innovation "Jamie Dimon is an exception"
15. Diversity of boards is more useful for large companies.

Annexure 2

Summary of Validation Interviews post analysis

1. Many board members/ CEOs observed that the role of the board is generally to monitor the management (in line with the agency theory), and at the same time also provide key strategic inputs on opportunities and challenges. Boards do see themselves as having excessive regulatory oversight and so they see meeting the regulatory objectives and risk objectives as primary and driving innovation as a next level objective as subset of strategic direction and financial resource allocation.
2. Key issue is to be able to clearly identify role of TMT and role of board and reduce overlap.
3. Boards generally encourage risk taking by the management and support getting different points of view from the management to

be able to debate. Boards do not appreciate unitary recommendations by management.

4. The board should not just reflect variety in skills (that is more a requirement for having specialists in TMT), still the variety and heterogeneity in functional experience is useful at the board , largely to ensure that key areas like risk, finance , technology, customer experience etc. are well understood by the board as a unit.
5. Boards look to compile for themselves broad expertise of skills, institutional knowledge, professional networks and business/industry relevant expertise.

6. Board engagement is dependent on the intra group chemistry of the board. That has a big impact on board member participation. Groupism on board is prevalent but

   Board members in general understand the importance of engaging with each other. However, they do seek social/ experiential support when they give opinions so as not be seen as “dramatically divergent”. Consensus is the preferred way. Largely driven by self-protection.
7. Boards tend to generally agree with their own subject matter expert. That tends to reduce the quality of debate on an issue.
8. Progressive CEOs focus on building social engagement amongst board members. X functional teams on boards helps to get sharing of views and build intra-member trust.

9. Asian board members tend to avoid disruptive conversations and engage with Chairman/ CEO on sidelines for controversial/ divergent views.
10. Small boards have excellent discussions, but their limited knowledge makes them seek external advisory views and they become restricted and limited by those.
11. Larger boards are operationally dysfunctional, have "unnecessary participative debate" driven by 'desire to be seen as contributing to discussion", and cause unnecessary delays in decision making. Moderate board size- 10-11 is considered as most optimal.
12. Friendly nominations are negative catalyst to board discussions as they promote group think and reduce debate on the issue with quick group alignment votes.
13. CEO Duality is generally a hinderance to POV (points of view on the board) and leads to "ineffective review of management strategy".
14. Specialized skills are becoming more important, especially in technology led companies.
15. Racial issues are relevant to a minimal extent and that too maybe in the US. Gender is more seen as a "good to have/ ought to have", but the focus is on getting the "person" with the right skills, experience and capabilities.
16. Conflict is not seen as good, but difference of opinion is welcomed.

17. Differences in backgrounds cause conflict- PE vs Govt background. The risk vs innovation, short term vs long term view become evident in such conversations. These are welcomed in the boards.
18. Old boys club is still largely personal connection club, though no longer boys only. Association with CEO is a big issue on quality of analysis and quality of debate.
19. Entrepreneurship is a great experience to have. Lessons from failure are critical. But this trend is not yet well represented in boards.
20. Some boards have 360-degree view on each other. That promotes transparency and improves dialogue.

Annexure 3.

Transcript of In depth interview

Ajay Makhija Hi XXXX, Good morning, thank you so much for doing the session. I really appreciate your time. I know it's difficult to get time with people like you. Thank you so much for this. Just to give it a recap of the conversation that we had and the personal document that you signed. This is really intended towards having a discussion to get your views around the topic of my research, which I'm doing for my PhD program at SMU. My research area is focused on understanding the relationship between diversity of a board in a public limited company and how it has a relationship with innovation in an organization both being hot topics today. So, I'm just trying to gather experiences of people who have been on boards and you have multiple such experiences. So, let me begin by just asking you- How do you as a board member, look at the board's process and board's thought process on looking at the critical factor of innovation for an organization?

Board member 1 Well, I think, you know, in general, what you do is the epicentre of innovation and new things, you know, or even running day to day. It's about management first of all. So, the most important thing is to make sure that you have the right management team in place, because as a board member, you can you know, be provocative in terms of questions and, you know, you can ask for benchmark. You can look at new trends. But at the end of the day, I think the most important thing the board's going to do is to make sure that

a. you have the right management in place and

b. You focus the discussion, at least at some frequency, because, you know, there is a lot of routine stuff to cover in board meetings and you know most board members are very busy people.

So, you just have to consciously kind of walk a few sessions a year where this is the topic and you don't have anything else that crowds out. You know, this approval, that approval and particularly since I'm in financial services, there's lots of compliance stuff that comes up. Right. So, having the right management and then creating the space, which forces the discussion is the best way to do it? I mean, you got to remember, board is not management and board cannot micromanage. And if it is doing that, then you don't have the right people in place.

Ajay: So, I agree with that. So, as a board member, your one job is to make sure that the right people in the management, but also that you focus a conversation which is with the management in terms of setting objectives and processes around that. So, when you set those processes, how do you as a as a team of board members, which may be ranging from what 8-10-12- fifteen. Right. I'm guessing on that level. How does that decision-making process go about? How do you look at this?

Board member 1: You start with the objective? I mean, then you have a plan that you want to achieve for the next day / year and that has financial elements to it. And then it has various other elements to it. Customer service, cost management this that and another. And you therefore basically work on, you know, you when you have a strategic plan discussion, for instance, you ask what's going to drive? You know, you don't just you know, what technology will you bring that will improve the customer experience? What is it that is going to drive increased cross-sell. So, what is it that's going to drive better scoring of credit applicant? So, you have a whole bunch of objectives. And within that, then you essentially look at management and say Ok, what is it that's going to drive you to make it happen? And sometimes we wouldn't get some people from outside like a consulting firm or somebody who does a report, which is more genetic and then you try to adapt it. But I keep repeating myself, which is that it is at least the boards I've been part of do not spend incredible amounts of time playing to think it for themselves, they come with their background. If you have a sufficiently, you know, board with different experiences like for example, in one of the boards and we have a guy who used to be very senior at Cognizant and doesn't have a financial background but he comes with a lot of technology background, you know, so people will then react to things that management is talking about. But each of these has to be driven by what key objectives for the firm. So, for instance, in customer service, you want to you know, you see that you are lagging behind others or do

you feel that you can, you know, increase your level of engagement with the customer? And ABC ways. So, you just focus on those and say how are we going to do this? I mean, in credit card business in India, you know, we had a whole bunch of issues associated with how the call centres were dealing with the routine stuff. Right. So, using bots and using self-dealing stuff, doing proactive messaging, etc. you dealt with 70 percent of that stuff went away. And then you do what, you know, left the people for doing good stuff.

Ajay Makhija So let me let me focus your thoughts on that. How did these decisions on choosing these bots or these solutions?

Board member 1 I think our job was to make sure that they got the budget on. First of all, we challenged them for it and then we make sure that we give them the resources forward. We made sure that, you know, they did not fudge between operating expenses and investment expenses. So, this was sort of monitored separately and we tracked it.

Ajay Makhija: So, when this proposal comes to you that you want to invest in something. And this is a significant investment with a certain pay out. And with the certain pay back in terms of the customer experience or other financial opportunity, like you mentioned in bigger credit scoring. All right. So, in this discussion is happening at the board, not that's really the resource allocation part that you are doing. And that is setting the agenda for innovation for the organization. So, when you do that in those debates, in those conversations, how do the different views emerge? How do you look at that? How do you look at the board composition impacting those discussions and how do those decisions get taken? Is there any value? Is it any specific process or is it engagement? How does it go about?

Board Member 1: Every board is different, I guess. So, I don't think that is one standard thing we can apply to everybody, and obviously the discussion that emerges is based on a couple of factors. One is the composition of the board- who comes and with what experiences, and that makes a difference. The second is what are the structure? Very often the boards have committee structures, correct. So, you may have well, in our technology steering committee or you may have whatever. So very often a lot of that discussion happens in those committees as the boards typically don't meet for very long. Right. And there's a long list of things to go on. So, typically those happen through specific committees where, you know, if you are running the thing properly, you want to do it with the right kinds of experiences relevant to that area. So you may have somebody from technology, you may have somebody with people or a HR background you may have an accounting person. So, it depends on the different types of committees. The problem you're trying to solve, but I don't think there is one we don't have at least I haven't seen on all the boards had been that we'd have a structured process that works everywhere.

Ajay Makhija It cannot be it cannot be a one-size-fits-all. So, when you have people with different experience and so now there's a lot of talk around, you know, these experiences give different levels of engagement during the subcommittee meetings or during the full board meetings. But in those conversations, have you come across situations where there is collusion of thought in one or two directions. And then there is differences of opinion. And how do those differences operate? Are there other issues beyond just simple direct skill? experiences? Other things which

are involved in the engagement of groups different interests do you see across those situations competing interests, other thoughts, which are there?

Board member 1 Everyone can not inherently stand on where they sit ...know where what their background is, what constituency, who they are representing. Sometimes you will have representatives of the promoters, some of them who will have independent directors who are friends with the promoters. Sometimes you may have somebody from a previous management. So, it is there will always be different views. Depends on the culture you create in the board discussions. Very often it is quite you know, it can be quite direct that two three people who are strong. Maybe one person usually and everyone kind of gives an opinion, but it doesn't necessarily push doesn't want to prolong the discussion. That's whether there are other boards where people encourage this engagement and that is back and forth. And people ask, why don't you go in and check what happened here? So, it depends not just on whether people come with different backgrounds, but also the comfort with each other. If it is a very formal one of people don't know each other. If you don't create social engagement between the people cetera, then it is one of those things you show up at, attend, then you'll say a few things, you know, then they will do what they want to do. They don't really care so much. But if there's good engagement, if people are you know, they can of trust each other. And so, they did feel free to give their views. Then it comes. And to me, that is even more important than having diversity of thought.

Ajay Makhija So interesting couple of points that you raise, let me take deeper with you on that. So, when you say that there is engagement, people know each other, there is comfort. Right. So how what defines, what drives this comfort? Is it coming from previously knowing each other? Is it coming from working together in a group? Is it coming from gender?

Board member 1: The tone that the Chairman sets and how often the chairman basically seeks to pull information, I think that's number one. Number two would also depend on how the board has been constituted. There are different ways to construe boards. And, you know, if it's been done in the way that you keep in mind the overall dynamics and interest. And the third thing is whether you will consciously work to some efforts around bringing the team together even in informal situations. So, having some sort of offsite with the directors, well, once in a year, doing the strategy plan around that and to let people engage both at the social level. In addition to coming to the board meeting, spending a few hours and leaving

Ajay Makhija So interesting point to me is about, how the board is constructed. So, give me your thoughts on how it is constructed. Your experiences.

Board member 1: Well, the challenge with constructing boards is that, you know, that particularly in public companies, you don't have the ability to change the board where you step in when at the point in time you can just change it because, you know, that is a good thing, because otherwise there would be no independence at all. And you could just fill it up with your cronies. Right. But on the other hand, who inherited this stuff? So, you know, you can only make incremental decisions. So, you

look at you look at, you know, the first question is that what are you looking for in a board? Sometimes you want someone who has strong technical skills in a particular area. You certainly want people with stature so that when they speak, you know, others will listen. So, you kind of look at that. You then look at how they have worked in their life, at the operating style, you know what people who work with them say about that. Number four, you meet them and see if chemistry works, because at the end of the day, you may have all of that, but the chemistry may not work. And then I think it's important for the management CEO to be comfortable with the board with the person you're bringing in.

Ajay Makhija So when you look at these facets, do you find sometimes boards being heavy on certain areas on. But then what happens with those decisions?

Board member 1 issue Is that they recruit people that they know from their own background, therefore they get lopsided. And, you know, clearly then, you know, decision making gets lopsided. You focus on the same thing. You think alike, less likely that you will come up with a different way of approaching a problem.

Ajay Makhija: And all these, in your view, do that really at the board level at least some impact on the decision making in innovation? Or is it that even if it happens, the management really need to do what they have to?

Board member 1: Depends on the relative power of the individuals involved

There are some managements which will have a rubber stamp of a board. You can make it as diverse as you want. But if the CEO is, you know, very powerful and, you know, those typically end up badly, extremely powerful CEOs who have been there for a long time. Don't listen to anyone, going anywhere. I mean, that maybe one or two examples where they did, but sooner or later they go kaput. So, it all, you know, contextually, therefore, just having diversity is not enough. Allowing diversity to have a say is more important in my view. So, in particularly Asian boards, I think it's incredibly important that the people, you know, generally people want to await conflict. Board is one of those positions when you kind of think of yourself as an advisor or whatever. And so, people do not want to engage in over 70 percent of the time, or they don't get into conflict. So, if the culture doesn't allow for a discussion and if, you know, there are strong personalities and they do not provide enough encouragement for it, that's a problem.

Ajay Makhija So you also mentioned something about trust. Right.
So, do you see diversity helping in trust formation or how is the relationship between diversity and trust and innovation exist in your in your experience?

Board member 1 You know it, but inevitably you'll have to put a little bit more effort to build connection if there is a lot of diversity. If you have known people from extremely different background, you've got somebody just as an example from the government, then you'll get somebody from hard judging private sector. It is you know, people come with preconceived notions. Right. So, it is it I'm not saying it's going to

be big issue. When I have seen this, for example, I have seen in SBI Card Board, but it takes effort. People who have views, you know, I I'm from private equity and people will think of me as someone who wants to maximize profits in the short term. And B, when you know, they will come and say, we are looking at the long term and we have to think of social this and all. And so, there is a level of suspicion around diversity and it is incumbent on the people to gain trust and that takes time. Now, if everybody on the board had some private equity background, then, you know, if you have that emotion, then you trust them, work with, in terms of, you know, his interests versus my interests. But you speak the same language in that sense. So, on the surface, therefore, if you have people who are similar, it might be easier to build trust. But it kind of masks your ability or it inhibits your ability to be better because there was the three of you doing/thinking the same way doesn't necessarily mean that you are doing better.

Ajay Makhija So among other things that we really look at on this topic is this whole thing around regulatory engagement in monitoring how boards should be constituting on certain affirmative action and things related to that. What are your thoughts and experiences on that?

Board member 1 [00:17:46] I think that was probably, you know, look, ideally you would want it to happen naturally. But I think there is some benefit. Enforcing it at least until it becomes natural. You know, that is most often people you know, the most easy way to do this is gender, because other areas are there was not that visible. Can we have some of them aren't that visible. And I think it's a fact that most boards are

men. So, for people to therefore say that, you know, it doesn't make a difference, it's hard to tell because you haven't tried it. And I think that there is value in forcing it up to a point. No, it should not become forever. And hopefully over time, this will become less and necessary. But the natural tendency for people is to reach out to the people they know they're comfortable with. And so I have no problem in having some level of affirmative action. I wouldn't call it a forced one, where people go to look not for a weaker candidate, but, force them to look for good candidates and that there are good candidates, just that you have to make the effort.

Ajay Makhija [00:19:01] So when then these boards interact, you know, they have a complex decision to make. You are now that there is divergence of views. There is also the overall culture, the management process, all these things combined together are there. And it's not a unitary process. It's not a standardized standard operating procedure. All right. But now, from your own experience, when you look at board, which are small and board which are large, do you find any differences in the way these boards operate? vis-a-vis the outlook towards issues of diversity and innovation.

Board member 1 [00:19:47] Size of the board makes a difference towards how the board will operate. Looking at these things, well, by definition if the board is large, then it becomes less participatory. Right. Because if there are 40, 50 people sitting in a room, it's very different from a nine people sitting. And so, all other things being equal. Of course, large boards can be participative and small boards can be dictatorial. But, you know, all things being equal, I think, you know, there is an optimal size, if not too small a board, then, you know, basically it

becomes difficult. I think you'll need enough experience which comes from different backgrounds. So, in my view, depending on different things. So I went around 7to10 is a good number, anything beyond 12-13 with diminishing returns.

Ajay Makhija And that's an interesting view. Also, let me also ask your thoughts on diversity of experience. You say diversity of perspectives. You mentioned technology. So that's one area. But generally, what are the experiences that you think in the modern world are relevant where you say, okay, I would like to have a board which would probably have diversity on the following factors. So, what does the idea look?

Board member 1: Clearly, one is international versus being local on some level of exposure to different markets.

Ajay Makhija So that's work experience. It's not education. You're talking of work-related experience?

Board member 1 Well, I think in a general sense, human living experience globally vs living in the same place for ever, I think it makes a difference in.

Ajay Makhija How do you think that?

Board member 1 Because you will experience different cultures. You experience different ways of doing things. You experience being

different vs. being part of the same team. So, I think that having a broader world view is helpful. Obviously, in experience and further because you see best practice in their best practices. Yeah, so. And someone is therefore Geographic sort of exposure. The second is like, for instance, we had, you know, we are invested in the life insurance company. So, distribution is important, too. So, if you can find people from consumer areas, from web marketing areas, it was kind of areas where they build distribution in unrelated products, they can provide some benefit around those experiences. I think that that is helpful. Sometimes having someone who can help you if, you know, particularly in financial services, which I do, and one of the most important constituency is the government. Right. So, having someone on the board who can help provide a perspective of what our government might think about an issue or an issue has come up. What's the best way to deal with that? I think that is helpful. So, you have to be thoughtful about it. Maybe after somebody who's got an audit kind of an experience so that when you are looking at issues in audit committee, you have the right expertise there. And they said, you know, from a business point of view, someone who brings a different perspective on how to service customers rather than just someone who has been in the same industry geographic experience. And I think gender also should matter.

Ajay Makhija [00:23:28] So in the modern world, in the recent world of “start-ups” and entrepreneurship, what's your view about having entrepreneurs on boards of large firms?
Is it a relevant experience? Is it a useful experience? How do you see?

Board member 1 I don't have enough data to sort of speculate. What I what I might say would be speculative. I think that, you know, when you bring the entrepreneur on a very large board, that entrepreneur has reached a level of scale which is already sort of he's operating in the big company environment to some extent. It it's not likely that, you know, some start-up, but then people will. And unless you have some prior experience when he was part of something bigger. Yes. That entrepreneurial piece is not going to in a small context, just starting that is not going to propel someone into the board of a large company. Barring you know, family relationships and all that sort of. I think just bringing one entrepreneur on the board. I'm not sure it can change the culture. I'm not sure it'll change. I mean, look, unless the person is the chairman or whatever and has lot more authority, I don't think just bringing in one who can be challenging, and you can ask to look at things. You know, why is it necessary? Why have you always done like this, etc.? I don't know.

Ajay Makhija So you've got to work this thing around the chairman and the piece a few times. Right. And I'm sure it must be a critical factor. So let me ask you views on things like what in the academic world is CEO duality so Chairman /CEO being the same?

Board member 1 I don't like that idea.

Ajay Makhija And how did the foster/ engage the board process? and innovation ?

Board member 1 [00:25:40] I think it inhibits checks and balances. And honestly, I think that is a lot to be said about having some level of checks and. Because the CEO is also the chairman. It becomes, you know, it's harder to have open discussion about issues in the company and not because he controls the agenda. So, I'm not a strong proponent. I know that some you know, Jamie Dimon and all of these people have been successful or not. But I have seen in my experience, that is a recipe for high risk and not necessarily good for the company because no one to challenge. So, you know, you're just depending on that one individual and only reason to do it is not because it's the better way, but because you have a powerful person. So that is a role created for a powerful person other than what is best for the company. Good to see you can find the agenda any way without being the chairman. CEO can come and has the authority So for him to be the chairman also – What's the point. I don't see any substantial reason why that should be except that he is too big. And you know, he will not abide by another person who is a chair.

Ajay Makhija OK, so last question before I I'm impinging on your time and I'm coming to the end of my requested time is between large and small company. Since you have a lot on the boards of large company and you're also through your private equity experience, you're on the board of a small company. How do you see the role of the board in the context of diversity of the board? Right. Driving the future innovation of the company. Different, if in any way.

Board member 1: You know, look, I think when a company is really small, the focus has to be on details. So, I don't know if you can afford a lot of diversity in many small companies. I mean, you have perhaps you

don't people will anyway come from different experiences. And I think it become a lot more important as you become bigger because it is easy to fall into group think. You know what I wouldn't do even when the kind of management you have in small companies, I call it line of sight management. You'll have executives who basically want to touch and feel everything. And the board should be not exactly the same, but, have that same mentality. Whereas in a large company it's about empowerment. It's about the structure, the processes. So, I don't know that we're sitting in the huge factor differentiating between big and large. But if I had to choose, I would say that larger companies get more out of diversity because it's easier to fall into groupthink. You are successful. You are big. You have all your friends on the board. So, you'd better be better off with people who are more different, and you can afford it.

Ajay Makhija Thank you. Thank you for your time. Appreciate.

Annexure 4

FORBES LIST OF COMPANIES ON WMI – 2011-2018

		2018		2017		2016		2015		2014		2013		2012		2011
Compar	Country		Name	Premium	Name	Premium	Name	Premium	Name	Premium	Name	Premium	Name	Pemium	Name	Premium
1	ServiceNow	89.22	1 Service Now	82.46	1 Tesla	82.40	1 Tesla	84.8	1 Salesforce	75.9	1 Salesforce	72.8	1 Salesforce	73	1 Salesforce	75.1
2	Workday	82.84	2 Tesla	78.43	2 Salesforce	75.52	2 Salesforce	77.8	2 Alexion Pharmaceuticals	71.4	2 Alexion Pharmaceuticals	72.3	2 Alexion	72.3	2 Amazon	58.9
3	Salesforce.com	82.27	3 Amazon	72.78	3 Regeneron	72.85	3 Alexion Pharmaceuticals	72.5	3 ARM	65.6	3 VMware	63.7	3 Amazon	58.3	3 Intuitive	57.6
4	Tesla	78.27	4 Shanghai RAAS	71.72	4 Incyte	70.81	4 Regeneron Pharmaceuticals	72.1	4 Unilever	65.1	4 Regeneron	63.1	4 Redhat	58.1	4 Tencent	52.3
5	Amazon.com	77.40	5 Netflix	71.54	5 Alexion pharmaceuticals	69.95	5 Arm	69.8	5 Regeneron Pharmaceuticals	64.7	5 Arm	61.2	5 Baidu	57.6	5 Apple	48.2
6	Netflix	71.23	6 Incyte	70.91	6 Under Armour	68.92	6 Unilever	67.9	6 Amazon	62.4	6 Baidu	60.6	6 Intuitive Surgicals	54	6 Hindustan U	47.7
7	Incyte	70.59	7 Unilever	68.59	7 Monster beverages	68.80	7 incyte	67.9	7 Biomarin Pharamaceuticals	58.9	7 Amazon	60.2	7 Rakuten	51.5	7 Google	44.9
8	Hindustan Unilever	67.20	8 Asian paints	68.28	8 Unilever Indonesia	67.93	8 Amazon	67.6	8 CP All	57.8	8 Intuitive Surgicals	53.9	8 Edwards Lifesciences	46.9	8 Natura Cosm	44.5
9	Naver	64.62	9 Naver	65.85	9 vertex Pharmaceuticals	67.89	9 Underarmour	66.6	9 VM Ware	57.6	9 Rakuten	50.7	9 Larsen & tubro	46.1	9 BHEL	43.6
10	Facebook	64.42	10 Regeneron	64.40	10 Biomarin Pharmaceutic	67.43	10 Bio Marin Pharmaceuticals	65.2	10 Aspen Pharmacare Holdings	57.1	10 Natura Cosmeticos	48.5	10 ARM Holdings	45.4	10 Monsato	42.6
11	Monster Beverage	64.26	11 Unilever indonesia	63.65	11 Amazon	63.80	11 Baidu	64.7	11 vertex Pharmaceuticals	56.8	11 Henan Shuanghui Investment	48	11 Tencent Holdings	44.1	11 Reckitt Beck	40.6
12	Unilever Indonesia	63.91	12 Bio Marin Pharmaceuticals	63.57	12 Arm Holdings	63.70	12 Aspen pharmacare holdings	64	12 Redhat	56.4	12 Coloplast	46.5	12 Hindustan Unilever	43.9	12 celgene	40.5
13	Adobe Systems	62.38	13 Monster Beverage Corp	63.16	13 naver internet	63.28	13 Monster Beverage Corporation	63.3	13 Hermes Paris	55.7	13 Cerner	45.9	13 FMC technologies	40.7	13 Nidec	40
14	Celltrion	62.30	14 Adobe	62.75	14 Fleetcor	62.09	14 Catamaran	63.2	14 Hindustan Unilever	54.7	14 Unicharm	43.5	14 Cerner	39.2	14 Terumo	38
15	Autodesk	62.04	15 Autodesk	62.39	15 Netflix	60.34	15 Vertex Pharmaceuticals	62.4	15 Monster Beverage Corporation	54.1	15 Estee Lauder	41.4	15 Pernod Ricard	39	15 Infosys	37.1
16	Regeneron Pharmaceuticals	61.11	16 AmorePacific	61.53	16 Shanghai RAAS	60.17	16 Fleetcor	61.6	16 Priceline.com	52.5	16 Jeronimo Martins	41.3	16 Monsato	38.6	16 Pernod Ricar	36.6
17	Vertex Pharmaceuticals	60.93	17 Vertex Pharmaceuticas	61.41	17 Rakuten	60.02	17 CP All	61.2	17 Rakuten	51.9	17 FMC Technologies	40.8	17 Perrigo	38.3	17 Keyence	36.1
18	Amorepacific	60.81	18 Illumina	58.97	18 Asian paints	59.77	18 Verisk Analytics	61	18 Marriot International	51.7	18 Tencent	40.7	18 Kweichou Moutai	37.9	18 FMC tech	36
19	AmerisourceBergen	58.69	19 Marriot International	58.46	19 LG Household	59.48	19 Rakuten	58.8	19 Fastenal	50.9	19 Starbucks	40.6	19 Infosys	37.7	19 Starbucks	35
20	Illumina	58.33	20 Alexion Pharmaceutical	58.46	20 Verisk Analytics	59.47	20 Shanghai RAAS	58.5	20 Chipotle	50.5	20 Pernod Ricard	40.5	20 Wuliangye Yibin	37.6	20 Nintendo	35
21	Marriott International	58.15	21 CPAll	57.82	21 Amorepacific personal p	59.14	21 Naver	58.2	21 Stericycle	50.1	21 Beam	40	21 Starbucks	37	21 Alcom	34.9
22	Alexion Pharmaceuticals	58.04	22 Constellation Software	57.62	22 Coloplast	57.48	22 Hermes Paris	58.2	22 Cerner	49.6	22 Perrigo	39.9	22 Nidec	36.1	22 Activision Bl	34.6
23	CP All	57.32	23 Red Hat	57.38	23 Marriot International	56.53	23 Magnit	57.9	23 Coloplast	49.6	23 Essilor International	39.3	23 Estee Lauder	36	23 Beiersdorf	34.5
24	Red Hat	56.93	24 Tencent	57.29	24 Illumina life	55.98	24 Chipotle	57.9	24 Henan Shuanghui Investment	49.6	24 Beiersdorf	38.3	24 Google	35.9	24 Proctor & Ga	33.4
25	Tencent Holdings	56.77	25 FleetCor	56.85	25 Redhat	55.87	25 The Priceline Group	57.1	25 Tingyi	48.6	25 Grifols	38.2	25 Danone	35.8	25 Essilor Interr	33.2
26	FleetCor Technologies	56.50	26 Rakuten	56.83	26 Amerisourcebergen	55.63	26 Redhat	56	26 Hengan International Group	48.2	26 Fanuc	37.9	26 Apple	35.7	26 L'Oreal	33.1
27	LG Household & Health Care	55.26	27 Sysmex Corporation	56.24	27 Visa	55.52	27 Netflix	55.9	27 Ambev	47.9	27 Diageo	37.5	27 Proctor & gamble	35.3	27 Schlumberge	32.7
28	Ctrip.com International	53.55	28 LG	56.08	28 Sysmex Health	54.44	28 Amore Pacific	55.3	28 Express Scripts	47.8	28 Hershey	36.2	28 Essilor International	35.2	28 Ecolab	32.6
29	Hermès International	52.38	29 Coloplast	55.52	29 Baidu	54.24	29 Marriot International	55.2	29 Illiad	47.3	29 Danone	35.6	29 TCS	35.1	29 Alstom	32.5
30	Starbucks	50.77	30 Nielsen	54.50	30 Mastercard	54.03	30 Mead Johnson	54.9	30 Netflix	47.2	30 Proctor & Gamble	35.5	30 Reckitt Beckinser	34.5	30 ICL- Isreal ch	32.3
31	Align Technology	50.58	31 Idexx Laboratories	53.25	31 Hindustan Unilever	53.99	31 Valeant Pharmaceuticals	54.8	31 Baidu	46.5	31 Dassault	35.5	31 Ecolab	34.1	31 General Mill	32.3
32	Fast Retailing	50.57	32 Fast Retailing	53.13	32 Hermes	53.68	32 Visa	54.8	32 Mastercard	46.2	32 Colgate Palmolive	35.3	32 Keyence	34	32 CSL	32.1
33	Ihs Markit	50.40	33 Almarai	53.07	33 Transdigm Group	52.11	33 Coloplast	54.7	33 Starbucks	45.6	33 Ecolab	34.6	33 Diageo	33.9	33 Colgate Palm	32
34	Expedia	49.82	34 Ulta Beauty	52.46	34 Perrigo Pharmaceuticals	51.97	34 Cerner	54.1	34 Whole Foods market	45.6	34 Monsato	34.3	34 L'oreal	33.6	34 NetApp	31.6
35	Sirius XM Radio	48.90	35 Hermes Paris	52.34	35 priceline	51.88	35 Illumina	53.9	35 Fanuc	44.1	35 Reckit Benckiser	34.1	35 Hershey	33.2	35 Danone	31.5
36	Visa	48.44	36 HIS Markit	50.81	36 Adobe Systems	51.67	36 Mastercard	52.9	36 Illumina	43.7	36 Keyence	33.9	36 Beiersdorf	33	36 Citrix	30.4
37	Anheuser-Busch InBev	47.64	37 Unicharm	50.66	37 Cerner Health care	51.41	37 Stericycle	51.4	37 tencent	43.1	37 Kone	33.1	37 Colgate Palmolive	32.7	37 Areva	30.3
38	Keyence	47.50	38 Verisk Analytics	50.57	38 Luta Beauty Specialist s	51.39	38 fast retailing	51.4	38 Novozymes	43.1	38 Yahoo Japan	32.8	38 Sun Pharmaceutical	32.7	38 Rockwell	30.3
39	Bard	46.80	39 Genmab	50.44	39 Chipotle	51.14	39 VM Ware	51.1	39 SBA Communications	43	39 BRF- Brasil Foods	32.8	39 Citrix Systems	32.3	39 Kone	30.1
40	Oriental Land	46.28	40 Amerisourcebergen	50.27	40 Almarai	50.99	40 Perrigo	50.8	40 Unicharm	42.6	40 TCS	32.6	40 Dassault	31.9	40 China Oilfiel	30
41	Molson Coors Brewing	46.07	41 Expedia	50.25	41 Fast Retailing Apparel	50.99	41 Hindustan Unilever	50.8	41 Li & Fung	42.6	41 Yum Brands	31.7	41 Technip	31.8	41 Syntheses	29.6
42	Booking Holdings	45.35	42 Starbucks	49.89	42 Starbucks	50.76	42 TransDigm Group	50.5	42 Kone	42.4	42 Teradata	31.5	42 Kone	31.6	42 Juniper Netv	29.6
43	China Molybdenum	45.27	43 Shimano	49.82	43 Unicharm	50.56	43 Keurig Green Mountain	50.4	43 intuitive Surgical	42.4	43 Praxair	31.4	43 Fanuc	31.1	43 Praxair	28.8
44	Intuitive Surgical	45.18	44 Sirius XM Radio	49.36	44 Sirius XM	49.03	44 Fastenal	50	44 Keurig Green Mountain	42.3	44 CSL	31.1	44 Schlumberger	31	44 Estee Lauder	28.4
45	Baidu	45.15	45 Visa	48.77	45 Iliad Alternative Carriers	48.49	45 Starbucks	49.8	45 Perigo	42.3	45 Anheuser Busch	31.1	45 Nintendo	31	45 Fanuc	28.3
46	Mastercard	44.31	46 Perrigo	48.74	46 Magnit Retail	48.49	46 Cielo	49.8	46 Fast Retailing	42.1	46 Kweichow Moutai	30.9	46 Praxair	30.7	46 Hershey	27.2
47	Falabella	44.09	47 KDX	48.50	47 Autodesk Application	47.97	47 Almarai	48.6	47 RB	40.6	47 Google	30.9	47 Syntheses 3	30.7	47 Avon produc	25.9
48	Dassault Systemes	43.76	48 Smith & Nephew	48.12	48 Tencent Holdings	47.84	48 Kone	48.3	48 Brown Forman	40.6	48 L'Oreal	30.8	48 Yum Brands	30.3	48 Paccar	25.7
49	General Mills	43.28	49 Keyence	47.69	49 Shanghai Oriental	47.82	49 Iliad	48	49 Essilor International	40.6	49 Sherwin-Williams	30.8	49 CSL	29.2	49 SMC Corp	25.5
50	Roper Technologies	43.28	50 Global Payments	47.59	50 Lindt	47.75	50 Whole Foods Market	46.9	50 Bureau Veritas Registre Interna	40.6	50 Citrix Systems	30.7	50 General Mills	28.8	50 Pepsico	25.4
51	Intuit	43.17	51 Bard	47.30	51 Reckit Benckiser	47.72	51 Unicharm	46.6	51 Luxxotica	40.5	51 Smith & Nephew	29.8	51		51	
52	Essilor International	43.16	52 Mastercard	46.99	52 Cielo data processing	47.68	52 SBA Communications	45.9	52 Beiersdorf	40.4	52 Mondelez International	29.8	52		52	
53	Coca-Cola	42.73	53 Magnit	46.81	53 Ctrip.com	47.49	53 RB	45.7	53 Naver	40.1	53 Infosys	29.1	53		53	
54	Inditex	42.64	54 ABInbev	46.58	54 Mead Johnson	47.10	54 Amerisourcebergen	45	54 Estee Lauder	40	54 Kellog	29	54		54	
55	Edwards Lifesciences	42.13	55 Ctrip.com.International	46.51	55 Shimano Leisure	46.95	55 Tencent	44.8	55 Keyence	39.7	55 Ultrapar Participacoes	28.9	55		55	
56	Reckitt Benckiser Group	41.83	56 Oriental Land	46.42	56 Kone	46.93	56 Lindt	44.8	56 Dassault Ssystemes	39.6	56 Intuit	27.9	56		56	
57	Experian	41.80	57 TransDigm Group	45.98	57 Dassault	46.72	57 Expedia	44.7	57 tata Group	39.6	57 Technip	27.3	57		57	
58	Constellation Brands	41.75	58 Booking Holdings	45.87	58 Expedia	46.10	58 Ambec	44.6	58 Larsen & tubro	39.4	58 Pepsico	27.1	58		58	
59	Kone	41.70	59 Lindt	45.85	59 Proseibensat.1 broadcas	45.70	59 Novozymes	44.6	59 Dairy farm international Holding	39.4	59 Schlumberger	26.3	59		59	
60	Brown-Forman	41.69	60 Baidu	45.85	60 Brown-Forman	45.28	60 Capita	44.6	60 Capita	39.1	60 Fresenius Medical care	26.1	60		60	
61	Luxottica Group	41.54	61 Intuitive Surgical	45.78	61 SBA Communications	45.16	61 Falabella	44.4	61 Geberit	38.9	61 SMC Corp	26	61		61	
62	Mondelēz International	41.28	62 Chipotle	45.74	62 Essilor Healthcare	44.94	62 Essilor International	44.3	62 Jeronimo Martins	38.9	62 Valeant Pharmaceuticals	25.8	62		62	
63	Compass Group	41.25	63 Nornickel	45.52	63 Allergan Pharmaceutical	44.90	63 Keyance	44.3	63 Falabella	38.8	63 Unilever	25.8	63		63	
64	Jiangsu Hengrui Medicine	41.12	64 Dassault Systems	44.11	64 Keyence Electronics	44.24	64 TCS	44	64 Grifols	38.7	64 China Oilfield Services	25.4	64		64	
65	Boston Scientific	40.96	65 Roper	43.76	65 Oriental Land Co	44.09	65 Luxxotica	44.9	65 Sun Pharmaceutical Industries	38.3	65 Automatic Data Processing	25.3	65		65	
66	Procter & Gamble	40.96	66 Intuit	43.72	66 TCS	43.85	66 Express Scripts	43.9	66 Starwood Hotels and resorts	37.8	66 Carlsberg	25.1	66		66	
67	PepsiCo	40.74	67 Brown- Forman	43.64	67 Intuitive Surgical	43.26	67 Shimano	43.3	67 Diageo	37.3	67 Covidien	24.9	67		67	
68	Cerner	40.56	68 Essilor International	43.42	68 Fastenal Trading	43.23	68 Brown Foreman	43.2	68 Roper	37.1	68 Bajaj Auto	24	68		68	
69	Yahoo Japan	40.38	69 Iliad	43.05	69 Roper Technologies	43.20	69 Geberit	42.9	69 Pernod Ricard	37	69 Tyco International	23.9	69		69	
70	Unilever	39.62	70 Inditex	42.86	70 Smith & Nephew	43.05	70 Jazz Pharmaceuticals	42.9	70 Lindt	36.9	70 Novo Nordisk	23.4	70		70	
71	Colgate-Palmolive	39.61	71 Equifax	42.72	71 Experian Research	42.96	71 Sun Pharmaceuticals	42.6	71 Amerisourcebergen	36.5	71 Johnson Controls	23	71		71	
72	Sodexo	39.59	72 Edwards Lifesciences	42.72	72 Colgate Palmolive	42.82	72 Sonova Holdings	42.6	72 Coca Cola	35.8	72 SAP	22.7	72		72	
73	United Parcel Service	39.59	73 RB	42.42	73 Sun Pharmaceutical	42.49	73 Autodesk	42.5	73 SGS	35.8	73 Amphenol	22.6	73		73	
74	Cielo	39.16	74 Constellation Brands	42.23	74 Acuity Brands Electrical	42.43	74 Adobe	42.2	74 H&M	35.8	74 Sandvik	22.6	74		74	
75	ASML Holding	39.08	75 Pandora	41.91	75 Molson Coors Brewing	42.43	75 Hengan International Group	42.1	75 oriental Land	35.5	75 LVMH	22.6	75		75	
76	Paychex	38.55	76 Luxxotica Group	41.87	76 Fanuc Industrial Machin	42.18	76 Dassault Systemes	42	76 Paychex	35	76 Rope Industries	22.4	76		76	
77	Clorox	38.22	77 Mead Johnson	41.50	77 Inditex Apparel	42.06	77 Tingyi	41.6	77 Colgate Palmolive	34.9	77 ASML Holding	22.3	77		77	
78	Assa Abloy	38.14	78 Bharti Airtel	41.40	78 Luxxotica	42.06	78 Dairy Farm Internaional Holdin	40.9	78 Ecolab	34.8	78 Assa Abvloy	22.3	78		78	
79	Alphabet	37.91	79 Coca Cola	41.32	79 Sab Miller Breweries	42.03	79 Equinix	40.9	79 Anheuser-Busch	34.6	79 Apple	22.3	79		79	
80	Nidec	37.77	80 Geberit	41.30	80 Bard Health care	42.03	80 Inditex	40.7	80 hershey	34.3	80 Air Products & Chemicals	22.2	80		80	
81	Fanuc	37.67	81 Cerner	41.23	81 General Mills	41.97	81 Coca Cola	40.5	81 Autodesk	33.9	81 Tenaris	22.2	81		81	
82	Allergan	37.59	82 Jiangsu Hengrui medicine	41.15	82 Novozymes Speciality	41.61	82 Colgate Palmolive	40.5	82 Inditex	33.7	82 Precision Castparts	21.8	82		82	
83	Hershey	37.56	83 SGS	41.03	83 Edwards Life Sciences	41.30	83 NXP	40.4	83 Groupo Bimbo	33.7	83 Rockwell Automation	21.3	83		83	
84	Waste Connections	36.99	84 Yahoo	40.99	84 Equifax	40.92	84 Estee Lauder	40.4	84 Proctor & Gamble	33.7	84 Nintendo	21.1	84		84	
85	RELX Group	36.90	85 Molson Coors Brewing	40.98	85 Geberit	40.71	85 Want Want	40.3	85 yahoo	33.7	85 Cameron International	21.1	85		85	
86	Larsen & Toubro	36.88	86 General Mills	40.93	86 Capita Human Resource	40.40	86 H&M	40.2	86 Danone	33.6	86 Secom	20.9	86		86	
87	Shiseido	36.76	87 Ramsay Healthcare	40.92	87 Falabella	40.38	87 Intuitive Surgical	40.2	87 ST Engineering	33.6	87 Schindler Holding	20.8	87		87	
88	Kellogg	36.58	88 Boston Scientific	40.73	88 Liberty Global	40.18	88 Experian	40	88 Inner Mongolia Yili	33.5	88 Campbell Soup	20.6	88		88	
89	Republic Services	36.50	89 Proctor & Gamble	40.72	89 Larsen & Tubro	40.00	89 Oriental Land	39.9	89 Sodexo	33.2	89 Kubota	19.9	89		89	
90	Hikvision	36.16	90 Falabella	40.61	90 Assa Abloy	39.85	90 Tractor Supply Company	39.9	90 Kuhne+Nagel	33.2	90 Mylan	19.8	90		90	
91	China Shipbuilding Industry	36.09	91 Mondolez International	40.60	91 Hangzhou Hikvision	39.75	91 Grouppo Bimbo	39.8	91 General Mills	33.1	91 BG Group	19.8	91		91	
92	Bharti Airtel	35.95	92 Compass Group	40.42	92 Constellation Brands	39.74	92 Grifols	39.8	92 BRF Brasil Foods	33	92 Adidas	19.6	92		92	
93	Ecolab	35.87	93 Cielo	40.40	93 Coca Cola	39.70	93 Starwood Hotels & resorts	39.8	93 Assa Abloy	32.8	93 Henkel	19.6	93		93	
94	L'Oréal Group	35.77	94 Experian	40.39	94 Omnicom	39.67	94 SGS	39.7	94 Nidec	32.5	94 Atlas Copco	19.6	94		94	
95	NXP Semiconductors	35.66	95 Pepsico	40.34	95 Paychex Data	39.49	95 nidec	39.7	95 Walmart	32.4	95 Syngenta	19.5	95		95	
96	Sun Pharmaceuticals Industr	35.64	96 Fanuc	40.25	96 Starwood Hotels	39.47	96 Cognizant Technology Solution	39.6	96 Bajaj Auto	31.7	96 Pentair	19.3	96		96	
97	The Estée Lauder Companie	35.53	97 Colgate Palmolive	40.19	97 ITV Broadcasting	39.38	97 Smith & Nephew	39.6	97 Experian	31.6	97 Kao	19.2	97		97	
98	Diageo	35.18	98 McCormick	30.73	98 Church & Dwight	39.33	98 ASML	39.5	98 The Colorox Company	31.5	98 Fidelity National Information	19.1	98		98	
99	Maruti Suzuki India	35.08	99 Labcorp	39.65	99 Grifols biotech	39.04	99 Hershes	39.4	99 Sherwin-Williams	31.4	99 Media Tek	18.6	99		99	
100	Norilsk Nickel	34.92	## ASML	38.94	## Avic Aviation Engine	39.04	## Equifax	39.3	## Digi.com Berhad	31.3	100 Daikin Industries	18.6	100		100	