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A CONCEPTUAL PAPER ON THE FIRM LIFE CYCLE, BOARD DIVERSITY, AND INVESTMENT EFFICIENCY

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Abstract*: Due to the ever-increasing failures of governments throughout the world, such as Enron, HealthSouth, Arthur Anderson, and WorldCom, diversifying the board of directors have attracted a great attention and difficulties. Moreover, improving firm value is subject to efficient investment. The majority of research on board diversity and corporate investment efficiency has been done from a static perspective. This is not in accordance with reality. The agency costs of free cash flows, in accordance with the firm life cycle theory, are persistent problems that arise after firms reach a particular stage in their life cycle. This study examines the effects of firm life cycle (measured by free cash flow of the firm) and board diversity (measured through CEO duality, board size, board independence, board nationality, board education level, and women representation) on firm investment efficiency. Our findings suggest that the investment made by corporations in tangible and intangible assets is significantly influenced by the firm life cycle. In addition, a crucial component of the corporate governance environment, the board's structure and role change depending on the stage of the life cycle.*

Keywords*: Firm Life Cycle, Board Diversity, and Investment Efficiency.*

Introduction

Investment efficiency depends on risk, return, and overall cost of investment management, and is also subject to the restrictions that investors must adhere to (Hodgson et al., 2000). Efficient firm investments are therefore essential to the company's development and profitability, and according to investment theory, in a perfect capital market, firms would invest in all projects with a positive Net Present Value (NPV) in order to extend their value (Modigliani and Miller, 1958).

Nonetheless, friction in the real world brought on by agency problems and information asymmetries impacts firms' decisions for investment and ultimately results in inefficient investment, either over-investing or under-investing (Myers and Majluf, 1984; Jensen, 1986). Under-investment happens when a business ignores the opportunities available for investment with a positive NPV, while over-investment takes place when a firm invests in more projects than is expected, even if the NPV is negative (Richardson, 2006; Biddle et al., 2009).

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Previous studies have demonstrated that using governance mechanisms, improving the quality of financial information, and altering the environment of corporate information can all increase the efficiency of firm investment (Chen and Chen, 2012; Biddle et al., 2009; Badertscher et al., 2013). Additionally, boards of directors are widely acknowledged as having a crucial role in corporate governance because they are important for making strategic decisions (Hermalin and Weisbach, 1998; Carter et al., 2003; Huang and Kisgen, 2013). Therefore, according to the resource dependence theory, board diversity may affect investment policies by enhancing oversight, lowering agency conflict, and connecting the organization to outside resources (Carter et al., 2003; Jensen and Meckling, 1976; Carter et al., 2010; Salancik and Pfeffer, 1978).

Consequently, there should be diversity on the board of directors (Ullah et al., 2020). A diversified board of directors has several viewpoints on managing and conducting business appropriately and improving board function. Such a board is required to have a variety of traits and qualities to obtain both talent and capability, which can be broken down into demographic traits including age, education, gender, nationality, and ethnicity along with other features belonging to the board structure; which are CEO duality, the board size, and board independence (Hafsi and Turgut, 2013; Mahadeo et al., 2012). Therefore, there is no consensus among researchers about the connection between board diversity and investment efficiency. They disregard the firm life cycle because they see the firm as a static thing (Dickinson, 2011; Habib and Hasan, 2019). The reality does not support this.

A company's internal and external environment evolves over several stages of its life cycle, from the viewpoint of the theory of firm life cycle (Miller and Friesen, 1984; Dickinson, 2011). As a result, during various stages of a firm life cycle, its ownership structure, organizational behaviour, and corporate strategies are all connected (Dodge et al., 1994; Drobetz et al., 2015). The corporation will thus experience a range of resource-seeking and agency challenges, which will force the firm to reshuffle its board of directors. The board's structure will change as it progresses through its life cycle stages (Jawahar and Mclaughlin, 2001). When a firm is just getting off the ground, it often has a small staff, and its founders also serve as its owners and managers. The firm's ability to survive depends on its ability to gather the resources required to enter the market. When a business is just getting started, it is more likely to look for opportunities to expand (Jawahar and Mclaughlin, 2001).

As the firm develops, the founders might be persuaded to hire outside, professional managers to operate it, which would lead to a division of ownership and management control. The firm is well-established in several different business sectors and is run by its board of management who are experienced. It is in a mature stage and growing more slowly. The firm should be able to create cash flow and raise more capital during this period (Dodge et al., 1994). Therefore, it requires less outside assistance than other stages. The firm's growth is slowing down in the decline stage, internal bureaucracy is rising, and internal prevarication is getting worse, all of which pose a threat to the firm's future (Jawahar and Mclaughlin, 2001). In order to produce new products or restructure strategically, the firm will require outside resources (guidance).

According to the growth-based account of investment, early-stage firms are more likely to invest more in order to maximize their development potential, whereas mature firms are more likely to invest in order to maintain their existing assets (Hubbard, 1997). At the start of a firm's life cycle, there are limited number of assets in place, which has a negative or low impact on operating cash flows and profit. Nonetheless, sizable financial investments in both tangible and intangible assets result in drastic sales growth during the life cycle's growth phase (Anthony

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and Ramesh, 1992; Habib, 2010), producing profitable operating cash flows. Mature firms have more assets and less unstable operating environments than earlier stages of the life cycle (Faff et al., 2016; Dickinson, 2011), ensuring steady cash flows and profitability. Firms reproduce their investment and research and development (R&D) activity during the declining stage of the life cycle (Chuang, 2017; Owen and Yawson, 2010). The firm life cycle is generally thought to have a substantial impact on firm investment in tangible and intangible assets, according to recent studies (Dickinson, 2011; Faff et al., 2016; Habib and Hasan, 2017).

On the other side, the life cycle of the firm may be impacted by investment efficiency, leading to the so-called endogeneity problem (Habib and Hasan, 2019; Al-Hadi et al., 2016). Through a number of factors, including increased competition, market saturation, and a decrease in readily available investment options, the reduction in the rates of return on investment can result in changes in the firm life cycle (Mueller, 1972; Grabowski and Mueller, 1975). Due to the inefficiency of their prior investments, firms may transition from the growth stage to the decline stage in such a condition. Examining the effect of firm life cycle and board diversity on investment efficiency will emphasize the importance of these factors in this paper.

Literature Review

Investment Efficiency

Investment has been regarded as a main topic in the previous studies on this subject, particularly in firm finance-related research. As opposed to what would be anticipated in a hypothetical setting, firms in practice, for instance, deviate from their investment behaviour and do not substantially rely on current investment prospects (Modigliani and Miller, 1958, 1958; Biddle et al., 2009; Lai and Liu, 2018). According to Gao and Yu (2020), one of the key factors determining a firm's value is consulting efficiency, which is represented in the wealth and welfare of its shareholders.

García-Sánchez and García-Meca (2018) defined efficient investment as making investments in response to investment opportunities at the best level possible. According to neo-classical literature, the ratio between the stock-market valuation of current tangible capital assets and their real replacement cost determines capital investment in frictionless capital markets (Gao and Yu, 2020). Firms are required to invest up until the point where the marginal return on capital equals the marginal cost of capital (Biddle et al., 2009). Tobin's Q, which measures the relationship between the marginal benefit of a capital investment and its marginal replacement cost, can therefore be used to describe investment opportunities (Richardson, 2006). In spite of the fact that Tobin's Q cannot be observed, average Tobin's Q and sales growth have been utilized in empirical studies as proxies for investment opportunities (Biddle et al., 2009; Chen et al., 2011; García-Sánchez and García-Meca, 2018; Lai and Liu, 2018).

Biddle et al. (2009) define investment efficiency as a project with a positive NPV despite market conflicts of interest such as adverse selection and agency costs. As a result, under-investment happens when a company overlooks a project with a positive NPV. Contrarily, overinvestment happens when a company takes on projects that have a negative NPV.

Board Diversity

Board diversity is one of the most important challenges in contemporary corporate governance in many organizations. Therefore, the board diversity is the variety inherent in a board's composition (Bernile et al., 2018), and it can be assessed in a number of ways (Ullah et al.,

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2020). Board diversity is also described as a "varied combination of characteristics, attributes, and expertise contributed by individual board members in relation to board process and decision making" (Walt and Ingley, 2003). By merging demographic features related to diversity inside a board of directors into a composite measure and demographic features related to diversity between boards, a few recent studies have sought to create a comprehensive picture of their simultaneous influence on firm value (Hafsi and Turgut, 2013; Ben-Amar et al., 2013).

There are two dimensions to the boardroom's diversity. The diversity-in-boards index is a composite index that takes into account a variety of factors that affect board diversity based on the demographics of the board members. The other dimension takes into account the variations among the different boards. The diversity-of-boards index is a composite index that they present after evaluating board formation criteria and comparing them across boards of firms. These two components of board diversity are measured by the diversity-of-boards index (dissimilarities between firm boards, a dimension relating to board structure) and the diversity-in-boards index (dissimilarities between directors within a board, a dimension referring to the demographic characteristics of board members) (Hafsi and Turgut, 2013).

Firm Life Cycle

A firm is a dynamic entity that changes as it advances through several stages of development over time (Habib and Hasan, 2019). The stages that a corporation goes through from its creation to its eventual demise are referred to as the firm life cycle. Miller and Friesen (1984) believe that each stage of the lifecycle is a multidimensional construct that captures a particular combination of organizational features. Changes in internal factors (such as strategy, organization, and decision-making techniques) and external factors (i.e., environment) can also result in transitions between stages.

According to earlier studies, the life cycle has five stages: introduction, growth, maturity, shake-out, and decline (Dickinson, 2011; Shahzad et al., 2019; Drobetz et al., 2015). He concentrates on the investing, operating, and financing cash flows when categorizing firms into life cycles. Castro et al. (2015) employed this methodology for the first time in a capital structure study, where they cited its ability to track variations by stage and its application to investing, operating, and financing cash flows as advantages. By evaluating all three aspects of the business at once, this method overcomes the prejudice that results from using only one discriminant variable, which is frequent in the literature (Dickinson et al., 2018).

Theoretical Perspective on Firm Life Cycle, Board Diversity, and Investment Efficiency

Making an investment selection is one of the most critical decisions a firm can make because investment is a key factor in determining corporate value ((Lei and Chen, 2019). A firm's value in a frictionless capital market is decided simply by its profit stream, according to the theory of investment, drawing on Modigliani and Miller's (1958) concept of perfect capital markets. Financing decisions and capital structure are irrelevant in such a market.

However, in reality, firms do not operate in a flawless capital market. A variety of factors, according to Stein (2003), affect how firms behave while making investments. Financial factors including cash flow availability and leverage are said to have an impact on firm investment (Lei and Chen, 2019; Lai and Liu, 2018), and financing an investment with external funds (equity or debt) is more costly than financing an investment with internal funds (cash) (García-Sánchez and García-Meca, 2018). Moreover, it may be argued that agency issues and information

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asymmetry are the most pervasive and important factors among the many other ones that affect how well investment decisions are made in capital markets (Stein, 2003).

A costly and ineffective contract between managers and shareholders comes from the separation of ownership and control in firms, according to agency theory(Jensen and Meckling, 1976). Moreover, information asymmetries can lead to moral hazard and adverse selection, two forms of capital rationing (Ullah et al., 2020). When an agent's behaviour is imperceptible and has a different value for the agent than it does for the principal, moral hazard results(Agyei-Mensah, 2021). When management has access to more information than potential capital suppliers, such as investors, adverse selection occurs (Ullah et al., 2020).

The focus of resource dependence theory is on the resources and potentialities of the internal firm environment for competitive advantage (Salancik and Pfeffer, 1978). For example, directors with a large network of social and professional connections will be better able to spot investment possibilities, proposed investments, and support investments even when the firm is under financial constraints, which will limit underinvestment (Alqatan et al., 2021). Directors' extensive industry and functional understanding also enables them to select investments more wisely when weighing their options, helping management make better judgments (Huang et al., 2014). Moreover, reputable, and credible directors will lessen the issue of adverse selection and decrease underinvestment while enhancing investor confidence in the companies' investment decisions (Agyei-Mensah, 2021).

In order to reduce agency issues and information asymmetry, agency theory and resource dependence theory have suggested that the board of directors should be more diversified and thus of higher quality in order to increase firm value (Agyei-Mensah, 2021; Ullah et al., 2020; Alqatan et al., 2021). In order to reduce agency issues and information asymmetry, agency theory and resource dependence theory view corporate board diversity, including outside directors, separate leadership structures, board size, board nationality, women representation, and board education level, as ideal monitoring tools. These tools also allow for the addition of external knowledge and skills, which will increase the firm's investment efficiency (Rashid, 2015; Med bechir and Jouirou, 2021; Ullah et al., 2020). The best stage of the firm's development at which board diversity increases investment efficiency, however, was not specified by agency theory or resource dependence theory.

Mueller proposed the theory of firm life cycle in 1972. He concentrated on the agency issue within the company and how managers should decide between maximizing shareholder value and pursuing growth for the purpose of the firm alone by making excessive investments in assets that are not in the best interests of shareholders. According to Mueller (1972; 2003), the agency problem is either non-existent or negligible at the beginning for three reasons: First of all, the business offers so many lucrative investment opportunities that pursuing growth is consistent with pursuing profits. Second, the corporation will need to seek capital from other sources because internal earnings are unlikely to be enough to pursue all investment opportunities, meaning that management will be closely watched (Ahmed et al., 2020). Third, the goals of the entrepreneur or manager are in line with those of the other capital suppliers because they still hold a sizable portion of the company's stock (Khuong et al., 2022).

Agency issues are more likely to appear as a company matures. The firm's management should start paying out dividends to shareholders at this stage of the life cycle, and when all potential investment opportunities have evaporated, the management should sell off all assets and

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distribute the proceeds to shareholders (Habib and Hasan, 2019). This is unlikely to happen, leading to an agency issue where management keeps funding unprofitable projects to keep the business expanding and so boost their own wealth and power at the expense of the interests of shareholders (Li and Zhang, 2018). According to theory, board diversity will have varying effects on investment efficiency across the firm's life cycle.

Theoretical Framework

Figure 1 shows the hypothesized correlations between board diversity and investment efficiency at different firm life cycle stages. The theoretical framework is made up of the board diversity, which is measured by two indicators: the first index, diversity-of-board (CEO duality, board size, and board independence) (Hafsi and Turgut, 2013; Aktas et al., 2019), the second index, diversity-in-board (women representation, board nationality, and board education level) (Hafsi and Turgut, 2013; Midavaine et al., 2016), and how it affects the investment efficiency measured by sales growth based on a methodology proposed by Biddle et al. (2009) at various stages of the firm life cycle including introduction, growth, mature, shake-out, and decline using Dickinson's (2011) classification of cash flow patterns from the three activities operating, investing, and financing.

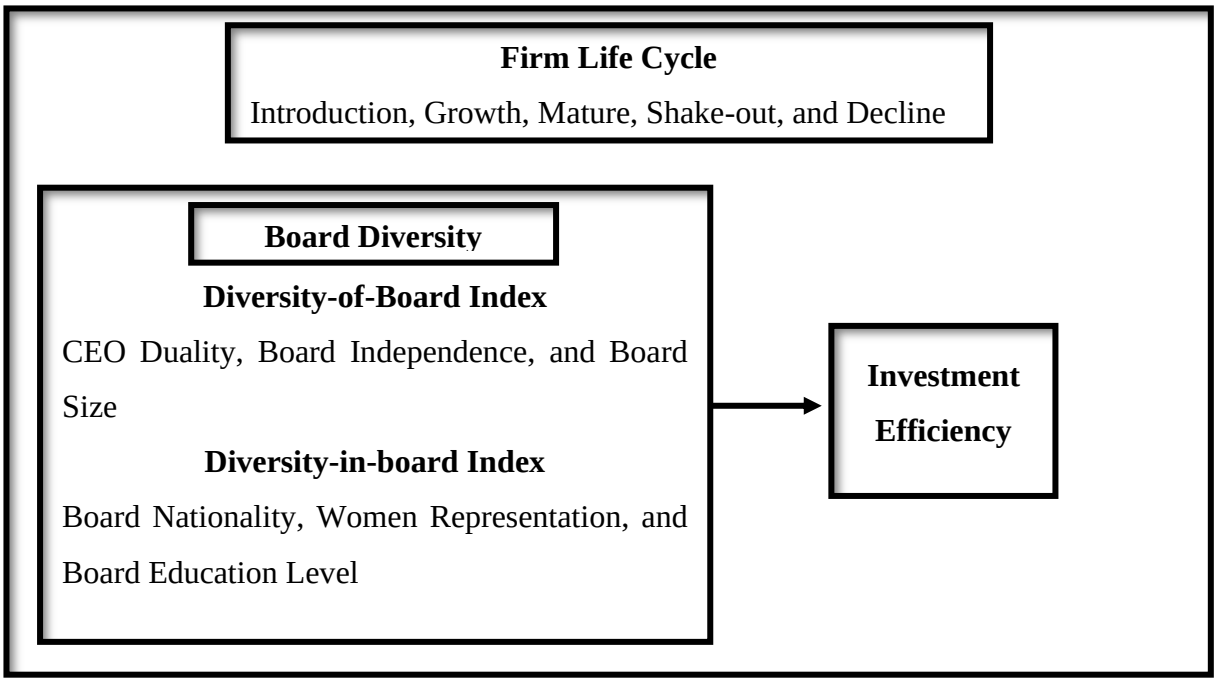

Figure 1: Theoretical Framework

Methodology

Data

The data of this paper comes from secondary sources, the base data taken from S&P Capital IQ database, which it has all annual reports (financial and corporate governance reports) for companies within Dow Jones MENA index, for the period Jan. 2010 to Dec. 2019. Through financial reports, data on investment efficiency will be obtained, as investment expenditures have been used as a function of future growth opportunities, expressed in the growth rate of the company's basic revenue. In addition, firm life cycle, where operating cash flows (OCF), investing cash flows (INVCF), and financing cash flows (FINCF) have been used to classify companies into five stages: introduction, growth, mature, shake-out, and decline. While,

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through corporate governance reports, data on board diversity will be obtained, where board diversity is measured by six characteristics and attributes: CEO duality (if the positions of chairman and the CEO were held by single person or two separate persons), board independence (the number of independent board members in the board of director), board size (the number of directors on the board), board nationality (the number of foreign board members in the board of director), women representation (the number of women board members in the board of director), board education level (the graduate level of board members in the board of director).

Measurement of Variables

Firm Life Cycle

In this paper, the firm life cycle is measured according to the Dickinson (2011) methodology as ordinal variable (which means that contain the property of ranking, but not of distance. For example, one can rank firms on life cycles from introduction to decline, but one cannot measure the difference in between), that take values from 1 to 5, so that the introduction stage is 1, and the shake-out stage is 5. where this methodology is based on the following cash flow pattern classification:

(1) Introduction: if OCF < 0, INVCF < 0 and FINCF > 0.
(2) Growth: if OCF > 0, INVCF < 0 and FINCF > 0.
(3) Mature: if OCF > 0, INVCF < 0 and FINCF < 0.
(4) Decline: if OCF < 0, INVCF > 0 and FINCF ≤ or ≥ 0; and
(5) Shake-out: the remaining firm years will be classified under the shake-out stage, Where:
OCF = cash flow from operations is cash flow resulting from producing activities of the entity and other activities that are not investing or financing activities (Dickinson, 2011; Mackenzie et al., 2012).

INVCF = cash flow from investment are cash flow resulting from activities of the entity that relate to acquisition and disposal of long-term assets (such as property, plant, and equipment) and other noncurrent assets (including investments) other than those included in cash equivalents. Also implicate cash advances and collections on loans made to other entities (Dickinson, 2011; Mackenzie et al., 2012).

FINCF = financing cash flows is cash flow resulting from activities that result in changes in the size and composition of the equity capital and borrowings of an entity (Dickinson, 2011; Mackenzie et al., 2012).

In addition, to reduce the impact of single-year effects, we use three-year moving averages of each cash flow type rather than fiscal year-end values to obtain the final life cycle classification (Drobetz et al., 2015). At this point we deviate from Dickinson (2011), who uses fiscal year-end cash flow data as reported by the firm to implement her life cycle proxy. The applied correction of the measure controls for non-fundamental life-cycle classification changes of firms with cash flows around zero. In such cases, cash flows may change signs due to single-year effects that are not related to the operational capability or strategy choice of the firm (Drobetz et al., 2015), resulting in a life cycle classification possibly providing misleading information on the actual life cycle stage of the firm. Though the choice of using a three-year moving average is ad hoc to a certain extent, it seems to be a reasonable way to deal with single-year effects (Drobetz et al., 2015). Eventually, using a moving average-based classification does not substantially affect the distributional characteristics of the life cycle proxy. However,

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it slightly increases the average dwelling time per life cycle stage relative to the Dickinson (2011) classification.

Board Diversity

This paper relies on Hafsi and Turgut's (2013) methodology to measure the board diversity. As follows: The independent variable which is board diversity employed in this study include two indices: An index for the diversity-of-boards (IDoB), and one for the diversity-in-boards (IDiB). We constructed these two indices using six variables: CEO duality, board independence, board size, board nationality, women representation, and board education level. As follows:

Procedure for Diversity-of-Boards Index

In this study, the diversity-of-boards index measures the dissimilarity among company boards. This mechanism helps us to gauge how each firm's board differs from other firms' boards in sample of study. Therefore, the diversity-of-boards index are represented with three dimensions: the first dimension is CEO duality which means that CEO also acts as chairman or not. the second dimension is the percentage of independent directors of a given board; the third dimension represents the board size which is the number of directors sitting in each board. As such, diversity-of-board variable is composed of heterogeneous dimensions, in which the first dimension is of a dichotomous nature, the second dimension is continuous, and the third dimension is discrete.

As a result, this study is used the inter-sample distance-measurement method (Deza and Deza, 2014). This method assesses how dissimilar—in terms of all three diversity of boards variables— a firm is from all other firms in the sample. Technically, in a matrix, this study will first measure the distance between a firm and another firm (i.e., a pair of companies) taking into consideration all variables at the same time. We do that for the distance with all other companies. Then, we take the average. As a result, we assess how distant (or diverse) a company is from the rest of the sample.

Physically, distance is a numerical description of how far apart objects are. In mathematics, distance reflects physical distance. Using a dissimilarity matrix, a collection of proximities that are available for all pairs of n objects can be stored. In measuring inter-sample distances, the distance-measurement tool compares data samples in a matrix and provides a metric to assess how (dis)similar they are. Measured difference, or dissimilarity between two objects, or $d_{(i,j)}$, is a non-negative number that is close to 0 when objects $i$and j are highly similar or ‘‘near’’ each other and becomes larger as they differ more. Several measures of inter-sample distances are formulated depending on the types of variables (i.e., binary, nominal, interval-scaled, and ratio-scaled). For instance, the Euclidean distance metric previously used in management studies (e.g., Roth and O'Donnell, 1996; Thatcher et al., 2003) measures distances only in same type variables.

However, as discussed earlier, since our data set in diversity of board variable is made of different types of dimensions, this study is used an aggregated distance function that enables us to combine all types of dimensions in a single dissimilarity matrix, and, hence, assess them together (Han et al., 2022). That is, the dissimilarity between data points can be computed even when the dimensions describing these data points are of different types. This function is defined by Han et al. (2022) as:

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$$d_{(i,j)} = \frac{\sum_{f=1}^{p} \delta_{ij}^{(f)} \, d_{ij}^{(f)}}{\sum_{f=1}^{p} \delta_{ij}^{(f)}} \dots\dots\dots (1)$$

Where $i$and j are two p-dimensional data points represented as $(x_{i1}, x_{i2}, \dots, x_{ip})$ and $(x_{j1}, x_{j2}, \dots, x_{jp})$ respectively, and $d_{(i,j)}$ is a distance function (metric) used to express the (dis)similarity between two data points (i.e., i and j in this case). Then, the contribution of dimension f to the dissimilarity between $i$and j (i.e., $d_{ij}^{(f)}$) is computed dependent on its type:

1. If f is binary or nominal: $d_{ij}^{(f)} = 0$ if $x_{if} = x_{if}$, or otherwise $d_{ij}^{(f)} = 1$
2. If f is interval-scaled: $d_{ij}^{(f)} = \frac{|x_{if} - x_{jf}|}{max_h \, x_{hf} - min_h \, x_{hf}}$
3. If f is ordinal or ratio-scaled: compute ranks r_{if} and $z_{if} = \frac{r_{if}-1}{M_f-1}$, and treat z_{if} as interval-scaled ($r_{if} \in \{1, \dots, M_f\}$).

In this function, the contribution of all different types of dimensions to the dissimilarity (i.e., $d_{ij}^{(f)}$)are normalized, and hence expressed on a common scale of (0, 1).

In our analysis, this study will individually compute the distance of each data point (i.e., company board) to all other data points in our data set using the above-mentioned metric. Here, this study has given equal weights to the relative contributions of each variable to the distance function (i.e., $d_{ij}^{(f)} = 1$). Then, this study averages the computed distances of each data point to all other data points using the formula below:

$$d_{(i,j)} = \frac{\sum_{f=1}^{p} d_{ij}^{(f)}}{s} \dots\dots\dots (2)$$

And for the average distance to all the other boards we use:

$$D_{(i)} = \frac{\sum_{z=1}^{k} d_{(i,z)}}{k-1} \dots\dots\dots (3)$$

where, x_{i1}, the board size i; x_{i2}, the percentage of independent directors i; x_{i3}, the fact that whether CEO of company board i also acts as chairman or not; s, the number of dimensions representing diversity of boards (i.e., board size, independence and duality); k, the number of company boards; $d_{ij}^{(f)}$, the distance of company board i to company board j with respect to the variable f; $d_{ij}^{(f)}$, the relative contribution of the dimension f to the distance between the company board i and the company board j; $d_{(i,j)}$, the distance of company board i to company board j ; $D_{(i)}$, the average distance of company board i to all other boards.

The output of this distance-measurement metric provides information on how (dis)similar a given board, taken into consideration three dimensions at the same time, from all other boards in our sample. This information represents the nature of diversity of boards.

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Procedure for Diversity-in-Boards Index

The diversity-in-board index measures differences in director demographic attributes within a given board. In this study, the diversity-in-boards index are represented with three demographic attributes: the first attribute is board nationality which means the percentage of foreign directors in the board (Miller and del Carmen Triana, 2009; Darmadi, 2011); the second attribute is the percentage of woman representation of a given board (Miller and del Carmen Triana, 2009; Khaw et al., 2016), these 2 board attributes are dichotomous, so they are categorized as binary 0 or 1 variables (Ararat et al., 2010). The third attribute represents the board education level. A board member educational qualification is divided into four categories such as bachelors, masters, PhD and below bachelors (Midavaine et al., 2016). We then take the standard deviation of educational levels of members in each board. Therefore, the board education level is a continuous variable (Ararat et al., 2010).

As a result, diversity-in-board in this study will measure by using Blau's (1977) index. Blau's (1977) index has been suggested as an optimal measure of diversity to capture variations within a group of people (Harrison and Klein, 2007). It is also an ideal measure of diversity, because it meets the four criteria that have been laid out for a good measure of diversity: it has a zero point to represent complete homogeneity, larger numbers indicate greater diversity, the index does not assume negative values, and the index is not unbounded (Harrison and Sin, 2006). In addition, Blau's (1977) index has been frequently used and noted as a suitable measure of diversity for categorical variables, where the measure is not skewed in a proportion of any one category (i.e., nationality, women representation, and education level) (Bantel and Jackson, 1989; Harrison and Sin, 2006). Therefore, this study follows Harrison and Klein, (2007) which notes that heterogeneity in categorical attributes should be defined as "variety" and is best measured using the Blau's (1977) index defined as:

$$1 - \sum_{i=1}^{k} p_i^2 \ldots\ldots\ldots (4)$$

Where, p_i = the proportion of the board members in the 'i'th category of a given attribute.
k = number of categories in each attribute.

This study subsequently operationalizes the extent of diversity in each attribute and in each board by calculating a Blau's (1977) index value for each diversity attribute and then add them up to create a Blau's index for each board in our sample. As a follow: the board nationality, Blau's (1977) index can range from 0 when there is only citizen on the board to 0.50 when there are equal numbers of citizen and foreign on the board. For women representation, Blau's (1977) index can range from 0 when there are only men on the board to 0.50 when there are equal numbers of men and women on the board. the education of board members into four categories: Bachelor, Master, Doctorate, and Other. All four categories were used to calculate Blau's (1977) index. The range of the index is dependent upon the number of categories, where the number ranges from 0 to (i - 1)/i. Therefore, board education diversity can range from 0 when only one education level is represented on the board to 0.75 when there are equal numbers of all four-education level represented on the board. We then take the standard deviation of educational levels of members in each board.

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This study next standardizes the Blau's indices for each of these 3 attributes by dividing each by its theoretical maximum value ((k-1)/k). Then we form a diversity-in-board index (IDiB) for each board by summing the standardized Blau's values for all attributes (Agresti and Agresti, 1978).

Investment Efficiency

Recently, many studies (e.g. Chen et al., 2011; Lei and Chen, 2019; García-Sánchez and García-Meca, 2018; Rajkovic, 2020) follow Biddle et al. (2009) to measure investment efficiency. Therefore, according to Biddle et al. (2009) model, we estimate the amount of investment deviating from normal investment level, that is, take the residual of the model as proxy variable of investment efficiency. The details as follows:

The first step to apply the methodology proposed by Biddle et al. (2009) is an estimate of the expected investment, an estimate of the optimal level of investment expenditures, assuming that investment expenditures are a function of future growth opportunities, expressed in the growth rate of the company's basic revenue (Modigliani and Miller, 1958; Hubbard, 1997; Biddle et al., 2009), As the relation between investment and revenue growth could differ between revenue decreases and revenue increases (Eberly, 1997; McNichols and Stubben, 2008), we allow for differential predictability for revenue increases and revenue decreases by employing a piecewise linear regression model, taking into account a number of independent variables that affect investment expenditures, such as: financial leverage, cash held ratio, firm age, firm size, and stock return (García-Sánchez and García-Meca, 2018; Lei and Chen, 2019; Lai and Liu, 2018). All explanatory variables are lagged by one year (t-1) in order to avoid any possible bias between the independent variables and the dependent variable (Lei and Chen, 2019). Following Biddle et al. (2009), we also include the lagged investment expenditures, and control for the industry fixed effects and year fixed effects. Provided that the optimal level of investment expenditures is estimated according to the following model:

$$I_t = a + \beta_1 Growth_{t-1} + \beta_2 LEV_{t-1} + \beta_3 Cash_{t-1} + \beta_4 Age_{t-1} + \beta_5 Size_{t-1} + \beta_6 Returns_{t-1} + \beta_7 I_{t-1} + \sum \gamma_k Year + \sum \gamma_j Industry + \varepsilon \dots\dots\dots (5)$$

Where I_t is investment expenditures in year t, estimated as capital expenditures plus research and development plus acquisition expenditures less cash receipts from sales of property, plant, and equipment, scaled by the average total assets. $Growth_{t-1}$ represents the sales growth rate in year t-1, which is the percentage change in sales from year t−1 to t. LEV_{t-1} is the debt-to-asset ratio at the end of year t−1; $Cash_{t-1}$ means the number of monetary capital divided by total assets at the end of year t−1; Age_{t-1} means the age of company listing at the end of year t−1; $Size_{t-1}$ means the natural logarithm of total assets at the end of year t−1; $Returns_{t-1}$ is the annual stock returns expressed as the change in the market value of the share at the end of year t−1; I_{t-1} is the investment expenditures in year t−1. Year and Industry dummy control year and industry fixed effects separately for the purpose of introducing the fixed effect into the model (5).

The second step to apply the methodology proposed by Biddle et al. (2009) is a deviation from the expected investment amount, in light of the investment efficiency, the deviation from the estimated value of investment expenditures expressed in the residuals (ε) of the model (5) equals zero. Therefore, the researcher will be used the absolute value of the difference between the optimal level of investment expenditures estimated according to the model (5), and the

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normal value of investment expenditures or what is known statistically as the residuals (ε) of the model (5) to express the investment efficiency, and the higher the deviation of the normal value of investment expenditures from the optimal level of investment expenditures, this is an indicator on the low investment efficiency (Jin and Yu, 2018).

Findings

1. The investment made by corporations in tangible and intangible assets is significantly influenced by the firm life cycle.
2. A crucial component of the corporate governance environment, the board's structure and role change depending on the stage of the life cycle.
3. The majority of studies conducted on finance tend to demonstrate a relationship between the firm life cycle and the financial or governance outcome in terms of research methodology and estimation approaches. The instruments used in these studies are subject to common criticisms, such as weak instruments or exclusion-related restrictions. The instruments used in these studies are subject to common criticisms, such as weak instruments or exclusion-related restrictions. A few studies demonstrate that the relationship between the life cycle and the outcome variable is strong compared to an instrumental variable approach in order to mitigate the endogeneity problem. In addition, employing a two-stage least squares technique does not offer solid proof of the causal relationship. Kahn and Whited (2018) state in this regard that "causal effects are…difficult to estimate because econometricians rarely observe occasions where one variable is altered while others are held constant, that is, where there is genuine exogenous variation in a variable". Recent studies on finance use a natural experiment or difference-in-difference technique to establish causal relationships. However, it is still challenging to establish causal inferences from life cycle studies, maybe as a result of the absence of an exogenous shock.
4. The four life cycle stages must be included as explanatory variables in the regression model in order to use Dickinson's (2011) life cycle classification. Finding tools or exogenous shocks that are relevant to all life cycle stages at a particular time is challenging. Due to this restriction, readers should exercise caution when interpreting the results of this review, a causal relationship could reinforce the inferences from the study.

Conclusions and Recommendations for Future Research

1. Research conducted on board diversity and corporate investment efficiency is nearly entirely static in nature. The life cycle theory, however, made clear that because the organizations, operating features, and strategies of a firm alter dramatically depending on its stage of development, the impact of board diversity on investment efficiency will likewise change over time. Hence, this study suggests creating an index of the firm life cycle and carrying out an empirical investigation on the connection between board diversity and investment efficiency from a dynamic perspective.
2. The majority of earlier research has examined the relationship between the diversity of the board and investment efficiency to gauge board diversity using a variety of factors, including CEO duality, the board size, board independence, and board nationality. The representation of women which is a crucial aspect of diversity has been overlooked in the previous research. The recommendation made in this paper is that women be included in the board diversity measure since their participation enhances the board's ability to function by bringing a variety of viewpoints, skills for problem-solving, and motivation for creative thinking.
3. Further investigation is required to see how governance structures have changed over firm development and how this has affected firm value. Undoubtedly, the US rules the field of

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empirical research on this ground. Studies on the determinant's investment efficiency in developing countries have almost been neglected. Institutional variations between developed and developing countries could be a significant source of information for studies on firm investment efficiency. In order to better comprehend how country-specific idiosyncratic characteristics affect the determinants of firm investment efficiency, this study calls for more research from a global perspective.

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