INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 12, Issue 4, (2023) E-ISSN: 2226-3624

The Impact of Diversity-In-Board on Investment Efficiency Across the Stages of the Firm Life Cycle in The MENA Region

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To Link this Article: http://dx.doi.org/10.6007/IJAREMS/v12-i4/19440 DOI:10.6007/IJAREMS/v12-i4/19440

Published Online: 25 November, 2023

Abstract

This study investigates the dynamic impact of diversity-in-board on investment efficiency across different stages of the firm life cycle using the framework of firm life cycle theory as a guide. It explores the relationship between the diversity-in-board index measured by (board nationality, women representation, and board education level) and investment efficiency at different stages in the firm life cycle as measured by free cash flow. The analysis encompasses 332 non-financial firms listed in the Dow Jones MENA Index from 2010 to 2021, yielding 285, 795, 2241, 513, 150 firm-year observations in the introduction, growth, mature, shake-out, and decline stages, respectively. Data was gathered from the S&P Capital IQ database and analysed using STATA software, employing panel data techniques. The findings reveal the diversity-in-board index exhibits varying effects, being insignificant during the introduction stage, positive during growth and decline stages, and negative during mature and shake-out stages on investment efficiency in the companies within the MENA region. These results endorse firm life cycle theory, emphasizing the dynamic role of diversity-in-board in investment efficiency. This research offers valuable insights for economists and policymakers, advancing our comprehension of how board attributes (board nationality, women representation, and board education level) impact a firm's investment efficiency in a dynamic context.

Keywords: Firm Life Cycle, Diversity-in-Board, Investment Efficiency, Dow Jones MENA Index, and The MENA Region.

Introduction

Diversity-in-Board and Investment Efficiency

Investment efficiency is the outcome of balancing risk, return, and total management costs within the constraints that investors (Hodgson et al., 2000). Therefore, efficient firm investments are critical for growth and profitability, where perfect markets would lead to investments in all projects with positive Net Present Value (NPV) for maximum value

(Modigliani & Miller, 1958; Biddle et al., 2009). However, real-world frictions like information asymmetries and agency problems can cause inefficient investments—either over-investment or under-investment. Under-investment (missing NPV-positive options), while over-investment (unnecessary projects, even if NPV is negative) (Richardson, 2006; Biddle et al., 2009).

Inefficient firm investments reduce market value and harm the economy (Chen et al., 2011). As a result, enhancing investment efficiency is critical for corporate and macroeconomic wealth. Previous research has shown that exercising governance mechanisms (Xie, 2015; Cheng et al., 2013), enhancing the quality of financial information (Biddle et al., 2009), and changing the environment of company information (Badertscher et al., 2013), can improve the efficiency of firm investment.

Diversity-in-board is one of the internal corporate governance mechanisms, such as board nationality, women representation, and board education level (Hafsi & Turgut, 2013), can improve the effectiveness of investments. Specifically, diversity-in-board influences the investment policies by improving monitoring and reducing the agency conflict (Carter et al., 2003; Ullah et al., 2020), and by linking the organization to the external resources as suggested by the resource dependence theory (Carter et al., 2010; Shin et al., 2020). However, the impact of diversity-in-board on investment efficiency lacks substantial evidence.

Firm Life Cycle, Diversity-in-Board, and Investment Efficiency

Prior studies have investigated how diversity-in-board improves firm investment efficiency from a static perspective (Estélyi & Nisar, 2016; Ullah et al., 2020; Loukil & Yousfi, 2016). Wherefore, the main motivation of the current study investigate how diversity-in-board influences firm investment efficiency from the dynamic perspective by incorporating the concept of firm life cycle stages.

According to firm life cycle theory, a company's internal and external environment changes during several stages of its life cycle (Dickinson, 2011; Faff et al., 2016). Therefore, a corporation's ownership structure, organisational behaviour, and corporate strategies are all linked at different periods of its life cycle (Habib & Hasan, 2019). As a result, the company will face a variety of agency problems and resource-seeking issues.

Effective resource allocation is vital for investment efficiency, involving consideration of a firm's life cycle, growth prospects, and competitive position (Drobetz et al., 2015). Prioritizing high-growth opportunities during the growth stage is more advantageous than investing during the mature or decline stages (Faff et al., 2016). Effective firms analyse returns and risks to allocate resources to projects with optimal value creation potential.

Moreover, the agency costs related to free cash flow are a persistent concern as companies mature, leading to challenges in effectively utilizing excess funds (Mueller, 2003). As firms age, cash flows increase significantly while suitable investment opportunities decrease, making growth-focused strategies less viable (Dickinson, 2011). To prevent this situation, executives may consider negative NPV projects to avoid stagnation (Akbar et al., 2020). However, excessive investment could lead to undervaluation and potential hostile takeovers. This danger of takeover is what keeps firm management from going overboard with their investments.

Regarding to firm life cycle and diversity in-board, Jawahar & Mclaughlin (2001) argue that as a company progresses through its life cycle, its structure changes. In the introduction stage, founders run the small company and seek resources to enter the market. As the company grows, it may bring in experienced managers, leading to a split of ownership and control (Li & Zhang, 2018). In the mature stage, a professional management team oversees an established company with slower growth (Ribeiro et al., 2021). The decline stage sees slowed growth, internal challenges, and a need for external resources to the firm's survival (Habib et al., 2018). As a result, the corporation will need external resources (advice) to manufacture new items or restructure strategically.

The literature cited above has established a theoretical connection between firm life cycle, diversity-in-board, and investment efficiency; yet empirical investigation on this topic is still under-explored. This study aims to fill this gap with a comprehensive empirical investigation on the question how diversity-in-board affects investment efficiency at different stages of the firm life cycle. Complementary to most studies on boards using data from developed countries, this study aims to examine how diversity-in-board affects investment efficiency at a different stage of the firm life cycle in MENA region, which are characterized by a weak internal corporate governance. Compared with developed countries, MENA's companies are growing in a weak governance system (Piesse et al., 2012; Saidi, 2004; Baydoun et al., 2012).

Why MENA Region?

After the Arab Spring of 2010, the Middle East and North Africa (MENA) area have recognized the significance of diversifying the board of directors to improve the firm value (Jamali et al., 2007; Loukil & Yousfi, 2016). For instance, Saudi Arabia, a traditional Islamic country, has given women remarkable rights in various areas such as banking, driving, political roles. Since then, women are allowed to run for office and be elected as political office holders (Kamrava, 2012). Additionally, some MENA countries have enacted regulations promoting board diversity, offering insights for other regions contemplating similar reforms (Loukil & Yousfi, 2016). As a result, board diversity research became highly prevalent after this period.

Literature Review and Hypothesis Development

In today's firms, the board of directors is at the top of the decision-making hierarchy. It performs a variety of tasks, including regulating and monitoring managers, providing guidance and counsel to managers, checking organisational compliance with applicable laws and legislation, and connecting the company to the outside world (Estélyi & Nisar, 2016; Shin et al., 2020). Moreover, the board of directors is involved at various stages of a company's investment decision-making process and has a direct influence on those decisions (Ullah et al., 2020).

According to agency theory, more diverse boards are more independent and better able to perform their monitoring and investment decision-making functions (Adams & Ferreira, 2009; Al-Musali & Ku Ismail, 2015). In addition, Ullah et al. (2020) studied 2,431 firms in China from 2003 to 2018 and found that the task-oriented diversity (i.e., education) and relation-oriented diversity (i.e., gender) in the board improves firms' investment efficiency by discouraging sub-optimal investment.

The role of boards in investment decision-making is also consistent with resource dependence theory, which shows that the resources brought to firms by boards can influence corporate investment (Pugliese et al., 2014). Furthermore, resource dependence theory claims that appointing women and foreigners to the board of directors promotes board legitimacy (Liu et al., 2014). According to Terjesen et al (2015), having more women on the board will boost problem-solving creativity and innovation. Meanwhile, women have more diverse networks and have experience from nonprofessional networks than male representatives.

While existing research provides ample evidence on the relation between board diversity and investment efficiency (Al-Musali & Ku Ismail, 2015; Ullah et al., 2020), they regard the firm as a static object, and ignore the firm life cycle. This is not in accordance with reality (Dickinson, 2011; Habib & Hasan, 2019). In firm life cycle theory, corporate is the same as life, and will go through the process from birth to die. The firm's organizations, operating characteristics and strategies in each life cycle stage are significantly different (Dickinson, 2011; Faff et al., 2016). Therefore, it inevitably affects the selection of board of directors (Habib et al., 2018; Esqueda & O'Connor, 2020). Consequently, this will be affects the efficiency of companies' investment at different stages of firm life cycle.

It's feasible to find an explanation for the link between diversity-in-board and investment efficiency at different stages of the firm life cycle by looking at the cash flow pattern (that is, operational, investment, and financing activities) as well as the resourcing differences across the firm's life cycle stages. Variations in strategy, environment, decision-making style, and organisation distinguish the various stages (Mueller, 2003; Habib & Hasan, 2017).

The cash flow pattern is one method for separating the various stages of a company's life cycle (Thanatawee, 2011). Dickinson (2011) used models to distinguish between positive and negative cash flow indications to divide the stages of the firm's life cycle (such as operating, investing, and financing activities). As a result, Dickinson's (2011) divided the stages of the firm life cycle into five stages (introduction, growth, mature, decline, and shake-out).

Introduction Stage

The introduction stage is marked by revenue and cost unpredictability, high managerial opportunism, and a strong focus on gaining a competitive edge and market share (Hasan et al., 2015). Moreover, capital costs are often high due to concerns about future cash flows and fundraising challenges (Dickinson, 2011). In addition, according to Esqueda & O'Connor (2020), there are variances in the variables of character corporate governance in each stage of the life cycle, namely the complexity of the corporate governance structure, managerial competences, and the firm's resource requirement. Firm size is often small in the introduction stage, and the founders of the firm are also its proprietors and operate the firm on their own. Obtaining resources to enter the marketplace is critical for the firm's sustainability (O'Connor & Byrne, 2015).

H1: There is positive impact between the diversity-in-board index and firm investment efficiency at the introduction stage of the firm life cycle.

Growth Stage

The growth stage is characterized by profit maximization, significant investments, positive operating cash flows, and a preference for debt financing due to tax benefits (Dickinson, 2011). In addition, effective internal control, coordination, and integrated decision-making are crucial for managing expanding operations (Habib et al., 2018). Managers contribute significantly to growth by utilizing their skills, expertise, and networks. Appointing additional managers in this phase enhances the organization's credibility and reassures external stakeholders about its viability (Perrault & McHugh, 2015). As the company enters a more stable sales phase, changes in the board of directors may be necessary because the previous success criteria may no longer be relevant (Saravia, 2013).

H2: There is positive impact between the diversity-in-board index and firm investment efficiency at the growth stage of the firm life cycle.

Mature Stage

In mature stage, firms in this stage characterized by enhanced operational efficiency and stable cash inflows from operations, experience capital outflows from investing and financing activities (Dickinson, 2011). Moreover, they focus on retaining market share and profitability rather than making new investments, concentrating on improving production processes and reducing manufacturing costs (Faff et al., 2016). As a result, the firms will face more serious agency issues and rely on external resources less than it did throughout its growth stage (Pham & Pham, 2020). Consequently, its resource requirements decrease, but management's commitment to addressing agency problems between shareholders and the professional CEO intensifies (Jawahar & Mclaughlin, 2001).

H3: There is positive impact between the diversity-in-board index and firm investment efficiency at the mature stage of the firm life cycle.

Shake-Out Stage

In shake-out stage, the number of producers in the industry starts to decline. When it comes to cash flow patterns for these firms, they are classified as shake-out firms by default if their cash flow patterns don't align with the established theoretical stages (Dickinson, 2011). Shake-out companies facing declining profitability have two options: they can either make new investments to rejuvenate the business or start downsizing. This stage makes it difficult to determine the impact of changes in cash sales and Property, Plant, and Equipment (PP&E) on cash flows or investment patterns (Drobetz et al., 2015).

Moreover, when a company enters the shake-out stage, the board of directors frequently re-evaluates the methods in place to deal with the various stakeholder groups (Habib et al., 2018). In addition, To ensure survival and regain market dominance, boards may consider strategies like product redevelopment, mergers, downsizing, and layoffs (Ribeiro et al., 2021). A key survival strategy is to create new products, but due to industry competition, limited resources, and external challenges, this can be extremely challenging (Jawahar & Mclaughlin, 2001). Consequently, boards often seek strategic advice from managers who can help formulate and execute new and potentially risky initiatives to keep the company competitive (Koh et al., 2015).

H4: There is positive impact between the diversity-in-board index and firm investment efficiency at the shake-out stage of the firm life cycle.

Decline Stage

Firms in the decline stage experience cash outflows from operating activities and cash inflows from investing activities due to diminishing growth rates and asset liquidation (Ahmed et al., 2020). Cash flows from financing activities can be positive or negative depending on debt repayment or renegotiation (Dickinson, 2011). To combat financial difficulties, managers might invest in high-risk projects, with debtholders bearing the cost if these projects fail (Habib & Hasan, 2017).

Moreover, a failing company needs significant strategic reorientation, and having a diverse board is crucial for helping the CEO implement a successful strategy (Habib et al., 2018). Encouraging directors to remain on the board or appointing new directors can be instrumental in overcoming difficulties during the declining stage (Ribeiro et al., 2021).

H5: There is positive impact between the diversity-in-board index and firm investment efficiency at the decline stage of the firm life cycle.

Research Design

Measurement of Variables

Dependent Variable

This study adopts Biddle's et al. (2009) model to measure investment efficiency, which is a dependent variable of the current study. This involves estimating the amount of investment deviating from normal investment level. In other words, the residual of the model is utilized as a proxy variable for measuring investment efficiency. Here are the specific details:

To apply the methodology from Biddle et al. (2009), the first step involves estimating the expected investment, which is essentially the optimal level of investment expenditures based on the company's future growth opportunities. This estimation considers the relationship between investment and revenue growth, where the growth rate of the company's basic revenue plays a crucial role (García-Sánchez & García-Meca, 2018). Since this relationship can differ depending on whether revenue is increasing or decreasing (McNichols & Stubben, 2008), a piecewise linear regression model is employed to account for this difference. Additionally, various independent variables, including financial leverage, cash held ratio, firm size, and stock return, are factored in as they influence investment expenditures (Lei & Chen, 2019). Importantly, all these explanatory variables are lagged by one year (t-1) to prevent potential bias between them and the dependent variable. Moreover, it also includes the lagged investment expenditures. Provided that the optimal level of investment expenditures is estimated according to the following model:

$$I_t = a + \beta_1 \, Growth_{t-1} + \beta_2 \, LEV_{t-1} + \beta_3 \, Cash_{t-1} + \beta_4 \, Size_{t-1} + \beta_5 \, Returns_{t-1} + \beta_6 \, I_{t-1} + \varepsilon \ldots \ldots \ldots (1)$$

Where $I_{i,t}$ represents investment expenditures in year t. $Growth_{i,t-1}$ is the sales growth rate in year t-1. $LEV_{i,t-1}$ is the debt-to-asset ratio at the end of year t-1. $Cash_{i,t-1}$ is the ratio of cash to total assets at the end of year t-1. $Size_{i,t-1}$ is the natural logarithm of total assets at the end of year t-1. $Returns_{i,t-1}$ the annual stock returns expressed as the change in market value from year t-1 to t. $I_{i,t-1}$ represents the investment expenditures in year t-1.

The second step in applying Biddle's et al. (2009) methodology focuses on measuring investment efficiency by assessing the deviation from the expected investment level. This deviation is quantified using the residuals (ε) from the model. When this deviation is zero, it signifies that investment aligns perfectly with the estimated optimal level. To express investment efficiency, researchers use the absolute difference between the model's (1) estimated optimal investment level and the statistically calculated normal investment level (residuals ε). Essentially, 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 & Yu, 2018).

Independent Variable

In this study, the independent variable is the diversity-in-board index, which quantifies differences in demographic attributes among board members. This index considers three specific attributes: firstly, board nationality, which represents the percentage of foreign directors on the board (García Martín & Herrero, 2018); secondly, woman representation, calculated as the ratio of female board members to the total number of directors (Benkraiem et al., 2017); and thirdly, board education level, which measures the diversity in director graduate qualifications across four categories: bachelor's, master's, PhD, and other. To assess the diversity in education level within the board, a coefficient of variation ($\sigma \div \mu$) is used, aiming to determine the proportion of the graduate level group (Hafsi & Turgut, 2013). It's important to note that these three board attributes are treated as continuous variables in the study (Hoang et al., 2018).

As a result, diversity-in-board is measured using the terciles split method. To create the diversity-in-board index (Hafsi & Turgut, 2013), the sample is divided into three equal terciles for each attribute, ranking the levels of diversity for each one. These groups are assigned values: 0 for the first tercile (indicating below average diversity), 1 for the second tercile (average diversity), and 2 for the third tercile (above average diversity). The diversity-in-board index is then calculated as the sum of these ranked attributes, providing a measure of demographic diversity within a board for each company. A higher value signifies greater diversity-in-boards (Hoang et al., 2018).

Classification Variables

In Dickinson's (2011) work, who addresses the limitations of Anthony & Ramesh's (1992) methodology for assessing a firm's life cycle. whom draws insights from economic literature covering various aspects of a firm's behavior, such as production, learning, investment, entry/exit patterns, and market share (Spence, 1981; Wernerfelt, 1985; Jovanovic & MacDonald, 1994). Dickinson (2011) then creates a simplified proxy for a firm's life cycle, relying on the prediction of how operating, investing, and financing cash flows behave at different stages of a firm's life cycle. These stages are determined by a firm's performance and resource allocation. who argues that cash flows can indicate differences in a firm's profitability, growth, and risk, making them useful for categorizing firms into life cycle stages like introduction, growth, mature, shake-out, and decline.

In this study classified all the sample firms into different life cycle stages on the basis of the following cash flow pattern:

(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 is cash flow from operations; INVCF is cash flow from investment; FINCF is cash flow from financing. 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).

Measurement of Control Variables

The regression analysis took into account several other firm-specific variables were included as controls, namely firm size, debt ratio, slack, market-to-book ratio, tangible assets ratio, and loss. These variables are considered influential factors in assessing a firm's investment efficiency, as highlighted in previous literature. Therefore, the researcher identified the control variables and the method of measuring them as follows:

Firm size, determined as the natural logarithm of total assets, signifies a firm's influence and capability. Larger firms tend to enjoy more accessible and favorable financing terms (Shen et al., 2015), potentially enabling greater investment capacity. Debt ratio, calculated as total liabilities divided by total assets, accounts for potential investment distortions and financing obstacles due to high indebtedness (Lei & Chen, 2019). Slack, measured as the total cash balance divided by total assets, affects future sales growth and, consequently, a firm's investment efficiency (Argilés-Bosch et al., 2018). The market-to-book ratio, derived from the market value divided by the book value of equity, reflects a firm's growth prospects, potentially facilitating external financing for investments (Nugroho, 2020). Tangible assets ratio, calculated as fixed assets divided by total assets, inversely relates to a firm's investment efficiency; an increase in it typically corresponds to decreased investment efficiency (Jeon & Oh, 2020). Lastly, the Loss is a dummy variable, equaling 1 when a firm reports negative net income and 0 otherwise, allowing for the consideration of profitability's impact on investment efficiency (Lei & Chen, 2019).

Data and Sample Selection

The sample selection includes all non-financial companies within the Dow Jones MENA Index over the time span of (12) years from 2010 to 2021. The Dow Jones MENA Index was chosen because it measures the performance of companies in the MENA region, including (11) countries. It aims to represent 95% of the market capitalization in the region, making it a comprehensive indicator of regional market trends. The total number of constituents the Dow Jones MENA Index (790) companies during the period 2010 to 2021. Exclusion of (178) financial companies and (280) companies that the firm life cycle variables, diversity-in-board index and other important variables are not complete. As a result, the sample size was (332) non-financial firms with (3984) firm-year observations. Table 1 shows the number of constituents of each country.

Data for this study was sourced from the S&P Capital IQ database, which contains all annual reports (financial and corporate governance reports) for companies in the Dow Jones MENA index. Financial reports were used to calculate investment efficiency and various control variables such as firm size, debt ratio, slack, market-to-book ratio, tangible assets ratio, and loss. Additionally, cash flow data from financial reports was used to determine firm life cycle stages. While data on the diversity-in-board index was collected from corporate governance reports. This index assesses diversity-in-board using three attributes: board nationality (count of foreign board members), women representation (count of women board members), and board education level (the educational qualifications of board members).

Table 1：
The Number of Constituents of Each Country

Country	Number of Constituents
Saudi Arabia	86
Kuwait	35
UAE	45
Qatar	20
Oman	45
Bahrain	11
Egypt	37
Morocco	21
Tunisia	19
Jordan	12
Lebanon	1
Sum	**332**

Empirical Model

To test the proposed relationship, we proposed the following regression model. The model is mathematically expressed as follows:

$$absI_{ij} = \beta_0 + \beta_1 IDiB_{ij} + \beta_2 FSIZE_{ij} + \beta_3 DRATIO_{ij} + \beta_4 SLACK_{ij} + \beta_5 MTB_{ij} + \beta_6 TAR_{ij} + \beta_7 LOSS_{ij} + \varepsilon_{ij} \ldots\ldots\ldots (2)$$

Where $absI_{ij}$ investment efficiency is the absolute value of the regression residual of model (1); $IDiB_{ij}$ diversity-in-board index is measured using the terciles split method; $FSIZE_{ij}$ firm size, determined as the natural logarithm of total assets; $DRATIO_{ij}$ debt ratio, calculated as total liabilities divided by total assets; $SLACK_{ij}$ slack, measured as the total cash balance divided by total assets, affects future sales growth and; MTB_{ij} market-to-Book ratio, derived from the market value divided by the book value of equity; TAR_{ij} tangible assets ratio, calculated as fixed assets divided by total assets; Lastly, $LOSS_{ij}$ loss is a dummy variable, equaling 1 when a firm reports negative net income and 0 otherwise. The study categorizes the companies of the study sample into five stages based on Dickinson's (2011) classification: introduction, growth, mature, shake-out, and decline, each determined individually. Subsequently, model (2) was used for each stage to assess how the diversity-in-board index affects investment efficiency during different stages of a firm's life cycle.

Results and Discussion

Descriptive Analysis

Table 2 provides descriptive statistics for the sample used in the study, broken down by the stages of the firms' life cycles.

Table 2
Descriptive Analysis

FLC Stage / **Variable**	**Introduction** (285 Obs.) Mean (Std. Dev.)	**Growth** (795 Obs.) Mean (Std. Dev.)	**Mature** (2,241 Obs.) Mean (Std. Dev.)	**Shake-Out** (513 Obs.) Mean (Std. Dev.)	**Decline** (150 Obs.) Mean (Std. Dev.)
Investment Efficiency i,t	.003 (.001)	.002 (.001)	.001 (.001)	.002 (.001)	.005 (.002)
IDiB i,t	2.839 (1.328)	2.686 (1.292)	2.853 (1.231)	2.945 (1.173)	2.64 (1.48)
FSIZE i,t	8.453 (.728)	8.674 (.693)	8.635 (.733)	8.548 (.669)	8.345 (.693)
DRATIO i,t	.545 (.212)	.496 (.197)	.421 (.199)	.411 (.251)	.46 (.222)
SLACK i,t	.048 (.052)	.06 (.059)	.077 (.075)	.082 (.086)	.056 (.058)
MTB i,t	1.71 (1.721)	1.836 (1.25)	1.91 (1.349)	1.218 (.768)	1.46 (1.504)
TAR i,t	.466 (.251)	.619 (.216)	.577 (.208)	.593 (.231)	.554 (.227)
LOSS i,t	.337 (.473)	.116 (.32)	.135 (.342)	.257 (.438)	.353 (.48)

Investment efficiency exhibits a varying trend, with the mean decreasing from 0.003 (Std. Dev. = 0.001) in the introduction stage to 0.001 (Std. Dev. = 0.001) in mature stage, and then increasing in decline stage to 0.005 (Std. Dev. = 0.002). The diversity-in-board index (IDiB) shows minor variability, with mean values ranging from 2.839 (Std. Dev. = 1.382) in introduction stage to 2.64 (Std. Dev. = 1.48) in decline stage, while peaks at the shake-out stage with a mean of 2.945 (Std. Dev. = 1.173). Although firm size (FSIZE) declines to a mean of 8.345 (Std. Dev. = 0.693) in decline stage, it remains largely stable throughout stages of the firm life cycle. The debt ratio (DRATIO), which initially has a high mean of 0.545 (Std. Dev. = 0.212), typically declines over time. The slack rises until the shake-out stage, when it reaches a mean of 0.082 (Std. Dev. = 0.086), before declining in the stage of decline. The market-to-book ratio (MTB) significantly varies in shake-out stage, falling to a low mean of 1.218 (Std. Dev. = 0.768). The tangible assets ratio (TAR) fluctuates as well, reaching its peak in the growth stage with a mean of 0.619 (Std. Dev. = 0.216). Finally, The LOSS variable, which represents negative net income, starts at a mean of 0.337 (Std. Dev. = 0.473), fluctuates significantly, and reaches a mean of 0.353 (Std. Dev. = 0.48) in decline stage. Collectively, these metrics show how firms' financial and strategic positions have changed over different life cycle stages.

Variance Inflation Factor (VIF)

Regression analysis uses the Variance Inflation Factor (VIF) test to measure multicollinearity among predictor variables, which can lead to instability in coefficient estimates. Each predictor's VIF value is calculated, with a typical threshold set at 5 or 10. When the VIF rises above this limit, there is significant multicollinearity, which forces researchers to make corrections like removing correlated variables or using dimensionality reduction methods (Hair, 2009).

In table 3 the VIF values for the various constructs are fairly close to (1–5), indicating no issues with multicollinearity. As a result, each construct's independent variables are not highly correlated, which is advantageous for regression analysis.

Table 3
Variance Inflation Factor (VIF)

Constructs	**Introduction**	**Growth**	**Mature**	**Shake-Out**	**Decline**
Investment Efficiency Model	VIF	VIF	VIF	VIF	VIF
Growth $_{i,t-1}$	1.082	1.036	1.072	1.023	1.071
LEV $_{i,t-1}$	1.162	1.219	1.221	1.222	1.46
Cash $_{i,t-1}$	2.603	1.454	2.948	3.69	2.541
Size $_{i,t-1}$	1.153	1.13	1.152	1.19	1.443
Returns $_{i,t-1}$	1.073	1.048	1.066	1.014	1.072
I $_{i,t-1}$	2.552	1.347	2.855	3.549	2.438
Empirical Model					
IDiB $_{i,j}$	1.057	1.061	1.004	1.013	1.069
FSIZE $_{i,j}$	1.278	1.35	1.45	1.382	2.076
DRATIO $_{i,j}$	1.48	1.363	1.359	1.462	2.093
Slack $_{i,j}$	1.135	1.24	1.175	1.236	1.28
MTB $_{i,j}$	1.096	1.137	1.064	1.063	1.234
TAR $_{i,j}$	1.4	1.31	1.334	1.286	1.397
LOSS $_{i,j}$	1.219	1.083	1.121	1.114	1.222

Table 4
Model Specification Test of Investment Efficiency

Tests / Stage	**Introduction**	**Growth**	**Mature**	**Shake-Out**	**Decline**
Lagranigian Multiplier Test	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Hausman Test	183.23 (0.000)	219.54 (0.000)	484.390 (0.000)	163.62 (0.000)	45.49 (0.000)
Autocorrelation Test	26.423 (0.000)	44.243 (0.000)	246.800 (0.000)	19.688 (0.000)	37.969 (0.000)
Heteroscedasticity	1.60E+05 (0.000)	2.2e+06 (0.000)	1.8e+06 (0.000)	4.0e+06 (0.000)	2.6e+07 (0.000)
Cross-Sectional Dependence	0.78 (0.435)	0.34 (0.731)	1.19 (0.235)	-0.32 (0.747)	-0.57 (0.569)

In table 4 the Hausman Test consistently showed that the Fixed Effect model was the best option for the panel data analysis across various life cycle stages. However, the use of the Feasible Generalized Least Squares (FGLS) model, a reliable technique capable of addressing these problems by estimating error covariance, was required due to the presence of autocorrelation and heteroscedasticity in all stages. It is important to take this dependence into account when interpreting the results because cross-sectional dependence varied across stages, indicating that firm behavior may be influenced by others in some stages. Overall, the researcher showed a strong method for statistical analysis and model choice, ensuring the accuracy of their panel data research results.

Table 5
Investment Efficiency Models

	Introduction	**Growth**	**Mature**	**Shake-Out**	**Decline**
I i,t	Coef.	Coef.	Coef.	Coef.	Coef.
Growth i,t-1	0.004	.000	0.019***	-0.005***	0.008***
LEV i,t-1	0.017*	-0.029***	-0.003	-0.019***	-0.041***
Cash i,t-1	0.3***	0.234***	0.33***	0.269***	-0.183***
Size i,t-1	0.003	0.002**	0.003***	-0.004***	-0.004
Returns i,t-1	0.005	0.025***	0.007***	0.013***	0.009***
I i,t-1	0.542**	0.552***	0.543***	0.520***	0.664***
Constant	-0.017	0.049***	0.005	0.072***	0.085***
R-Squared	0.5691	0.3953	0.643	0.5563	0.4783
Wald chi2	1182.4	15780.83	9207.04	4703.26	597.51
p-value	0.0000**	0.0000**	0.0000**	0.0000**	0.0000**
Obs.	285	795	2,241	513	150

Table 5 displays the regression results for model used to calculate the dependent variable (investment efficiency) for each stage of the life cycle (introduction, growth, mature, shake-out, decline). The model' R-squared values show how well they account for variation at various stages of a firm's life cycle. The mature stage stands out as having a strong explanatory capacity because it has the stage with the highest R-squared value (0.643) of these stages. It is followed by the introduction stage with the second-highest R-squared value (0.569), the shake-out stage comes next, with the third highest R-squared value (0.556), followed by the decline stage, with the fourth highest R-squared value (0.478), and finally the growth stage, with the lowest R-squared value (0.395). The Wald chi-squared test and associated p-values assess the overall significance of each model. Moreover, the large Wald chi-squared values for all models indicate a strong overall explanatory power.

Table 6
Model Specification Test of Empirical Model

Tests / Stage	Introduction	Growth	Mature	Shake-Out	Decline
Lagranigian Multiplier Test	34.50 (0.000)	103.91 (0.000)	349.62 (0.000)	40.78 (0.000)	1.28 (0.1287)
Hausman Test	8.63 (0.3747)	13.80 (0.0873)	84.66 (0.000)	33.02 (0.000)	9.45 (0.2218)
Autocorrelation Test	28.809 (0.000)	73.025 (0.000)	63.205 (0.000)	19.688 (0.000)	19.825 (0.0001)
Heteroscedasticity	10.85 (0.001)	9.62 (0.0019)	3.7e+06 (0.000)	4.0e+06 (0.000)	1.24e+06 (0.000)
Cross-Sectional Dependence	-	-	2.57 (0.010)	-0.32 (0.747)	1.37 (0.170)

Table 6 provides a summary of the study's methodology for data analysis in different firm life cycle stages for the empirical model. On the basis of the Lagranigian Multiplier and Hausman test, this study was used panel data analysis in the mature, shake-out, and decline stages for the empirical model, whereas choosing to analyze pooled data in the introduction and growth stages for the empirical model. The choice of fixed and random effect models for different firm life cycle stages suggests the researcher's diligence in accounting for unobserved individual-specific effects and variations within the dataset. Moreover, the consistent presence of heteroscedasticity and autocorrelation across all stages of firm life cycle for the empirical model underscores the importance of addressing these issues. To mitigate these concerns, the researcher wisely applied the FGLS model in panel data analysis and employed robust standard errors in the pooled data analysis. This approach enhances the reliability and robustness of the statistical analyses, ultimately contributing to the validity of the research findings.

Table 7
Hypothesis Test (Empirical Model)

	Introduction	Growth	Mature	Shake-Out	Decline
AbsI	Coef.	Coef.	Coef.	Coef.	Coef.
IDiB	.000	.000***	.000***	.000***	.000***
FSIZE	.000	.000**	.000***	.000***	.000
DRATIO	-.001	.000***	.000***	.000**	-.002***
Slack	.009***	.002***	.003***	.005***	.011***
MTB	.000	.000	.000***	.000	.000**
TAR	.001***	.000*	.000***	.000	.000
LOSS	.000	.000*	.000***	.000***	.000
Constant	.003***	.001***	.002***	.001***	.005***
R-squared	0.208	0.306	0.334	0.193	0.40
F-test	14.593	8.029	717.67	496.06	323.23
Prob > F	0.000	0.000	0.000	0.000	0.000

**** p<.01, ** p<.05, * p<.1*

Table 7 presents the significance and explanatory power of the empirical model for each firm life cycle stage by the R-squared values and corresponding F-tests. The decline stage has the highest R-squared value (0.40) of all of these stages, indicating that the empirical model explains for a significant amount of the variance in this stage. The mature stage comes next, with the second-highest R-squared value (0.334), indicating a moderately strong explanatory capability. Next is the growth stage, which has a noticeably lower but still significant R-squared value (0.306). The R-squared value for the next stage, introduction, is significantly lower (0.208), but it is still notable. The shake-out stage has the weakest ability to explain variance, as evidenced by its lowest R-squared value (0.193). Importantly, all F-tests have p-values lower than (0.000), demonstrating the empirical model' overall significance across all stages of the firm life cycle. The empirical model can statistically explain variations in the dependent variable at each stage of the life cycle.

This study evaluate the hypotheses related to the impact of diversity-in-board on investment efficiency across different firm life cycle stages in the MENA region. It conducted regression analyses for each firm life cycle stage (introduction, growth, mature, shake-out, decline) using absolute investment efficiency (absI) as the dependent variable and the diversity-in-board index (IDiB) as independent variable. The significance levels for the coefficients were set at $p<.01$ for highly significant, $p<.05$ for significant, and $p<.1$ for marginally significant.

The results indicate that in the introduction stage, IDiB is not statistically significant, failing to support H1. In the growth and decline stages, IDiB has highly significant positive impacts on investment efficiency ($p<.01$), supporting both H2 and H5. In the mature and shake-out stages, IDiB has highly significant negative impacts on investment efficiency ($p<.05$ and $p<.01$), rejecting both H3 and H4.

The findings imply that in the MENA region, the impact of diversity-in-board on investment efficiency different depending on the stage of the firm life cycle. The diversity-in-board index (IDiB) emphasizes the significance of taking the specific firm life cycle context into account when assessing the impact of diversity-in-board by playing significant roles in improving investment efficiency at different stages.

Specific control variables have been seen to exert varying degrees of significance on investment efficiency (absI) in each stage of the firm life cycle in the MENA region. In the Introduction stage, both Slack and Tangible Assets Ratio (TAR) show significant importance at the 1% level, suggesting a positive impact on investment efficiency. However, other control variables such as Firm Size (FSIZE), Debt Ratio (DRATIO), Market-to-Book Ratio (MTB), and Net Income (LOSS) do not show statistically significant impacts on investment efficiency at this stage.

At growth stage, Slack emerges as highly significant at the 1% level, indicating a positive impact on investment efficiency. FSIZE, TAR, and LOSS also marginally affect investment efficiency, albeit at varying levels of significance 5% and 10% level, highlighting their roles in this stage. While the DRATIO negatively affect investment efficiency at the 1% significance level in this stage.

In the mature stage, there is high significance for many of the control variables: DRATIO, Slack, MTB, and TAR are all highly significant at the 1% level, indicating that companies with higher debt ratios and slack resources, higher market-to-book ratios, and higher levels of tangible assets tend to have better investment efficiency. While the FSIZE and LOSS significantly negatively affect investment efficiency at the 1% significance level at this stage.

In shake-out stage, both FSIZE and Slack are highly significant at the 1% level, indicating a significant positive impact on investment efficiency. While DRATIO and LOSS negatively impact investment efficiency at varying 5% and 1% levels at this stage.

Lastly, in the Decline stage, both Slack and MTB show significant importance at the 1% and 5% levels, suggesting a positive impact on investment efficiency. While DRATIO negatively impacts investment efficiency at the 1% level. However, other control variables such as FSIZE, TAR, and LOSS do not show statistically significant impacts on investment efficiency at this stage.

Conclusions and Recommendation

The empirical and theoretical research on how diversity-in-board impacts investment efficiency across firm life cycle stages lacks consistency, while board diversity literature generally and especially in the MENA region remains scant and not comprehensive. Therefore, this study used data from 332 non-financial firms listed in the Dow Jones MENA Index from 2010 to 2021 to examine the impact of the diversity-in-board index (board nationality, women representation, and board education level) on investment efficiency at different stages of firm life cycle (introduction, growth, mature, shake-out, and decline).

The major findings show that the diversity-in-board index has a range of impacts: it has little or no impact during the introduction stage, but has a positive impact on investment efficiency during the growth and decline stages and a negative impact during the mature and shake-out stages in the MENA region.

This complex pattern underscores the unique and critical role that diversity-in-board plays within the diverse and specific cultural frameworks of the MENA region. The dynamic interconnection between the various attributes of diversity-in-board and the distinct stages of a firm's development sheds light on the profound influence this governance dimension can have in improving investment efficiency. It is interesting to note that the insights derived from this study stimulate further exploration and consideration in the broader context of corporate governance and decision-making processes.

Future studies can compare the results with those from the current study using different study samples, such as the Jones MENA Ex-Saudi Index, Dow Jones GCC Index, and Dow Jones GCC Ex-Saudi Index. The suggestion to combine quantitative data with qualitative analysis to create and validate new metrics for evaluating diversity-in-board index. Finally, by using flexible accelerator models, future studies can examine the sustained effectiveness of investment. These models provide important insights for economists and policymakers, assisting in the understanding of how economic conditions affect investment patterns and enabling predictions about how economic policies will affect investment and overall economic growth.

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