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Is Bankruptcy Risk Tied to Corporate Life-cycle? Evidence from Pakistan

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Abstract: In this paper we analyze the relationship between bankruptcy risk and the corporate life cycle in Pakistan from 2005 to 2014. For this purpose, we run a Hierarchical Linear Mixed Model (HLM) for a sample of 301 non-financial listed firms in 12 different sectors. The empirical outcomes reveal that firms during introduction, growth and, decline stages (mature stage) of life-cycle experience higher (lower) bankruptcy risk. Moreover, in juxtaposition with growth stage, bankruptcy risk is higher at the introduction stage of life-cycle. These findings suggest that financial managers should be cautious about the financial fragility of the firm at each stage of corporate life-cycle. The results also entail that Pakistani firms do not follow a sequential pattern in their life-cycle rather they have the tendency to revert to a previous stage or jump to the next stage of life-cycle. This is the first study that empirically examines the association between firm life-cycle stage and corresponding bankruptcy risk and asserts that managers must incorporate the life-cycle effects into their financial planning and decision making for sustainable working of an enterprise.

Keywords: Corporate Life-cycle; Bankruptcy Risk; Financial Sustainability; Pakistan

1. Introduction

Sustainability is considered as one of the most important issues that society is facing. It is also one of the key challenges in the business world. Therefore, the concept of sustainability is widely applied by the corporations through their mission statements and strategies [1]. The United Nations Global Compact (UNGC) defines corporate sustainability as "a company's delivery of long-term value in financial, social, environmental and ethical terms". Although all of the above mentioned four pillars of corporate sustainability are equally important. However, financial sustainability has emerged as a focal area of research, especially after the recent financial crisis. Miljenović et al. [2] states that the major challenge firms faced during global financial crises of 2007 was financial sustainability. Firms faced financial troubles mainly because of difficult access to new capital which led to low level of liquidity or insolvency.

The most accepted and widely used definition of financial sustainability is the likelihood that a firm is operationally and financially self-sufficient without any substantial external financing

requirement [3]. Financial sustainability is not merely important for the firm itself instead it also have a social value. Every firm is part of a network of relations, such as; labor relations, supplier relations, sales relations, customer relations, financial institutions relations, tax payments, social relations and many more. Therefore, any financial trouble within a firm will directly impact its associated socio-economic system and subsequently sustainability in the long-run [4,5].

Li et al. [6] states that high financial risk has serious implications for firm's financial sustainability, while studies such as [7,8] point out that financial distress threatens the corporate financial health. Thus, the establishment of an early warning mechanism for financial distress can improve firm's financial sustainability. Consequently, recent studies [4,9] have employed different measures of financial distress to gauge the financial sustainability of firms.

Firm life-cycle theory proposes that firms pass through a series of foreseeable development phases and that the strategies and structure of the firms vary significantly with the change in corresponding phase of development [10-12]. Numerous studies put forward different life-cycle models by applying a diverse array of measures such as, organizational state, leadership style, strategic orientation, critical development zones, age of the firm, dividend payout policy, and firm cash flow patterns to determine each stage of development [13-15]. Though the number of stages suggested for the life-cycle models varies from three [16] to ten [17], yet all models reveal similar pattern of development. Models with several development stages classify general phases to specific periods, whereas models with fewer development stages integrate two or more stages to attain a parsimonious model [18].

Corporate life-cycle and bankruptcy risk propensity have received substantial research interest in the contemporary literature. Studies on firm life-cycle suggest that it has a strong impact on firm's operating performance [19], financing [20,21] investment [22] and dividend decisions [15,23]. While literature on financial distress reveals a significant relationship with firm investment decisions [24], stock returns [25], bond returns [26], productivity [27], dividend payment [28] and operational restructuring [29]. Notwithstanding the profundity of these studies, they mainly focus on a narrow aspect of firm's bankruptcy risk while paying less attention to the variations in bankruptcy risk propensity with the change in firm life-cycle. Surprisingly, an in-depth exploration of the extant literature did not result in even a single study that empirically examines the association between firm life-cycle stage and corresponding financial vulnerability. Thus, owing to the importance of this subject, dearth of empirical evidence, and recent advancements in the development of appropriate constructs for firm life-cycle motivated us to explore the relationship between these two distinct aspects of an enterprise. For this purpose, we use a sample of non-financial listed firms of Pakistan. We focus on this developing economy for many reasons. First, it is located in South Asia-World's fastest growing region. Second, Pakistan's domestic credit to private sector to GDP ratio of 15.4% is quite low as compared to other countries of the region such as India (52.2%), Bangladesh (43.9%) and Sri Lanka (40.7%) as well as the advanced economies, such as United States (189%), Australia (137.6%) and Euro region (90.4%). Whereas, non-performing loans of Pakistan (11.1%) are higher than those of India (7.6%), Sri Lanka (3%), United States (1.5%), Australia (1%) and European Countries (5.4%) [30]. These evidences unveil that comparatively, Pakistani firms have less access to external financial resources while, their pay-back ability is also lower than that of other countries in the region. It depicts that in case of prolonged financial trouble, firms have very limited options of getting external financing. These grounds make Pakistan an appropriate case for this study.

Our empirical outcomes posit that when compared to the shake-out stage, bankruptcy risk of a firm will be higher at the introduction, growth, and decline stages, which is lower during the mature stage only. Results further suggest that bankruptcy risk of the sample firms is higher during the introduction stage as compared to the growth stage of life-cycle. On the whole, these results document a significant influence of life-cycle stage on the financial viability of a firm. It is worth mentioning that, the purpose of these findings is not limited to the identification of certain stages where firms face financial troubles. Rather, to consider that if financial fragility prevails for a

significantly longer time period, it will ultimately affect the stakeholders in terms of job losses, loss of capital, and loss of business relationships. Thereby, it also serves as an early warning mechanism for the stakeholders (labor, investors, suppliers and sellers) to rationally distance themself from the firm if the management is not taking corrective actions to control the financial risk of the firm.

Our study makes at least three significant contributions to the literature. First, this study is first of its kind that extends the firm life-cycle literature by examining its influence on bankruptcy risk thus has important implications for the longevity and sustainable functioning of an enterprise. Second, findings of this study can help the managers to make optimal financial decisions by taking into account the corresponding stage of their corporate life cycle. Third, it provides an early warning mechanism for the stakeholders (labor, investors, suppliers and sellers) to pressurize the management to take corrective actions in the instance of a prolonged financial distress.

The rest of the paper is organized as follows. First, we review the relevant literature to develop testable hypotheses. Then we describe the sample, provide measurement of the variables and research design. The subsequent section reports empirical findings and the final section concludes the study.

2. Literature Review and Hypotheses Development

Corporate life-cycle theory proposes that firms, like living organism, pass through foreseeable stages of development and possess varying risk characteristics [31], strategies, structure and capabilities at each corresponding life-cycle stage [10,12].

At introduction stage of firm life-cycle, also known as "entrepreneurial stage" [12] and "existence stage" [14], firms are small, tightly controlled by owners, having simple structure, struggling to become viable entities that necessitates bold decision making and substantial risk-taking. During this stage, firms require substantial investments and have more opportunities to invest in positive NPV projects [32]. Consequently, these firms are likely to bear higher debt ratios than growth and mature firms [33]. However, selling of entrepreneurial ideas to the financiers remains a key problem [34], as pervasive information asymmetry surrounding new businesses, uncertain future cash flows, and higher firm-specific risk [35] leads to skepticism among potential investors. As a result, firms borrow external funds at higher rates to overcome the shortage of capital [36,37]. Moreover, small firms bear higher debt ratios with lower profit margins [4] which leads to increased financial distress.

During the second stage of life-cycle, known as "survival stage" [14] and "growth stage" [13], firms develop formal structures [12] expand through innovation and diversification [38] establish distinctive competencies, emphasize on rapid sales growth, delegate some authority to middle-managers, and broaden their product line [11]. Growing firms also prefer to develop or buy physical assets to build competitive advantage either by outperforming an equivalent competitor's assets or by capitalizing and improving firms' internal mechanism [39]. While the potential challenge to a growth firm is to produce, distribute, and sell its products in large volume and to evade the state of being shaken out of the market [40,41]. Thus, firms at this stage heavily rely on external financing as their demand for capital is normally higher than their ability to generate funds internally [42]. However, superior firm performance and less information asymmetry at growth stage reduce uncertainty about future stock returns and cash flows [43] Therefore, cost of their equity capital will be lower as compared to introduction firms [44]. Growing firms would have lower debt ratios than firms in the introduction and decline stages [33], enjoy higher sales growth [45] with highest level of solidity [46]. Furthermore, growth firms are older and larger in size than their introduction stage counterparts [11]. Even though growth firms require substantial external financing to fund their rapid growth, however, improved information environment, higher sales growth, accumulation of profits,

lower cost of equity capital and consequent lower debt ratios allow them to improve their financial standing as compared to the introduction stage firms.

The third stage of life-cycle is referred to as "formalization and control stage" [12], and "maturity stage" [13]. Maturity stage of a firm's life-cycle gets underway when the sales growth begins to slow down [47]. At this stage sales level of the firm stabilizes, innovation declines and it prefers to exploit profits by evading expensive changes and keeping favorable prices of the products. Firms at this stage are conservative and prefer to protect what they have already achieved [14,48]. Managers become more risk-averse than at any other stage with less innovative and proactive attitude generally ignoring the long-term strategic orientation in their approach [11] that is marred by slower decision-making process [49]. Consequently, firms may also fail to exit the sectors with limited positive NPV projects [50]. Hence, at this stage top-level management assumes monitoring role leading to severe agency conflicts that may arise because of risk-averse and self-serving managerial behaviors [51]. Such firms usually possess higher level of retained earnings [15], liquidity [46] and higher operating cash flows thus have significantly lower demand for external capital to finance fewer profitable investment opportunities even though they can borrow at lower rates [33]. Therefore, during this phase, firms are usually financially more stable and are less prone to the possibility of going bankrupt.

The fourth stage of firm life-cycle is known as, "revival phase" [11], "renewal" [14] and "shake-out stage" [13]. We find competing arguments about this stage of firm life-cycle. For some this is the most exciting stage of firm life-cycle as substantial major and minor product-line innovations take place during the revival stage [11,14]. Consequently, organizations tend to be proactive, rapidly growing and are larger than their competitors. Therefore, firm size increases as compared to any other stage. On the contrary, others [13,52] argue that at this stage of life-cycle, number of products begin to decline leading to falling prices [53]. However, the true role of the shake-out stage in life-cycle theory remains unclear [13]. Following [54], we use the shake-out stage as the base to compare and interpret the results of other stages of firm life-cycle.

The final stage of firm life-cycle model is the decline stage [13], for which most of the scholars have almost similar view point as it seems quite different from all other stages. At this stage, firms become stagnant with inelastic demand for their products, declining revenues and contracted market share. Firms also face internal inefficiencies, erosion of business ideas and management strategies. Although, distressed firms can increase their chance of survival by reducing investment [55]. In juxtaposition, declining firms tend to increase their investment [54] and spend more on research and development in an attempt to regain their market share [13]. However, they generally fail as decision-making is concentrated in the hands of few top-level managers. Managers spend most of their time to handle the prevailing crises, and they find a very little time to make an analysis about the state of affairs before taking any decision [11]. Consequently, they may invest in risky negative NPV projects just to signal the stakeholders that investment opportunities still exist [56]. Based on the above arguments, we have developed the following hypotheses.

Considering the shake-out stage as the benchmark stage:

H1: Firms face the highest bankruptcy risk at the introduction stage of life cycle.

H2: Growth firms face lower bankruptcy risk than those at the introduction stage of life cycle.

H3: Mature firms face the lowest bankruptcy risk.

H4: Firms face bankruptcy risk at the decline stage of life cycle.

3. Research Design

3.1. Measurement of variables

3.1.1. Dependent variable

Firm's bankruptcy risk is the dependent variable of this study. Li et al. [6] contends that high financial risk directly impacts financial sustainability while, Lee et al. [57] point out that companies should avoid bankruptcy risk to ensure the smooth working of an enterprise. Keeping in view, we choose two widely used and most cited overall measures of bankruptcy risk, namely: [58] and [59] as a proxy to reflect the financial stability of the sampled firms. Over the last few decades, Altman's Z-score emerged as the most recognized tool for evaluating the financial health of firms [60]. This is also confirmed by the recent studies [61-65]. In Altman (1968) model, lower values of Z-score indicate that firm is facing financial trouble and its ability to finance projects internally is worsening. Put differently, firm is facing a phenomenon of deteriorating financial vulnerability. Conversely, higher Z-score values are an indication of lower bankruptcy risk or sound financial standing that is an ultimate sign of financial stability. Thus, the inverse of Z-score is used in the regression analysis. We also employ Zmijewski (1984) model, the most widely used measure of financial distress in the accounting literature [66], as an alternative proxy. The parameters of this model are developed using Probit analysis. Therefore, the resulting score will lie between 0 and 1. If the score lies at or above 0.50, it is associated with higher level of bankruptcy risk or lower financial stability. While, a score below 0.50 referred to the situation of satisfactory financial standing.

3.1.2. Explanatory variables

Life-cycle stages of the firm are explanatory variables of the study. It is hard to assess the life-cycle stage of an individual firm. A firm is composed of many overlapping and distinct life-cycle stages because of its fairly diverse product offerings in multiple industries [13]. To address this issue, the study has followed the approach of [13] to develop proxies for firm life-cycle stages. She maintained that firm's cash flows capture differences in its growth, profitability, allocation of resources, and risk. Thus, one can classify firms in different life-cycle stages such as, 'introduction,' 'growth,' 'maturity,' 'shake-out' and 'decline' by using cash flow from operating (CFO), investing (CFI) and financing (CFF) activities. Our adopted methodology is established on the following cash flow pattern, Table 1.

Table 1: Cash flow pattern over life-cycle stages

Life-cycle stage	Operating cash flows	investing cash flows	Financing cash flows
Introduction	-	-	+
Growth	+	-	+
Mature	+	-	-
Decline	-	+	+ or -
Shake-out	Any pattern other than of the ones that are mentioned above		

'+' indicates positive cash flows or cash flows > '0', while '-' shows negative cash flows or cash flows< '0'.

3.1.3. Why cash flow based measure of firm life-cycle?

A wide range of studies [11,18,67] suggest that firm life-cycle do not follow a sequential pattern. However, most of the empirical measures of life-cycle stages use firm age, growth, and size which are sequential measures [68]. Certainly, these life-cycle measures are criticized because of their linear nature and incompatibility with the real world scenarios [69]. Dickinson [13] postulates that "a firm is a portfolio of multiple products, each potentially at a different stage of life-cycle". While entry into new markets, product innovations, and operational variations could also provide a root to non-sequential changes in firm life-cycle stages. Hence, Dickinson suggests a cyclical measure of life-cycle stages based on cash flow patterns of the firm. The cash flow patterns based model has two key benefits. Firstly, it reflects the entire financial information of the company instead of being a one-dimensional measure of firm related attributes (e.g., firm age, sales growth, size, and flexibility). Secondly, it is cyclical in nature and indicates the true state of the business cycle.

As a robustness check, we also use retained earnings scaled by total assets (RE/TA) measure of firm life-cycle employed by DeAngelo et al. [15]. They argued that firms with higher RE/TA ratio tend to be mature with declining investments, while lower RE/TA ratio implies that firms are young and growing. To classify the firms into introduction, growth, maturity, and decline stages, we follow O'Connor and Byrne [70] and take the median of RE/TA ratio, where firms above the sample median are considered as mature firms. Further, firms at their early stage of life-cycle are deficient in retained earnings [71] and are inclined to raise all or most of the investment funds from external sources. Over time, successful firms start to accumulate profits and managers prefer to plow back the cash flows to finance their growth opportunities. As time elapses, firms and their products become mature, and they face lack of opportunities because further investment in the primary innovation starts to generate declining returns. In response, managers tend to invest internal funds in the negative NPV projects which further aggravate the existing losses [72]. Following these lines of arguments, we infer that firms during introduction and decline stages of their life-cycle have null or negative balance of retained earnings while mature firms tend to have higher retained earnings than growth firms. Hence, the firms below sample median have been classified into two categories: growth firms having positive RE/TA ratio; and introduction and decline stage firms having zero/negative RE/TA ratio.

3.1.4. Firm-level controls

A plethora of literature suggests that firm financial trouble is influenced by numerous internal factors. To avoid unobserved heterogeneity, we include several firm-level controls that prior studies [54, 73-75] have found to be associated with corporate financial health. Larger firms, we use natural log of the market value of equity to measure firm size (FSIZE), possess more assets and are expected to maintain creditworthiness. Leverage (LEVG) is measured as total liabilities scaled by shareholders' equity. We use market value of equity to book value of equity (MTB) to proxy potential growth of firms [76]. Firm's sales growth (SGROW) indicates firm's operating performance relative to the preceding year. Anthony [77] claims that investment will be less rewarding if sales growth is slow. Profit margin (PM) measured as net profit before taxes scaled by total sales is included to control for firm's current profitability. We employ fixed assets growth (FAGR) as the ratio of current year's fixed assets to lagged fixed assets to proxy the growth in capital expenditures.

Moreover, considering that our both dependent variables i.e. Altman's Z-score and Zmijewski Score, are constructed with financial ratios, while the firm specific explanatory variables are also based on some variation of these financial ratios. Thus, there could be a potential problem of endogeneity if both dependent and the explanatory variables are based on the financial statement observations from the same period. To address this issue we have lagged the financial ratios as the explanatory variables by one period.

3.1.5. Industry level controls

At the industry level, we control for the extent of competition among the rival firms (INDCOM) using Herfindahl index that measures firm's market share in relation to the industry. Herfindahl index is calculated as sum of the squares of the market share of firms within an industry. The resulting

industry's competition index will range from 0 to 10000 where smaller Herfindahl index indicates highly competitive industry with a lower level of concentration and vice versa.

3.1.6. Country level controls

We further employ country level economic controls that may have an impact on corporate financial sustainability. We use economic controls such as industrial growth (INDGR), growth in real GDP (GGDP) and inflation (INF).

4. Data, sample and methodology

4.1. Sample and data selection

Sample of this study includes all non-financial firms listed on Pakistan Stock Exchange (PSX) for the period of ten years (2005 to 2014). Our sample period begins from 2005 because prior to this period cash flow data required to calculate firm life-cycle stage has several missing observations. A firm must have consecutive five years of reported data to be part of the sample of this study. This resulted in an unbalanced panel of 301 firms with 2789 firm-year observations. Cash flow data for calculating firm life-cycle stages is obtained from OSIRIS database. Stock prices information has been retrieved from khistocks.com website. The data to calculate bankruptcy risk proxies and control variables is extracted from Balance Sheet Analysis (BSA) published by the State Bank of Pakistan (SBP). The data related to economic variables (GDP growth and inflation) is acquired from World Development Index (WDI) available at World Bank's website whereas the data on industrial growth is extracted from CIA World Fact book. Additionally, annual reports were also consulted in some cases to make up for the missing values of firm-level variables.

Our sample firms are nested under 12 different industries, Figure 1. The number of firms in each industry varies significantly from the other industries. Textile sector alone contributes a portion of 39.2% in our sample. While, other services and electrical machinery are the smallest sectors that contribute a share of 2.33% & 1.66% respectively.

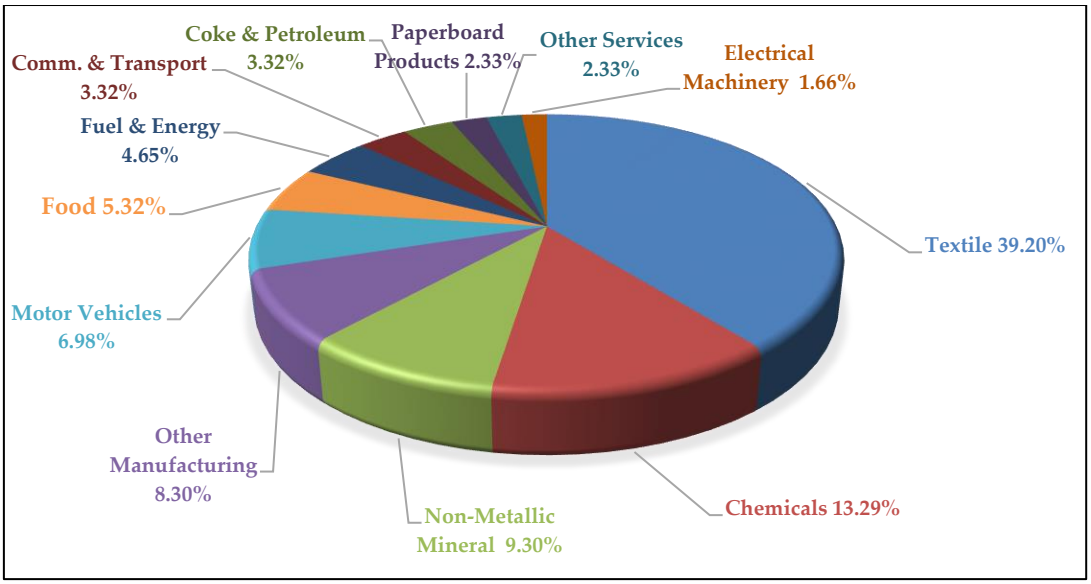

Figure 1: Industry wise distribution of data

In figure 2, we provide the distribution of sampled firms over life-cycle using Dickinson method. The pie chart indicates that a large percentage (43%) of our sample consists of mature firms and only 7% firms are at the decline stage of their life-cycle. In the remaining sample, introduction, growth, and shake-out stages represent a share of 18%, 18%, and 14% respectively.

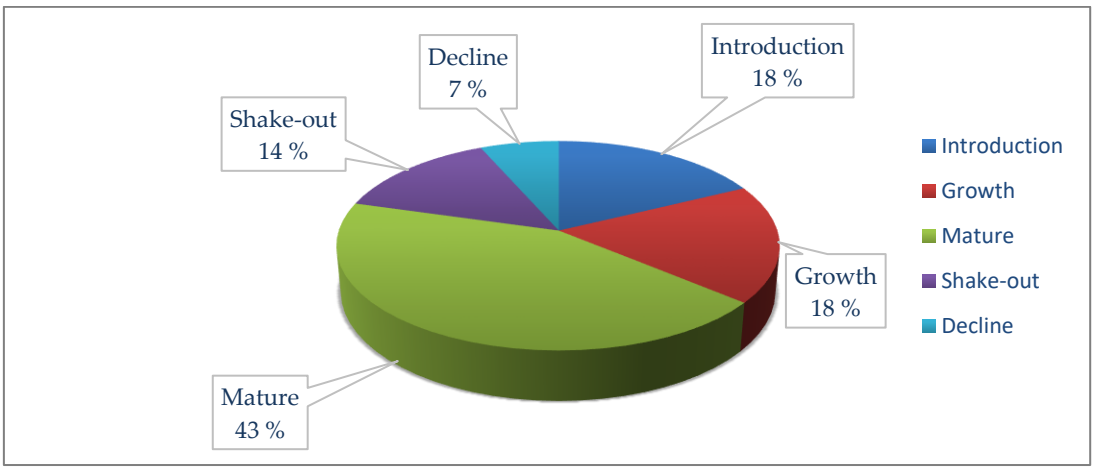

Figure 2: Distribution of sample firms over corporate life-cycle using Dickinson's model

4.2. Empirical model

We employ the following regression model to test the association between financial sustainability and firm life-cycle stages:

$$\text{Bankruptcy risk}_{i,t} = \alpha_0 + \sum_{i=1}^{4} \beta_i \text{FLCS}_{i,t} + \beta_5 \text{FSIZE}_{i,t} + \beta_6 \text{LEVG}_{i,t} + \beta_7 \text{MTB}_{i,t} + \beta_8 \text{SGROW}_{i,t} + \beta_9 \text{PM}_{i,t} + \beta_{10} \text{FAGR}_{i,t} + \beta_{11} \text{INDCOM}_{i,t} + \beta_{12} \text{INDGR}_{i,t} + \beta_{13} \text{GGDP}_{i,t} + \beta_{14} \text{INF}_{i,t} + \varepsilon_{i,t}$$

Bankruptcy $\text{risk}_{i,t}$ is inverse of Altman's Z-score and Zmijewski's ZMI-score of firm i at time t.

LCS is a vector of dummy variables which represent different stages in firm's life-cycle, wherein β1, β2, β3 and β4 denote introduction, growth, mature, and decline stages respectively.

4.3. Methodology

Considering hierarchical structure of our data set that nests 301 firms in 12 industries, while we have employed both firm level and industry level explanatory variables. From an econometric modeling perspective, observations at the firm-level are grouped under higher units (e.g., industries and countries) and analyzing the data through Ordinary Least Squares (OLS) or General Linear Models (GLS) could give rise to numerous problems such as biased estimates of coefficient standard errors, correlated errors and wrongfully interpreting the results and significance of the variables [78]. Moreover, it is important to differentiate the effects that take place at the firm-level from those that take place at industry level. Therefore, we used a recently developed modeling technique Hierarchical Linear Mixed Models (HLM) that processes multilevel data where observations are not completely independent [79]. There are several distinct advantages from using a multilevel hierarchical model in our setting. First, we can statistically test multilevel theories, simultaneously modeling the variables at firm and industry level without recourse to data aggregation or dis-aggregation. Second, the HLM has the ability to handle unbalanced data where sample size varies across higher levels, as in present study number of firms varies widely across industries. Third, while explaining bankruptcy risk, the HLM focuses on differences between groups (e.g., industries) in relation to differences within groups (e.g. among firms within industries). Moreover, when data is of hierarchical nature, the individuals (firms) in the same group (industry) could be more similar to each other than those of the individuals of other groups [80]. Which violates the "independence of observations" assumption of ordinary least square regression analysis. In contrast, HLM models are designed to deal with the partial interdependence among parameters of same group by modelling both individual and group level residuals [81]. Thus, HLM is not only needed, but required in this

study. However, two necessary conditions should be met before using HLM in a multilevel data set. First, the sample size should be appropriate as small sample could weaken the statistical power of the analysis. Though, there is no consensus among the statisticians on a particular sample size to use HLM. Nezlek [82] is of the view that ten or more level 2 units (in our study level 2 consists of 12 industries) can provide a suitable basis for making inferences about the population. The second condition is that the dependent variable should belong to the lower level parameters (in our case a firm level variable) [83].

3.5. Alternate Methodology

Habib and Hasan [53] argues that organizations are heterogeneous in nature and there are always some dynamics that are difficult to measure and are not concealed in the model, nevertheless these dynamics can have an impact on firm performance. The benefit to use panel data models is that they help us to control unobserved heterogeneity, consequently, minimize the chance of getting biased empirical findings arising from the issue of heterogeneity [84]. Following these arguments, in addition to the HLM methodology, study have also applied panel data fixed-effects and random-effects techniques to test the proposed hypotheses. Hausman post estimation test was applied to select the technique that provides more consistent results between fixed effects and random effects models.

5. Results and Discussion

5.1. Descriptive statistics

In Table 2, Panel-A presents pooled descriptive statistics for dependent, independent, and control variables while Panel-B reveals the correlation analysis. In Panel-A the values of Z-score for introduction (-1.29), growth (-1.78) and decline (-0.929) stages are higher than mature (-2.83) and shake-out (-2.38) stages. Similarly, the mean values of ZMI-Score for introduction (0.45), growth (0.31) and decline (0.47) stages are higher than that of mature (0.26) stage. Moreover, as compared to the growth stage, average Z-score and ZMI-Score are higher during the introduction stage. These outcomes support the hypothesis that firms assume higher bankruptcy risk during the introduction, growth and decline stages while lower risk at the mature stage. It also confirms that average bankruptcy risk propensity will be higher during the introduction stage as compared to the growth stage of life-cycle. In addition, mean values of RE/TA for introduction (-0.031), growth (0.021), mature (0.035), and decline (-0.019) stages strongly support the notion that RE/TA ratio will be negative for introduction and decline stages while positive for growth and maturity stages. Moreover, this ratio is higher at the mature stage as compared to the growth stage of life-cycle for sample firms. Furthermore, FSIZE reveals that firms are smaller at introduction stage (12.92) and grow progressively during the growth (13.60) and mature (13.74) stages. However, they again start to shrink at the shake-out (13.24) and decline (12.13) stages. Consistent with the life-cycle theory for firms, statistics reveal that MTB and PM progressively increase when the firms move from introduction to mature stages and start to decline as firms transform from mature to decline stages. Additionally, sales and fixed assets grow from the introduction to growth stage while decrease during the mature stage and reach to the minimum level at the decline stage.

Table 2: Descriptive statistics

Panel-A: Descriptive analysis										
Variables	**N**	**Mean**	**S.D**	**5thperce**	**95thperce**	**Intr**	**Growt**	**Matu**	**Shak**	**Decli**
Z-score	2789	-2.18	3.03	-.651	6.54	-1.29	-1.78	-2.83	-2.38	-.929

ZMI-score	2755	.331	.268	.022	.94	.45	.31	.26	.31	.47
RE/TA	2789	.0127	.176	-.149	.153	-.031	.021	.035	.001	-.019
FSIZE	2789	13.39	2.27	9.90	17.31	12.9	13.60	13.74	13.24	12.13
LEVG	2789	1.47	44.4	-2.41	6.32	1.81	-.77	2.35	1.22	1.48
MTB	2789	1.04	10.3	-.118	3.80	.307	1.01	1.35	1.13	.839
SGROW	2789	.318	6.30	-.454	.776	.243	.372	.147	1.0	.038
PM	2789	-17.22	287.	-48.24	29.42	-24.9	-2.74	.995	-22.8	-144.3
FAGR	2789	.276	2.06	-.111	.982	.246	.399	.195	.444	.194
INDCOM	2789	1180	1144	232	3980	984.	1162	1210	1378	1133
INDGR	2789	4.39	3.08	-1.9	10.7	4.64	4.93	4.15	4.41	3.74
GGDP	2789	3.87	1.78	1.6	7.7	3.80	4.35	3.80	3.79	3.45
INF	2789	11.01	3.95	7.2	20.3	11.6	10.3	10.9	11.08	11.2

In Panel-B of Table 2 we find a positive correlation of bankruptcy risk with introduction, growth, and decline stages while it is negatively associated with the mature stage. This empirical outcome is in line with the hypothesis of the study. Both FSIZE and PM have a positive correlation with growth and mature stages. However, this association is negative for introduction, shake-out and declining stages of firm life-cycle. It reveals that as compared to growth and mature stages, firms are relatively small and less profitable at the early and decline phases of life-cycle. Likewise, MTB ratio exhibits a negative and significant association with introduction and growth stages but this relationship becomes positive at mature stage of firm life-cycle. Moreover, growth in fixed assets is negative at the introduction, mature and decline stages while growth stage firms invest heavily in acquiring fixed assets since at this stage of life-cycle, firms thrive to achieve competitiveness. Summing up, the correlations among life-cycle stages, risk-taking, and control variables are in the predicted directions, thus provide support for the measures and constructs of this study.

Table 2: Correlation analysis

Panel-B: Life-cycle-wise correlation analysis					
Variable	**Introduction**	**Growth**	**Mature**	**Shake-out**	**Decline**
Z-score	0.1353*	0.0629**	-0.1898	-0.0264*	0.1097*
ZMI-Score	0.1051*	-0.0196	-0.1148*	-0.0029	0.1029*
FSIZE	-0.0951	0.0435***	0.1331*	-0.0280*	-0.1476
LEVG	0.0036**	-0.0238*	0.0174**	-0.0023**	0.0000**
MTB	-0.0332*	-0.0013**	0.0269**	0.0033**	-0.0052**
SGROW	-0.0055**	0.0041**	-0.0236*	0.0437***	-0.0118**
PM	-0.0125**	0.0238**	0.0555**	-0.0079**	-0.1176

FAGR	-0.0068**	0.0283***	-0.0345*	0.0329***	-0.0106**
INDCOM	-0.0796	-0.0073**	0.0235**	0.0700**	-0.0108**
INDGR	0.0385***	0.0820**	-0.0677	0.0029**	-0.0559*
GGDP	-0.0201**	0.1246*	-0.0372*	-0.0182**	-0.0632
INF	0.0766**	-0.0774	-0.0133**	0.0070**	0.0192**

As mentioned earlier, firms do not follow a sequential pattern of the life-cycle. Table 3 shows patterns of transition for sample firms from one stage to another using [13] model. We use four dummies to define this transition: $stayer_{i,t}$, $developer_{i,t}$, $repeater_{i,t}$ and $rusher_{i,t}$. A sample firm is designated as stayer at year t ($stayer_{i,t}$ =1) if it was in the same stage of the life-cycle in year t-1. Whereas, a firm is considered as developer ($developer_{i,t}$ =1) if it was at the previous stage of the life-cycle in year t-1 and transited sequentially to the very next stage in year t. Similarly, a sampled firm is defined as repeater ($repeater_{i,t}$ =1) if it was at an advanced stage in the year t-1 and in a former stage at year t. A firm is labeled as rusher ($rusher_{i,t}$ =1) if it was at an earlier stage of the life-cycle in year t-1 and jumped to an advanced stage by skipping one or more stages in year t. In Table 4 we report that of all sampled firms, 52.85 percent of the firms stayed in the same stage of life-cycle; 13.23 percent of firms transited sequentially to the next stage; 23.13 percent reverted to an earlier stage of their life-cycle; and 10.79 percent firms entered into an advanced stage by skipping one or more stages.

Table 3: Transition of firms over life-cycle stages

Description	Pooled	Introduction	Growth	Mature	Shake out	Decline
Stayer %	52.85	45.97	50.29	63.06	40.51	37.50
Developer %	13.23	---	15.32	10.83	32.82	17.39
Repeater %	23.13	54.03	34.38	13.47	10.00	---
Rusher %	10.79	---	---	12.64	16.67	45.11

Note: firms in 2005 are considered as stayers.

5.2. Regression results

We present Table 4 in two panels. Panel-A shows the regression results of HLM for bankruptcy risk and Dickinson's life-cycle proxies. We separately regress two bankruptcy risk measures, namely Z-score and ZMI-score on FLCS and a set of firm-level, industry-level, and country-level control variables.

Table 4: Panel-A: Association between firm life-cycle and bankruptcy risk following Dickinson (2011) Model

Variables	Expected Sign	Z-score	ZMI-Score
Introduction	+	0.454***	0.0685***
		(3.27)	(5.86)
Growth	+	0.302**	0.0210*
		(2.14)	(1.77)
Mature	-	-0.282**	-0.0185*

		(-2.40)	(-1.89)
Decline	+	0.437**	0.0470***
		(2.56)	(3.29)
FSIZE	-	-0.386***	-0.0368***
		(-8.97)	(-9.58)
LEVG	+?	-0.0021**	0.00001
		(-2.56)	(0.21)
MTB	+	0.0274***	0.0001
		(7.17)	(0.53)
SGROW	-	-0.009	-0.002
		(-0.43)	(-1.12)
PM	-	-0.0002	-0.00005***
		(-1.62)	(-4.49)
FAGR	+	0.0991***	-0.00130
		(6.06)	(-0.95)
INDCOM	-	-0.0001	-0.00001
		(-1.39)	(-1.07)
INDGR	-	-0.0838***	-0.00541***
		(-5.87)	(-4.53)
GGDP	-	-0.106**	0.0105***
		(-2.27)	(2.67)
INF	-	-0.0197	0.00656***
		(-1.24)	(4.89)
Constant		4.125***	0.747***
		(6.08)	(12.33)
N		2488	2467

Robust t-statistics in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

Table 4: Panel-B: Random-effects parameters

Random-effects	Standard deviation	Standard error
Industry	.0599	.024
Firm	.198	.008
Residual	.137	.002

The regression results provide strong evidence that compared to the shake-out stage of life-cycle; firms assume high bankruptcy risk during introduction, growth, and decline stages. While, the insolvency risk is lower at mature stage of life-cycle hence supporting H_1, H_2, H_3 and H_4. Moreover, a bankruptcy risk measure has positive coefficients during introduction (0.454), and growth (0.302) stages both significant at ($p<0.01$ & $p<0.05$ respectively). The higher coefficient on introduction stage conjectures that, once firms have successfully transited from introduction to growth stage their bankruptcy risk propensity will decline by more than 30% (i.e., from 45.4% to 30.2%). Owing to limited literature on firm life-cycle and bankruptcy risk association, a reliable comparison of our findings is almost impossible. The only available comparison is with Iotti and Bonazzi [4]. Using a sample of 17 tomato processing firms they find that smaller firms are more distressed with lower profit margins, whereas, larger firms have adequate financial structure with better financial standing. Demand for external capital reduces substantially at the maturity stage as cash flows generated from internal sources are sufficient to meet the financial requirements of the firm [33]. Consistent with the proposition, the coefficient on mature stage is negative with Z-score, whereas decline stage post a positive and statistically significant ($p<0.05$) coefficient with bankruptcy risk suggesting that declining firms face internal inefficiencies with the erosion of business ideas, thus may spend more on research and development in an attempt to regain their market share through innovation in internal processes and/or product market. Additionally, the results for an alternate measure of bankruptcy risk ZMI-score provides strong support to the findings of our first analysis, as the introduction ($p<0.01$), growth ($p<0.1$), and decline ($p<0.01$) stages are positively while mature stage ($p<0.1$) is negatively associated with the bankruptcy risk. Moreover, the coefficient at introduction (0.0685) stage is larger than that of the growth (0.0210) stage, hinting a rapid decline in the firm financial risk-taking in the event of its successful transition from introduction to growth stage.

Small firms are usually more vulnerable to take risky investments while large firms should exhibit lower risk owing to their valuable asset base. Such firms are expected to have better credit worthiness with sustainable returns [53]. In line with the previous literature, FSIZE demonstrates a negative and significant ($p<0.01$) coefficient with Z-score. In addition, MTB reports a positive while PM has a negative relationship with bankruptcy risk of firms both significant at ($p<0.01$). Acquisition of fixed assets requires raising capital potentially from external sources, thereby, the coefficient on FAGR is positively significant ($p<0.01$) with Z-score. Country-level industrial growth ($p<0.01$) and GDP growth ($p<0.05$) reveal a negative and significant linkage with the bankruptcy risk. The reason is perhaps during periods of economic growth firms generally operate in conducive business environment and have easy access to the external finance with low-interest rates and lenient payback conditions which will ultimately reduce their financial troubles.

Table 4, Panel-B reports the regression estimates for the random effects parameters. In this part residual of the observations are segregated into three parts based on their magnitude relative to the firm, industry, and the grand mean. Results show that the observations deviate from the respective mean of firms by an average value of 0.137. Whereas the firm mean of observations diverge from the corresponding industry mean by 0.198 on average. However, the industry mean deviates from the grand mean by an average value of 0.0599. Altogether, these statistics confirm that model's specification is quite reasonable.

5.2.1. Robustness check

Table 5 entails an alternative proxy to measure firm life-cycle stage to check the robustness of the empirical outcomes witnessed in preceding analyses. The findings provide strong support to all the hypotheses of this study. Our first measure Z-score has a positive and statistically significant ($p<0.01$) relationship with the introduction and decline stages of firm life-cycle. The coefficient at growth stage is also positive and significant ($p<0.01$) with Z-score while mature firms are found to be negatively associated with bankruptcy risk ($p<0.01$). Similarly, firm size, leverage, and profit margin are negatively related with bankruptcy risk, while growth in fixed assets ($p<0.01$) has a positive relationship with insolvency risk which is consistent with the statistical outcomes yielded by the preceding proxy of firm life-cycle. In the context of country level controls, all the variables such as industrial growth, GDP growth, and inflation rate have a negative and significant association with the bankruptcy risk tendency of firms. In a nutshell, the empirical results reported by Deangelo's proxy are in line with the findings of Dickinson's model. Thus, it provides strong backing to the proposition that financial stability of an enterprise varies with the change in life-cycle stage.

Table 5: Panel-A, Association between firm life-cycle and bankruptcy risk using Deangelo's (2006) model

Variables	Expected sign	Z-score	ZMI-Score
Intro-Dec	+	1.611***	0.185***
		(17.71)	(25.29)
Growth	+	0.981***	0.0811***
		(9.32)	(9.58)
Mature	-	-1.370***	-0.145***
		(-16.87)	(-21.76)
FSIZE	-	-0.365***	-0.0350***
		(-8.88)	(-10.02)
LEVG	+?	-0.002**	0.0000
		(-2.57)	(0.76)
MTB	+	0.0254***	-0.0001
		(6.95)	(-0.58)
SGROW	-	-0.001	-0.001
		(-0.09)	(-0.89)
PM	-	-0.0001	-0.00004***
		(-1.26)	(-4.12)
FAGR	+	0.105***	-0.0004
		(6.76)	(-0.40)
INDCOM	-	-0.00009	-0.000002
		(-0.89)	(-0.27)

INDGR	-	-0.0616***	-0.00296***
		(-4.53)	(-2.72)
GGDP	-	-0.0988**	0.0112***
		(-2.22)	(3.12)
INF	-	-0.0264*	0.00592***
		(-1.75)	(4.87)
Constant		3.000***	0.636***
		(4.65)	(11.40)
N		2488	2467

Robust t-statistics in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01

Table 5: Panel-B, Random-effects parameters

Random-effects	Standard deviation	Standard error
Industry	.572	.208
Firm	1.91	.087
Residual	1.57	.023

Similar results were found when we re-ran the above regression models using the panel fixed-effect and random-effect models. These findings assert that firms' riskiness changes significantly along with its respective life-cycle stage. Therefore, managers should incorporate life-cycle information into their planning and decision making process to ensure the financial stability of the firm.

Additionally, we have examined the association between transition of firm life-cycle stages and bankruptcy risk to capture the non-linear relationship between bankruptcy risk and transition of firm life-cycle stages, see appendix 1 and 2. The empirical results provide a strong support to our hypotheses. Stayer firms are found to have a significantly ($p<0.01$) negative relationship with our bankruptcy risk measures. Interestingly, highest percentage (63.06%) of our mature firms are stayer. One plausible explanation of this negative relationship could be the one evident in the literature that at mature stage firms' innovation starts to decline and they prefer to protect what they have achieved by evading expensive changes. All other transitional phases (repeater, developer & rusher) have positive and significant association with firm bankruptcy risk. It entails that when a firm transits from one stage of life-cycle to another its bankruptcy risk accelerates. Moreover, if we look at the coefficients, rushers have the highest coefficient (0.21) followed by developer (0.20) and then repeaters (0.16). It shows that firm bears the highest level of risk when it breaks the sequence and jumps to the next stage of life-cycle, while firms take moderate level of risk if they sequentially proceed to the very next stage of their life cycle.

6. Conclusions

The present study examines whether corporate life-cycle theory can explain variations in the bankruptcy risk of a firm at various stages of its life-cycle? As firms at different stages of corporate life-cycle have varying levels of resources, capabilities, strategies, structure, information asymmetry

and competitive advantage, hence their financial stability should also vary systematically over the life span. Using a sample of non-financial listed firms of Pakistan during 2005-2014, our research reveals that bankruptcy risk varies significantly across the corporate life-cycle. More precisely, study suggests that firms face higher bankruptcy risk at the introduction, growth and decline phases of life-cycle, while it is lower at mature stage therefore a different financial policy response will be desirable at different life-cycle stages. Results further show that, as compared to the introduction stage, firms are financially more stable during the growth stage of firm life-cycle. Interestingly, during various life-cycle stages of a firm the corresponding bankruptcy risk resembles a 'U' shaped relationship. These findings remain unaffected when tested with alternate measures of financial distress and corporate life-cycle.

Overall, these empirical outcomes contribute to the growing body of sustainable corporate finance literature that centers on the managerial implications of the firm life-cycle theory. Hence, concerned managers must account for the life-cycle effects on the financial standing of a firm. It will, in turn, assist the management in taking such decisions that ensure the long-term financial viability of the firm. More precisely, managers should avoid taking such decisions that require heavy financing from external sources for limited positive NPV projects during introduction and decline stages of corporate life-cycle. Because this type of financing will, increase financial liabilities of the firm while decreasing returns that will lead to increased financial distress. Moreover, present study will also benefit the investors in the optimal management of their investment portfolios. As they can avoid investing heavily in introduction and decline phase firms. Hence, forcing the managers of these financially vulnerable firms to take corrective measures by taking their firm into somewhere between growth and maturity phase of life cycle to attract more investment.

In particular, this study unveils the role of the firm life-cycle in influencing bankruptcy risk of the firms in Pakistan thus have important implications for the sustainable functioning of an enterprise. The findings of this study can be generalized to the countries with similar stage of economic development. Future research in this area can focus on examining and comparing the proposed relationship in other emerging and developed economies. Moreover, it will be interesting to see the impact of corporate life-cycle on organizational structure, strategy, and earning management practices of firms.

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696 **Appendix 1. Association between transition of firm life-cycle stages and bankruptcy risk by**
697 **using HLM**

	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Z-score	**Z-score**	**Z-score**	**Z-score**
Stayer	-0.352***			
	(-4.76)			
Repeater		0.168**		
		(2.10)		
Developer			0.205**	
			(2.05)	
Rusher				0.210*
				(1.92)
FSIZE	-0.385***	-0.385***	-0.390***	-0.385***
	(-8.89)	(-8.85)	(-8.96)	(-8.84)
LEVG	-0.002**	-0.002**	-0.002**	-0.002**
	(-2.56)	(-2.56)	(-2.50)	(-2.54)
MTB	0.027***	0.027***	0.027***	0.027***
	(7.16)	(7.07)	(7.10)	(7.06)
SGROW	-0.006	-0.008	-0.009	-0.009
	(-0.28)	(-0.38)	(-0.42)	(-0.43)
PM	-0.0002	-0.0002*	-0.0002*	-0.0002*
	(-1.64)	(-1.69)	(-1.71)	(-1.74)
FAGR	0.097***	0.099***	0.101***	0.099***
	(5.88)	(5.99)	(6.13)	(6.03)
INDCOM	-0.0001	-0.0001	-0.0001	-0.0001
	(-1.39)	(-1.43)	(-1.45)	(-1.41)
INDGR	-0.074***	-0.077***	-0.078***	-0.076***
	(-5.15)	(-5.39)	(-5.43)	(-5.31)
GGDP	-0.084*	-0.080*	-0.082*	-0.081*
	(-1.80)	(-1.71)	(-1.75)	(-1.72)
INF	-0.010	-0.0091	-0.008	-0.01
	(-0.66)	(-0.57)	(-0.54)	(-0.63)

Constant	4.099***	3.877***	3.970***	3.896***
	(6.02)	(5.66)	(5.81)	(5.70)
N	2488	2488	2488	2488

t statistics in parentheses. While, ***p < 0.01, **p < 0.05, * p < 0.1

Appendix 2. Association between transition of firm life-cycle stages and bankruptcy risk by using HLM

	(Model 1)	**(Model 2)**	**(Model 3)**	**(Model 4)**
	ZMI-score	**ZMI-score**	**ZMI-score**	**ZMI-score**
Stayer	-0.0268***			
	(-4.29)			
Repeater		0.00654		
		(0.97)		
Developer			0.0126	
			(1.49)	
Rusher				0.0311***
				(3.37)
FSIZE	-0.0363***	-0.0365***	-0.0368***	-0.0362***
	(-9.32)	(-9.32)	(-9.40)	(-9.27)
LEVG	0.00002	0.00002	0.00002	0.00002
	(0.36)	(0.36)	(0.40)	(0.36)
MTB	0.0001	0.0001	0.0001	0.0001
	(0.50)	(0.43)	(0.45)	(0.43)
SGROW	-0.002	-0.002	-0.002	-0.002
	(-1.09)	(-1.21)	(-1.22)	(-1.22)
PM	-0.00005***	-0.00005***	-0.00005***	-0.00005***
	(-4.39)	(-4.44)	(-4.44)	(-4.48)
FAGR	-0.001	-0.001	-0.001	-0.001
	(-1.01)	(-0.85)	(-0.78)	(-0.91)
INDCOM	-0.00001	-0.00001	-0.00001	-0.00001
	(-1.11)	(-1.15)	(-1.17)	(-1.12)
INDGR	-0.004***	-0.004***	-0.004***	-0.004***
	(-3.74)	(-3.98)	(-4.00)	(-3.80)
GGDP	0.0125***	0.0128***	0.0127***	0.0128***

	(3.14)	(3.20)	(3.18)	(3.19)
INF	0.007***	0.007***	0.007***	0.007***
	(5.65)	(5.71)	(5.74)	(5.60)
Constant	0.739***	0.726***	0.731***	0.722***
	(12.27)	(12.00)	(12.09)	(11.95)
N	2467	2467	2467	2467

t statistics in parentheses. While, ***p < 0.01, **p < 0.05, * p < 0.1