

ESTIMATING CORPORATE RISK AND CORPORATE VALUE AN APPLICATION OF ALTMAN'S Z-SCORE ON THE KSE-30 INDEX

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ABSTRACT

This study is a first endeavor to examine the impact of corporate sustainability risk variables on the financial stability of companies within the specific context of Pakistan. Through the examination of data derived from the KSE-30 index stocks, covering the timeframe from 2020 to 2022, and utilizing Altman's Z-Score as a measure of financial stability, our objective is to elucidate the complex correlation between Environmental, Social, and Corporate Governance (ESG) risk scores and the probability of a company's continued existence. The results of our study indicate a significant decrease in the overall ESG ratings of stocks listed in the KSE-30 index in recent years. This suggests that companies are increasingly focusing their efforts and allocating resources towards tackling sustainability issues. It is noteworthy that our findings indicate that Altman's Z-Score is negatively influenced by Environmental (E) and Social (S) risk variables, whereas Governance (G) have a low impact. The aforementioned fresh insights possess significant significance, as they show a previously unestablished connection between heightened environmental and societal hazards and a decline in financial stability. This connection eventually leads to an increase in default risks and the subsequent costs connected with them. Furthermore, our research highlights the increased susceptibility of alterations in Altman's Z-Score to fluctuations in Environmental (E) risk, particularly among enterprises of smaller size. The aforementioned findings highlight the utmost importance of sustainability risk, namely social risk, in influencing the likelihood of a firm's survival. Hence, the implementation of efficient risk reduction strategies can greatly contribute to the improvement of financial stability inside corporations.

Keywords: ESG Disclosure, Altman's Z-Score, Pakistan Stock Exchange (PSX), KSE-30 Index

1. INTRODUCTION

In a period marked by increased environmental awareness, social consciousness, and demands for ethical corporate practices, the relationship between Environmental, Social, and Governance (ESG) aspects and the long-term viability of corporations has become a significant area of investigation (Deng and Zhao2022). Pakistan, as a developing economy characterized by a distinct socio-economic environment, finds itself at a critical point where environmental, social, and governance (ESG) hazards have the potential to significantly influence

the sustainability and adaptability of enterprises (Costantiello and Leogrande 2023). This study undertakes a thorough investigation of the relationship between ESG hazards and the long-term viability of corporations in Pakistan. The research use Altman's Z-Score, a reliable financial statistic, to analyze this interplay (Destriwanti et al., 2022). This study aims to inspect the impact of ESG aspects on the performance of shares and long-term viability of firms functioning in dynamic business landscape of

Pakistan with the help of a tested technique of the risk factor by using Altman's Z score.

ESG related dangers pose a serious threat to business landscape of Pakistan. Where the firms are working under a threatening environment and the business risk is swelling day by day (Dhaliwal et al., 2014; Malik et al., 2023). According the World Bank report there are significant environmental challenges, including water dearth, toxic waste, and vulnerability to the bearings of climate change (World Bank, 2022). Environmental, Social and Governance threats are apparent in numerous facets such as labor relations, safety contemplations, and community participation (Malik et al., 2019). The concept of governance risks encompasses a range of factors, including ethical difficulties, adherence to legal requirements, and the level of transparency demonstrated by corporations (Iqbal et al., 2023). The confluence of these hazards gives rise to a dynamic environment in which firms must adeptly traverse a multifaceted set of problems in order to secure their longevity and achieve sustainable expansion.

In the midst of this intricate environment, Altman's Z-Score arises as a prominent analytical instrument for evaluating the financial soundness of corporations and, consequently, their possibilities for survival (Barboza et al., 2023). The Z-Score, a measure of corporate distress prediction, was introduced by Edward I. Altman in the late 1960s (Altman, 1968). The Z-Score is a composite indicator that quantifies a firm's financial health and the probability of bankruptcy by combining numerous financial ratios. The application of the Z-Score is a conventional practice in finance over the decades but measuring the ESG risk through this is a new phenomenon. However, its potential application in assessing ESG concerns presents a fresh and captivating concept.

Elahi et al., (2023) reported that business firm of Pakistan are taking interest in ESG practices and ESG disclosure. In this regard, to inspect the interconnectedness between the performance of stocks of firms and their vows to sustainability, so in this regard the incorporation of Altman's Z-Score offers a systematic approach. This study aims to augment the applications of the Z-Score model by assimilating ESG-related factors. Through this paper it is to determine whether firms those vigorously manage ESG related risks have amplified financial

resilience and a higher probability of endurance under stimulating conditions.

The significance of this research holds great importance for multiple players within the corporate ecosystem of Pakistan. This study provides practical insights for enterprises, investors, legislators, and regulatory authorities by highlighting the crucial relationship between ESG risk management and the long-term viability of companies. The objective of this study is to improve the understanding of how businesses functioning in a developing country like Pakistan can effectively address ESG issues to ensure their long-term viability and flexibility. The PSX plays a crucial role in the financial infrastructure of Pakistan, functioning as a key enabler for the trading of securities and the mobilization of money inside the country. The PSX, established in 2016 through the amalgamation of three stock exchanges, offers a unified platform for a diverse range of financial instruments, including equities, fixed-income securities, and derivative products. The platform serves as a dynamic marketplace that enables the engagement of both domestic and foreign investors, consequently fostering liquidity and playing a substantial role in the growth of Pakistan's capital markets. The KSE-30 Index, regarded as a key benchmark of the PSX, serves as a monitoring tool for assessing the financial performance of the thirty most notable companies listed on the exchange. The stock market index provides a comprehensive and accurate representation of the overall condition of the stock market. It serves as a benchmark for investors, analysts, and policymakers to assess and make well-informed choices. The selection of these 30 companies has been determined by a meticulous examination procedure, considering multiple aspects including market capitalization, liquidity, and transparency. The KSE-30 Index bears considerable significance as it functions as a vital tool for monitoring and evaluating the performance of Pakistan's most powerful firms. The statement accurately reflects the correlation between the prevailing economic conditions and the overall investment prospects in the country.

2. Literature Review

Within the dynamic realm of global business, the discussion pertaining to ESG concerns has beyond traditional understandings of corporate accountability and has become a crucial factor in

ensuring the long-term viability of corporations. Pakistan, a country known for its distinct socio-economic difficulties and rapidly growing corporate industry, finds itself at a critical juncture where ESG concerns interact with the crucial need for business resilience (Böhm et al., 2022). The objective of this literature review is to provide a thorough examination of the relationship between ESG concerns and the long-term viability of corporations in Pakistan. The focal point of this inquiry revolves around the application of Altman's Z-Score, a widely recognized financial indicator, as a means to assess the financial well-being and vulnerability of companies operating within Pakistan. This review aims to shed light on the intricate correlation between ESG factors and the likelihood of business longevity, drawing upon a comprehensive analysis of contemporary scholarly literature and empirical research.

Pakistan, akin to numerous developing countries, confronts a wide range of ESG hazards that possess the capacity to influence enterprises operating in distinct sectors (Fang et al., 2022). The hazards in question exhibit a noteworthy level of complexity, spanning over several domains such as the environment, society, and governance. Each of these domains has its own distinct array of obstacles and potential benefits (Elkington, 1994). Pakistan is currently faced with significant environmental challenges, which encompass water scarcity, air pollution, and susceptibility to climate change (World Bank, 2022). The environmental problems mentioned in the statement are not limited to regulatory concerns, but also encompass operational hazards that have the potential to disrupt supply chains and need expensive adjustments (Malik & Kanwal, 2019). Social hazards inside Pakistan include labor disputes, health and safety problems, and community engagement challenges (Shahzad et al., 2023). The aforementioned social issues have a profound impact on stakeholders, shaping their opinion of a brand and its standing within the market. The maintenance of confidence in organizations relies heavily on governance risks, which are demonstrated through regulatory compliance, ethical governance practices, and transparency (Iqbal et al., 2023).

The foundation of this study is Altman's Z-Score, a resilient financial statistic developed by Edward I. Altman during the latter part of the 1960s (Altman, 1968). The Z-Score is a comprehensive measure that

combines many financial ratios, such as liquidity, profitability, leverage, and solvency, in order to generate a composite score that assesses a company's financial health and probability of experiencing bankruptcy. Historically, the Z-Score has been utilized as a means of evaluating the likelihood of financial difficulty and has established itself as a fundamental tool in financial research.

In the context of Pakistan, there exists a body of empirical investigations and scholarly research that has provided insights into the convergence of ESG issues and the long-term viability of corporations. The study conducted by Dhaliwal et al., (2014) examined the commencement of corporate social responsibility (CSR) reporting in Pakistan and its influence on the cost of equity capital. The researchers' analysis revealed that companies that choose to disclose nonfinancial information voluntarily, such as ESG-related data, observed a decrease in their cost of equity capital. This finding suggests that the incorporation of ESG factors can impact investors' assessments of business risk and value. In their study, Malik and Kanwal (2019) conducted an investigation into the correlation between ESG risk variables and the financial performance of firms operating in South Asia, specifically including Pakistan. The findings of their study indicate that environmental risk variables exert a noteworthy detrimental influence on the performance of firms. This implies that companies operating in the examined region encounter considerable financial risks associated with the aspect of environmental sustainability.

Iqbal et al., (2023) examined the relationship between corporate governance practices, ownership structures, and business performance within the context of Pakistan. The research findings underscored the significant impact of governance practices on augmenting company value and minimizing risks, underscoring the crucial role of effective governance in guaranteeing the longevity of corporations. Rehman et al., (2023) inspected the increasing inclination of Pakistani investors towards investments that adhere to ESG principles, as well as sustainable finance. The growing inclination of investors in Pakistan towards ESG variables demonstrates a rising recognition of their importance and the potential influence they might have on investment choices. The existing body of literature pertaining to ESG risks and business survival in the specific context of Pakistan, during the years 2022,

2021 and 2020 highlights the significant significance of incorporating ESG elements into the evaluation of corporate resilience and long-term sustainability. The complex and diverse nature of ESG risks, which encompass environmental, social, and governance factors, requires a holistic approach to effectively manage these risks and make informed strategic decisions. The application of Altman's Z-Score as a financial indicator provides a systematic framework for assessing the extent to which companies' financial stability corresponds to their approach in addressing ESG concerns. In light of global sustainability imperatives and an increased emphasis on corporate responsibility, it is evident that Pakistan's corporate environment is also facing these challenges. The studies and research mentioned in this document offer valuable insights into the complex connections between ESG risks and the long-term viability of corporations. These findings underscore the importance for businesses to take proactive measures in addressing these risks in order to secure their continued success within Pakistan's ever-changing socio-economic landscape. On the basis of above stated literature this study proposes following hypotheses.

H1: There is a significant adverse relationship of environmental risk variables (E) and a firm's stock performance in the context of Pakistan as determined by Altman's Z-Score, suggesting that higher environmental hazards have a negative impact on stock performance.

H2: There is a significant adverse relationship of social risk variables (S) and a firm's stock performance in the context of Pakistan as determined by Altman's Z-Score, suggesting that higher social hazards have a negative impact on stock performance.

H3: There is a significant adverse relationship of governance risk variables (G) and a firm's stock performance in the context of Pakistan as determined by Altman's Z-Score, suggesting that higher governance hazards have a negative impact on stock performance.

3. Methodology

This study utilizes a methodologically rigorous framework to examine the correlation between ESG hazards and the long-term viability of corporations within the Pakistani setting. The focal point of this inquiry revolves around the application of Altman's Z-Score, a widely recognized financial indicator, as

a means of evaluating the financial well-being and vulnerability to distress of companies operating within Pakistan. The detached of this study is to experimentally investigate the impact of ESG factors on the long-term viability of corporations operating in the dynamic and ever-changing socio-economic environment of Pakistan. The present study employs a quantitative research methodology, which is in line with the aim of measuring the influence of ESG concerns on the long-term viability of corporations. This study utilizes a comprehensive dataset for three years from 2020 to 2023 containing of financial and ESG-related data for firms listed in KSE-30 index of the PSX. The sample is based on sector, encompassing enterprises from both well-established and growing industries within the corporate landscape of Pakistan. The data analysis procedure is intricately crafted with the purpose of addressing the research objectives and discerning the impact of ESG concerns on the long-term viability of corporations. The quantification of ESG risks involves assigning numerical values to ESG risk indicators, which are then integrated into a research framework. This enables a thorough evaluation of the extent to which each company is exposed to ESG risks.

Authoritative financial databases are the primary source of financial data, encompassing income statements, balance sheets, and cash flow statements. ESG data is gathered from several sources, including firm sustainability reports, ESG rating organizations, and pertinent sustainability indices. This data encompasses information pertaining to environmental effect, social responsibility efforts, and governance procedures.

The calculation of Altman's Z-Score involves is performed for each firm within the sample of the assessment of financial ratios related to liquidity, profitability, leverage, and solvency for each firm included in the sample. The Z-Score is a quantitative indicator that assesses the level of financial stability and risk of distress for each company included in the dataset.

4. Results and discussion

We computed the annual Altman's Z-score for each firm and gathered ESG risk variables. Table 1 presents a comprehensive overview of descriptive statistics. The statistical analysis encompasses the entirety of the data collected from 2020 to 2022, as depicted in Figure 1. Year-by-year averages refer to

the calculation of average values over a specific period of time, typically on an annual basis.

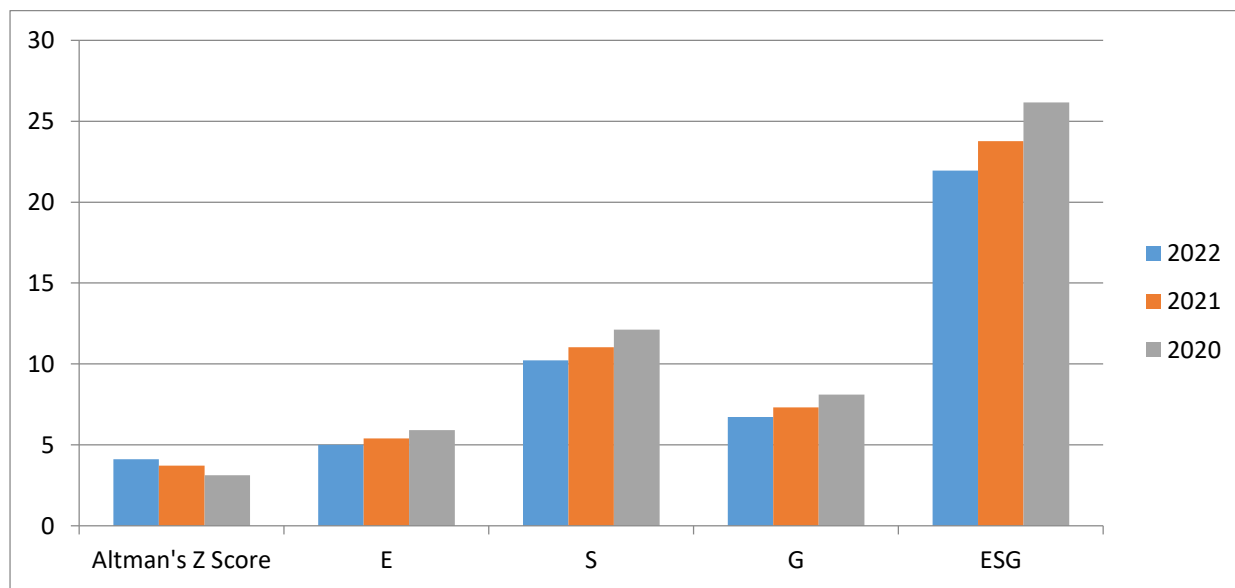
Table 1 Descriptive statistics data 2020–2022

	E	S	G	ESG	Altman's Z
Average	12.45	7.23	5.42	25.1	3.92
St. Dev	5.34	2.45	2.12	9.91	3.02
Max	21.75	18.14	15.72	55.61	16.5
Min	3.41	2.22	0.41	6.04	-1.34

E for Environmental, S social, G corporate governance, ESG the total sustainability risk factor Altman's Z=financial stability score, $Z > 2.6$ —safe zone, $1.1 < Z < 2.6$ grey area zone, $Z < 1.1$ distress zone.

According to the data presented in Table 1 and Figure 1, there has been a decline in the overall Environmental, Social, and Governance (ESG) hazards from 2019 to 2021. The observed occurrence

aligns with the hazards associated with E, G, and S factors. The presence of electronic dangers has been identified. The risks seen in all the studied years were found to be higher than those associated with S and G. user's text is already academic. The ESG factors exhibit the biggest standard deviation in relation to the E factor, with a value of 5.34. This observation highlights the association among the KSE-30 Index stocks and the aforementioned ESG components.



There exists a notable disparity in the environmental sensitivity and behavioral patterns exhibited by various entities, whereas their approach towards corporate governance matters demonstrates a reasonably uniform stance. The variability of Altman's Z score is significant.

There exists a broad spectrum of firms, ranging from those that are highly financially stable to those that are not with a high likelihood of experiencing bankruptcy in the foreseeable future. The first figure of the study is depicted in Figure 1 additionally

illustrates that the mean Altman's Z-score possesses. The grade point average experienced a rise from 3.12 in 2020 to 3.72 in 2021, followed by a subsequent increase. The value increased to 4.12 in the year 2022.

The study yields explanatory variables. Initially, the solitary survival factor on the stocks returns (Eq. 1) was as followed by...

The regression model was extended to include the ESG explanatory factors in Equation 2.

$$R_i = \alpha_i + \beta_1 Z_i \tag{1}$$

$$R_i = \alpha_i + \beta_1 Z_i + \beta_2 ESG_i \tag{2}$$

The result of Eq1 is given below

$$R_i = 8.52 + 2.41Z$$

t stat (2.59)(3.89)

$$R^2 = 0.24, F = 15.7$$

Equation 1 demonstrates a statistically significant positive relationship between Altman Z-score and stock returns. The variable β_1 , which quantifies the influence on the coefficient of Z in relation to the return on stocks, is 2.71. Table 2 presents a comprehensive summary of the data of the outcomes derived from Equation 2.

In this study, we proceed to develop and apply an econometric framework to assess the influence of

different ESG risk variables, as well as two key macroeconomic indicators, namely Pakistan's 10-year bond yields and Gross Domestic Product (GDP) growth rate, on the Altman's Z-score of firms listed in the KSE-30 Index. The objective of our study is to assess the significance of various ESG scores, in addition to external economic data, in determining the likelihood of survival for specific firms. The model implementation is depicted in Equation 3.

$$AltZ = 6.43 - 0.15E - 0.29S + 0.11G - 0.58 Yield + 0.09 PAKg \tag{3}$$

t stat: (7.00 **) (-3.08 **) (-4.32 **) (0.82)(-0.92) (1.18)

$$R^2 = 0.25, F = 6.29,$$

Table 2. The Impact of Altman Z and ESG Factors on the Stock's Returns

Model	α_i	$\beta_1(Z_i)$	$\beta_2(ESG_i)$	
1	4.31(0.45)	2.85(3.75)	0.15(0.52)	$R^2 = 0.19$ F = 12.4
2	5.72(1.34)	2.90(4.12)	0.38(1.14)	$R^2 = 0.18$ F = 13.8
3	15.72(2.18)	2.72(3.64)	0.56(1.09)	$R^2 = 0.19$ F = 14.2
4	1.31(0.18)	2.51(4.02)	0.92(1.02)	$R^2 = 0.18$ F = 13.2

The independent variable under consideration is the return of the stock, whereas the values included between brackets are the t-statistics.

Where: AltZ = Altman's Z-score, E = environmental risks, S = social risks, G = corporate governance risks, Yield=yields of PAK government 10 years bonds, PAK g=PAK economy GDP growth rate, **=significant at 95%.

Table 2 provides evidence of a statistically significant beneficial influence of Altman Z on the return of stocks. Furthermore, the inclusion of ESG elements in the regression model has resulted in an increase in the beta coefficient (β_1) from 2.75 to 2.85 for the ESG factor, 2.90 for the environmental (E) factor, and 2.72 for the governance (S) factor and 2.51 for (G). The delta value of β_1 between the original model (Equation 1) and β_1 in the second model (Eq.2) demonstrate the sensitivity of Z impact on the return of stocks.

According to the econometric model, it can be observed that Altman's Z-score is adversely affected by the variables E and S, whereas the variable G does not exhibit a significant influence. The significance of these findings lies in their capacity to demonstrate that corporations' financial stability can be diminished and their default risks can be heightened by high environmental and social hazards, resulting in the incurrence of default costs (Merton, 1974; Lu and Zheng (2023)). The aforementioned results provide evidence in favor of the proposition that allocating resources towards mitigating environmental and social risks can potentially enhance the overall worth of a firm. This is due to the fact that such efforts can effectively decrease the likelihood of default, which in turn minimizes the associated costs that could potentially diminish the company's value by as much as 25% of its pre-default valuation.

These findings additionally provide support for the notion that companies have an economic incentive to allocate resources towards addressing the environmental and social harm they do to their surroundings, particularly when they are confronted with dangers to their existence. The findings also indicate that G risks do not have a significant impact on Altman's Z-score in comparison to the other two ESG components. From the standpoint of investors, it is advisable to refrain from investing in companies with significant environmental and social risks if their likelihood of survival is low or if they require a larger return on investment to offset the additional risks involved.

According to Model 4, there is a statistically significant negative relationship between changes in the S score and changes in Altman's Z-score. The present model incorporates additional data to the findings of Model 3 by highlighting the significant impact of social risks on the company's likelihood of survival. There were no documented instances of sensitivity seen in relation to alterations in E and G. The findings of this study suggest that corporations facing financial stability issues should prioritize the mitigation of their social hazards over their environmental and social risks.

$$\Delta \text{AltZ} = 0.02\Delta E - 0.35\Delta S + 0.35\Delta G \quad (4)$$

t stat: (0.09) (-2.42 **) (1.08),

$R^2 = 0.18$, $F = 3.85$

Where: ΔAltZ = changes in Altman's z-score, ΔE = changes in the risk of environment, ΔS = changes in the risk of , ΔG = changes in the risks of corporate governance

** = significant at 95%.

This study is the initial endeavor to investigate the influence of corporate sustainability risk factors on the stock performance of the firms of KSE-30 Index. All three developed hypotheses are supported by the findings. We conducted an analysis on the impact of the ESG risk score on a company's likelihood of survival by utilizing data on KSE-30 Index companies from the period of 2020 to 2022 and employing Altman's Z-score calculation. In conjunction with the ESG scores, our model incorporates external economic data pertaining to Pakistani government bond yields and the country's GDP growth rate. The researchers observed a decline in the overall ESG scores of the KSE-30 Index, indicating a decrease in the attention given to sustainability concerns. Efforts were made to

allocate resources towards mitigating this decline. A decrease in the E, S and G metrics has been seen, additionally, our findings indicate that Altman's Z-score is adversely affected by the variables E and S, but it is not influenced by the variable G.

5. Conclusion

The findings of this study lies in the capacity to establish a direct correlation between elevated environmental and social risks and the potential decline in financial stability of corporations, leading to an increased likelihood of default and subsequent expenses associated with failure. Furthermore, we have seen a significant correlation between alterations in Altman's Z-score and changes in the variable S, particularly among enterprises of relatively smaller size. There were no sensitivities observed in Altman's z changes for the variables E and G. The findings of this study underscore the significance of sustainability risk, with a particular emphasis on social risk, in relation to a firm's likelihood of survival. Consequently, the effective management and reduction of these risks can have a substantial positive impact on the financial stability of corporations. The present study was constrained by many limitations. Firstly, it focused solely on the KSE-30 Index of the PSX. Additionally, the study only examined a three-year time period. To gain a more comprehensive understanding, future research could consider doing longitudinal studies that encompass a broader range of indices within the PSX.

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Appendix

LIST OF COMPANIES INCLUDED IN THE KSE-30 INDEX ON THE BASIS OF RE-COMPOSITION AS ON DECEMBER 31, 2020

Sr. No.	OIL & GAS EXPLORATION COMPANIES		(4 companies)
	Symbol	Company Name	Outstanding Shares
1	OGDC	Oil and Gas Development Company Limited	4,300,928,400
2	PPL	Pakistan Petroleum Limited	2,720,967,548
3	POL	Pakistan Oilfields Limited	283,855,104
4	MARI	Mari Petroleum Company Limited	133,402,500
	COMMERCIAL BANKS		(8 companies)
	Symbol	Company Name	Outstanding Shares
5	BOP	Bank Of Punjab Limited	3,271,569,321
6	NBP	National Bank Of Pakistan	2,127,512,862
7	MEBL	Meezan Bank Limited	1,789,624,275
8	BAFL	Bank Al-Falah Limited	1,577,165,119
9	HBL	Habib Bank Limited	1,466,852,508
10	UBL	United Bank Limited	1,224,179,688
11	MCB	MCB Bank Limited	1,185,060,006
12	BAHL	Bank Al-Habib Limited	1,111,425,419
	CEMENT		(5 companies)

	Symbol	Company Name	Outstanding Shares
13	FCCL	Fauji Cement Company Limited	2,452,847,220
14	MLCF	Maple Leaf Cement Factory Limited	1,073,346,232
15	DGKC	D.G. Khan Cement Company Limited	438,119,097
16	LUCK	Lucky Cement Limited	313,375,000
17	CHCC	Cherat Cement Company Limited	194,295,038
	FERTILIZER		(3 companies)
	Symbol	Company Name	Outstanding Shares
18	EFERT	Engro Fertilizers Limited	1,335,299,375
19	FFC	Fauji Fertilizer Company Limited	1,272,238,147
20	ENGRO	Engro Corporation Limited	576,163,230
	POWER GENERATION & DISTRIBUTION		(1 company)
	Symbol	Company Name	Outstanding Shares
21	HUBC	Hub Power Company Limited	1,297,154,400
	FOOD & PERSONAL CARE PRODUCTS		(1 company)
	Symbol	Company Name	Outstanding Shares
22	UNITY	Unity Foods Limited	1,194,050,000
	OIL & GAS MARKETING COMPANIES		(3 companies)
	Symbol	Company Name	Outstanding Shares
23	HASCOL	Hascol Petroleum Limited	999,120,680
24	SNGP	Sui Northern Gas Pipelines Limited	634,216,665
25	PSO	Pakistan State Oil Company Limited	469,473,300
	CABLE & ELECTRICAL GOODS		(1 company)
	Symbol	Company Name	Outstanding Shares
26	PAEL	Pak Elektron Limited	856,012,155
	TECHNOLOGY & COMMUNICATION		(1 company)
	Symbol	Company Name	Outstanding Shares
27	TRG	TRG Pakistan Limited	545,390,665
	ENGINEERING		(1 company)
	Symbol	Company Name	Outstanding Shares
28	ISL	International Steels Limited	435,000,000
	PHARMACEUTICALS		(1 company)
	Symbol	Company Name	Outstanding Shares
29	SEARL	The Searle Company Limited	390,065,855
	TEXTILE COMPOSITE		(1 company)
	Symbol	Company Name	Outstanding Shares
30	NML	Nishat Mills Limited	351,599,848

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