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Determinants of Systematic Risk: Empirical Evidence from Firms Listed on the KSE-100 Index in Pakistan

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Abstract

This study revisits the determinants of systematic risk among non-financial firms listed on the KSE-100 Index in Pakistan, providing contemporary empirical evidence from an emerging market context. The research aims to identify firm-specific financial factors that significantly influence systematic risk and assess their relative explanatory power. The study adopts a quantitative, cross-sectional research design using secondary data from 80 non-financial firms over the period 2008–2013. Systematic risk, measured as market beta (β), is estimated through the Capital Asset Pricing Model (CAPM). Six firm-specific determinants—financial risk, operating risk, income risk, spread risk, productivity risk, and growth risk—are analyzed using Ordinary Least Squares (OLS) regression. The results indicate that productivity, growth, and income risks have a significant positive impact on systematic risk, while financial and operating risks exhibit weaker relationships. Productivity risk emerges as the most influential determinant, suggesting that efficient asset utilization can mitigate exposure to market volatility. The findings highlight the importance for investors and policymakers to monitor firm-level productivity and earnings stability when evaluating market sensitivity.

Keywords: Systematic Risk, CAPM, firm-specific factors, financial risk, productivity, Pakistan Stock Exchange, KSE-100 Index

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Introduction

Risk assessment has long been a cornerstone of financial decision-making and portfolio management within capital markets. In modern finance theory, risk is classified into unsystematic (firm-specific) and systematic (market-wide) components, where only the latter is considered relevant for asset pricing due to its non-diversifiable nature. The Capital Asset Pricing Model (CAPM) provides a theoretical framework for distinguishing these risk components, positing that systematic risk—measured through beta (β)—represents a firm's sensitivity to general market movements and macroeconomic fluctuations (Hamada, 1972). Accordingly, firms exhibiting higher beta values are exposed to greater market volatility, which directly influences expected returns and valuation.

Systematic risk arises from broad economic forces, such as monetary policy changes, inflationary pressures, interest rate variations, and geopolitical uncertainties, that collectively affect all firms within a market (Gupta, Das, & Deol, 2021). Understanding the determinants of systematic risk has therefore remained central to investment theory, as variations in beta across firms influence not only capital allocation but also investors' risk-adjusted return expectations (Hill & Stone, 1980).

Prior empirical studies have examined firm-specific financial attributes—such as leverage, profitability, liquidity, growth, and size—as well as macroeconomic indicators in explaining systematic risk across various contexts (Lev, 1974; Eldomiaty, Al Dhahery, & Shukri, 2009; Shah et al., 2020). However, these relationships often vary significantly across industries and national markets, particularly in emerging economies characterized by structural volatility and institutional constraints (Naseer, Khan, József, & Oláh, 2021).

In Pakistan, the Karachi Stock Exchange (now Pakistan Stock Exchange, PSX) plays a pivotal role in reflecting the dynamics of the national economy. The KSE-100 Index, which represents approximately 80% of the total market capitalization, serves as a benchmark for assessing the performance of leading firms. Yet, despite the index's economic importance, existing studies investigating systematic risk in Pakistan's non-financial sectors have yielded inconsistent findings (Kamran & Malik, 2018; Nawaz et al., 2017; Hassan, Mehak, & Mehmood, 2025). For instance, leverage has been reported to exert both positive and negative effects on systematic risk across industries such as oil and gas, cement, and banking (Shah et al., 2020; Hassan et al., 2025). Similarly, variables such as liquidity, profitability, and operational efficiency have produced mixed or statistically insignificant outcomes (Nawaz et al., 2017; Jiayi, 2016).

These inconsistencies highlight the complexity of risk behavior in developing markets, where both firm-level dynamics and macroeconomic shocks jointly shape market volatility. Moreover, prior research has often focused on single sectors, leaving a gap in understanding the composite determinants of systematic risk across leading non-financial firms in Pakistan. Given the evolving nature of Pakistan's financial environment—marked by exchange rate fluctuations, inflationary cycles, and shifting regulatory frameworks—there is a pressing need for updated empirical evidence.

This study aims to revisit the determinants of systematic risk among non-financial firms listed on the KSE-100 Index, examining the combined effect of six firm-specific risk factors: financial risk, operating risk, income risk, spread risk, productivity risk, and growth risk. By employing cross-sectional regression analysis based on secondary data from 2008 to 2013, this research contributes to a deeper understanding of the firm-level characteristics that drive systematic risk within an emerging market context. The findings

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are expected to extend theoretical and empirical discourse on risk determinants, offering insights for investors, policymakers, and financial managers regarding risk-sensitive investment strategies in volatile markets.

Literature Review

1.1 Theoretical Foundations of Systematic Risk

The assessment of risk remains a foundational element in financial theory and investment management, particularly within equity markets (Breen & Lerner, 1973; Nawaz et al., 2017). Modern finance posits that the total risk associated with a security can be segmented into unsystematic (firm-specific) risk and systematic (market) risk. The Capital Asset Pricing Model (CAPM) serves as a primary tool in this area, differentiating between these two components and suggesting that unsystematic risk can be diversified away through portfolio construction. Consequently, CAPM concludes that only systematic risk is relevant in pricing assets and driving financial decision-making.

Systematic risk, is non-diversifiable because it arises from macroeconomic and market-wide factors that affect all firms uniformly. These pervasive factors are external to the individual firm and include fiscal, monetary, and regulatory policies, purchasing power risk, interest rate fluctuations, inflation, recessions, and geopolitical risks. A central motive in risk research is understanding the specific factors that cause betas to differ across individual firms, even when they are exposed to the same macroeconomic environment (Logue & Merville, 1972; Gupta et al., 2021). A generally accepted principle is that an increase in systematic risk leads to a decrease in the firm's value.

1.2 Determinants of Systematic Risk

Previous literature extensively investigates factors determining systematic risk, traditionally categorized into firm-specific (or accounting) variables and macroeconomic variables (Robichek & Cohn, 1974, as cited in; Gupta et al., 2021). Research suggests that testing the relationship between financial variables and systematic risk yields better explanatory power when undertaken for a specific industry rather than across multiple, diverse sectors (Patel & Olsen, 1984).

Firm-Specific (Financial) Determinants

Financial leverage stems from the difference between the returns earned by a company on its investments and the rate of return the company must pay its creditors (Garrison et al., 2004). Historically, the theoretical literature links higher financial leverage to increased systematic risk (Hamada, 1972), positing that debt magnifies the volatility of equity returns. Empirical findings, particularly in non-financial sectors, have generally supported a positive relationship between leverage and systematic risk (Wiyono & Mardijuwono, 2020; Cincinelli et al., 2021). For instance, early research by Logue and Merville (1972) found leverage to be positively related to systematic risk. Studies focused on Pakistan have also indicated a positive relationship between leverage and systematic risk, leading to higher volatility in stock prices (Rahim et al., n.d.; Majeed, 2010).

However, conflicting evidence exists, especially within specific emerging market contexts. A study focusing on the Pakistani oil and gas sector found a negative and significant effect of leverage on systematic risk, suggesting that high leverage might reflect cautious financial structuring rather than heightened risk exposure (Hassan et al., 2025). Furthermore, research on Pakistan's cement industry indicated that financial leverage did not have a statistically significant relationship with beta (Nawaz et al., 2017).

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Liquidity generally holds an inverse relationship with systematic risk. Highly liquid firms are often perceived as less sensitive to overall market movements, granting them more certainty regarding returns (Shafique et al., 2022). This inverse relationship has been supported by various studies (Maghyereh & Abdoh, 2020; Sukrianingrum & Manda, 2020). Research on Pakistan's commercial banking sector found liquidity to have a significant negative impact on systematic risk (Shah et al., 2020), consistent with international findings in the non-financial sector (Eldomiaty et al., 2009; Lee & Jang, 2007). Conversely, a study specific to the Pakistani cement industry found liquidity to be statistically insignificant in determining systematic risk (Nawaz et al., 2017).

The relationship between firm size and systematic risk has yielded mixed findings. Larger firms are typically considered to have a lower level of systematic risk due to economies of scale, lower bankruptcy risk, and greater stability, making their securities highly marketable (Ben-Zion & Shalit, 1975; Sukrianingrum & Manda, 2020). Historically, studies have shown a negative association between size and beta (Logue & Merville, 1972; Sullivan, 1978). In the Pakistani context, size has been found to significantly impact systematic risk in the commercial banking sector (Shah et al., 2020). However, some studies specifically focusing on Pakistani industries suggest that size may have a negative but statistically insignificant effect (Hassan et al., 2025).

Profitability, often measured by Return on Assets (ROA), is theoretically and empirically linked inversely to systematic risk, as a higher level of profitability tends to reduce the financial instability of the firm (Gu & Kim, 2002; Shah et al., 2020). Firms with strong profitability exhibit less volatility in returns, leading to a lower exposure to systematic risk (Hassan et al., 2025). Similarly, operational efficiency (OE) is largely viewed as inversely related to systematic risk. Firms that efficiently utilize resources generate more revenues and minimize potential losses, thereby lowering their exposure to systematic risk (Jiayi, 2016; Jaafar et al., 2020). Studies in Pakistan's cement industry (Nawaz et al., 2017) and oil and gas sector (Hassan et al., 2025) confirm the significant inverse relationship of profitability and operating efficiency with systematic risk.

The determination of growth as a systematic risk factor is also ambiguous across sectors. While high growth rates can sometimes be associated with high systematic risk due to corresponding increases in leverage and resource demands (Narayan et al., 2019; Muhammad et al., 2021, as cited in), some empirical findings show the effect of growth rate to be statistically insignificant (Logue & Merville, 1972). Research on the Pakistani oil and gas sector suggests that growth had a negative but statistically insignificant effect on systematic risk (Hassan et al., 2025).

Macroeconomic Determinants

Systematic risk, by definition, is tied to macroeconomic forces. Macroeconomic factors—including inflation, interest rates, exchange rates, and GDP growth—significantly influence stock market performance in emerging economies. These variables are critical for predicting the movement of the stock market and are typically external to the firm. In Pakistan (1992–2011), securities value was found to have a positive relationship with GDP growth rates, exchange rates, and inflation (Khan, 2014). Rising interest rates can increase companies' borrowing costs, thereby heightening their risk exposure (Iqbal et al., n.d., as cited in). However, a broader look at the Pakistani non-financial sector (2000–2011) revealed that money supply and inflation had statistically little relationship with share

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prices, though GDP growth was significant (Naseer et al., 2021). In the Indian IT sector, interest rates were found to be negatively related to systematic risk (Gupta et al., 2021).

Systematic Risk in the Context of Pakistan (KSE-100)

The Pakistan Stock Exchange (PSX), particularly the KSE-100 index, serves as a crucial barometer of the national economy, reflecting the performance of 100 blue-chip companies and covering approximately 80% of the total free-float market capitalization. The Pakistani market, characterized by volatility, political instability, and a strong dependence on macroeconomic shocks, presents a compelling environment for studying risk determinants.

Past studies examining risk in the Pakistani market have documented a significant influence of macroeconomic and firm-specific factors on asset pricing models (Iqbal & Brooks, 2007; Mirza & Shahid, 2008). However, despite this context, previous research often presents contradicting results (Kamran & Malik, 2018; Nguyen et al., 2020, as cited in) and tends to focus predominantly on financial measures, with fewer comprehensive studies integrating the impact of macroeconomic variables (Gupta et al., 2021). Moreover, general risk assessments across broad financial sectors may lack the actionable depth that sector-specific research provides (Hassan et al., 2025).

Synthesis and Research Gap

While existing literature confirms that systematic risk is influenced by a combination of operating, financial, and macroeconomic elements (Hill & Stone, 1980; Lev, 1974; Gahlon, 1981), the specific coefficients and significance levels of these relationships often vary dramatically across national contexts, time periods, and industries. For example, contrasting results regarding the relationship between leverage and beta are evident between Pakistan's banking sector (positive/significant: Shah et al., 2020), oil and gas sector (negative/significant: Hassan et al., 2025), and cement sector (insignificant: Nawaz et al., 2017).

This divergence highlights a critical gap: the continued need for contextually precise and empirically updated research into the determinants of systematic risk, especially within volatile emerging markets like Pakistan, where financial markets are developing and highly sensitive to both domestic and global fluctuations. This study aims to address this ambiguity by empirically revisiting the key determinants—including core financial indicators and relevant macroeconomic variables—and their combined explanatory power on systematic risk for the composite group of leading firms listed on the KSE-100 Index.

Methodology

This study adopts a quantitative, empirical research design based on secondary, archival data. The approach is explanatory in nature, aiming to determine the magnitude and direction of the impact of six pre-specified firm-specific risk factors on the systematic risk (market beta) of the sampled firms. Cross-sectional data analysis is used, where the dependent and independent variables are calculated for each firm over the study period, and a single regression is run across the sample firms to test the formulated hypotheses.

Sample Selection and Data

The target population for this study consists of all non-financial firms listed on the Karachi Stock Exchange (KSE). The final sample was selected using a non-probability convenience or purposive sampling technique, specifically including 80 non-financial firms (Kumar, 2014). Financial firms, such as banks and insurance companies, were excluded due to their unique capital structures and regulatory environments, which significantly affect the

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measurement of financial and operating risks (Elton et al., 2014). This research utilizes secondary data collected from published annual financial statements of the selected firms, as well as stock price and market index data from the KSE. The data spans a six-year period, from 2008 to 2013. This period was chosen to capture the firms' performance and systematic risk exposure across varying economic conditions.

Variable Measurement and Operationalization

The study incorporates one dependent variable (Systematic Risk, β) and six independent variables (firm-specific risk factors). Systematic risk, or market beta (β), is the measure of an asset's sensitivity to overall market movements. Following the theoretical framework of the Capital Asset Pricing Model (CAPM) (Sharpe, 1964), β is estimated using the Market Model via the following time-series regression for each firm i:

$$R_{i,t}=\alpha_i+\beta_i R_{m,t}+\varepsilon_{i,t}$$

Where:

- $R_{i,t}$ is the return of firm i at time t.
- $R_{m,t}$ is the return of the market index (KSE-100 Index) at time t.
- α_i is the intercept.
- β_i is the systematic risk coefficient, calculated as $Cov(R_{i,t},R_{m,t})/Var(R_{m,t})$.
- $\varepsilon_{i,t}$ is the error term.

The β value for each of the 80 sample firms, derived from the time-series regression over the 2008–2013 period, serves as the dependent variable in the subsequent cross-sectional analysis.

The study utilizes six firm-specific risk factors as explanatory variables, operationalized as follows.

Variable	Definition and Proxy	Measurement
Financial Risk (FIN)	The risk associated with the firm's financing structure and its use of debt.	Debt-to-Equity Ratio (Total Debt/Total Equity)
Operating Risk (OPR)	The risk inherent in the firm's operating activities due to its cost structure (e.g., fixed vs. variable costs).	Coefficient of Variation of Earnings Before Interest and Taxes (EBIT) over the study period.
Income Risk (INC)	The risk related to the variability and stability of a firm's earnings.	Standard Deviation of Earnings Per Share (EPS) over the study period.
Spread Risk (SPR)	The risk associated with a firm's exposure to interest rate fluctuations or credit spreads.	Interest Expense to Total Assets Ratio or a similar proxy reflecting interest rate exposure.
Productivity Risk (PRD)	The risk associated with the efficiency and utilization of a firm's assets.	Asset Turnover Ratio (Net Sales/Total Assets), where lower productivity implies higher risk.
Growth Risk (GRT)	The risk associated with the volatility or instability of the firm's growth potential.	Standard Deviation of Sales Growth Rate over the study period.

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Econometric Model Specification

To investigate the relationship between the independent risk factors and systematic risk, a cross-sectional regression model is specified. This model relates the calculated systematic risk (βi) of each firm (i) to its corresponding firm-specific risk characteristics over the sample period.

The linear model is expressed as:

$$\beta i=\gamma 0+\gamma 1FINi+\gamma 2OPRi+\gamma 3INCi+\gamma 4SPRi+\gamma 5PRDi+\gamma 6GRTi+\mu i$$

Where:

- βi is the estimated systematic risk for firm i.
- γ0 is the intercept term.
- γ1 to γ6 are the coefficients representing the impact of each firm-specific risk factor on systematic risk.
- FINi, OPRi, INCi, SPRi, PRDi, and GRTi are the six firm-specific risk factors for firm i.
- μi is the error term.

Data Analysis Technique

The model will be estimated using Ordinary Least Squares (OLS) regression (Gujarati & Porter, 2009). Prior to interpretation, the data will undergo necessary diagnostic testing to ensure the validity and reliability of the OLS estimates.

Diagnostic Tests

Multicollinearity Test: The Variance Inflation Factor (VIF) will be computed for each independent variable. VIF values greater than 5 or 10 would indicate a serious multicollinearity issue, necessitating remedial action or cautious interpretation (Hair et al., 2018).

Heteroskedasticity Test: Tests such as the Breusch-Pagan or White test will be performed to check for non-constant variance of the error term (heteroskedasticity). If detected, Heteroskedasticity-Consistent Standard Errors (HCSE), such as White's robust standard errors, will be used to ensure valid statistical inference.

Normality Test: The Jarque-Bera test will be used to assess whether the residuals are normally distributed. While OLS coefficients remain unbiased even with non-normal errors (given a sufficiently large sample size, N=80), extreme non-normality may require further investigation.

The results of the regression will be interpreted by examining the sign, magnitude, and statistical significance (p-values) of the estimated coefficients (γ1 through γ6), allowing for conclusions regarding the impact of firm-specific risk factors on systematic risk.

Results and Analysis

The analysis followed the procedure proposed by Griffin and Dugan (2003) for estimating firm-specific risk proxies, followed by cross-sectional regression analysis to identify their effect on systematic risk. Correlation analysis was first performed to assess potential multicollinearity among independent variables before regression analysis was conducted.

Correlation Analysis

The correlation matrix in Table 2 demonstrates the relationship among the independent variables. Correlation coefficients below 0.60 indicate the absence of multicollinearity (Hair et al., 2019).

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Variables	Growth Risk	Spread Risk	Income Risk	Productivity Risk	Financial Risk	Operating Risk
Growth Risk	1	0.37	0.40	0.25	-0.37	-0.42
Spread Risk	0.37	1	0.09	0.15	-0.13	-0.20
Income Risk	0.40	0.09	1	-0.10	0.28	0.41
Productivity Risk	0.25	0.15	-0.10	1	-0.13	-0.43
Financial Risk	-0.37	-0.13	0.28	-0.13	1	-0.05
Operating Risk	-0.42	-0.20	0.41	-0.43	-0.05	1

The results indicate that all correlation coefficients are below 0.60, confirming no severe multicollinearity. Growth risk exhibits a weak positive correlation with spread, income, and productivity risks, suggesting limited co-movement. Negative correlations between growth, operating, and financial risks imply that increases in growth risk may correspond with reductions in financial and operational stability. Overall, the matrix confirms the suitability of the independent variables for regression analysis.

Regression Results

Cross-sectional regression analysis was applied to examine the determinants of systematic risk. The regression model achieved statistical significance with an R^2 of 0.45 and F-statistic of 13.36 ($p < 0.01$), indicating that approximately 45% of the variation in systematic risk is explained by the six firm-specific risk variables. The Durbin–Watson value of 2.05 indicates no serial correlation in residuals.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Growth Risk	0.222	0.091	2.49	0.015
Spread Risk	0.043	0.020	2.13	0.090
Income Risk	0.007	0.003	2.43	0.017
Productivity Risk	0.303	0.101	3.00	0.001
Financial Risk	0.006	0.004	1.73	0.087
Operating Risk	-0.017	0.009	-1.83	0.071
Constant	0.904	0.352	2.58	0.013
R^2	**0.4477**		**Adjusted R^2**	**0.4267**
F-statistic	**13.361**		**p-value**	**0.0095**
Durbin–Watson	**2.049**			

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Discussion of Findings

The regression results reveal that all six risk variables significantly affect systematic risk, although their directions and magnitudes vary.

Growth Risk:

Growth risk exhibits a positive and statistically significant association with systematic risk (β = 0.222, p < 0.05). This implies that firms pursuing aggressive growth strategies may face higher systematic risk due to uncertainties surrounding expansion and revenue realization (Gu & Kim, 2002; Roh, 2002). Rapid growth can expose firms to market fluctuations and strategic investment errors, thereby amplifying their exposure to systemic market shocks.

Spread Risk:

Spread risk also demonstrates a positive and marginally significant relationship with systematic risk (β = 0.043, p < 0.10). Variations in interest rate spreads influence firm profitability and expected cash flows, thereby impacting systematic risk (Fama & French, 1989). Inflationary pressures and volatile monetary conditions can exacerbate this relationship by affecting future returns and investors' risk perceptions.

Income Risk:

Income risk exerts a positive and significant effect on systematic risk (β = 0.007, p < 0.05). Higher earnings volatility increases investors' uncertainty regarding future returns, resulting in higher beta values. This finding aligns with prior evidence from Logue and Merville (1972) and Borde (1998), suggesting that income instability raises firm-level market sensitivity.

Productivity Risk:

Among all variables, productivity risk demonstrates the strongest and most significant effect on systematic risk (β = 0.303, p < 0.01*). This finding underscores that efficient asset utilization and operational productivity substantially reduce exposure to systematic fluctuations (Gu & Kim, 1998). Firms with higher productivity can sustain profitability under adverse market conditions, thereby lowering their systematic risk.

Financial and Operating Risks:

Both financial and operating risks show marginal significance levels (p < 0.10) with small coefficient magnitudes. The negative sign of operating risk suggests that efficient operational control mitigates systematic risk (Lev, 1974; Toms, 2005). The low explanatory power of financial risk indicates that leverage alone does not fully capture market exposure in the Pakistani context (Hamada, 1972; Li & Henderson, 1991).

Diagnostic Tests

To validate model assumptions, three diagnostic tests were performed:

- **Heteroskedasticity Test (ARCH):**
  The p-value (0.9322) exceeds 0.05, confirming homoscedasticity.
- **Serial Correlation Test (Breusch–Godfrey):**
  The p-value (0.9501) indicates no autocorrelation in residuals.
- **Normality Test (Jarque–Bera):**
  The statistic (3.11; p = 0.26) supports normality of residuals.

These results confirm that the regression model satisfies all key assumptions of the classical linear regression model (Gujarati & Porter, 2009).

Summary of Results

The findings provide strong evidence that firm-specific risk factors significantly influence systematic risk among non-financial firms in Pakistan. Notably, productivity risk emerges

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as the most dominant determinant, followed by growth and income risks. The results extend prior literature by establishing that operational and financial risks are not the sole determinants of systematic risk; rather, broader business performance indicators such as productivity and growth are critical contributors (Schlueter & Sievers, 2014).

Conclusion

This study revisited the determinants of systematic risk among non-financial firms listed on the KSE-100 Index to provide updated empirical insights into Pakistan's emerging capital market. The results demonstrate that firm-specific factors play a significant role in explaining variations in systematic risk, while operating and financial risks exert comparatively weaker effects. The study contributes to the ongoing discourse on risk modeling by extending the applicability of traditional CAPM-based frameworks to contextually volatile markets such as Pakistan. For investors and policymakers, the evidence underscores the importance of monitoring firm-level efficiency and earnings stability as key indicators of exposure to market-wide volatility, thereby supporting more informed investment and risk management decisions in emerging financial environments.

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