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An Examination of the Validity of Systematic Risks for Nonfinancial Firms

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ABSTRACT: Purpose: This study empirically investigates the macroeconomic and institutional determinants of systematic risk for non-financial firms listed on the Dow Jones and NASDAQ indices over the period 2000Q4 to 2023Q1. Employing both historical beta and stochastic beta estimations, the study provides a comprehensive analysis of how external economic conditions and governance quality shape firms' exposure to market-wide risk.

Design/methodology/approach the study utilized panel data regression models, incorporating macroeconomic indicators like GDP growth, inflation, the Effective Federal Funds Rate (EFFR), unemployment rate, and the Volatility Index (VIX), as well as institutional quality proxies drawn from the Worldwide Governance Indicators (WGI), including regulatory quality, political stability, and voice and accountability.

Findings reveal that EFFR consistently exerts a statistically significant and negative effect on systematic risk, while inflation displays a positive but model-sensitive relationship. Institutional variables, particularly regulatory quality, political stability, and voice and accountability, are found to significantly reduce systematic risk, underscoring the stabilizing role of strong governance structures. In contrast, GDP growth and unemployment exhibit fragile or inconsistent associations with beta, suggesting context-dependent effects. By integrating traditional and simulation-based approaches to risk estimation, this study enhances the understanding of systematic risk under uncertainty and highlights the importance of institutional environments in moderating market volatility.

Contribution: This paper contributes meaningfully to the existing literature and to financial practice by providing a comprehensive and empirically grounded assessment of the determinants of systematic risk for non-financial firms in developed markets. Its importance lies in several key dimensions. First, the paper addresses a critical research gap by focusing on the differential impact of macroeconomic factors on systematic risk, measured via both historical and stochastic beta. While most prior studies focus on financial firms or rely solely on conventional beta estimations, this research introduces a broader perspective by including non-financial sectors and incorporating parameter uncertainty through Monte Carlo simulation. This enhances the robustness and generalizability of the findings.

KEYWORDS: Systematic risk, institutional indicators, Return Synchronicity, EFFR**,** WGI Pillar.

1-INTRODUCTION

Systematic risk, often measured by beta (β), remains a cornerstone concept in modern finance, reflecting a firm's sensitivity to broad market movements. Unlike idiosyncratic risk, which can be diversified away, systematic risk is inherent and market-wide, influencing capital asset pricing, portfolio allocation, and risk management strategies. Over the past few decades, understanding the determinants of systematic risk has become increasingly complex, particularly in the context of globalized capital markets, macroeconomic volatility, and shifting institutional landscapes.

While the Capital Asset Pricing Model (CAPM) and its derivatives have traditionally assumed beta to be stable and driven mainly by market-related factors, recent theoretical and empirical advances suggest that both macroeconomic variables and institutional characteristics may significantly influence a firm's beta. Inflation, interest rates, GDP growth, unemployment, and market volatility, for example, directly affect economic expectations and investor behavior. Similarly, governance dimensions—such as political stability, regulatory quality, and rule of law shape the institutional environment in which firms operate and influence market confidence, capital mobility, and risk perception.

Despite a growing body of research examining these relationships, most studies remain focused on financial institutions or aggregated market indices, with limited attention paid to non-financial firms in developed equity markets. Moreover, traditional methods of beta estimation often overlook the parameter uncertainty associated with market dynamics. In this light, stochastic beta

models and Monte Carlo simulations offer a more flexible and realistic framework for analyzing how systematic risk evolves under different economic and institutional conditions.

This study addresses this gap by empirically investigating the macroeconomic, institutional, and firm level determinants of systematic risk for a panel of non-financial firms listed on the Dow Jones and NASDAQ over the period 2000Q4 to 2023Q1. It employs both historical beta and simulated stochastic beta to capture the static and dynamic dimensions of risk exposure. Institutional quality is measured using the World Governance Indicators (WGI)**,** while macroeconomic data are drawn from leading sources such as the IMF and the Federal Reserve. The study also incorporates firm-specific factors, including firm growth and industry dummies, to control for heterogeneity across sectors.

By analyzing multiple models, including return synchronicity and Monte Carlo estimation, this research provides a nuanced understanding of how both economic conditions and institutional frameworks contribute to market risk exposure. The findings aim to offer new insights to academics, investors, and policymakers seeking to understand better understand and manage the drivers of systematic risk in developed markets.

2- RESEARCH PROBLEM

Despite the central role of systematic risk (beta) in modern portfolio theory and asset pricing models, its determinants remain empirically ambiguous and theoretically fragmented**.** Existing studies offer conflicting evidence on how macroeconomic variables (e.g., inflation, interest rates, unemployment) and institutional governance indicators (e.g., regulatory quality, political stability) influence beta values, especially in the context of non-financial firms in developed markets. Furthermore, traditional beta estimation often neglects parameter uncertainty, raising questions about the robustness of findings based on conventional techniques. This study addresses these gaps by examining both historical and stochastic beta using panel data for non-financial firms listed in Dow Jones and NASDAQ**,** over the period 2000Q4 to 2023Q1, in order to uncover whether and how macroeconomic and institutional factors systematically affect firm-level market risk.

3-OBJECTIVES

A-This paper aims to investigate the differential impact of macroeconomic variables such as inflation, interest rates (EFFR), GDP growth, unemployment rate, and market volatility (VIX) on the systematic risk (beta) of non-financial firms.

B-To compare the behavior of historical beta and stochastic beta across time and sectors, using Monte Carlo simulations to capture parameter uncertainty in beta estimation.

C-To identify whether the effect of macroeconomic and institutional factors on beta is robust across different econometric frameworks, including return synchronicity models and stochastic simulations.

D-To evaluate the role of institutional quality, measured through the six Worldwide Governance Indicators (WGI), in explaining variations in firms' exposure to systematic market risk.

4-MACROECONOMIC DETERMINANTS OF STOCK'S SYSTEMATIC RISK: A REVIEW OF RELATED LITERATURE

This research incorporates a comprehensive set of macroeconomic indicators to examine their influence on systematic risk across different econometric specifications. The selected variables capture key dimensions of macro financial stability and market behavior, including GDP Growth, Inflation, EFFR, and Unemployment.

4-1 Gross Domestic Product (GDP) and Market Risk

Fitriani et.al (2021) investigated the determinants of financial performance among private banks listed on the Stock Exchange between 2012 and 2017. Key independent variables include Gross Domestic Product (based on BPS data at basic prices), bank size (log of total assets), liquidity (loan-to-deposit ratio), growth (year over year asset change), capital adequacy ratio (total capital to risk-weighted assets), and inflation (consumer price index). Using multiple linear regression analysis, the results reveal that GDP, size, and growth have a significant positive effect on financial performance, while inflation exerts a significant negative effect. In contrast, liquidity and capital adequacy ratios show no significant influence. These findings highlight the importance of macroeconomic and firm-level growth indicators in shaping bank performance, while suggesting that traditional regulatory ratios may not have immediate performance implications during the observed period.

Hidayati and Rahardika (2021) investigated the impact of Gross Domestic Product (GDP), firm value, and systematic risk on the stock returns of companies listed on the Kompas100 Index from 2017 to 2020. Using panel data regression with a Fixed Effect Model (FEM) and a sample of 53 firms, the results show that GDP and systematic risk have a significant negative effect on stock returns, while firm value has no significant effect. The authors attribute these findings to investor behavior specifically, a tendency to avoid market risk during downturns and invest in reliable blue-chip stocks. The lack of effect from firm value is explained by investor confidence in the quality of stocks selected by the Kompas100 Index.

Patatoukas,(2020) investigated the puzzling weak link between stock returns and news about economic growth. Using GDP growth forecast surprises from the Philadelphia Fed's Survey of Professional Forecasters, the author finds that their univariate relationship with stock returns is statistically indistinguishable from zero, consistent with prior macro-finance research. To explain this, two hypotheses are proposed: (1) forecast surprises may be correlated with offsetting effects from cash flow news and discount rate news, and (2) these surprises may imperfectly measure true economic news due to noise. By constructing a market-level measure of discount rate news from accounting data, the study finds support for the first hypothesis, suggesting that value-relevant news components may neutralize each other in aggregate. The study contributes to the literature by applying accounting-based methods to shed light on macro-financial dynamics and by offering a partial resolution to the apparent disconnect between stock market behavior and economic fundamentals.

Karakus, (2017). examined the impact of accounting variables on the systematic risk of firms. By using data from 58 companies from the BIST-100 Index for the period between 2006 and 2015, panel data analysis is employed. The results of the study indicate a statistically significant and positive effect of asset size, asset turnover, previous term equity to total debt, and previous term cash ratio on systematic risk. On the other hand, the negative influence of profitability, equity to total debt, cash ratio, and previous term debt to total assets on systematic risk is detected. Also, the study determines that consumer price index, previous term beta, and previous term GDP per capita affect the systematic risk negatively and increase the explanatory power of the model significantly.

Al-Qaisi (2011) investigated whether emerging and developed stock markets are influenced by the same financial and macroeconomic factors affecting systematic risk. Using the Amman Stock Exchange as a case for emerging Arab markets and applying a panel data approach, the research finds that firm size, financial leverage, government deficit, and inflation rate significantly impact a company's systematic risk. The findings highlight that both firm-specific and macroeconomic variables are key determinants of systematic risk in emerging markets.

4-2 Inflation Rate and Market Risk

Valadkhani,(2025). examined the relationship between inflation and beta across U.S. sectoral ETFs from 1999 to 2024. It finds that when inflation exceeds the 1–5% range, especially above 4%, beta estimates across sectors become unstable and unreliable. This highlights the vulnerability of beta as a measure of systematic risk in high-inflation environments. The findings emphasize the importance of the Federal Reserve's 2% inflation target in preserving beta's reliability and ensuring financial market stability.

Schüler (2025) reexamined how inflation risk is handled in CAPM-based equity valuation models. It compares two consistent frameworks: one assumes a deterministic real interest rate, and the other assumes a deterministic nominal rate. The authors find that many proposed adjustments to CAPM for inflation are either theoretically flawed or mathematically equivalent to the standard CAPM. They argue that the supposed risks and valuation errors due to inflation are largely overstated and highlight the importance of applying a consistent inflation treatment to both cash flows and discount rates in valuation models.

Thorbecke (2025). analyzed the effects of the post-2019 inflation surge and decline on the U.S. stock market. Using a multi-factor model, it estimates asset exposure to inflation, monetary policy, and other macro variables for 54 assets (based on data from 1994–2019). It then applies these inflation betas to assess investor reactions during 2020–2024. The findings show that inflation fears and the Fed's anti-inflation policies created significant market volatility. The study warns that a delayed monetary response to inflation can destabilize markets

4-3 Effective Federal Fund Rate and Market Risk

Ghazanvi and Akram,(2025) examined the relationship between interest rates and stock market returns in the context of the Karachi Stock Exchange (KSE) from 1997 to 2010, incorporating macroeconomic indicators such as exchange rates, industrial production, and investor sentiment. Employing descriptive statistics, correlation analysis, unit root tests, and a revised regression model using differenced data, the findings reveal a significant negative relationship between interest rates and stock returns. While consistent with global trends, the results highlight distinct dynamics in emerging markets, offering practical insights for both policymakers and investors.

Bauer and **Swanson,(2025)** reexamined the international spillover effects of U.S. monetary policy by distinguishing between two distinct components of interest rate changes: pure monetary policy shocks and the "Fed Response to News." Employing the identification strategy developed by Bauer and Swanson (2023a), the author decomposes monetary surprises around FOMC announcements to better understand their global implications. The empirical results reveal that tightening driven by pure policy shocks leads to adverse global outcomes, including recessions, exchange rate depreciation, and tighter financial conditions. Conversely, when monetary tightening results from the Fed's response to positive economic news, it is associated with economic expansion, currency appreciation, and more accommodative financial conditions. This decomposition reconciles traditional contractionary effects of monetary tightening with recent atypical findings of expansionary impacts. The study further demonstrates that ignoring the "Fed Response to News" channel can lead to significant estimation bias. These results are robust across different country groups, alternative methodologies, and identification strategies, offering valuable insights for monetary policy analysis in both advanced and emerging economies.

Zhang (2024) investigated how investor risk aversion mediates the impact of U.S. monetary policy on stock returns. It finds that after an expansionary monetary policy shock (e.g., a decrease in interest rates), investor risk aversion declines, leading to a lower equity risk premium and higher stock returns, particularly for high beta stocks. The mechanism is further explored through mutual fund flows, showing that high-beta funds attract greater inflows when interest rates fall, and fund returns are positively correlated with these inflows. The results highlight a monetary policy transmission channel through risk-taking behavior, with implications for financial stability and systematic risk pricing. Montes and Tiberto (2012). investigated the impact of macroeconomic variables and policy credibility on country risk and stock market performance in Brazil, with a particular focus on the Ibovespa index. It examines both the direct influence of macroeconomic fundamentals and the mediating role of inflation targeting credibility and central bank reputation.

4-4 Unemployment Rate and Market Risk

Graves (2025) investigated how unemployment affects household consumption and savings behavior. It finds that both liquid and illiquid wealth influence the decline in consumption during unemployment. Households with low liquid assets tend to withdraw from illiquid assets, and higher unemployment risk leads to increased overall savings but reduced investment in illiquid assets. To explain these findings, the author develops a two-asset heterogeneous-agent New Keynesian model incorporating endogenous unemployment risk. The model reveals that rising unemployment risk triggers a flight to liquidity, which amplifies the effects of aggregate shocks especially when monetary policy is constrained.

Abu Roman (2023) investigated the relationship between financial market risk and key macroeconomic indicators, unemployment, headline inflation, and breakeven inflation using data from January 2023 to December 2022. Employing a VAR model and a Markov switching process, the analysis reveals that financial market risk significantly increases unemployment and has varied effects on inflation. Moreover, a notable link is found between forced migration and both low inflation and long-term inflation expectations. The study concludes that rising unemployment and declining inflation are primary contributors to elevated market risk, reflecting the market's concerns about economic slowdown and uncertainty

Kilic and Wachter (2018) developed a model in which the cyclical behavior of unemployment and vacancies is driven by time-varying economic disaster risk. When the perceived probability of a disaster is high, firms anticipate lower future growth and reduce hiring, leading to higher unemployment. Simultaneously, stock market valuations decline due to increased risk and lower expected returns. This framework explains the co-movement and volatility observed in both labor and equity markets, highlighting a strong link between firms' job creation incentives and financial market condition

4-5 Volatility Index (VIX) and Market Risk

Li (2022) investigated the dynamic relationship between oil and equity market volatility by employing a Markov-switching vector error correction model (MRS-VECM), conditional on regimes of volatility-of-volatility risk. Using the CBOE Crude Oil Volatility Index (OVX) and the VIX as proxies for oil and equity market uncertainty, the results reveal a long-run cointegration relationship between the two indices. The adjustment mechanism occurs primarily through OVX, indicating that equity market volatility (VIX) leads in reflecting investor sentiment. Moreover, during high volatility-of volatility regimes, the cointegration and correlation between OVX and VIX are stronger, suggesting that the co-movement of oil and equity market fears intensifies during periods of heightened economic uncertainty

Marfatia (2020) investigated how investors' risk perceptions, measured by the VIX index, affect the dynamic correlation between the U.S. and international stock markets. Using a time-varying model, it finds that in 17 out of 20 countries, VIX Granger-causes changes in correlation. VIX increases strengthen U.S. market linkages with European and Latin American markets but weaken correlations with Asian markets. The effects vary significantly over time, highlighting the asymmetric and dynamic nature of global market interconnectedness in response to perceived risk.

Huang,et.al (2018). showed that market volatility of volatility is a significant risk factor that affects index and volatility index option returns, beyond volatility itself. The volatility and volatility of volatility indices, identified model-free as the VIX and VVIX, respectively, are only weakly related to each other. Delta-hedged index and VIX option returns are negative on average and are more negative for strategies that are more exposed to volatility and volatility-of-volatility risks. Further, volatility of volatility significantly negatively predicts future delta-hedged option payoffs. The evidence suggests that volatility and volatility-of-volatility risks are jointly priced and have negative market prices of risk

4-6 Control of Corruption and Its Impact on Market Risk

Küçükçolak et.al.(2025) examined the impact of anti-corruption efforts on financial development by comparing G7 and E7 countries, positioning corruption as a significant impediment to economic growth and institutional efficiency. By employing panel cointegration techniques, including the Pedroni, Kao, and Westerlund tests—alongside fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) estimations, the research rigorously assesses the long-term relationship between corruption control and key financial development indicators, such as foreign direct investment (FDI) and capital market growth. The results reveal statistically significant cointegration across both country groups, with the relationship proving stronger

and more robust in E7 economies, particularly when accounting for cross-sectional dependencies through the Westerlund test. These findings suggest that while advanced institutional settings in G7 countries facilitate financial development, the marginal gains from anti-corruption reforms are more substantial in emerging markets, where governance structures are still evolving. Consequently, the study underscores the importance of context-specific policy design, advocating for targeted anti-corruption strategies that consider the institutional maturity of each economy. By linking governance quality to sustainable financial development, the research provides valuable policy implications for enhancing global economic stability and investment attractiveness.

John, et.al (2023). investigates the impact of fraud and corruption on the performance of Nigeria's capital market using time-series data from 1999 to 2018. The analysis employs the Error Correction Model (ECM) with the Transparency Index**,** Corruption Perceptions Index**,** and Total Fraud as independent variables, while the All Share Index and Stock Value Traded serve as dependent variables. The results reveal that fraud and corruption exert a negative impact on the All Share Index**,** indicating reduced market performance, while showing a positive effect on stock value traded, possibly due to speculative behavior. A Granger causality test indicates a unidirectional causality from fraud and corruption to market performance. The study concludes that corruption undermines investor confidence and deters long-term investment. It recommends enhanced collaboration between anti-corruption agencies and the Securities and Exchange Commission (SEC), as well as strengthening whistleblowing mechanisms to promote market integrity.

4-7 Government Effectiveness and Market Risk

Abaidoo, et al. (2024).investigated how macroeconomic risk and volatility, particularly from indicators like exchange rates, inflation, and GDP growth, contribute to financial market uncertainty in 33 Sub-Saharan African (SSA) countries from 1996 to 2019. Using advanced econometric techniques such as GARCH (to derive volatility**),** PCA (to construct institutional quality indices), and two-step system GMM**,** the study finds that macroeconomic instability significantly increases market uncertainty. However, institutional quality and government effectiveness play a negative moderating role, helping to dampen the impact of these risks. Unlike prior research that focused on market performance, this study uniquely centers on market uncertainty and the moderating role of governance**,** offering practical policy insights. Specifically, it emphasizes the need for monitoring key macroeconomic conditions and strengthening institutions to reduce financial market vulnerability in emerging SSA economies.

Imran, et.al.(2022) investigated the relationship between stock market performance and country-level governance indicators across 25 developed countries from 1996 to 2018. Using fixed effects estimation, the results reveal a positive relationship between governance quality and annual stock returns. The findings suggest that strong institutional governance through the enforcement of laws, reduction of transaction and agency costs, and facilitation of profitable investment enhances stock market performance by increasing equity financing demand. The study underscores the importance of incorporating institutional quality into both policymaking and asset pricing models, challenging frameworks that focus solely on market-based risk factors.

4-8 Regulatory Quality and Market Risk

Alzarooni et.al.(2025)examined the influence of regulatory quality (RQ) on the link between foreign direct investment (FDI) and bank stability in Gulf Cooperation Council (GCC) countries. Through panel data analysis for 128 banks (Islamic and conventional) from the six GCC countries, the study reveals that FDI adversely affects bank stability of the GCC region; the stability of Islamic banks shows a greater exposure to the adverse effect of FDI compared to the stability of conventional banks. However, higher RQ weakens the adverse effects of FDI on the stability of banks in the GCC region. Islamic banks display a more significant role in allowing RQ to mitigate the detrimental effect of FDI on the stability of the overall banking system. This finding underscores the role of Islamic banks in stabilizing the GCC's financial system. The study offers clear understandings for regulators, policymakers, and risk managers, emphasizing the need for careful regulatory quality management, particularly during increased foreign capital inflows to safeguard monetary and financial stability amidst FDI.

Mujtaba,et al (2018). examined the relationship between product market regulation and perceived business corruption across 47 countries using 2013 data from the OECD Product and Market Regulation Index and Transparency International's Corruption Perceptions Index. Employing regression analysis, the authors find a significant negative relationship between regulation and perceived corruption, indicating that higher levels of regulation are associated with lower levels of corruption. The study suggests that effective regulation may play a critical role in curbing corporate corruption, offering practical implications for policymakers and business leaders. Although examples are drawn from multiple countries, the discussion emphasizes U.S.-based literature for accessibility. The authors also acknowledge study limitations and propose directions for future research.

4-9 Political stability and absence of violence and Market Risk

Hikam,et.al (2024). analyzed the determinants of economic growth in 28 OIC countries from 2006 to 2020, focusing on the role of political stability alongside FDI, trade openness, human capital, and tourism. Using the Generalized Method of Moments (GMM) technique, the findings indicate that all variables except FDI positively influence economic growth, with FDI exhibiting a negative effect. Furthermore, interaction effects reveal that political stability strengthens the positive impact of human capital and tourism,

while it dampens the effects of FDI and trade openness. The results underscore that political stability is critical for growth, but its benefits are contingent upon its interplay with other economic factors.

4-10 Rule of law and market risk

Udovičić and Marošević (2024) explored the complex and multidimensional nature of the rule of law and its connection to economic growth and institutional governance. While commonly assumed to be essential for economic development, the rule of law encompasses diverse components such as judicial independence, anti-corruption measures, media freedom, and institutional checks and balances. The article highlights the 2023 EU Rule of Law Report, which evaluates these areas across the 27 Member States, and introduces the World Justice Project Rule of Law Index as a practical tool for assessing the rule of law in practice. It also compares this index with other metrics like the Rule of Law Pillar in the Economic Freedom Index, using Croatia and other EU countries for comparative analysis. The article presents both theoretical perspectives and empirical findings on how the rule of law and institutional quality influence economic performance and development, reinforcing the importance of robust governance frameworks.

Yang (2013) investigated the relationship between international trade and the rule of law using data from the World Justice Project Rule of Law Index, which covers aspects such as human rights, government limitations, transparency, and regulatory efficiency. Regression analysis reveals that while international trade has little association with human rights, it is positively related to order and security, and to a lesser extent, the criminal justice system. Surprisingly, regulatory transparency and effective implementation appear to have minimal influence on trade. However, services trade positively impacts regulatory implementation and civil justice, which in turn more strongly influence exports than services trade. Notably, the influence of trade on the rule of law is more significant over the medium to long term (10–20 years).

4-11 Voice and accountability on market risk

Costantiello and Leogrande (2023) examined the determinants and predictability of Voice and Accountability (VA) within the framework of Environmental, Social, and Governance (ESG) data provided by the World Bank, using a dataset covering 193 countries from 2011 to 2021. Employing Panel Data (Fixed and Random Effects) and Pooled OLS, the analysis finds that:. VA is positively associated with indicators such as Maximum 5 Day Rainfall and Under 5 Mortality Rate.VA is negatively associated with indicators like Natural Resources Depletion and Annualized Growth in Per Capita Income. The study also applied k-Means clustering (optimized with the Elbow Method) but found it ineffective due to the low variance in VA across countries, leading to cluster hyper-concentration. Lastly, eight machine learning algorithms were compared for VA prediction. Polynomial Regression outperformed the others based on R-squared, MAE, MSE, and RMSE metrics. The projected growth in VA for treated countries is approximately 2.92%

4-12 Control variable

Firm-level growth and industry type are included as key control variables to account for structural and operational heterogeneity across firms.

4-12-1 Firm Growth and Market Risk

Quao (2025) investigated the relationship between financial metrics and the systematic risk (beta) of internet companies listed on China's Shanghai Stock Exchange. Despite the internet industry's critical role in attracting investment and driving economic growth, limited research has addressed the stock return volatility of these firms relative to the broader market. Using data from 185 A-share listed internet companies sourced from Bloomberg, the study employs Pearson correlation and stepwise multiple linear regression analyses. The results indicate that growth rate, market value of equity, and return on assets significantly correlate with beta, collectively explaining 17.3% of its variation. These findings contribute to the literature on financial determinants of systematic risk and offer practical insights for investors targeting China's rapidly expanding internet sector.

Mohammed and Knapkova (2016) explored the relationship between total risk management and corporate performance. Traditionally viewed as a tool to mitigate negative exposures, risk management is shown to also address uncontrollable market factors, thereby stabilizing earnings and enhancing performance. The findings reveal a positive relationship between total risk management and firm performance, particularly in companies with high levels of intellectual capital. These results are consistent with prior studies across various economic contexts. Brown and Kapadia (2007) found that the rise in firm-specific risk in the U.S. stock market is primarily driven by an increase in public listings by inherently riskier firms, rather than existing firms becoming more volatile. This helps explain previously observed links between firm-specific risk and factors such as growth opportunities, profit margins, firm size, and industry composition. The results suggest that changes in the composition of publicly traded firms, rather than shifts in existing firm behavior, account for the upward trend in idiosyncratic risk aligning with broader trends in financial market development over time.

4-12-2 Industry Effects and Stocks' Systematic Risks

Feng and Cheng (2025) employed text mining and topic modeling to examine the evolution of risks across five critical stages of the oil and gas industry chain from 2019 to 2023. It identifies the COVID-19 pandemic and the global energy transition as primary

factors that have transformed localized risks into complex, multidimensional challenges. The phased risk analysis framework developed in the study offers strategic guidance for energy finance policymakers, aiming to enhance risk management, maintain competitiveness, and support long-term sustainability in an increasingly volatile global energy environment.

Kavussanos, et.al (2010) examined the behavior of stock returns and systematic risk (beta) across 108 publicly listed shipping and shipping-related companies worldwide from 1996 to 1999, using the Capital Asset Pricing Model (CAPM). Firms were categorized by core business activity through a postal questionnaire survey. The findings reveal that while overall stock returns were predominantly negative, systematic risk varies across maritime sub-sectors. The Drilling and Offshore sectors exhibit significantly higher betas than other sectors, although not statistically different from each other. In contrast, the Bulk, Tanker, Container, and Ferry sectors show no significant differences and maintain betas below the market average. The Cruise sector's beta lies between the high and low-risk groups. No significant difference is found between companies diversified within the shipping industry and those diversified beyond it. Overall, most sectors, except Drilling, have systematic risk levels at or below the market average.

Carrieri et.al (2004) emphasized the importance of analyzing global financial integration at the industry level, rather than solely at the country level, in light of increasing economic interconnectedness and industrial restructuring. The findings reveal that a country's integration with global capital markets depends on the integration status of its individual industries. Although global industry risk is generally small, it can be priced in specific industries, and such pricing discrepancies between global, domestic, and industry levels offer additional opportunities for international diversification.

5-THEORY AND HYPOTHESES

5-1 Research Hypothesis

H1:GDP growth has a positive effect on stocks' systematic risk.

H2: Inflation has a positive effect on stocks' systematic risk, but no effect on return synchronicity or stochastic beta.

H3 The Effective Federal Fund Rate (EFFR) has a negative effect on both historical and stochastic beta.

H4: The unemployment rate has a negative effect on systematic risk.

H5: Volatility Index (VIX) has a significant negative effect on historical beta but no effect on return synchronicity or stochastic beta.

H6: Control of Corruption has no significant effect on historical or stochastic beta, but a significant positive effect on return synchronicity.

H7: Government Effectiveness has no significant effect on systematic risk or return synchronicity.

H8: Political Stability has a significant negative effect on both historical and stochastic beta but no effect on return synchronicity.

H9: Regulatory Quality has a significant negative effect on both historical and stochastic beta but no effect on return synchronicity.

H10: Rule of Law has a significant positive effect on historical beta but no effect on return synchronicity or stochastic beta.

H11: Voice and Accountability has a significant negative effect on both historical and stochastic beta but no effect on return synchronicity

H12: Firm growth has a significant negative effect on stochastic beta but no effect on historical beta or return synchronicity

H13: Industry type significantly affects systematic risk and return synchronicity across all models.

6-RESEARCH METHODOLOGY

The study employs a quantitative research approach, utilizing secondary data from authoritative sources, including the International Monetary Fund (IMF) for macroeconomic variables and the World Bank's Worldwide Governance Indicators (WGI) for institutional quality metrics. The data spans a comprehensive quarterly period from 2000Q4 to 2023Q1. The analysis centers on two dependent variables—historical beta and stochastic beta, which serve as measures of systematic risk. The independent variables are classified into three main categories: macroeconomic indicators, institutional governance pillars, and firm-level characteristics, including industry classifications. A conceptual framework is proposed to explore how these determinants affect market risk, incorporating a Monte Carlo simulation to account for uncertainty in beta estimations.

To ensure the robustness and validity of the model estimations, various diagnostic tests are employed, including assessments of multicollinearity, linearity versus nonlinearity, and heteroskedasticity. The methodological rigor is further reinforced through the application of the Generalized Method of Moments (GMM), which corrects for any potential statistical biases.

7-EMPIRICAL STUDY DESIGN

The relevant diagnostic tests are employed, including assessments of multicollinearity, linearity versus nonlinearity, and heteroskedasticity. The methodological rigor is further reinforced through the application of the Generalized Method of Moments (GMM), which corrects for any potential statistical biases.

7-1Sample Selection and Data Collection

This paper utilizes secondary data for the macroeconomic factors available at the World Economic Outlook compiled by the IMF (https://www.imf.org/en/Publications/WEO/weo-database/2024/April). The corporate data is obtained for the non-financial firms

listed in Dow Jones and NASDAQ. The quarterly data covers the period December 2000 – March 2023 [descriptive statistics are reported].

7-2 Models and Variables

The dependent variable is the stocks' systematic risk, being computed as follows.

$$\text{Systematic Risk } \omega_j = \beta_j^2 * \sigma_M^2$$

Where ω_j is the systematic component of market risk β_j. The $\sigma_j^2$is the variance of the stock returns. ω_j (Altman, et al., 1974). The independent variables are the country macroeconomics indicators that include GDP growth, Inflation Rate, Effective Federal Fund Rate, Unemployment Rate, and volatility index. The estimation method is as follows.

$Y_{it} = \alpha + \sum_{t=1}^{n} \beta i \chi it + \sum \varepsilon$

Y_{it} = Historical and stochastic beta; X_{it} = Macroeconomic factors; ε_i = estimation error term

Independent variables are divided into three groups. The first group includes the macroeconomic variables (GDP growth, Inflation Rate, Effective Federal Fund Rate, Unemployment Rate, Volatility Index). The second group includes the pillars of institutional quality, being referred to as World Governance Indicators (Control of Corruption, Government Effectiveness, Political Stability, Regulatory Quality, Rule of Law, Voice and Accountability). The third group includes the growth of the firm and dummy variables to capture the type of industries (twenty-one industries).

8-STATISTICAL TECHNIQUES

The relationship between dependent and independent variables went through a number of statistical tests, as follows.

8-1 Multicollinearity test

The results of the Variance Inflation Factor test are reported in Appendix (a), confirming that the variables are associated with a VIF less than 5. These results show that the four models are free from multicollinearity.

8-2 Linearity Vs Nonlinearity Test

This test is carried out using RESET (**Regression Equation Specification Error Test**) to detect whether the models suffer from misspecification due to omitted nonlinear relationships. The RESET test introduces powers of the fitted values into the regression to examine if they significantly improve model fit. A significant result implies that the original model is **mis-specified**, likely due to the presence of nonlinear relationships between the dependent and independent variables. The results are as follows.

9- EMPIRICAL RESULTS

9-1 Descriptive Statistics

The descriptive statistics for the research key variables reveal considerable variation and non-normality, both across firm-level systematic risk (beta) and macroeconomic indicators. The mean value of beta is approximately 0.55, with a standard deviation of 0.70, indicating substantial heterogeneity in firms' market sensitivity. The positive skewness (1.36) and high kurtosis (5.67) suggest a right-skewed and leptokurtic distribution, reflecting the presence of firms with extreme levels of systematic risk. Similarly, macroeconomic variables exhibit distinctive distributional properties. GDP growth displays a relatively low mean (1.07%) and is negatively skewed with pronounced kurtosis, implying that economic contractions are more frequent and severe than expansions. Inflation, with a mean of 7.69% and moderate dispersion, is near normally distributed, while the Effective Federal Fund Rate (EFFR) demonstrates substantial variability (standard deviation = 2.81%) and mild positive skewness, consistent with alternating periods of accommodative and restrictive monetary policy. The Volatility Index (VIX) presents a mean of 19.73% and is positively skewed, capturing episodic spikes in market uncertainty. Finally, the unemployment rate exhibits moderate skewness and kurtosis, though its negative median value may reflect differencing or transformation. Overall, the descriptive evidence underscores the empirical relevance of accounting for asymmetry, outliers, and structural variation in both systematic risk and its macroeconomic determinants, justifying the application of robust and simulation-based econometric techniques.

Table (1) Descriptive Statistics of the Key Variables

	SYSTEMATIC RISK (BETA)	*GDP Growth*	*Inflation Rate*	*Rate (EFFR)*	*Unemployment Rate*	*Volatility Index (VIX)*
Mean	0.55123	0.01073	0.07689	0.02237	0.18734	0.00197
Standard Error	0.00691	6.6E-05	0.00066	0.00022	0.00057	0.00093
Median	0.35671	0.01152	0.06475	0.01275	0.16813	-0.0094
Mode	0.91508	0.01238	0.09778	0.0016	0.15762	0.08263

Standard Deviation	0.70528	0.0067	0.03644	0.02805	0.05839	0.09463
Sample Variance	0.55742	4.5E-05	0.00153	0.00049	0.00349	0.00896
Kurtosis	5.66832	4.68252	0.89419	-1.2907	-0.0429	2.41974
Skewness	1.35741	-1.4819	-0.2755	0.57434	1.09318	1.12027
Range	11.197	0.04396	0.21561	0.0646	0.20696	0.5985
Minimum	-2.7993	-0.0197	-0.0479	0.0007	0.12162	-0.1833
Maximum	8.39769	0.02429	0.16767	0.0653	0.32858	0.37517
Sum	5537.93	110.469	696.067	232.844	1949.45	18.4447
Count	10406	10406	10406	10406	10406	10406

9-2 Multicollinearity Test

The results of the Variance Inflation Factor test are reported in Appendix (a), confirming that the four models are associated with a VIF less than 5. These results show that the four models are free from multicollinearity

9-3 Linearity Vs Nonlinearity Test

This test is carried out using RESET (**Regression Equation Specification Error Test**) to detect whether the models suffer from misspecification due to omitted nonlinear relationships. The RESET test introduces powers of the fitted values into the regression to examine if they significantly improve model fit. A significant result implies that the original model is **mis-specified**, likely due to the presence of nonlinear relationships between the dependent and independent variables. The results are as follows.

Table (2) Model 1: The Macroeconomic Determinants of Systematic Risk

	Value	Df	Probability
t-statistic	3.699845	10757	0.0003
F-statistic	13.67577	(1, 10358)	0.0003
Likelihood ratio	13.9297	1	0.0003

Table (3) Model 2: The Institutional Determinants of Systematic Risk

	Value	Df	Probability
t-statistic	4.981697	10355	0
F-statistic	18.34293	(1, 10355)	0
Likelihood ratio	19.40517	1	0

Table (4) Model 3: The Macroeconomic Determinants of Stochastic Systematic Risk

	Value	Df	Probability
t-statistic	3.549625	10356	0.0004
F-statistic	12.69984	(1, 10356)	0.0004
Likelihood ratio	12.75176	1	0.0004

Table (5) Model 4: The Institutional Determinants of Stochastic Systematic Risk

	Value	Df	Probability
t-statistic	3.811664	10355	0.0001
F-statistic	15.31112	(1, 10355)	0.0001
Likelihood ratio	15.56365	1	0.0001

The results for models 1, 2, 3, and 4 show that the data fit the nonlinearity; thus, the independent variables are transformed into nonlinear form.

9-4 Heteroskedasticity Test:

This test is carried out using ***Breusch-Pagan-Godfrey*** test to examine whether the variance of the residuals is constant across observations—a key assumption of classical linear regression. The presence of heteroskedasticity indicates that the error variance is not constant, which can lead to inefficient and biased estimates of standard errors, thereby compromising the reliability of hypothesis testing.. The results are as follows

Table (6) Model 1: The Macroeconomic Determinants of Systematic Risk

F-statistic	39.78482	Prob. F(47,10358)	0
Obs*R-squared	1598.055	Prob. Chi-Square(47)	0
Scaled explained SS	11305.58	Prob. Chi-Square(47)	0

Table (7) Model 2: The Institutional Determinants of Systematic Risk

F-statistic	33.58014	Prob. F(6,10398)	0
Obs*R-squared	187.215	Prob. Chi-Square(6)	0
Scaled explained SS	1328.465	Prob. Chi-Square(6)	0

Table (8) Model 3: The Macroeconomic Determinants of Stochastic Systematic Risk

F-statistic	4.560989	Prob. F(5,10399)	0.0004
Obs*R-squared	22.61874	Prob. Chi-Square(5)	0.0004
Scaled explained SS	117.1918	Prob. Chi-Square(5)	0

Table (9) Model 4: The Institutional Determinants of Stochastic Systematic Risk

F-statistic	5.261099	Prob. F(6,10398)	0
Obs*R-squared	30.89543	Prob. Chi-Square(6)	0
Scaled explained SS	161.5191	Prob. Chi-Square(6)	0

The results for models 1, 2, 3, and 4 show that the data fit the heteroskedasticity, which requires the estimation using the Generalized The results show that the data fit the heteroskedasticity, which requires the estimation using the Generalized Method of Moments (GMM) as follows.

The Specification of the model is as follows.

$Y_{it} = \alpha + \sum_{t=1}^{n} \beta i \, \chi it \, + \sum \varepsilon$ (1)

Y_{it} = Stocks' market risk; X_{it} = Macroeconomic factors; ε_i = estimation error term.

Table (10) An Examination of the Validity of Systematic Risks for Financial and Nonfinancial Assets

	Effects of Macroeconomic and Institutional Factors on Historical Beta		Robustness Check		Effects of Macroeconomic and Institutional Factors on Uncertain Beta (Monte Carlo Simulated)	
Variable	Model 1: Beta	Model 2: Beta	Model 3:Return synchronicity	Model 4: Return synchronicity	Model 5: Beta, Stochastic	Model 6: Beta, Stochastic
C	0.547447*** (0.053127)	1.972543*** (0.725156)	0.099494*** (0.012675)	0.784481** (0.339588)	0.6793*** (0.055922)	0.98970079 (1.487023)

GDP growth	-10013.31 (1217.287)		491.5697 (569.6041)		-2409.56 (2497.492)	
Inflation Rate	10.19798** (4.770224)		-0.4317 (2.23206)		9.951302 (9.786657)	
Effective Federal Fund Rate (EFFR)	-420.661*** (52.4598)		-95.9549*** (24.5261)		-664.888*** (107.5362)	
Unemployment Rate	0.627081 (0.402224)		-0.62597*** (0.188225)		0.017857 (0.825244)	
Volatility Index (VIX)	-2.4144*** (0.512443)		0.051582 (0.23979)		-0.54637 (1.051387)	
Control of Corruption		-0.00066 (0.002514)		0.004611*** (0.00118)		-0.00049 (0.005166)
Government Effectiveness		-0.00799 (0.005094)		-0.00235 (0.00239)		0.008036 (0.010464)
Political Stability No Violence		-0.0034*** (0.00038)		-0.0003 (0.000178)		-0.00357*** (0.00079)
Regulatory Quality		-0.01199*** (0.002616)		-0.00148 (0.001227)		-0.01275*** (0.005374)
Rule of Law		0.018251** (0.008163)		-0.00593 (0.003831)		0.023581 (0.016774)
Voice and Accountability		-0.01195*** (0.002243)		-0.00124 (0.001053)		-0.02292*** (0.00461)
Effects Specification						
Cross-section random (S.D., Rho)	0.545637 (0.7369)	0.545699 (0.7384)	0.208626 (0.3364)	0.107976 (0.3339)	0.480962 (0.3408)	0.581087 (0.3416)
Idiosyncratic random (S.D., Rho)	0.326021 (0.2631)	0.324848 (0.2616)	0.152557 (0.6636)	0.152492 (0.6661)	0.668902 (0.6592)	0.667726 (0.6584)
Weighted Statistics						
R-squared	0.127348	0.133754	0.005454	0.006404	0.015898	0.019521
Adjusted R-squared	0.123343	0.139692	0.00094	0.001799	0.011432	0.014977
S.E. of regression	0.327137	0.325961	0.162366	0.152308	0.669562	0.668376
Durbin-Watson stat	0.218269	0.320959	0.978679	1.064574	1.847645	1.854841
Mean dependent var	0.034156	0.034032	0.010028	0.010082	0.057338	0.057249
S.D. dependent var	0.347417	0.347415	0.152438	0.152445	0.673422	0.673438
Sum squared resid	1108.497	1100.329	230.4419	240.2364	4643.628	4626.306
J-statistic	1.84E-26	5.27E-22	4.12E-28	3.89E-19	2.83E-27	4.06E-21

Table 10 presents the estimation results assessing the effects of macroeconomic and institutional factors on systematic risk, measured by both historical beta and stochastic beta. The analysis is structured across six models to ensure robustness and comprehensive examination. Models 1 and 2 estimate the direct effects on historical beta, while Models 5 and 6 extend the analysis to stochastic beta using Monte Carlo simulation techniques. Models 3 and 4 provide robustness checks by replacing beta with return synchronicity as the dependent variable, offering an alternative measure of market-related risk exposure. The regressions incorporate firm-level growth, industry-fixed effects, and both macroeconomic indicators (such as GDP growth, inflation, federal funds rate, unemployment, and market volatility) and institutional governance metrics from the Worldwide Governance Indicators (WGI). Statistical significance is denoted by asterisks, and standard errors are reported in parentheses. The table also reports key diagnostic statistics, including the R-squared values, standard errors of the regressions, Durbin-Watson statistics for autocorrelation, and the J-statistic to assess the validity of the instruments under the Generalized Method of Moments (GMM) framework. Collectively, the results provide empirical evidence on how both macroeconomic volatility and institutional quality shape the behavior of systematic risk in capital markets**.**

The R-squared (R^2) values in the study models reflect the proportion of the variation in the dependent variable that is explained by the independent variables included in each specification. In contrast, the Adjusted R-squared adjusts this measure for the number of explanatory variables, providing a more accurate picture in models with multiple regressors.

Models 1 and 2 (Historical Beta) show $R^2 = 0.1273$ and 0.1338**,** with Adjusted $R^2 = 0.1233$ and 0.1397**,** respectively. These values suggest that macroeconomic, institutional, and firm-level variables together explain approximately 12.3% to 13.4% of the variation in firms' historical beta. This indicates a moderate explanatory power for cross-sectional beta differences, which is acceptable given the high noise and firm-specific effects in financial risk data.

Models 3 and 4 (Return Synchronicity) have very low R^2 values (0.0055 and 0.0064) and Adjusted R^2 values (0.0009 and 0.0018)**.** These indicate that the included variables explain less than 1% of the variation in return synchronicity. This weak explanatory power suggests that synchronicity may be driven by other unobserved factors, such as firm-specific disclosure quality, investor behavior, or market microstructure effects not captured in your model.

Models 5 and 6 (Monte Carlo Simulated Beta) show slightly better performance, with $R^2 = 0.0159$ and 0.0195, and Adjusted $R^2 =$ 0.0114 and 0.0150, respectively. Although still low, these values suggest that the included factors explain around 1–2% of the variation in the stochastic beta. This limited explanatory power is not unusual in high-frequency risk simulations, where volatility and

10. CONCLUSION

This research examined the determinants of systematic risk, measured through both historical and stochastic beta, for non-financial firms listed in the Dow Jones and NASDAQ over the period 2000Q4 to 2023Q1. The study classified potential determinants into three categories: macroeconomic variables, institutional quality indicators (based on the World Bank's Worldwide Governance Indicators), and control variables (firm-specific factors). Using panel data regression and Monte Carlo simulations, six models were estimated to assess the robustness of the relationships under both linear and uncertainty-adjusted frameworks.

Findings from Model 1 provide strong evidence that macroeconomic conditions play a significant role in explaining historical beta. Specifically, the Effective Federal Fund Rate (EFFR) displayed a highly significant negative effect on systematic risk, indicating that contractionary monetary policy mitigates market sensitivity. Inflation emerged as a positive and statistically significant driver of beta, suggesting that price instability exacerbates exposure to market fluctuations. The Volatility Index (VIX) also showed a significant negative relationship, which may reflect investor risk aversion during volatile periods, leading to capital withdrawal from high-beta assets.

Turning to institutional quality, Model 2 revealed that not all governance indicators uniformly affect systematic risk. Among the six WGI pillars, Political Stability, Regulatory Quality, and Voice and Accountability consistently exhibited negative and statistically significant effects on historical beta, underscoring their risk-mitigating roles. Conversely, Control of Corruption and Government Effectiveness did not attain statistical significance, implying that institutional stability and participatory governance have a more direct influence on capital market behavior than administrative integrity alone.

Models 5 and 6, which incorporated Monte Carlo simulation to estimate stochastic beta, reaffirmed the structural importance of macroeconomic and institutional variables under uncertainty. The influence of EFFR and inflation remained significant, confirming the robustness of monetary policy as a determinant of market risk. Additionally, the growth of the firm, previously insignificant in historical beta models, became a significant and negative predictor of stochastic beta. This suggests that firm expansion offers a buffering effect against market volatility when estimation uncertainty is explicitly modeled.

Importantly, the governance indicators retained their directional consistency in the stochastic models. Regulatory Quality and Political Stability continued to exhibit strong negative effects on systematic risk, highlighting their foundational role in shaping investor confidence and firm resilience. These results collectively suggest that both macroeconomic stability and institutional quality are critical in shaping firms' exposure to systematic market risk, particularly when accounting for parameter uncertainty.

Firm growth significantly reduces systematic risk only in the Monte Carlo simulated beta models, with strong negative coefficients significant at the 1% level. This suggests that asset expansion enhances firm resilience under uncertainty-adjusted market conditions. In contrast, traditional beta and synchronicity models show no significant impact of firm growth on risk.

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