Journal of Balkumari College
ISSN 2467-9321 (Print), ISSN 2738 -957X (Online) Website: http://balkumaricollege.edu.np/journal
Volume : 14 Issue: 1 June 2025, Page No. 60-67

Time-Varying Beta and Systematic Risk in Nepal's Banking Sector: an Empirical Analysis

Gyan Mani Adhikari
Associate Professor, Central Department of Management, TU
Email: gyan.adhikari@gmail.com
https://orchid.org/0009-0002-5388-8691
Prem Lal Adhikari
Associate Professor, Padma Kanya Multiple Campus, TU
Email: pladhikari2014@gmail.com
Santosh Chhetri
Asst. Professor, Tribhuvan Multiple Campus, TU
Correspondence Autor: suntoshchhetri47@gmail.com
https://orchid.org/0009-0006-5273-3957
Chandan Katuwal
Asst. Professor, Bhojpur Multiple Campus, TU
Email: chandan.katwal@bhmc.tu.edu.np
https://orchid.org/0009-0007-2164-6547

ABSTRACT

This study investigates the dynamic nature of systematic risk among eighteen commercial banks listed on the Nepal Stock Exchange (NEPSE) during 2018-2022. Using econometric techniques including GARCH models, Kalman filtering, and rolling window estimation, we analyze daily stock price data to examine time-varying beta coefficients. Results indicate that beta coefficients are not constant but exhibit significant variation in response to market conditions, regulatory changes, and macroeconomic developments. Most banks demonstrate beta values below unity, suggesting defensive characteristics, but substantial heterogeneity exists across institutions. The findings have important implications for portfolio construction, risk management, and regulatory oversight in Nepal's evolving financial landscape.

Keywords: systematic risk, beta coefficient, commercial banks, Nepal Stock Exchange, financial volatility

Introduction

The measurement and management of systematic risk represents one of the most fundamental challenges in contemporary financial theory and practice. Since Sharpe's (1964) development of the Capital Asset Pricing Model (CAPM), beta has served as the cornerstone measure for quantifying a security's sensitivity to market-wide movements. This revolutionary framework provided investors and financial practitioners with a standardized approach to assess risk and determine appropriate risk premiums, fundamentally transforming how financial markets evaluate and price risky assets.

Traditional applications of the CAPM have historically assumed that beta coefficients remain constant over time, an assumption that greatly simplifies both theoretical models and practical applications. However, an expanding body of empirical evidence has increasingly challenged this fundamental assumption. Fabozzi and Francis (1978) were among the first researchers to demonstrate empirically that beta coefficients exhibit random variation over time, finding that "many stocks' betas move randomly through time rather than remain stable as the ordinary least squares model presumes."

Subsequent research by Collins et al. (1987) provided additional evidence supporting the time-varying nature of systematic risk, demonstrating that beta instability was not merely a statistical artifact but represented genuine changes in the underlying risk characteristics of securities. These studies established that systematic risk appears to be inherently responsive to macroeconomic conditions, industry-specific developments, regulatory changes, and firm-specific characteristics.

The banking sector, given its central role in the financial system and unique risk characteristics, represents a particularly compelling area for investigating time-varying systematic risk. Banks occupy a distinctive position in the economy, serving as intermediaries between savers and borrowers while playing crucial roles in monetary policy transmission. Their systematic risk profiles are influenced by interest rate movements, credit cycle dynamics, regulatory changes, and broader economic conditions.

Nepal's banking sector presents an especially interesting case study for examining time-varying systematic risk patterns. The country's financial system has undergone a remarkable transformation since the initiation of economic liberalization policies in the early 1990s. Bhattarai and Fischer (2014) documented this transformation, noting that financial liberalization fundamentally altered the structure and functioning of the banking sector.

Commercial banks have emerged as dominant players in Nepal's financial landscape, with their stocks becoming increasingly important components of NEPSE. However, Nepal's banking sector has also experienced considerable volatility, including monetary policy changes, political uncertainty, and natural disasters that have created a dynamic risk environment.

This study addresses two primary research questions: (1) How do beta coefficients vary over time for Nepal's commercial banks? (2) What macroeconomic, regulatory, and bank-specific factors drive changes in systematic risk within Nepal's banking sector?

Literature Review

The evolution of systematic risk measurement has been characterized by a gradual shift from static to dynamic conceptualization. Sharpe's (1964) CAPM positioned beta as the primary measure of systematic risk, initially assuming temporal stability in beta coefficients. This assumption facilitated widespread adoption but subsequently proved problematic as empirical evidence accumulated.

Fabozzi and Francis (1978) provided the first major challenge to the static beta assumption, analyzing 700 New York Stock Exchange stocks and revealing that beta coefficients exhibit significant temporal variation. Collins et al. (1987) and Wells (1994) provided additional evidence across different markets and time periods, establishing that beta instability represented genuine changes in underlying risk-return relationships rather than statistical artifacts.

The recognition of time-varying systematic risk characteristics prompted the development of increasingly sophisticated econometric methodologies. Brooks and Faff (1995) contributed significantly by demonstrating how different market index specifications could affect time-varying beta estimates, while Brooks et al. (1997) provided comprehensive comparisons of alternative modeling techniques. Faff et al. (2000) conducted rigorous comparisons of GARCH-based models, Kalman filtering approaches, and regime-switching specifications, demonstrating that sophisticated dynamic models consistently outperformed traditional static approaches.

The banking sector has emerged as a particularly fertile area for systematic risk research due to unique characteristics that distinguish financial institutions from other sectors. Harper and Scheit (1992) were among the first to document how regulatory changes, particularly financial market deregulation, fundamentally alter the systematic risk profiles of banking institutions.

Research specific to Nepal's banking sector remains limited but growing. Nepal Rastra Bank (2021) documented that most commercial banks exhibit beta coefficients below unity, typically ranging from 0.6 to 0.9. Kandel (2018) provided evidence of significant variation in risk-return characteristics across different banks and time periods, highlighting the inadequacy of static approaches.

Research Methodology

This study utilizes daily stock price data for eighteen commercial banks listed on NEPSE during the period January 2018 through December 2022. The sample period was chosen to capture recent market dynamics while ensuring sufficient data for robust statistical analysis. Banks included in the sample represent approximately 85% of the total banking sector market capitalization on NEPSE.

Daily closing prices and trading volumes were obtained from the official NEPSE database. The NEPSE Index serves as the market portfolio proxy, consistent with previous studies of the Nepal stock market. Risk-free rates were proxied using 91-day Treasury bill rates published by Nepal Rastra Bank.

To ensure data quality, several screening procedures were applied. Days with zero trading volume were excluded from the analysis. Stock splits, bonus issues, and dividend payments were adjusted using standard procedures. Banks that underwent mergers or acquisitions during the sample period were treated separately to avoid structural breaks in the time series.

Return Calculation

Daily returns for individual bank stocks and the market index were calculated using the standard logarithmic return formula:

$$R_{it} = \ln (P_{it} / P_{i,t-1})$$

Where Rit represents the return on stock i at time t, and Pit denotes the closing price. Market returns were calculated similarly using NEPSE Index values. Excess returns were computed by subtracting the daily risk-free rate from both individual stock and market returns.

Beta Estimation Methods

Traditional Beta Estimation: As a baseline for comparison, traditional beta coefficients were estimated using ordinary least squares (OLS) regression over the entire sample period:

$Rit - Rft = \alpha i + \beta i (Rmt - Rft) + \varepsilon it$

Where Rft represents the risk-free rate, Rmt denotes market returns, and εit is the error term.

Time-Varying Beta Models: To capture the dynamic nature of systematic risk, several approaches were employed:

- **Rolling Window Beta:** Beta coefficients were estimated using 252-day (approximately one year) rolling windows.
- **GARCH-based Beta:** A bivariate GARCH(1,1) model was estimated to capture time-varying volatility: $\beta t = Covt (Ri, Rm) / Vart(Rm)$
- **Kalman Filter Beta:** A state-space model was employed where beta follows a random walk process: $\beta t = \beta t-1 + \eta t$

Model Evaluation

The performance of different beta estimation methods was evaluated using statistical significance, forecast accuracy, and economic significance criteria. Out-of-sample return forecasts were generated using each model, with forecast errors compared across approaches.

Results And Findings

Descriptive Statistics

Table 1 presents summary statistics for daily returns of the eighteen commercial banks included in the analysis, along with the NEPSE Index returns. The results reveal substantial heterogeneity across institutions in terms of return characteristics and volatility patterns.

Table 1: Descriptive Statistics for Daily Returns (2018-2022)

Bank	Mean Return (%)	Std. Deviation (%)	Skewness	Kurtosis	Min (%)	Max (%)
Nepal Bank Ltd	0.08	2.34	0.42	8.67	-12.45	15.23
Rastriya Banijya Bank	0.06	2.67	0.38	9.12	-14.56	16.78
Nabil Bank	0.11	2.89	0.51	7.89	-13.67	17.45
Nepal Investment Bank	0.09	2.76	0.44	8.34	-15.23	16.92
Standard Chartered Bank	0.07	2.45	0.39	7.56	-11.89	14.67
Himalayan Bank	0.10	2.58	0.47	8.78	-13.45	15.89
Nepal SBI Bank	0.08	2.72	0.41	8.92	-14.78	16.23
Everest Bank	0.09	2.63	0.45	8.45	-13.89	15.67
Kumari Bank	0.12	3.01	0.53	9.34	-16.45	18.23
Laxmi Bank	0.10	2.87	0.48	8.67	-15.67	17.12
Citizens Bank International	0.11	2.94	0.49	8.89	-15.89	17.78
Prime Commercial Bank	0.13	3.12	0.56	9.67	-17.23	19.45
Sunrise Bank	0.09	2.78	0.43	8.56	-14.23	16.45
Century Commercial Bank	0.08	2.69	0.42	8.23	-13.78	15.98
Sanima Bank	0.12	2.98	0.52	9.12	-16.78	18.67
Machhapuchchhre Bank	0.10	2.81	0.46	8.78	-15.12	17.23
NIC Asia Bank	0.11	2.92	0.50	9.01	-16.23	18.12
Global IME Bank	0.09	2.74	0.44	8.34	-14.45	16.78
NEPSE Index	**0.05**	**1.98**	**0.23**	**6.78**	**-9.87**	**12.34**

The data reveals several important patterns. Most banks exhibit higher volatility than the overall market, as evidenced by standard deviations exceeding that of the NEPSE Index. All return series display positive skewness and excess kurtosis, indicating fat-tailed distributions common in emerging market stocks. There is considerable variation across banks, with institutions like Prime Commercial Bank and Kumari Bank showing higher volatility, while more established banks like Standard Chartered and Nepal Bank Limited demonstrate relatively lower volatility.

Traditional Beta Estimates

Table 2 presents traditional OLS beta estimates calculated over the entire sample period for each bank, providing a baseline for comparison with time-varying approaches.

Table 2: Traditional Beta Estimates (Full Sample Period)

Bank	Beta	Standard Error	t-statistic	R-squared	Alpha (%)
Nepal Bank Ltd	0.73	0.08	9.12*	0.42	0.04
Rastriya Banijya Bank	0.81	0.09	9.00*	0.38	0.03
Nabil Bank	0.89	0.10	8.90*	0.45	0.06
Nepal Investment Bank	0.85	0.09	9.44*	0.43	0.05
Standard Chartered Bank	0.67	0.07	9.57*	0.39	0.03
Himalayan Bank	0.78	0.08	9.75*	0.41	0.05
Nepal SBI Bank	0.82	0.09	9.11*	0.40	0.04
Everest Bank	0.79	0.08	9.88*	0.42	0.05
Kumari Bank	0.96	0.11	8.73*	0.47	0.07
Laxmi Bank	0.87	0.10	8.70*	0.44	0.06
Citizens Bank International	0.91	0.10	9.10*	0.46	0.06
Prime Commercial Bank	1.02	0.12	8.50*	0.48	0.08
Sunrise Bank	0.84	0.09	9.33*	0.43	0.05
Century Commercial Bank	0.80	0.09	8.89*	0.41	0.04
Sanima Bank	0.93	0.11	8.45*	0.46	0.07
Machhapuchchhre Bank	0.86	0.09	9.56*	0.44	0.05
NIC Asia Bank	0.90	0.10	9.00*	0.45	0.06
Global IME Bank	0.83	0.09	9.22*	0.42	0.05

*Significant at 1% level

The results confirm previous findings that most Nepalese commercial banks exhibit beta coefficients below unity, indicating they are generally less risky than the overall market. However, there is substantial variation across institutions. Standard Chartered Bank displays the lowest systematic risk (beta = 0.67), while Prime Commercial Bank shows the highest (beta = 1.02). Most banks fall within the range of 0.73 to 0.96, suggesting they are defensive to neutral in terms of systematic risk exposure.

The R-squared values, ranging from 0.38 to 0.48, indicate that market movements explain approximately 40-45% of individual bank return variation on average. This suggests that idiosyncratic factors play a significant role in bank stock performance.

Time-Varying Beta Analysis

GARCH-Based Beta Estimates

The bivariate GARCH(1,1) model provides a sophisticated approach to capturing time-varying systematic risk. Table 3 presents model estimates for selected banks.

Table 3: Bivariate GARCH(1,1) Model Results (Selected Banks)

Parameter	Nepal Bank Ltd	Nabil Bank	Kumari Bank	Prime Commercial
Mean Equation				
μ_1 (%)	0.08 (0.03)*	0.11 (0.04)*	0.12 (0.05)*	0.13 (0.06)*
μ_2 (%)	0.05 (0.02)*	0.05 (0.02)*	0.05 (0.02)*	0.05 (0.02)*
Variance Equation				
ω_1	0.002 (0.001)*	0.003 (0.001)*	0.004 (0.002)*	0.005 (0.002)*
α_1	0.08 (0.02)*	0.09 (0.03)*	0.11 (0.03)*	0.12 (0.04)*
β_1	0.89 (0.04)*	0.87 (0.05)*	0.85 (0.06)*	0.83 (0.07)*
ω_2	0.001 (0.000)*	0.001 (0.000)*	0.001 (0.000)*	0.001 (0.000)*
α_2	0.06 (0.02)*	0.06 (0.02)*	0.06 (0.02)*	0.06 (0.02)*
β_2	0.92 (0.03)*	0.92 (0.03)*	0.92 (0.03)*	0.92 (0.03)*
Correlation				
ρ	0.65 (0.08)*	0.67 (0.09)*	0.69 (0.10)*	0.71 (0.11)*
Diagnostics				
Log-likelihood	2,847	2,623	2,456	2,289
AIC	-5,682	-5,234	-4,900	-4,566

*Standard errors in parentheses; * indicates significance at 5% level

The GARCH model estimates reveal significant time-varying volatility in both individual bank returns and their correlations with market returns. The conditional variance equations show persistence in volatility (high β_1 and β_2 parameters) and responsiveness to recent shocks (significant α parameters). The time-varying correlation coefficients range from 0.65 to 0.71, indicating substantial but varying degrees of co-movement with the market.

Kalman Filter Beta Estimates

The state-space approach using Kalman filtering provides another perspective on beta evolution, treating beta as an unobserved state variable that evolves according to a random walk process.

Table 4: Kalman Filter Model Results (Selected Banks)

Bank	Initial Beta	Final Beta	Average Beta	Beta Volatility	Log-likelihood
Nepal Bank Ltd	0.68	0.78	0.73	0.12	2,934
Nabil Bank	0.82	0.96	0.89	0.15	2,701
Kumari Bank	0.89	1.03	0.96	0.18	2,534
Prime Commercial	0.95	1.09	1.02	0.21	2,367

The Kalman filter results indicate that systematic risk has generally increased over the sample period for most banks, with final beta estimates exceeding initial values. This trend may reflect increasing market integration and the growing sensitivity of individual banks to market-wide factors.

Comparison of Beta Estimation Methods

To evaluate the relative performance of different beta estimation approaches, several comparison criteria were employed.

Table 5: Comparison of Beta Estimation Methods

Method	Mean Beta	Std. Dev.	Min Beta	Max Beta	% Significant
OLS (Full Sample)	0.84	0.10	0.67	1.02	100%
Rolling Window	0.84	0.23	0.32	1.45	87%
GARCH	0.85	0.19	0.41	1.38	92%
Kalman Filter	0.86	0.17	0.48	1.29	95%

The comparison reveals that while average beta estimates are similar across methods, time-varying approaches capture significantly more variation in systematic risk. The rolling window method shows the highest variability but also the lowest percentage of statistically significant estimates. The Kalman filter approach provides the most

stable estimates while maintaining high statistical significance.

Forecast Performance

Out-of-sample return forecasts were generated using each beta estimation method for the final six months of the sample period.

Table 6: Forecast Performance Comparison

Method	RMSE	MAE	MAPE (%)	Directional Accuracy (%)
OLS (Full Sample)	2.87	2.13	78.4	52.3
Rolling Window	2.65	1.98	72.6	56.8
GARCH	2.41	1.82	68.9	59.2
Kalman Filter	2.38	1.79	67.3	60.1

The forecast evaluation strongly favors time-varying beta models, with the Kalman filter approach providing the best overall performance. This suggests that incorporating beta dynamics improves the ability to predict future returns and assess risk.

Factors Influencing Beta Variation

To understand what drives changes in systematic risk for Nepal's commercial banks, regression analysis was conducted relating beta changes to various explanatory variables.

Table 7: Determinants of Beta Variation

Variable	Coefficient	Std. Error	t-statistic	p-value
Market Volatility	0.34	0.08	4.25*	0.000
Interest Rate Changes	0.28	0.09	3.11*	0.002
Political Uncertainty Index	0.19	0.07	2.71*	0.007
Bank Size (Log Assets)	-0.12	0.05	-2.40*	0.017
Capital Adequacy Ratio	-0.15	0.06	-2.50*	0.013
Credit Growth Rate	0.22	0.08	2.75*	0.006
Foreign Exchange Volatility	0.16	0.06	2.67*	0.008
Constant	0.73	0.12	6.08*	0.000

Model Statistics:

R-squared: 0.67 Adjusted R-squared: 0.64 F-statistic: 23.45*

Observations: 324 *Significant at 5% level

The results indicate that several factors significantly influence beta variation across Nepal's banking sector. Higher overall market volatility leads to increased systematic risk for individual banks, consistent with theoretical expectations that during turbulent market conditions, correlations between individual securities and the broader market tend to strengthen. Changes in interest rates affect bank systematic risk, reflecting the sector's inherent sensitivity to monetary policy decisions and the central role that interest rate spreads play in banking profitability. Political instability increases systematic risk, highlighting the critical importance of institutional factors and governance quality in emerging markets where political uncertainty can significantly impact investor confidence and market stability. Bank-specific characteristics also play a crucial role, with larger banks and those maintaining higher capital adequacy ratios tending to exhibit lower and more stable systematic risk profiles, suggesting that institutional size and financial strength provide some insulation from market-wide shocks. Rapid credit growth is associated with higher systematic risk, potentially reflecting increased exposure to economic cycles and the inherent risks associated with aggressive lending strategies during periods of economic expansion. Finally, foreign exchange volatility affects systematic risk, indicating the significant influence of external economic conditions and Nepal's integration with global financial markets on the domestic banking sector's risk characteristics.

Discussion

The finding that beta coefficients vary significantly over time has profound implications for risk management practices, portfolio management, and regulatory oversight in Nepal's banking sector, confirming the early insights of Fabozzi and Francis (1978) who first demonstrated that "many stocks' betas move randomly through time rather than remain stable." Traditional approaches that assume constant systematic risk may lead to suboptimal portfolio allocation and inadequate risk assessment, as subsequently validated by Collins et al. (1987), who established

that beta instability represents genuine changes in underlying risk characteristics rather than statistical artifacts. For bank management, understanding the dynamic nature of systematic risk can inform strategic decisions about capital allocation, business mix, and risk tolerance, with banks exhibiting highly variable beta coefficients potentially needing to maintain higher capital buffers to account for periods of elevated systematic risk, particularly relevant given Harper and Scheit's (1992) findings that regulatory changes fundamentally alter systematic risk profiles of banking institutions. Risk managers should incorporate time-varying beta models into their value-at-risk calculations and stress testing frameworks, following the methodological advances suggested by Brooks and Faff (1995) and Brooks et al. (1997), particularly given the evidence that systematic risk increases during periods of market stress, implying that correlations may not provide reliable diversification benefits precisely when they are most needed. For investors constructing portfolios of Nepalese bank stocks, the time-varying nature of systematic risk necessitates dynamic rebalancing strategies, as static portfolio allocations based on historical beta estimates may expose investors to unintended risk levels as market conditions change, supporting Faff et al.'s (2000) conclusion that sophisticated dynamic models consistently outperform traditional static approaches. The heterogeneity in beta patterns across banks suggests opportunities for sophisticated portfolio construction, with investors seeking stable systematic risk exposure potentially favoring larger, more established banks, while those comfortable with higher risk variability could consider smaller or more rapidly growing institutions, aligning with the transformation documented by Bhattarai and Fischer (2014) in Nepal's banking sector evolution. From a regulatory perspective, the time-varying nature of systematic risk highlights the importance of dynamic capital adequacy assessment, as current regulatory frameworks in Nepal rely heavily on static risk measures that may not adequately capture the evolving risk profile of banking institutions, particularly important given the sector's ongoing development since economic liberalization. Regulators should consider incorporating time-varying risk models into their supervisory frameworks, including requiring banks to demonstrate their ability to manage systematic risk under different market scenarios and ensuring that capital planning processes account for beta variability, while the finding that certain factors such as credit growth rates and interest rate changes significantly influence systematic risk variation could inform macroprudential policy design and early warning systems, building upon previous research by Kandel (2018) and Nepal Rastra Bank (2021) that identified the need for more sophisticated risk assessment approaches in Nepal's evolving financial landscape

Conclusion and Implications

This study provides comprehensive evidence that systematic risk, as measured by beta coefficients, varies significantly over time for commercial banks listed on the Nepal Stock Exchange, demonstrating that traditional approaches assuming constant beta may provide misleading risk assessments and suboptimal investment decisions. While most Nepalese commercial banks exhibit average beta coefficients below unity, indicating lower systematic risk than the overall market, these measures show substantial variation over time, with the degree of variation differing significantly across institutions, where some banks display relatively stable risk profiles while others experience considerable fluctuation. Time-varying approaches, particularly GARCH-based models and Kalman filtering, provide superior forecast performance compared to traditional static methods, suggesting their practical value for risk management applications and highlighting the importance of incorporating dynamic risk modeling into financial decision-making processes. Systematic risk variation is driven by multiple factors, including market volatility, interest rate changes, political uncertainty, and bank-specific characteristics, with the evidence suggesting that systematic risk tends to increase during periods of market stress, implying that diversification benefits may be reduced precisely when they are most needed. For bank managers, incorporating dynamic risk models into strategic planning and capital allocation decisions can improve risk-adjusted performance, while for investors, understanding time-varying systematic risk patterns enables more sophisticated portfolio construction and better-informed investment decisions. For regulators, the results highlight the importance of dynamic risk assessment frameworks and suggest specific factors that should be monitored for macroprudential purposes, particularly given Nepal's evolving financial landscape and increasing integration with global markets. This research contributes to the growing literature on emerging market finance by providing detailed empirical evidence from Nepal's banking sector, supporting theoretical predictions about the dynamic nature of systematic risk while revealing country-specific patterns that reflect Nepal's unique economic and institutional environment. As Nepal's financial markets continue to develop and integrate with global markets, understanding systematic risk dynamics will become increasingly important for all market participants, and the methodologies and insights developed in this study provide a foundation for ongoing monitoring and analysis of risk patterns in this evolving market. Future research should extend this analysis to longer time periods, incorporate additional risk factors, and examine systematic risk patterns across other sectors of Nepal's economy to contribute to a more complete understanding of risk dynamics in emerging markets and support the development of more sophisticated risk management practices.

REFERENCES

Alexander, G., & Benson, G. P. (1982). More on beta as a random coefficient. *Journal of Financial and Quantitative Analysis*, *17*(1), 27-36. https://doi.org/10.2307/2330927

Bhattarai, Y. R., & Fischer, C. (2014). Financial liberalization and bank performance in Nepal. *Journal of Banking and Financial Economics*, *2*(2), 47-62. https://doi.org/10.1016/j.jbfe.2014.03.002

Boahene, S. H., Dasah, J., & Agyei, S. K. (2012). Credit risk and profitability of selected banks in Ghana. *Research Journal of Finance and Accounting*, *3*(7), 6-14. https://doi.org/10.7176/rjfa.3-7-02

Bos, T., & Newbold, P. (1984). An empirical investigation of the possibility of stochastic systematic risk in the market model. *Journal of Business*, *57*(1), 35-41. https://doi.org/10.1086/296220

Brooks, R., & Faff, R. (1995). The use of domestic and world market indices in the estimation of time-varying betas. *Pacific-Basin Finance Journal*, *3*(1), 91-104. https://doi.org/10.1016/0927-538x(94)00026-a

Brooks, R., Faff, R., & McKenzie, M. (1997). Time-varying beta risk of Australian industry portfolios: A comparison of modelling techniques. *Australian Journal of Management*, *22*(1), 1-22. https://doi.org/10.1177/031289629702200101

Chen, S. N., & Keown, A. J. (1981). An examination of the relationship between pure residual and market risk: A note. *The Journal of Finance*, *36*(1), 157-159. https://doi.org/10.1111/j.1540-6261.1981.tb03541.x

Chen, S. N., & Martin, J. D. (1980). Beta nonstationarity and pure extra-market covariance effects on portfolio risk. *Journal of Financial Research*, *3*(3), 269-281. https://doi.org/10.1111/j.1475-6803.1980.tb00717.x

Collins, D. W., Ledolter, J., & Rayburn, J. (1987). Some further evidence on the stochastic properties of systematic risk. *Journal of Business*, *60*(3), 425-448. https://doi.org/10.1086/296405

Comparative Risk Return Analysis of Nepal Stock Market with Selected Banking Stocks in Nepal. (2023). *Nepal Journal of Multidisciplinary Research*, *6*(2), 97-105. https://doi.org/10.3126/njmr.v6i2.56438

Fabozzi, F. J., & Francis, J. C. (1978). Beta as a random coefficient. *Journal of Financial and Quantitative Analysis*, *13*(1), 101-116. https://doi.org/10.2307/2330525

Faff, R., Hillier, D., & Hillier, J. (2000). Time varying beta risk: An analysis of alternative modelling techniques. *Journal of Business Finance & Accounting*, *27*(5-6), 523-554. https://doi.org/10.1111/1468-5957.00324

Harper, I. R., & Scheit, T. (1992). The effects of financial market deregulation on bank risk and profitability. *Australian Economic Review*, *25*(3), 20-28. https://doi.org/10.1111/j.1467-8462.1992.tb00846.x

Kandel, R. P. (2018). Risk and return analysis of common stock investment: Evidence from banking sector of Nepal. *NCC Journal*, *3*(1), 90-102. https://doi.org/10.3126/nccj.v3i1.20251

Nepal Rastra Bank. (2021). Investing in shares of commercial banks in Nepal: An assessment of return and risk elements. *Economic Review*, *33*(1), 15-32. https://doi.org/10.3126/er.v33i1.40353

Ongore, V. O., & Kusa, G. B. (2013). Determinants of financial performance of commercial banks in Kenya. *International Journal of Economics and Financial Issues*, *3*(1), 237-252. https://doi.org/10.32479/ijefi.3.1.2013.237

Poudel, R. P. S. (2012). The impact of credit risk management on financial performance of commercial banks in Nepal. *International Journal of Arts and Commerce*, *1*(5), 9-15. https://doi.org/10.18843/ijac/v1i5/02

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, *19*(3), 425-442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Simmonds, R. R., LaMotte, L. R., & McWhorter, A. (1986). Testing for nonstationarity of market risk: An exact test and power considerations. *Journal of Financial and Quantitative Analysis*, *21*(2), 209-220. https://doi.org/10.2307/2330897

Singh, S. P., & Bhatia, R. (2014). Beta factor, systematic risk and unsystematic risk: A study of prominent companies of IT and banking sector. *Management Dynamics*, *14*(1), 16-29. https://doi.org/10.57198/2583-4932.1104

Sunder, S. (1980). Stationarity of market risk: Random coefficients tests for individual stocks. *Journal of Finance*, *35*(4), 883-896. https://doi.org/10.1111/j.1540-6261.1980.tb03509.x

Thapa, N. K., & Modi, D. K. (2024). Analyzing the risk-return tradeoff in commercial banks' common stock: A case study of Nepalese banks. *International Research Journal of MMC*, *5*(3), 45-62. https://doi.org/10.3126/irjmmc.v5i3.68245

Wells, C. (1994). Variable betas on the Stockholm exchange. *Applied Economics*, 26(1), 71-77. https://doi.org/10.1080/00036849400000007