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Return Reversal in Portfolios Optimized under Exchange Rate Risk: Evidence from Vietnam's HNX Market

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ABSTRACT. This study examines the existence of short-term reversal effects in the Vietnamese equity market, with a focus on the Hanoi Stock Exchange (HNX) during the period January 2010 to April 2025. Using monthly stock returns for 46,882 firm–month observations, the analysis constructs portfolios based on an optimization framework that balances expected return, variance, and exposure to exchange rate risk. The empirical strategy involves both descriptive portfolio analysis and regression tests under standard asset pricing models, including the Capital Asset Pricing Model (CAPM) and the Carhart four-factor model (FF4), with adjustments for foreign exchange sensitivity. The results provide robust evidence of a short-term reversal anomaly. Portfolios formed on lagged information exhibit strongly negative abnormal returns at the one-month horizon, which weaken at two months and disappear entirely by the third month. Importantly, these effects cannot be explained by conventional risk factors, indicating the presence of inefficiencies inconsistent with the Efficient Market Hypothesis (EMH). Robustness checks further confirm that the anomaly persists across alternative model specifications and estimation windows. In particular, sensitivity tests with varying exchange rate risk parameters reveal a distinctive inverted U-shape in t-statistics, implying that reversal is strongest around central values and fades at extremes.

1. Introduction

Emerging equity markets have become an increasingly important focus of academic research and policy debate because of their rapid growth and due to their distinct structural vulnerabilities compared to developed markets. Among these vulnerabilities, exchange rate risk stands out as a critical factor influencing both asset returns and investor behavior. In economies

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where the capital account remains relatively open and external trade is a dominant driver of growth, fluctuations in the exchange rate have far-reaching implications for firms' cash flows, investment decisions, and stock market valuations. The literature has repeatedly documented that exchange rate exposure is a non-diversifiable source of risk, particularly in emerging markets, where shallow financial systems and limited hedging instruments amplify the impact of currency volatility on asset prices [1-3] . Despite its importance, exchange rate sensitivity remains underexplored in studies of short-term return predictability, especially in the context of behavioral anomalies such as the reversal effect.

Portfolio optimization provides a natural framework to study how exchange rate risk interacts with return dynamics. Since the pioneering work of Markowitz [4], mean–variance optimization has served as the cornerstone of modern portfolio theory, balancing risk and expected return. Yet, conventional models assume a risk space dominated solely by market factors and largely neglect the unique role of macro-financial risks such as exchange rate exposure. Recent research has argued that incorporating exchange rate beta into the optimization problem enhances both the realism and explanatory power of portfolio models [5, 6]. By embedding such exposure into optimization, one can capture not only the trade-off between risk and return but also the additional constraints faced by investors operating in open economies. This adjustment is especially relevant for Vietnam, a frontier market where exchange rate fluctuations remain a persistent macroeconomic concern, and where the Hanoi Stock Exchange offers a particularly illustrative case for studying the interaction between FX risk and short-term anomalies.

Alongside the traditional risk–return trade-off, the reversal effect has long been recognized as one of the most prominent short-term anomalies. First documented by Jegadeesh [7], reversal refers to the tendency of stock returns to reverse sign in subsequent periods, often attributed to investor overreaction and market correction. While well established in developed markets, evidence from emerging markets has been more mixed. Some studies report strong short-term reversals reflecting thin liquidity and heightened behavioral biases [8, 9], whereas others find weak or vanishing effects, suggesting that increasing integration with global markets enhances efficiency [10]. What remains largely unexplored, however, is how exchange rate risk conditions the strength and persistence of these reversal patterns. This omission is striking, given that currency shocks often trigger broad-based revaluations of firms, potentially amplifying or dampening investor overreaction.

This paper seeks to bridge these two strands of literature by investigating reversal effects in portfolios constructed under explicit exchange rate risk constraints. Specifically, we propose an optimization model that extends the mean–variance framework by penalizing portfolios for higher sensitivity to exchange rate fluctuations. Formally, the model introduces two parameters: A, representing the weight assigned to variance, and B, representing the penalty on FX beta (β_{FX}).

The resulting portfolios allow us to trace how different levels of exposure to exchange rate risk influence subsequent return dynamics. By focusing on lagged returns from one to three months, we can also test whether the reversal effect is strongest in the short run and whether it attenuates over longer horizons, as suggested by theories of investor overreaction and gradual information diffusion.

Empirically, we use monthly data from the HNX covering the period January 2010 to April 2025. This sample spans multiple economic cycles, episodes of currency volatility, and structural reforms in the Vietnamese capital market. Portfolios are constructed by solving the modified optimization problem with baseline parameters A=0.5 and B=1, generating three lagged portfolios (P1, P2, P3). Reversal is then evaluated through time-series regressions under both the CAPM and Carhart four-factor frameworks [11], using Newey–West corrections to account for autocorrelation. We further conduct sensitivity analysis by varying the penalty parameter B from –20 to 20, allowing us to detect potential nonlinearities in the interaction between FX exposure and reversal strength.

The results reveal three important findings. First, there exists clear evidence of reversal at the one-month lag. Portfolio P1 consistently displays negative and statistically significant alpha estimates, even after controlling for market, size, value, and momentum factors. This suggests that abnormal negative returns are not attributable to systematic risk but instead reflect behavioral dynamics consistent with investor overreaction. Second, the reversal effect weakens markedly at lag two and disappears by lag three, where alpha estimates approach zero and lose significance. This dynamic pattern indicates that while the HNX exhibits short-term inefficiencies, these anomalies are quickly arbitraged away, consistent with a gradual convergence toward market efficiency. Third, sensitivity analysis shows that the strength of reversal follows an inverted U-shaped relationship with respect to exchange rate exposure. Moderate levels of FX beta are associated with the strongest reversal, while both low and excessively high exposures dilute the effect. This finding underscores the complex, nonlinear role of macro-financial risks in shaping behavioral anomalies in emerging markets.

This study contributes to the literature in several ways. First, it introduces a novel methodological framework that integrates exchange rate risk into portfolio optimization, offering a more realistic lens for analyzing emerging markets where currency fluctuations are a pervasive concern. Second, it extends the literature on reversal anomalies by showing that their magnitude and persistence depend not only on investor behavior but also on macro-financial conditions. Third, it provides robust empirical evidence from Vietnam, an understudied yet increasingly significant frontier market, thereby enriching the comparative asset pricing literature. Finally, from a practical perspective, the findings suggest that investors may improve performance by strategically managing FX exposure rather than treating it as an exogenous risk to be fully hedged.

The remainder of this paper proceeds as follows. Section 2 reviews the relevant literature on reversal and FX risk in emerging markets. Section 3 presents our data sources, variable definitions, and econometric framework. Section 4 reports empirical results, including statistical descriptions, reversal tests, factor regressions, and sensitivity analyses. Section 5 discusses robustness checks, and Section 6 concludes with implications for theory and practice.

2. Literature review

Portfolio Optimization Theory

Modern portfolio theory traces its origins to the groundbreaking work of Markowitz [4], who formalized investment decision-making as a trade-off between expected return and risk, with risk measured by variance. This mean–variance (MV) framework revolutionized asset allocation by showing that diversification reduces risk without proportionally sacrificing returns. Despite its central role, however, the MV model has long been criticized for practical shortcomings. Chief among these is its acute sensitivity to input estimates of means and covariances, which are notoriously unstable in empirical settings [12]. In addition, the assumption of stable distributions and market conditions rarely holds in real-world settings, particularly in emerging markets characterized by volatility, structural breaks, and limited liquidity [13]. As a result, portfolios derived from traditional MV optimization can appear efficient in theory but fail to perform robustly in practice.

These limitations have spurred a rich body of research aimed at strengthening portfolio optimization. One important branch involves multi-objective portfolio optimization (MOPO), which recognizes that investors pursue multiple and sometimes conflicting goals—such as maximizing returns, minimizing risk, and ensuring liquidity—simultaneously. Advances in evolutionary computation, such as the non-dominated sorting genetic algorithm, allow researchers to approximate Pareto frontiers that balance these competing objectives [14, 15]. Nevertheless, in applied finance, multi-objective problems are often collapsed into single-objective ones using weighting methods, where investors assign subjective weights to competing objectives to arrive at a tractable solution [16]. While this introduces flexibility, it also highlights the importance of how weights are chosen and interpreted.

A further and highly relevant extension involves embedding macro-financial risk factors directly into the optimization process. Among such risks, exchange rate volatility is of particular significance in open and emerging economies. According to the International Capital Asset Pricing Model (ICAPM), when purchasing power parity does not hold, exchange rate fluctuations become a priced source of systematic risk [1]. Empirical studies confirm that the sensitivity of stock returns to currency fluctuations represents an important determinant of expected returns, especially in emerging markets where firms are heavily dependent on trade and external financing [3, 17].

Ignoring exchange rate risk in portfolio construction can therefore lead to misleading conclusions about risk-adjusted efficiency. Recent research has begun to integrate FX risk into optimization models explicitly, either by penalizing portfolios with high FX beta in the objective function or by imposing constraints on currency exposure [5, 6]. Moreover, econometric techniques such as multivariate GARCH or rolling-window estimation capture the time-varying nature of risk and co-movements, yielding more realistic portfolio allocations. This integration is particularly critical in frontier markets such as Vietnam, where exchange rate volatility often reflects broader macroeconomic fragility and can directly affect firm-level performance. Consequently, incorporating FX risk into portfolio optimization not only enhances the robustness of results but also aligns optimization more closely with the realities of open, vulnerable financial systems.

Short-Term Reversal Effect

Parallel to advances in portfolio theory, a large empirical literature has investigated the persistence of short-term anomalies in stock returns. Among the most prominent is the reversal effect [7]. This anomaly describes the tendency for stocks that underperform in one period (losers) to outperform in the next, while past winners subsequently experience lower returns. The reversal effect directly challenges the weak-form efficient market hypothesis, which posits that past price movements should not contain predictive power for future returns.

Two main explanatory frameworks have been developed. The first emphasizes behavioral biases, particularly investor overreaction to news and the tendency to extrapolate short-term trends [18-20]. Under this interpretation, reversals arise as corrections when mispricing induced by behavioral biases unwinds. The second explanation comes from market microstructure theory, where reversals are seen as compensation for providing liquidity in the face of temporary shocks. If certain investors are forced to trade due to liquidity needs, prices may deviate from fundamental values, only to reverse once liquidity conditions stabilize [21-23].

Empirical evidence on reversal is nuanced. In developed markets, reversal patterns are well documented but often modest in size. By contrast, emerging markets frequently exhibit stronger reversal effects, attributed to the dominance of individual investors and thinner liquidity [9]. In such contexts, sentiment-driven trading, noise, and structural inefficiencies amplify the likelihood of overreaction. However, findings remain mixed: some studies highlight persistent reversal effects [8], while others report diminishing anomalies as markets integrate with global capital flows and adopt modern infrastructure [10]. This heterogeneity suggests that reversal is not merely a universal behavioral phenomenon but one conditioned by the structural and macro-financial context of a market.

One particularly underexplored factor in this context is the interaction between exchange rate risk and short-term anomalies. Currency volatility can increase overall uncertainty, making investors more prone to behavioral overreaction and exaggerating reversal dynamics.

Simultaneously, exchange rate shocks can create liquidity stress, as firms with FX mismatches adjust positions or as investors face margin calls, leading to temporary mispricings. Both mechanisms suggest that exchange rate risk may amplify reversal effects, yet the empirical literature has rarely tested this systematically. By embedding FX beta into portfolio construction, this study aims to evaluate whether and how currency exposure conditions the strength and persistence of reversal anomalies in emerging equity markets.

To test reversal, researchers often rely on zero-net investment portfolios, in which long positions in losers are offset by short positions in winners of equal value. Such constructions eliminate exposure to aggregate market movements, isolating the abnormal component of returns [24]. More recently, optimization-based portfolio formation has been used to refine this approach, enabling researchers to account for multiple risk dimensions and enhancing statistical robustness [25]. Incorporating FX risk into this optimization framework thus provides a novel perspective for evaluating how systemic macroeconomic risks intersect with behavioral and liquidity-driven anomalies.

Hypothesis Development

Drawing on the theoretical foundations of portfolio optimization and the empirical literature on reversal effects, this study proposes three central hypotheses designed to capture the interaction between exchange rate risk and short-term return dynamics in an emerging market context.

Hypothesis H1: Existence of short-term reversal in optimized portfolios.

Based on extensive evidence of reversal anomalies worldwide, and particularly their prevalence in markets with high proportions of individual investors, we expect that portfolios constructed under our optimization framework will exhibit a negative and statistically significant alpha at the one-month horizon. In other words, portfolios that overweight past losers and underweight past winners should generate abnormal negative returns in the immediate subsequent period, consistent with investor overreaction and subsequent correction.

Hypothesis H2: Declining strength of reversal with time lag.

Both behavioral theories of overreaction and market microstructure explanations suggest that reversal is a short-lived phenomenon. Mispricing and liquidity imbalances tend to be corrected relatively quickly, implying that the predictive power of lagged returns decays with time. Therefore, we hypothesize that the reversal effect is strongest at a one-month lag, weaker at two months, and disappears by three months. This temporal pattern reflects a convergence toward market efficiency as arbitrage capitalizes on and eliminates anomalies.

Hypothesis H3: Nonlinear relationship between reversal strength and exchange rate risk.

The integration of FX beta into portfolio optimization highlights the potential role of exchange rate risk in conditioning reversal dynamics. We posit that the relationship is nonlinear: portfolios with either too little or too much sensitivity to FX fluctuations are unlikely to display strong reversal. Insufficient penalization may lead to portfolios dominated by currency-sensitive firms, masking behavioral anomalies, whereas excessive penalization may exclude firms that are most prone to reversal. Thus, we expect an inverted U-shaped relationship, where the reversal effect is strongest at moderate levels of FX exposure.

Together, these hypotheses form a testable framework for evaluating how exchange rate risk interacts with short-term return predictability. They extend traditional anomaly research by embedding macro-financial constraints into portfolio construction and by highlighting the role of FX exposure in shaping behavioral patterns in emerging equity markets

3. Method

Data and Variables

The empirical analysis is conducted using monthly data from the FiinPro-X platform (https://www.fiinpro.com), covering all firms listed on the Hanoi Stock Exchange over the period January 2010 to April 2025. The dataset includes both stock returns and factor series necessary to construct asset pricing models and to evaluate the reversal effect under exchange rate risk. All returns are expressed in percentage terms and adjusted for dividends where applicable. Excess returns are calculated relative to the Vietnamese one-year government bond yield, which serves as the risk-free benchmark, while the HNX-Index is employed as the proxy for the overall market portfolio.

Table 1 provides a summary of the key variables used in the empirical analysis, including their construction formulas and descriptions.

Table 1. Description of Variables.

Variable	Formula / Definition	Details
ret	$(P_t-P_{t-1})/P_{t-1}$	Monthly stock return, calculated from closing prices and adjusted for dividends.
β_{FX}	Regression beta of stock returns on FX changes	Sensitivity of individual stock returns to exchange rate fluctuations (USD/VND).
P1,P2,P3	Optimized portfolios with lags (1, 2, 3)	Constructed under optimization with A=0.5,B=1; P1 is lag-1, P2 lag-2, P3 lag-3.
Mkt	R_m-R_f	Market excess return: value-weighted return of all HNX stocks minus the risk-free rate.
SMB	$R_{Small}-R_{Big}$	Size factor: return difference between small- and large-cap portfolios.
HML	$R_{High}-R_{Low}$	Value factor: return difference between high and low book-to-market portfolios.
MOM	$R_{Winners}-R_{Losers}$	Momentum factor: return difference between past winners and losers (12-2 months formation).

Portfolio construction follows the optimization framework described in Section 2, in which portfolio weights are derived under the dual objectives of maximizing mean–variance efficiency while controlling exposure to exchange rate sensitivity. Three lagged portfolios (P1, P2, and P3) are analyzed, corresponding to one-, two-, and three-month lags, respectively. These portfolios are parameterized by A=0.5 and B=1, which balance the trade-off between return, volatility, and foreign exchange risk. In addition, standard risk factors are employed for asset pricing tests. The market excess return (Mkt), size factor (SMB), value factor (HML), and momentum factor (MOM) are constructed in accordance with the Fama–French and Carhart methodologies but adapted to the Vietnamese stock market context. These factors allow us to assess whether the observed reversal patterns are merely compensation for systematic risk exposures or reflect genuine market inefficiencies.

Portfolio Construction and Models

Portfolio formation in this study follows a two–stage procedure. First, individual stock sensitivities to exchange rate fluctuations are estimated. Specifically, the foreign exchange beta (β_{FX}) for each stock i is obtained from the following time–series regression:

$$ret_{i,t} = \alpha_i + \beta_{MKT,i}Mkt_t + \beta_{FX,i}RFX_t + \varepsilon_{i,t} \quad (1)$$

where RFX_t is the percentage change in the USD/VND exchange rate. The coefficient $\beta_{FX,i}$ thus captures the marginal sensitivity of stock i's return to exchange rate fluctuations, controlling for market-wide effects. To ensure time–varying dynamics are reflected, the estimation of $\beta_{FX,i}$ is conducted using a rolling window of 36 months, where parameters at month t are estimated based on data from the interval t–36 to t–1.

Second, portfolio weights are determined by solving a constrained optimization problem that balances mean–variance efficiency with exposure to β_{FX}. The optimization can be written as:

$$\max_{w_t}\left(\mu_{t-k}^T w_t - A w_t^T \textstyle\sum_{t-k} w_t - B\beta_{FX,t-k}^T w_t\right)$$

$$s.t. \sum_i w_{i,t} = 0, |w_{i,t}| \le 1 \forall i$$

where $\mu_{t-k}^T w_t$ is the expected portfolio return, $\beta_{FX,t-k}^T w_t$ is the portfolio's aggregate FX sensitivity, $\sum_{t-k}$ is the covariance matrix of returns. The parameters A and B are preference weights that determine the trade–off between return maximization, variance minimization, and exposure to exchange rate risk. Importantly, the subscript t−k indicates that the information set used to determine portfolio weights at time t is based on lagged data up to time t−k. To evaluate potential short–term reversal effects, we construct three portfolios (P1, P2, P3) corresponding to one–, two–, and three–month lagged signals from the optimization procedure. P1 is considered the primary portfolio of interest, as it directly reflects the most recent sensitivity to exchange rate risk, while P2 and P3 allow for examining whether the reversal effect persists or dissipates over longer horizons.

The performance of these portfolios is subsequently evaluated using standard asset pricing models. First, the Capital Asset Pricing Model (CAPM) is estimated as:

$$R_{i,t} = \alpha_{CAPM} + \beta_{MKT,p} Mkt_t + \varepsilon_{i,t} (2)$$

where $R_{i,t}$ is the return of portfolio P_i and $\varepsilon_{i,t}$ is the random error term.

Second, the analysis extends to a Carhart four–factor model, which includes size, value, and momentum factors in addition to the market:

$$R_{i,t} = \alpha_{MOM} + \beta_{MKT,p} Mkt_t + \beta_{SMB,p} SMB_t + \beta_{HML,p} HML_t + \beta_{MOM,p} MOM_t + \varepsilon_{i,t} \quad (3)$$

The FF4 specification allows us to assess whether portfolio returns are driven by systematic risk factors commonly found in the literature or whether the observed reversal patterns represent true anomalies associated with exchange rate sensitivity.

Test of Hypotheses

The empirical tests are designed to evaluate the three hypotheses developed in Section 2.3, focusing on the existence, persistence, and conditional nature of short-term return reversals under exchange rate risk. The testing framework relies on a combination of time-series portfolio regressions and sensitivity analyses that connect portfolio performance to both systematic factors and foreign exchange exposure.

To test H1 (existence of short-term reversals), we examine whether the optimized portfolios (P1, P2, P3) generate significant abnormal returns after controlling for common risk factors. Specifically, we estimate the CAPM and Carhart four-factor models, as specified in Equations (2) and (3). A statistically significant negative alpha for P1 is interpreted as evidence of short-term reversal consistent with investor overreaction. The use of Newey–West standard errors with a lag length of four ensures robustness to heteroskedasticity and autocorrelation in monthly returns.

For H2 (attenuation of reversals with increasing lags), we extend the analysis across lagged portfolios. Portfolios P2 and P3, constructed using two- and three-month lagged signals, are subjected to the same factor regressions. A systematic decline in the magnitude and significance of alpha estimates from P1 to P3 would support the hypothesis that reversal effects weaken over time and eventually disappear, consistent with theories of market correction and gradual information diffusion.

To address H3 (dependence of reversals on FX risk penalization), we conduct a sensitivity analysis by varying the penalty parameter B in the optimization framework from –20 to 20. This approach allows us to capture how the strength of reversal, measured by the statistical significance of alpha or by t-statistics, changes as portfolios become more or less exposed to exchange rate risk. The expectation of an inverted U-shaped relationship between B and reversal strength implies that moderate exposure to FX risk amplifies behavioral mispricing, while very low or excessively high exposures dilute the effect.

Taken together, these tests provide a comprehensive evaluation of the hypothesized dynamics. The combination of portfolio-level regressions, lagged signal analysis, and parameter sensitivity ensures that the findings are not only statistically robust but also theoretically grounded in the dual interaction of behavioral anomalies and macro-financial risks.

4. Result and Discussion

Descriptive Statistics and Correlation

The dataset comprises 46,882 monthly observations from the Hanoi Stock Exchange covering the period January 2010 to April 2025. The HNX, as one of the two main stock exchanges in Vietnam, is characterized by a high concentration of small- and medium-sized enterprises and a large presence of retail investors. This structural composition contributes to relatively high volatility and susceptibility to behavioral trading patterns, making it a particularly relevant setting for testing return reversals under exchange rate risk.

Descriptive statistics provide an initial overview of the distributional characteristics of the variables employed in the analysis (Table 2). Stock returns exhibit extreme variation, ranging from –80.3% to 450.9%, with a mean of 1.6% and a standard deviation of 16.3%. The wide dispersion underscores both the high-risk profile of the Vietnamese equity market and the instability inherent in emerging market dynamics. Exchange rate betas (β_{FX}) range from –74.6 to 163.5, with a mean close to zero (–0.61) but a negative median (–0.52). This distribution indicates that although the average sensitivity to currency fluctuations is balanced across the sample, the majority of stocks load negatively on FX risk, suggesting that exchange rate fluctuations constitute a latent systematic risk in this market.

Table 2. The descriptive statistics of the variables

Variable	Min	Max	Mean	SD	Median
ret	-80.303	450.855	1.6	16.317	0.000
β_{FX}	-74.598	163.498	-0.607	5.535	-0.523
P1	-34.961	36.228	-3.943	10.725	-3.298
P2	-39.61	32.667	-1.374	9.57	-1.014
P3	-32.705	27.811	-0.237	9.533	0.032
Mkt	-25.119	15.931	0.27	5.797	0.625
SMB	-7.461	6.794	-0.109	2.476	0.000
HML	-14.578	11.155	-2.348	3.791	-2.016
MOM	-22.075	13.342	0.000	4.131	-0.028

Turning to the reversal portfolios, all three optimized portfolios (P1, P2, and P3) constructed under the baseline parameterization (A=0.5, B=1) yield negative average returns. Portfolio P1 records the most pronounced reversal effect, with an average return of –3.94%, followed by P2 at –1.37% and P3 at –0.24%. The pattern demonstrates that reversal profits are concentrated in the short horizon and dissipate as the lag length increases. In other words, the optimized portfolio based on the most recent signals (P1) captures the strongest anomaly, while delayed strategies lose predictive power.

The risk factors constructed in line with the Fama–French–Carhart framework also exhibit distinctive features in the Vietnamese context. The market factor (Mkt) averages 0.27% but with a high standard deviation of 5.8%, reflecting the dominant role of systematic shocks. The size factor (SMB) fluctuates around zero, implying that size-based return spreads are not persistent over time. Interestingly, the value factor (HML) is negative on average (–2.35%), indicating that value stocks underperform growth stocks during the sample period—a result often documented in emerging markets and contrasting with evidence from developed economies.

The correlation matrix further reinforces these insights (Table 3). The correlations among P1, P2, and P3 are positive but very weak (ranging between 0.07 and 0.13), confirming that the reversal portfolios at different lags are nearly independent of one another. Notably, P1 exhibits very low correlation with the market, SMB, and HML, implying that its abnormal returns cannot be explained by conventional risk factors. By contrast, the momentum factor shows a strong positive correlation with P1 (0.62), suggesting that short-term reversal strategies and momentum dynamics may be closely linked in this market. Among the risk factors themselves, the market factor and SMB are strongly negatively correlated (–0.39), while the market factor and HML display a moderate positive correlation (0.39). These relationships are consistent with the structural properties of Fama–French factors in emerging markets, where size and value effects are often intertwined with broader market movements.

Table 3. The correlation of the variables

	P1	**P2**	**P3**	**Mkt**	**SMB**	**HML**	**MOM**
P1	1	0.075	0.127	-0.152	-0.036	-0.059	0.621
P2	0.075	1	0.098	-0.07	0.05	0.054	0.123
P3	0.127	0.098	1	-0.065	0.082	-0.072	0.144
Mkt	-0.152	-0.07	-0.065	1	-0.394	0.391	-0.188
SMB	-0.036	0.05	0.082	-0.394	1	-0.114	0.092
HML	-0.059	0.054	-0.072	0.391	-0.114	1	-0.218
MOM	0.621	0.123	0.144	-0.188	0.092	-0.218	1

The descriptive statistics and correlation patterns highlight several key findings. First, the HNX is characterized by extreme return volatility and meaningful exposure to exchange rate risk. Second, short-term reversal effects are clearly present, strongest in the one-month lagged portfolio (P1), and fade with longer horizons. Finally, the low correlation of reversal portfolios with traditional risk factors indicates that the anomaly is not simply a manifestation of systematic risks but more likely reflects inefficiencies and behavioral trading in the Vietnamese equity market

Portfolio Analysis

The portfolio-level analysis in Table 4 provides direct evidence of short-term reversal dynamics in the HNX market under the optimization framework with parameters A = 0.5 and B

= 1. Among the three constructed portfolios, P1 (lag 1) demonstrates the strongest reversal pattern. The portfolio yields an average monthly return of –3.94% with a standard deviation of 10.7%. The associated t-statistic is –4.99, significant at the 1% level, confirming the presence of a robust reversal effect. This result indicates that stocks that experienced large gains in the previous month tend to underperform in the subsequent month. The negative Sharpe ratio (–0.368) further highlights that the strategy does not deliver superior risk-adjusted returns, but rather reflects a market anomaly consistent with behavioral overreaction.

For P2 (lag 2), the magnitude of the effect diminishes substantially. The mean return is –1.37% per month with a similar volatility level of 9.57%. The t-statistic of –1.95 corresponds to a p-value of 0.053, which lies just above the conventional 5% threshold. This suggests that the reversal effect remains detectable at a two-month horizon but with substantially weaker statistical power. The Sharpe ratio (–0.144) is closer to zero compared with P1, underscoring the rapid fading of abnormal profitability as lag length increases.

In contrast, P3 (lag 3) shows no evidence of reversal. Its average return is nearly zero (–0.24%), volatility remains high (9.53%), and the t-statistic of –0.338 (p = 0.736) indicates no statistical significance. The Sharpe ratio is essentially zero (–0.025), confirming that the reversal anomaly disappears entirely beyond the two-month horizon.

Table 4. Portfolio Statistics and Tests (P1, P2, P3)

Portfolio	**Mean**	**SD**	**Min**	**Max**	**Median**	**Sharpe**	**t-stat**	**p-value**
P1	-3.94	10.7	-35	36.2	-3.3	-0.368	-4.99	0.000
P2	-1.37	9.57	-39.6	32.7	-1.01	-0.144	-1.95	0.053
P3	-0.237	9.53	-32.7	27.8	0.032	-0.025	-0.338	0.736

Taken together, these findings provide strong empirical support for Hypothesis H1, which posits the existence of short-term reversal effects in optimized portfolios. The magnitude and statistical significance of the effect in P1 confirm that reversal is a salient feature of the HNX market. At the same time, the sharp decline in effect size and significance across P2 and P3 validates Hypothesis H2, which predicts that reversal patterns weaken and eventually vanish with longer lags. The results suggest that investor overreaction and price adjustment mechanisms operate only over a very short horizon. In line with the view that emerging markets deviate from the Efficient Market Hypothesis (EMH), the Vietnamese equity market exhibits transient inefficiencies that dissipate quickly as market forces correct prior mispricing.

Regression Analysis and Testing the Reversal Effect

The regression results in Table 5 provide additional and more formal evidence regarding the reversal effect in the HNX market over the period from January 2010 to April 2025. For the one–month lagged portfolio (P1), the estimates consistently point to a significantly negative alpha across both the CAPM and the Carhart four–factor model. Under the CAPM, P1 delivers an alpha of –3.87 ($p < 0.01$), while the FF4 model yields a slightly smaller but still strongly significant alpha of –3.18 ($p < 0.01$). These findings indicate that the abnormal negative returns observed in P1 cannot be explained by exposure to the market factor, nor by the standard size, value, and momentum effects. Instead, they provide robust evidence of a genuine reversal anomaly, consistent with investor overreaction to past price movements and rapid correction in subsequent months.

Table 5. CAPM regression estimates for reversal portfolios

Portfolio	Term	Estimate	SE	t-stat	p-value	R^2	Adj R^2	N
P1	Alpha	-3.87	0.719	-5.38	0.000	0.023	0.018	184
	Mkt	-0.281	0.132	-2.13	0.035			
P2	Alpha	-1.34	0.713	-1.88	0.061	0.005	-0.001	
	Mkt	-0.115	0.122	-0.94	0.348			
P3	Alpha	-0.209	0.664	-0.314	0.754	0.004	-0.001	
	Mkt	-0.106	0.125	-0.846	0.399			

Note: Standard errors are corrected using Newey–West heteroskedasticity and autocorrelation consistent covariance matrix with lag length of 4.

The magnitude of this anomaly declines notably for the two–month lagged portfolio (P2). Within the CAPM specification, alpha decreases to –1.34 and becomes only marginally significant ($p \approx 0.06$). Under FF4, the alpha for P2 falls further to –0.63 and loses all statistical significance ($p \approx 0.44$). This pattern suggests that although some traces of reversal remain, they weaken substantially and are largely indistinguishable from noise once the lag extends beyond a single month. By the three–month horizon (P3), the reversal effect disappears entirely. Both CAPM and FF4 produce alpha estimates close to zero (–0.21 and –0.43, respectively), with no statistical significance. Furthermore, the explanatory power of the models collapses, with R^2 values approaching zero. This confirms that any abnormal return associated with reversal is transitory and vanishes as the holding period lengthens.

It is noteworthy that the inclusion of size, value, and momentum factors in FF4 substantially improves the explanatory power of the regressions. For P1, the CAPM produces an R^2 of only about 2–3%, whereas FF4 lifts the R^2 above 40%. This highlights the relevance of additional systematic factors in capturing return variation in emerging markets. However, the persistence of significantly negative alpha in P1 even under FF4 indicates that reversal is not subsumed by these risk factors. In other words, the anomaly reflects true short-term inefficiency rather than model misspecification.

Taken together, these findings confirm that short-term reversal in HNX portfolios is strong and statistically robust at a one–month lag, diminishes sharply at two months, and disappears entirely after three months. The evidence supports Hypothesis H1, which posits the existence of reversal effects in optimized portfolios, and Hypothesis H2, which predicts their decline with increasing lag. Importantly, the inability of standard asset pricing models to account for the anomaly underscores its role as a market inefficiency rather than compensation for systematic risk. This dynamic is consistent with the notion that emerging markets deviate from the Efficient Market Hypothesis (EMH) in the short run, but gradually converge toward efficiency as mispricing is corrected.

Table 6. Carhart four–factor regression estimates for reversal portfolios

<table>
<tr><th>Portfolio</th><th>Term</th><th>Estimate</th><th>SE</th><th>t-stat</th><th>p-value</th><th>R²</th><th>Adj_R²</th><th>N</th></tr>
<tr><td rowspan="5">P1</td><td>Alpha</td><td>-3.18</td><td>0.678</td><td>-4.69</td><td>0</td><td rowspan="5">0.411</td><td rowspan="5">0.398</td><td rowspan="15">184</td></tr>
<tr><td>Mkt</td><td>-0.241</td><td>0.137</td><td>-1.76</td><td>0.08</td></tr>
<tr><td>SMB</td><td>-0.574</td><td>0.228</td><td>-2.52</td><td>0.013</td></tr>
<tr><td>HML</td><td>0.325</td><td>0.193</td><td>1.68</td><td>0.094</td></tr>
<tr><td>MOM</td><td>1.64</td><td>0.175</td><td>9.41</td><td>0</td></tr>
<tr><td rowspan="5">P2</td><td>Alpha</td><td>-0.634</td><td>0.824</td><td>-0.77</td><td>0.442</td><td rowspan="5">0.029</td><td rowspan="5">0.007</td></tr>
<tr><td>Mkt</td><td>-0.138</td><td>0.118</td><td>-1.16</td><td>0.246</td></tr>
<tr><td>SMB</td><td>0.072</td><td>0.331</td><td>0.219</td><td>0.827</td></tr>
<tr><td>HML</td><td>0.296</td><td>0.273</td><td>1.08</td><td>0.28</td></tr>
<tr><td>MOM</td><td>0.303</td><td>0.151</td><td>2</td><td>0.047</td></tr>
<tr><td rowspan="5">P3</td><td>Alpha</td><td>-0.426</td><td>0.948</td><td>-0.449</td><td>0.654</td><td rowspan="5">0.027</td><td rowspan="5">0.005</td></tr>
<tr><td>Mkt</td><td>0</td><td>0.128</td><td>0.003</td><td>0.997</td></tr>
<tr><td>SMB</td><td>0.255</td><td>0.271</td><td>0.939</td><td>0.349</td></tr>
<tr><td>HML</td><td>-0.092</td><td>0.29</td><td>-0.317</td><td>0.751</td></tr>
<tr><td>MOM</td><td>0.3</td><td>0.269</td><td>1.12</td><td>0.266</td></tr>
</table>

Note: Standard errors are corrected using Newey–West heteroskedasticity and autocorrelation consistent covariance matrix with lag length of 4.

Sensitivity Analysis

In the next step, this study examines the sensitivity of the reversal effect to the weighting parameter B, while fixing A = 0.5 and allowing B to vary between –20 and 20. Figure 1 illustrates the evolution of the t-statistics from the mean-return test of portfolio P1 and the intercept (Alpha) t-statistics from the Carhart four–factor model. Both lines exhibit an inverted U-shape: when B approaches values close to zero, the t-statistics become most negative and highly significant. In contrast, for very negative or very positive B, the values converge toward zero and lose statistical significance.

Table 7 reinforces these observations. For P1, the t-statistics range from –5.93 to –1.12, with a mean of –3.56, confirming a consistently strong level of statistical significance. By contrast, P2 and P3 show much weaker magnitudes: their average t-statistics are only –1.18 and –0.43, respectively, with many cases close to or even above zero. In particular, P3 has a median of –0.97 and a maximum of 0.53, indicating that the reversal effect is largely absent at longer lags.

Table 7. Sensitivity Analysis of Parameter B

Variable	Min	1st Qu.	Median	Mean	3rd Qu.	Max
t_test_P1	-5.933	-4.431	-3.624	-3.564	-2.778	-1.122
t_test_P2	-2.071	-1.851	-1.697	-1.178	-0.38	-0.208
t_test_P3	-1.479	-1.416	-0.055	-0.427	0.414	0.527
t_value_P1 (α_{MOM})	-5.644	-4.694	-3.657	-3.276	-1.458	-0.571
t_value_P2 (α_{MOM})	-3.32	-3.048	-1.367	-1.251	0.486	0.621
t_value_P3 (α_{MOM})	-2.456	-2.193	-0.969	-0.906	0.288	0.704

Note: t_test_P1, t_test_P2, and t_test_P3 denote the t–statistics from mean return tests of reversal portfolios with lags 1, 2, and 3, respectively. t_value_P1 (α_{MOM}), t_value_P2 (α_{MOM}), and t_value_P3 (α_{MOM}) represent the t–statistics of the intercept (alpha) estimated under the Carhart four–factor model with momentum, using Newey–West corrections with lag length 4.

The implication is that the reversal effect in the HNX market is not confined to the baseline specification (A = 0.5, B = 1), but remains robust across a relatively wide range of B values. Nevertheless, its intensity varies significantly, with the strongest effects concentrated around values close to zero. This suggests that the reversal effect is fundamental and not an artifact of parameter choice, while also reflecting the influence of microstructural factors such as herding behavior or liquidity constraints. At longer lags (P2, P3), the effect rapidly fades away, which is consistent with the hypothesis that the market becomes more efficient over time, in line with the Efficient Market Hypothesis.

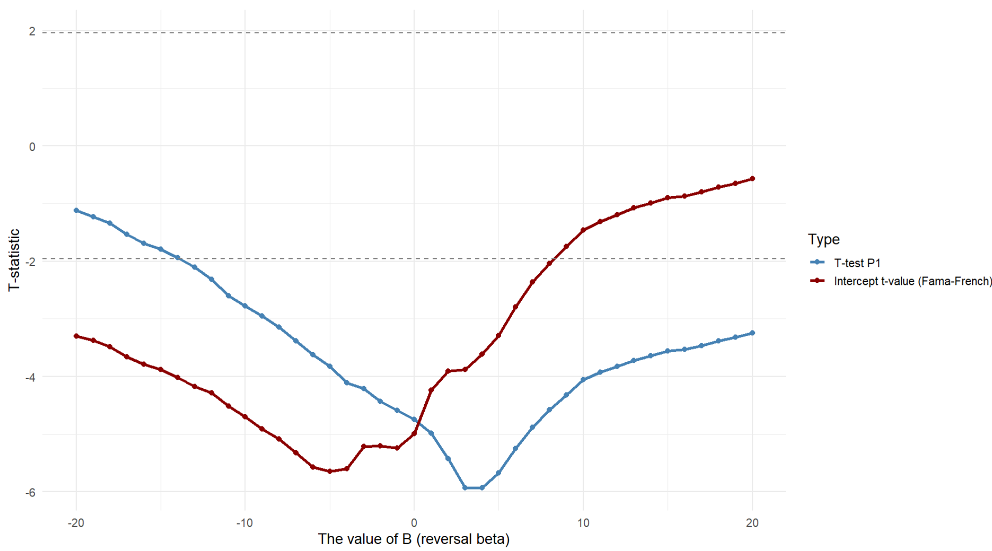

Figure 1. Sensitivity of t-statistics to Parameter B (A = 0.5)

Discussion

The empirical results presented in Section 4 provide strong evidence for the presence of a short-term reversal effect in the Vietnamese stock market, specifically on the HNX exchange. The reversal effect is most pronounced at a one-month lag (P1), as indicated by significantly negative portfolio returns and statistically meaningful alpha estimates under both CAPM and the Fama–

French four-factor model. The economic implication is clear: stocks that experience sharp gains in the previous month tend to underperform in the subsequent month. However, unlike classical contrarian strategies that might generate positive abnormal returns, the portfolios in this study show significantly negative abnormal returns. This finding highlights that the reversal anomaly in Vietnam is not exploitable in practice as a profitable trading rule, but rather represents a market inefficiency symptomatic of excessive investor reactions.

From a portfolio management perspective, the fact that P1 exhibits highly negative Sharpe ratios suggests that contrarian positions entail disproportionate risk relative to expected returns. For institutional investors and fund managers, this emphasizes the importance of risk controls and the necessity of accounting for short-term overreaction when allocating capital in emerging markets. The reversal effect might serve as a signal of temporary mispricing rather than a tradable arbitrage opportunity.

At longer horizons (P2 and P3), the reversal effect weakens and disappears entirely by the three-month lag. This pattern implies that price adjustments in Vietnam's market are rapid: initial overreaction dissipates within two months, after which asset prices appear to reflect fundamental values more efficiently. This result has financial implications for regulators and policymakers. It suggests that while short-term inefficiencies persist, the market as a whole exhibits a corrective mechanism that converges towards the Efficient Market Hypothesis. For investors, it means that attempts to systematically capture reversal profits at horizons longer than one month are unlikely to succeed, as the anomaly vanishes.

An important dimension of this study is the explicit incorporation of exchange rate risk into the portfolio optimization framework. The sensitivity of stock returns to currency fluctuations, captured by the FX beta, shows that exchange rate risk plays a meaningful role in shaping reversal effects. On average, stock-level FX betas are negative, implying that many firms are adversely exposed to depreciation shocks of the Vietnamese Dong. More importantly, reversal portfolios constructed with FX risk controls still exhibit abnormal returns, confirming that currency exposure is not the sole driver of the anomaly. The implication is that exchange rate risk constitutes a systematic factor in asset pricing that cannot be diversified away, consistent with Andrew Karolyi and Wu [2], Bonga-Bonga and Mpoha [26]. For international investors, this highlights the necessity of hedging exchange rate exposures when investing in emerging markets like Vietnam.

The sensitivity analysis with respect to parameter B further underscores the robustness of the reversal effect. Even when B varies from –20 to +20, the t-statistics for portfolio P1 remain strongly negative and statistically significant, forming an inverted-U shape. This demonstrates that the anomaly is not an artifact of a specific parameter choice, but persists across a wide range of optimization settings. Financially, this suggests that the short-term reversal is a structural feature of market behavior, likely linked to behavioral biases such as herding and overreaction, as well as liquidity frictions. However, as the lag horizon increases (P2 and P3), the stability of t-statistics declines sharply, reaffirming that the anomaly is temporary.

The findings of this study resonate with a large body of literature on short-term return reversals. Jegadeesh [7] documented that stocks often exhibit negative autocorrelation in short horizons, a phenomenon attributed to investor overreaction and microstructure effects. Our results for P1 are consistent with this evidence, particularly in the magnitude and statistical significance of reversal in the immediate subsequent month. Similarly, Chui, Ranganathan, Rohit and Veeraraghavan [22], though better known for their momentum studies, highlighted the existence of reversal at very short horizons, which aligns with our HNX results.

Relative to the literature on emerging markets, the results also echo Rouwenhorst [27], Griffin, Kelly and Nardari [28], who found that anomalies such as momentum and reversal are often stronger and more persistent in developing economies. The presence of reversal in Vietnam thus fits into the broader narrative that emerging markets are less efficient than developed ones, partly due to lower liquidity, weaker institutional frameworks, and higher investor sentiment effects. However, one divergence is that while many studies in developed markets report reversal strategies delivering positive returns to contrarian investors, our study finds significantly negative returns. This indicates that reversal in Vietnam reflects mispricing without offering exploitable arbitrage after accounting for transaction costs and market frictions.

This study's main novelty lies in linking the reversal effect with exchange rate risk. Prior research emphasizes that exchange rate risk behaves as a systematic risk factor in global asset pricing [2, 26]. Our results contribute to this line of inquiry by showing that even after controlling for FX beta, short-term reversal remains statistically robust. This suggests that reversal anomalies are not driven solely by currency exposure, but instead represent a distinct behavioral and structural feature of the market. In this sense, the paper extends the mean–variance optimization of Markowitz [4] to a mean–variance–FX beta framework, which is more suitable for open economies exposed to external shocks.

Furthermore, the regression results indicate that standard models such as CAPM and the Fama–French four-factor model cannot explain away the observed reversal effect. Although the inclusion of SMB, HML, and MOM significantly increases explanatory power (raising R^2 from ~2% in CAPM to ~40% in FF4 for P1), the alpha remains negative and significant. This finding corroborates the argument of Fama and French (1996) that anomalies may persist even after expanding the risk factor space, implying that reversal is a "true anomaly" rather than a compensation for risk [29].

From the standpoint of market efficiency, the existence of a pronounced mean reversal anomaly in the HNX poses a direct challenge to the Efficient Market Hypothesis, which asserts that abnormal returns should not systematically persist [30]. Our findings are consistent with the evidence of Khoa and Huynh [31], who documented that the Vietnamese stock market remains inefficient and that such inefficiencies can potentially be exploited for abnormal profits. At the same time, the fact that the reversal effect weakens and eventually disappears at longer horizons suggests that the HNX exhibits an adaptive adjustment process rather than a permanently inefficient structure. This dynamic pattern lends support to the Adaptive Market Hypothesis, whereby market efficiency is not static but evolves over time in response to changing conditions, investor behavior, and institutional developments [32].

Robustness Checks

To ensure that the documented reversal effect and the associated exchange rate sensitivity are not artifacts of specific parameter choices or methodological assumptions, a series of robustness checks was conducted. Two sets of tests were performed: (i) varying the risk–return trade-off parameter A in the portfolio optimization, and (ii) extending the estimation window for exchange rate beta (β_{FX}) from 36 months to 48 months.

The baseline analysis was carried out under the assumption A = 0.5, balancing mean–variance efficiency and exposure to exchange rate risk. To test robustness, we increased the weight on return–volatility trade-offs by setting A = 0.75, A = 1, and A = 2. Across these specifications, the reversal effect persisted in a qualitatively similar fashion. Specifically, portfolios formed at lag 1 (P1) consistently produced significantly negative abnormal returns, with t-statistics forming the same inverted U-shape as observed in the baseline. In other words, while the magnitude of the t-statistics shifted slightly with higher values of A, the key result—that reversal is strong in the short run and weakens at longer horizons—remained intact. This confirms that the evidence for mean-reversal is not sensitive to the particular calibration of A.

The second robustness test concerns the time span used to estimate foreign exchange betas. In the baseline setting, β_{FX} was estimated over a rolling window of 36 months. To assess whether a longer estimation horizon affects results, the window was extended to 48 months. The outcomes were virtually unchanged: P1 continued to display strong and statistically significant reversal patterns, while P2 showed weaker evidence, and P3 was largely indistinguishable from noise. This suggests that the short-run reversal effect is not an artifact of sampling variability in β_{FX} estimation.

Limitations

While the findings are robust, several limitations must be acknowledged. First, the analysis assumes the feasibility of short-selling, which is a restrictive assumption in the Vietnamese market where such practices remain either heavily constrained or outright prohibited for most investors. Without the ability to take short positions, contrarian strategies that exploit overvalued stocks may not be practically implementable. Combined with high transaction costs and limited liquidity in many HNX stocks, this substantially reduces the real-world applicability of the strategies implied by the reversal effect. Second, the scope of the study is confined to the HNX exchange. Although HNX is an important segment of Vietnam's equity market, it is relatively smaller and less liquid than HOSE. The results may therefore not fully generalize to the broader Vietnamese market. Third, while the models incorporate exchange rate risk, they do not capture other global macroeconomic drivers of Vietnamese equities, such as U.S. interest rates, global risk aversion (e.g., VIX), or commodity price fluctuations. The exclusion of such factors may leave out important channels through which external shocks affect local stock returns. Fourth, the risk models employed, although extended to include FX beta, remain fundamentally linear and parametric. Behavioral explanations for reversal—such as herding, feedback trading, or liquidity spirals—are inherently nonlinear and may not be adequately captured by the present framework. Finally, the dataset covers 2010–2025, a period that includes several structural breaks such as the Eurozone crisis, the COVID-19 pandemic, and volatile capital flows in and out of Vietnam. Although Newey–West corrections were applied to address heteroskedasticity and autocorrelation, the presence of such shocks may still bias the results.

5. Conclusion

The findings of this study provide strong evidence of a reversal effect in the HNX market. The anomaly is most pronounced at the one-month horizon, diminishes at two months, and disappears entirely by the third month. This pattern reflects the behavioral nature of investors in an emerging market: short-term overreaction and subsequent price correction create abnormal returns that are temporary and unsustainable. Incorporating exchange rate risk into the portfolio optimization framework further reveals that sensitivity to currency fluctuations significantly affects asset pricing, highlighting the vulnerability of Vietnamese equities to global macroeconomic conditions. Moreover, the inability of traditional asset pricing models to fully account for these abnormal returns underscores the presence of short-term inefficiencies. At the same time, the fading of the reversal effect over longer horizons indicates that the market does possess some self-correcting mechanisms, pointing toward a partially efficient and adaptive structure.

Despite the robustness of these results, several limitations must be acknowledged. The assumption of unrestricted short-selling, low transaction costs, and high liquidity does not fully reflect the realities of the Vietnamese equity market. In addition, the study focuses exclusively on the HNX exchange, which is smaller and less liquid than the HOSE, thus limiting the generalizability of the findings. Future research could broaden the scope by including data from other exchanges to capture a more comprehensive view of reversal dynamics across Vietnam's stock market. It may also be fruitful to integrate additional macroeconomic risk factors, such as interest rates or global risk aversion measures, into the analysis. Finally, the application of more advanced econometric or behavioral models could deepen the understanding of the mechanisms underlying short-term anomalies in emerging markets.

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