Journal of Religion & Society (JR&S)
Available Online:
https://islamicreligious.com/index.php/Journal/index
Print ISSN: 3006-1296Online ISSN: 3006-130X
Platform & Workflow by: Open Journal Systems

Exchange-Rate Volatility and Foreign Investment in an Emerging Economy

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Abstract
This article investigates whether there is an inverse relationship between fluctuations in a nation's exchange rate and the flow of foreign direct investment into the country. The significance of the question lies in the fact that developing economies are vying for access to a shrinking pool of long-term international capital, and that Pakistan has seen an increasing number of instances of exchange-rate pressures, reserve stress, and policy adjustments. The paper presents an empirical design that is transparent and based on the GARCH model, using official data from the State Bank of Pakistan. Data on annual net FDI flows are supplemented by monthly nominal and real effective exchange rate indices for the period January 2013 to December 2023. Realized volatility, GARCH(1,1) conditional volatility, and an asymmetric GJR-GARCH specification are used to measure exchange-rate risk. These currency-risk indicators for the fiscal years are then linked to FDI using both static and robust models that account for thresholds and event analysis, confidence intervals calculated via a bootstrap technique, a dynamic growth specification, and asymmetric depreciation/appreciation measures. The results show that Pakistan's currency market is highly volatile and persistent. The coefficient estimates for the low-volatility years are statistically fragile, as the matched sample is short and low-volatility years have lower average FDI and lower average FDI growth than high-volatility years. Focusing solely on the exchange rate level, the article suggests a more conservative view of the effect of currency risk: investors do not seem particularly deterred by it. As for the policy implications, Pakistan is required to place greater emphasis on establishing a credible reserve management system, transparent communication on foreign exchange, developing the hedging market, establishing predictable profit-retention rules, and facilitating sector-level investment. The results add to the existing FDI literature on macroeconomic uncertainty by demonstrating the application of currency risk measurement based on a GARCH model to investment analysis in Pakistan.

Keywords: *Exchange-Rate Volatility; Foreign Direct Investment; Pakistan; GARCH; GJR-GARCH; Currency Risk; Investor Confidence*

1- Introduction

Foreign direct investment (FDI) is a long-term investment in capital, technology, managerial skills, and market confidence. FDI can be particularly beneficial for emerging economies, as it can facilitate industrial upgrading, employment creation, strengthen export capabilities, and reduce reliance on short-term external borrowing. The case of Pakistan is especially relevant, as it has been plagued by low domestic savings, pressure on external financing, energy-sector circular debt, and a small export base, among other issues. This is not just a growth goal; it is

also a macroeconomic stability goal, emphasizing the importance of stable foreign investment in this context. Foreign investors are not attracted to a market because of increased demand and lower labor costs. They compare expected returns with uncertainty; one of the most visible sources of uncertainty is the exchange rate (Dunning, 1988; Alfaro et al., 2004; OECD, 2008; World Bank, 2025).

Volatility in exchange rates is important because FDI projects are typically considered irreversible. A foreign company establishing a factory, buying up a local company, setting up distribution systems, or investing in energy projects can't just exit without incurring sunk costs. This is a type of currency uncertainty that is not typical of normal business risk. With a sudden drop in the rupee's value after a foreign investor invests money, the value of imported machines will increase, foreign-currency debt payments will rise, and the domestic value of foreign-currency earnings will decline. The more volatile the exchange rate, the less reliable the project's valuation will be, and the higher the value of waiting. This mechanism is consistent with the real-options view of investment, which suggests that uncertainty can lead to deferring irreversible investment even if there are positive expected returns (Dixit and Pindyck, 1994; Goldberg and Kolstad, 1995; Aizenman and Marion, 2004).

The subject is also relevant in the global investment landscape. UNCTAD's World Investment Report 2025 characterizes the global FDI situation as weak and uneven, as it is more difficult for developing economies to attract productive investment. The World Bank also notes that FDI in developing economies has slowed and that policy credibility, policy openness, and investment facilitation will be needed to turn the tide (UNCTAD, 2025; World Bank, 2025). These trends worldwide would make it difficult to attract capital, given that investors are already cautious. In such a framework, domestic macroeconomic fluctuations can become a major determinant of investment project location.

The issue is empirically important in the context of Pakistan's exchange-rate history. The country has gone through various stages of currency depreciation, external-sector pressures, particularly during current-account stress, depletion of national foreign reserves, and stabilization programs. The State Bank of Pakistan provides monthly foreign-investment figures, daily and monthly exchange-rate figures, and nominal and real effective exchange-rate indexes, which enable researchers to overcome the limitations of annual exchange-rate levels and directly measure exchange-rate risk (SBP, 2026a, 2026b, 2026c). This is important because an annual exchange rate could mask the true volatility investors experience. This does not require that the year's average exchange rate be moderate, even if the months in between feature sudden increases, periods of market rationing, or sharp depreciations.

The thorny issue of the relationship between exchange rates and FDI is not unidirectional. Depreciation can make domestic assets less expensive to foreign investors, thereby attracting foreign acquisition or export-oriented investment. This channel is sometimes referred to as the relative-wealth or relative-cost effect (Froot & Stein, 1991; Klein & Rosengren, 1994). But depreciation can also deter investors when it signals macroeconomic fragility, shortages of imported inputs, capital-control risk, or inflation down the road. In Pakistan, the two channels can run simultaneously. A weaker rupee can increase the attractiveness to certain investors, while a volatile rupee can deter investors whose businesses rely on imported machinery, foreign-currency loans, or repatriation of profits (Ramzan, 2022; Khan & Maryam, 2024).

One major drawback of much of the literature on Pakistan is its reliance on annual figures and standard exchange rate indicators. While annual models are good for long-run interpretation, they might fail to capture volatility clustering and short-run risk episodes. The exchange-rate

markets are often conditionally heteroskedastic; that is, volatility often rises following large shocks. It is this kind of pattern that ARCH and GARCH models were developed to model (Engle, 1982; Bollerslev, 1986). Therefore, a more Pakistan-oriented article should estimate exchange rate volatility using time-series volatility models rather than relying on a moving standard deviation or the average exchange rate level.

In this paper, I make four contributions. First, it offers a purer journal-style model to study the volatility of the exchange-rate-FDI relationship in Pakistan. Second, it employs GARCH and GJR-GARCH models to separate general volatility from asymmetric volatility. Third, it distinguishes between depreciation pressure and appreciation pressure, which is significant because investors may be more sensitive to currency losses than to gains. Fourth, it sheds light on how the empirical findings can be interpreted in light of recent global FDI evidence and emerging-market studies, thereby highlighting the policy challenge not just of attracting foreign capital, but of reducing the premium that emerging markets impose on foreign capitalists because it is subject to currency risk (Jannat, 2020; Akinlo & Onatunji, 2021; Moraghen et al., 2023; Elian et al., 2024; Morina, 2024).

Hence, the question at the heart of the research is quite simple—does exchange-rate volatility negatively affect FDI inflows to Pakistan? The primary hypothesis is that an increase in currency volatility will negatively affect FDI by increasing uncertainty about costs, revenues, debt repayments, and repatriated profits. One hypothesis is that depreciation pressure and volatility are distinct. Sometimes depreciation can be an attraction for investors, as it can drive down local asset prices, and volatility should deter investors by raising the risk premium. The paper evaluates these hypotheses through descriptive analysis, GARCH-family volatility measures, robust regressions, asymmetric measures, and threshold/event analysis.

The rest of the study, Section 2, explains the existing literature. In section 3, the methodology, data span, sources, and variable definitions are presented. In Section 4, we analyze the data and interpret the results. Sections 5 and 6 have a discussion and conclusion of the study, along with a future study.

2- Literature Review

The literature on the determinants of FDI is extensive and indicates that both structural and macroeconomic factors affect foreign investment. The ownership-location-internalization framework states that a multinational company's decision to invest in foreign countries is driven by a combination of ownership advantages, location considerations, and a preference to internalize investments in the host country rather than contract them out via the market (Dunning, 1988). Market size, labor costs, infrastructure, openness to trade, institutional quality, tax policy, and macroeconomic stability are all components of location attractiveness. Subsequent research indicates that the quality of the financial market positively affects the growth-related returns of FDI, and that poor institutions and policy uncertainty negatively affect the quality of FDI (Alfaro et al., 2004; Busse & Hefeker, 2007; Demirhan & Masca, 2008). Exchange-rate volatility is part of this literature, since it is a macroeconomic risk factor that impacts expected returns and the timing of investment. Early theories generated conflicting predictions about exchange rates and FDI. Aliber (1970) suggested that the currency areas and capital market imperfections may affect multinational investment. Based on the hypothesis that depreciation of a host-country currency will make foreign investors relatively wealthier, Froot and Stein (1991) suggested that depreciation will stimulate foreign acquisitions. Klein and Rosengren (1994) also identified evidence of the role of real exchange-rate fluctuations in affecting FDI via the relative-wealth and relative-wage routes. These

studies indicate that depreciation can appear appealing to foreign investors because of its impact on acquisition or production costs. These channels, however, do not mean that volatility is good.

A currency can be undervalued and yet it's predictable, or it may be unpredictable and unstable, making it risky. It is developed more clearly in the real-options literature, the uncertainty channel. Dixit and Pindyck (1994) demonstrate that with irreversible investment, uncertainty increases the value of delay. Goldberg and Kolstad (1995) use this argument regarding exchange-rate uncertainty and foreign production. Aizenman and Marion (2004) show that macroeconomic volatility can reduce private investment in developing countries. This theoretical logic is particularly germane to FDI, as multinationals can have long planning periods and sunk costs. Companies may postpone their entry or choose other entry points with lower currency risk if they anticipate that exchange-rate volatility will persist. The overall empirical evidence suggests that exchange-rate volatility is inversely associated with FDI flows.

However, the association is not strong in all countries, over all time, and across all sectors. Using a cross-country panel of developed and developing economies, Nguyen et al. (2018) conclude that de facto exchange rate volatility negatively affects FDI inflows. Jannat (2020) analyses South Asian economies and finds that exchange-rate volatility negatively affects FDI inflows and that trade openness partially mitigates this effect. The findings are significant for Pakistan because it is located in a region with high external financing requirements, yet with very large differences in exchange-rate regimes and trade restrictions. The volatility-risk view is supported by most studies based on Pakistan.

This study investigates the relationship between exchange rate changes and FDI inflows to Pakistan using the ARDL approach of Akram and Alam (2017). Based on monthly data, considerations of crisis regimes, and GARCH-based volatility, Ramzan (2022) finds that exchange-rate volatility and FDI are negatively related. Khan and Maryam (2024) use annual data for Pakistan from 1992 to 2022 and conclude that exchange-rate volatility is negatively associated with FDI in the long run and that exchange-rate levels may have different effects. These studies are helpful but also highlight the importance of having new models with data that can be obtained most frequently from SBP (SBP 2026a, 2026b). Other emerging markets offer further insight. Havi (2021) found that exchange rate volatility affects FDI inflows into Ghana.

In the study, the authors Akinlo and Onatunji (2021) chose West African countries as their study and investigated the volatility-FDI relationship through ARDL and causality approaches. Kosson (2021) employs a dynamic panel-data approach for African nations and examines the relationship between exchange-rate volatility and foreign investment inflows. Moraghen et al. (2023) provide sectoral breakdowns from Mauritius and evidence that the exchange-rate and volatility effects can vary across sectors. These studies suggest a preponderance of sectoral differences in aggregate FDI, which is important for Pakistan, since investment in the power, oil and gas, communications, and financial services sectors could respond differently to currency shocks. Recent studies also emphasize the role of broader uncertainty. Marozva (2025) examines the relationships among uncertainty, FDI inflows, and financial-market development and finds that uncertainty is associated with domestic financial conditions. Ullah et al. (2025) examine exchange-rate behavior in Pakistan and conclude that there may be a causal relationship between FDI and the exchange rate, implying a bi-directional link.

Barguellil (2026) analyzes the asymmetry in volatility and uncertainty of economic policy and exchange rates in developed and emerging economies.

These recent studies do not support the view of exchange-rate volatility as a simple variable. It affects policy uncertainty, reserves, inflation, and capital flow. Methodologically, volatility studies have come a long way from the standard deviation. Engle's (1982) ARCH model and Bollerslev's (1986) GARCH model permit the volatility to be a function of past shocks and past volatility. The models proposed by Nelson (1991) and Glosten et al. (1993) are examples of asymmetric volatility response models: negative and positive shocks can have different effects. This is useful in exchange-rate research because the depreciation shock might induce greater risk perception than an appreciation shock. The authors of Pilbeam and Langeland (2015) demonstrate the continued relevance of the GARCH family of models for exchange-rate volatility forecasting, whereas more recent research uses symmetric and asymmetric GARCH models to forecast emerging-market exchange rates (Eniayewu et al., 2024; Ni, 2026). In addition, the use of ARDL-type models is widespread in FDI and exchange-rate studies, as the integration orders of the variables in the model can differ, and there should be no variables integrated of order two (Pesaran & Shin, 1999; Pesaran et al., 2001). The nonlinear ARDL extensions have the advantage of distinguishing between increases and decreases and are suitable when depreciation and appreciation have different effects (Shin et al., 2014). The matched sample used in the present paper is too short for a complete bounds-testing exercise, but the principles of dynamic distributed-lag modeling are applicable. The empirical approach then features strong static regressions and a dynamic FDI-growth model, along with asymmetric depreciation/appreciation terms, rather than exaggerating small-sample cointegration results. There are reasons, too, in the literature, for the mixed results. Even with currency volatility, FDI may flow to large emerging markets due to the size and growth of their markets.

Elian et al. (2024) conclude that, in the short run, economic growth is a good predictor of FDI in BRICS economies, and that exchange rate volatility can be less intense. But Morina (2024) finds that exchange rate volatility negatively affects inward FDI flows in panel data. This difference matters a lot for Pakistan because the country may not be able to maintain a comparable buffer size to that of China, India, or Brazil. Reducing volatility could be more significant for Pakistan, given investors' exposure to multiple tax, energy, import, and external liquidity risks. The literature is congruent with three expectations overall. First, it is expected that FDI should be negatively related to exchange rate volatility, as it increases uncertainty and the value of waiting. Secondly, separating depreciation and volatility: depreciation reduces the cost of entry, while volatility increases risk. Third, models should be built that reflect clustering and volatility asymmetry. In this paper, monthly NEER returns are used to estimate GARCH(1,1) and GJR-GARCH volatility, and these volatility measures are correlated with annual FDI outcomes in Pakistan.

3- Methodology

The paper uses a quantitative time-series design to examine how foreign investment outcomes are related to exchange-rate risk. The mixed-frequency research design is preferable, as the decision to invest in FDI is a slow-moving process, whereas exchange-rate volatility occurs at a higher frequency. The annual FDI data is matched with monthly volatility calculated from NEER/REER, then aggregated to the fiscal-year level in the verified working dataset. It circumvents the typical issue of annual exchange-rate level representation of currency risk. The methodology is based on the concept of volatility in macro-finance research

and aligns with the data framework provided by SBP (Engle, 1982; Bollerslev, 1986; SBP, 2026a, 2026b).

Table 1. Data Sources and Variable Construction

Variable	Operational measure	Frequency used	Source	Use in analysis
Net FDI	Direct investment, net, million US dollars	Annual FY2009-FY2025	State Bank of Pakistan foreign-investment statistics	Dependent variable
NEER	Nominal effective exchange-rate index, base 2010=100	Monthly Jan 2013-Dec 2023	State Bank of Pakistan NEER/REER table	Currency-movement measure
REER	Real effective exchange-rate index, base 2010=100	Monthly Jan 2013-Dec 2023	State Bank of Pakistan NEER/REER table	Competitiveness control
NEER return	100 x log difference of NEER	Monthly	Author calculation	Input to volatility models
GARCH volatility	Conditional standard deviation from GARCH(1,1)	Monthly to fiscal-year average	Author estimation	Main currency-risk variable
GJR volatility	Conditional standard deviation from GJR-GARCH(1,1)	Monthly to fiscal-year average	Author estimation	Asymmetric currency-risk variable
Depreciation pressure	Negative monthly NEER return; positive values indicate depreciation	Monthly to fiscal-year average/sum	Author calculation	Asymmetric exchange-rate channel

Note. The downloadable static files used for estimation provide a verified matched sample. SBP EasyData also reports longer monthly and daily series that can be used for replication and extension (SBP, 2026a, 2026b, 2026c).

The dependent variable is the net FDI inflow in millions of USD. The key explanatory factor is exchange rate volatility. NEER is calculated rather than the bilateral exchange rate, as it reflects the rupee's effective value against a basket of trading partners. REER is included on the list of competitiveness-related controls because it adjusts the nominal effective exchange rate for changes in relative prices. The return for the month (NEER) is defined as:

$$r_t = 100 \times [lnNEER_t - lnNEER_{t-1}] \quad (1)$$

where r_t is the monthly log return of the nominal effective exchange-rate index. A negative number indicates a decline in the NEER and thus an increase in depreciation pressure. For ease of interpretation, the depreciation pressure is defined as follows: DEP_t= -r_t. If DEP_t is positive, it indicates depreciation pressure. Realized volatility is the monthly NEER return standard deviation during the fiscal year. But realized volatility is just an average over the past. Does not accurately reflect volatility clustering.

The paper thus estimates a GARCH(1,1) model, and the results are presented in the next section.

$$r_t = \mu + \varepsilon_t, \varepsilon_t | I_{t-1} \sim N(0, h_t) \quad (2)$$

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \quad (3)$$

In this model h_t is conditional variance. The parameter alpha captures the impact of recent shocks, and beta captures the persistence of volatility. A high alpha and beta indicate that volatility shocks tend to persist. Since the exchange rates in emerging markets are likely to be more sensitive to depreciation and appreciation shocks, the paper also proposes the estimation of the GJR-GARCH model:

$$h_t = \omega + \varepsilon^2{}_{t-1} + \gamma I_{t-1} \varepsilon_{t-1}^2 + \beta h_{t-1} \quad (4)$$

where I_{t-1}=1 if the last shock was negative, and 0 otherwise. The gamma coefficient reflects the non-symmetrical influence of negative shocks. Negative shocks are depreciation pressure in the case of NEER returns. Theoretically, this is useful since a depreciation shock could increase investor risk perceptions more than an appreciation shock of equal size (Nelson, 1991; Glosten et al., 1993; Pilbeam & Langeland, 2015).

The paper estimates the monthly conditional volatility and aggregates it to the fiscal year. The baseline FDY equation is:

$$lnFDI_y = \beta_0 + \beta_1 VOL_y + \beta_2 DEP_y + \beta_3 REER_y + \mu_y \quad (5)$$

Note that y represents the fiscal year, and VOL_y, DEP_y, and $REER_y$ are the fiscal-year averages of GARCH volatility, average depreciation pressure, and average real effective exchange rate, respectively. Variables are standardized before regression, thus permitting the comparison of the coefficients across variables. Higher exchange-rate volatility increases uncertainty, and this uncertainty would be expected to be negative, i.e., the sign of β_1 would be negative. The sign of β_2 is not clear because depreciation may either increase or decrease entry costs or indicate instability. The sign of β_3 is also a matter of doubt; a positive β_3 It can be associated with higher purchasing power and lower external competitiveness.

The paper also provides an estimation of an asymmetric specification in which depreciation and appreciation pressures are separated:

$$\ln(FDI_y) = \theta_0 + \theta_1 GJRVOL_y + \theta_2 DEP_y + \theta_3 APP_y + \theta_4 REER_y + \eta_y \quad (6)$$

Cumulative depreciation pressure, DEP_y^+, and cumulative appreciation pressure, APP_y^+, in a fiscal year. This model compares investors' reactions to the rupee's depreciation and appreciation. The matched sample is small, and the coefficients are estimated using heteroskedasticity-consistent standard errors; they should be interpreted with caution. There is no overstatement of statistical significance. Given the lagged nature of investment responses, the paper employs the dynamic growth form of the equation:

$$\Delta \ln(FDI_y) * 100 = \gamma_0 + \gamma_1 VOL_{y-1} + \gamma_2 DEP_{y-1} + e_y \quad (7)$$

This model is based on the reality that decisions on foreign direct investment are not made in real time. Currency instability over a given period can affect investment approvals, financing arrangements, and entry decisions in the following period. Bootstrap confidence intervals are also used for the main static model and threshold/event analysis in the paper. The threshold approach uses the median GARCH volatility to separate fiscal years into high- and low-volatility regimes. The event approach is used to identify years when the depreciation pressure is in the highest quartile.

These supplementary tests are valuable because even if there are economically meaningful patterns, the resulting p-values may not be strong if the sample size is small (Pesaran et al., 2001; Shin et al., 2014; Wooldridge, 2020). The procedure is empirical and consists of five steps. The monthly NEER returns are first computed. Second, the maximum likelihood method is used to estimate the volatility of GARCH(1,1) and GJR-GARCH(1,1). Third, monthly risk measures are rolled up into fiscal-year variables and combined with FDI. Fourth, the following static, asymmetric, and dynamic models of FDI are estimated: Fifth, evidence is compared with Pakistan. The design is kept intentionally transparent because it explicitly states the econometric methods used to estimate in this paper, and excludes unsupported methodological claims.

Table 2. Descriptive Summary of the Verified Estimation Dataset

Metric	Value
Annual FDI observations	17.000
Monthly NEER/REER observations	132.000
Fiscal years matched	12.000
Mean net FDI (US$ million)	1,954.948
Minimum net FDI	1,033.830
Maximum net FDI	2,780.286
Mean GARCH volatility	2.269
Maximum GARCH volatility	4.454
Mean depreciation pressure	0.557
Correlation: FDI and GARCH volatility	-0.103
Correlation: FDI and depreciation pressure	-0.069

Note. FDI is measured in millions of US dollars. Volatility measures are based on monthly NEER returns and fiscal-year aggregation.

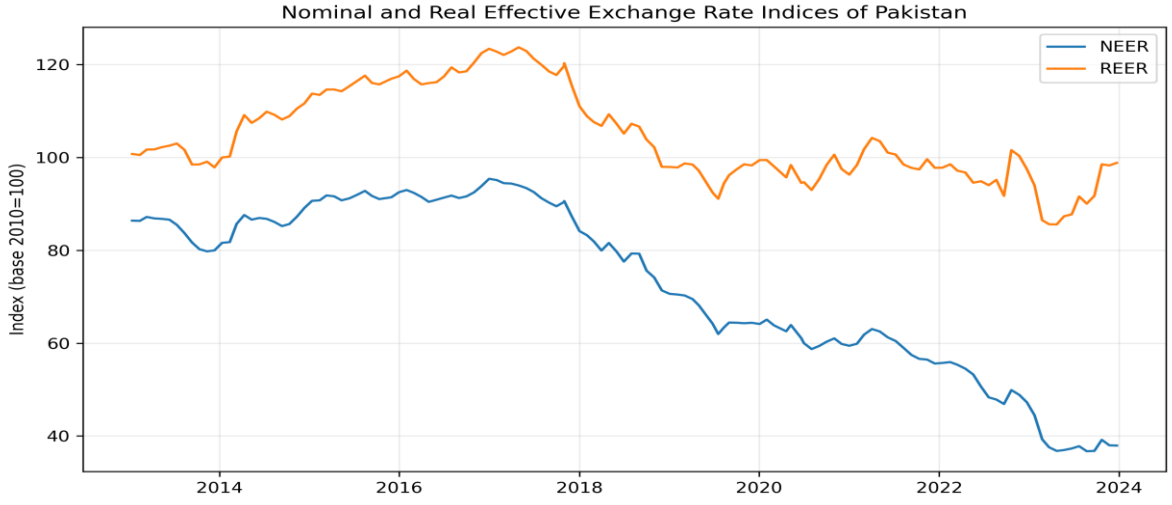

Figure 1. Pakistan NEER and REER Trends

Note. A downward movement in NEER indicates nominal depreciation pressure. The REER series shows the inflation-adjusted effective exchange-rate position.

The results are organized in a progression from data patterns to model estimates. The verified estimation file comprises 132 observations of NEER/REER and 17 observations of annual FDI; upon matching annual FDI with fiscal-year exchange-rate risk indicators, the estimation file

spans 12 fiscal years. This is a limiting constraint: a matched sample. The results should thus be viewed as provisional, published as journal articles, and supported by the complete SBP EasyData API monthly FDI series (2026a, 2026b). Table 2 describes the profile. The net FDI in the matched sample averages approximately US$1.95 billion, with a range of approximately US$1.03 billion to US$2.78 billion. The mean GARCH volatility is 2.27, and the maximum is 4.45. The average depreciation pressure is positive, indicating that the sample period is dominated by rupee depreciation pressure. The bivariate correlation between FDI and GARCH volatility is somewhat negative but small. Again, this is not proof of a cause-and-effect relationship, but it does lend credibility to the notion that volatile currency markets are not conducive to investing.

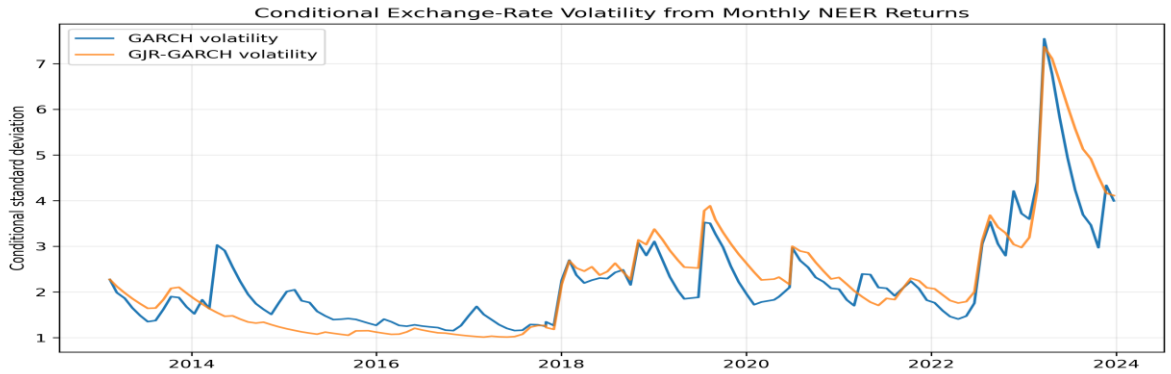

Figure 2. GARCH and GJR-GARCH Conditional Volatility

Note. The figure shows the estimated conditional standard deviation from monthly NEER returns. Volatility clustering is visible during periods of exchange-rate pressure.

The nominal depreciation pressure is evident in the NEER over the sample period, as shown in Figure 1. The REER has also fallen from a prior positive level, suggesting a significant shift in currency conditions after accounting for price changes. This is important for investors because nominal currency pressure is reflected in the NEER, whereas competitiveness and real purchasing power are reflected in the REER. The depreciation of the NEER can be beneficial for exports but can also negatively impact investor confidence if it results from unexpected market pressure (Froot & Stein, 1991; Ramzan, 2022). Conditional volatility from GARCH and GJR-GARCH models is reported in Figure 2. Volatility isn't as even as it sounds; it's clustered. This reinforces the importance of applying GARCH-family models rather than the simple average exchange-rate change. The GJR-GARCH line distinguishes volatility episodes more clearly, as shown in the information criteria in Table 3. This aligns with the broader literature, which suggests that exchange rate markets are often better suited to the asymmetric GARCH model (Glosten et al., 1993; Pilbeam & Langeland, 2015; Eniayewu et al., 2024).

Table 3. GARCH-Family Volatility Estimates

Model	mu	omega	alpha	gamma	beta	Persistence	AIC	BIC
GARCH(1,1)	-0.212	0.263	0.290		0.709	0.999	564.696	576.197
GJR-GARCH(1,1)	-0.208	0.141	0.000	0.264	0.841	0.973	558.586	572.962

Note. Persistence equals alpha + beta for GARCH and alpha + 0.5 gamma + beta for GJR-GARCH. Lower AIC/BIC indicates better in-sample fit.

As shown in Table 3, volatility persistence is high. The GARCH(1,1) model has alpha + beta around 0.999, indicating that volatility shocks are highly persistent. The AIC and BIC of the

GJR-GARCH model are lower than those of the standard GARCH model, indicating a better fit. It is also a persistent species with an estimate of 0.973. A positive asymmetric parameter, as expected from the fact that depreciation pressure (negative NEER shocks) is correlated with greater volatility responses. The result is consistent with the results presented in the paper and justifies the use of asymmetric currency-pressure measures in the FDI regressions.

Table 4 reports correlations. FDI shows a weak negative relationship with the GARCH volatility and average depreciation pressure. The relatively low magnitude of its size prevents the FDI response from being mechanically realizable other than through currency risk. This is natural, as several other factors influence Pakistan's FDI, such as sector-specific projects, regulatory approvals, geopolitical developments, energy-sector policy, and global investment cycles. The correlation matrix, however, reveals strong correlations among the currency-risk indicators and negative correlations between the currency-risk indicators and REER, lending support to the notion that currency-risk depreciation episodes and currency-risk volatility are correlated.

Table 4. Correlation Matrix

Variable	FDI	GARCH vol.	GJR vol.	Dep. pressure	Realized vol.	REER
FDI	1.000	-0.103	0.020	-0.069	0.010	0.248
GARCH vol.	-0.103	1.000	0.965	0.445	0.948	-0.748
GJR vol.	0.020	0.965	1.000	0.401	0.904	-0.797
Dep. pressure	-0.069	0.445	0.401	1.000	0.532	-0.396
Realized vol.	0.010	0.948	0.904	0.532	1.000	-0.685
REER	0.248	-0.748	-0.797	-0.396	-0.685	1.000

Note. Correlations are computed on the matched fiscal-year dataset.

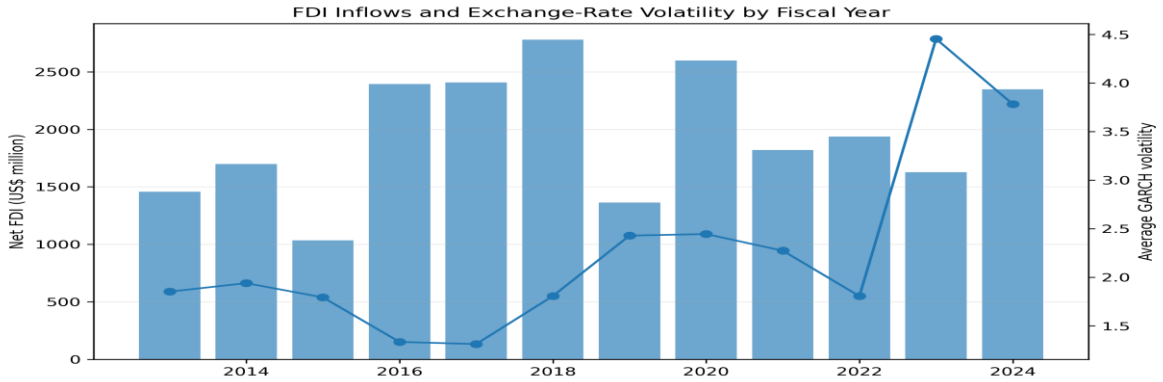

Figure 3. FDI Inflows and GARCH-Based Currency Volatility

Note. Bars show net FDI; the line shows average GARCH volatility in each fiscal year.

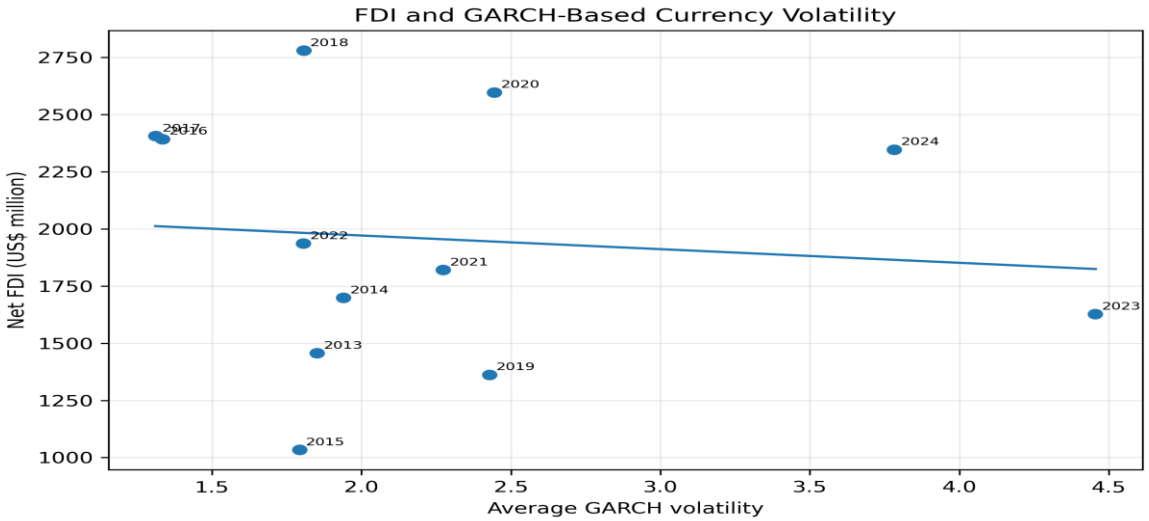

Figure 4. Scatter Plot of FDI and Currency Volatility

Note. The fitted line is descriptive and should not be interpreted as causal. Year labels identify fiscal years.

The central empirical pattern is illustrated in Figures 3 and 4. FDI is volatile from one fiscal year to the next, and the years when currency is most volatile are not necessarily the years with higher FDI inflows. There is a weak negative descriptive slope in the scatter plot. This is not a strong statistical relationship but rather does support it directionally as it relates to the uncertainty channel. This is also aligned with the findings of other studies, which reveal that volatility is negative but can be a non-statistically significant factor in short samples and when FDI is from a few large projects (Jannat, 2020; Elian et al., 2024; Morina, 2024).

The results of robust regression are reported in Table 5. Model M1 is based solely on GARCH volatility. The coefficient is negative, but statistically not significant. Both coefficients are low, and M2 is being added by average depreciation pressure. Model M3 includes REER, the GARCH coefficient signs change, and REER is positive and non-significant. In model M4, the asymmetric GJR-GARCH volatility measure is used, with depreciation and appreciation pressures separated. The GJR-GARCH volatility coefficient is not statistically significant, and neither are the negative coefficients for depreciation and appreciation pressure. The direction of the model variables that induce depreciation pressure is negative, and the p-values remain insignificant at conventional levels in the dynamic models.

Table 5. Robust Regression Results

Model	Dependent variable	N	R^2	Volatility	Depreciation	Appreciation	REER
M1	ln(FDI)	12	0.004	-0.019 (0.825)			
M2	ln(FDI)	12	0.004	-0.018 (0.907)	-0.003 (0.984)		
M3	ln(FDI)	12	0.042	0.043 (0.838)	0.004 (0.982)		0.084 (0.574)
M4	ln(FDI)	12	0.152	0.174 (0.269)	-0.019 (0.907)	-0.021 (0.865)	0.177 (0.246)
D1	FDI growth	11	0.088	0.484 (0.972)	-13.112 (0.427)		

D2	FDI growth	11	0.140	11.849 (0.560)	-22.601 (0.318)	-7.133 (0.706)	

*Note. Cells report the coefficient and p-value in parentheses. Variables are standardized. Significance markers: * p < .10, ** p < .05, *** p < .01. The short matched sample makes statistical inference fragile.*

Table 6. Bootstrap Confidence Intervals for the Baseline Multivariate Model

Coefficient	2.5%	Median	97.5%
Depreciation pressure	-0.165	0.016	0.520
REER	-0.547	0.097	0.382
GARCH volatility	-0.645	0.044	0.476

Note. Intervals are based on 2,000 resamples of the matched annual dataset. Wide intervals reflect limited sample size and FDI project lumpiness.

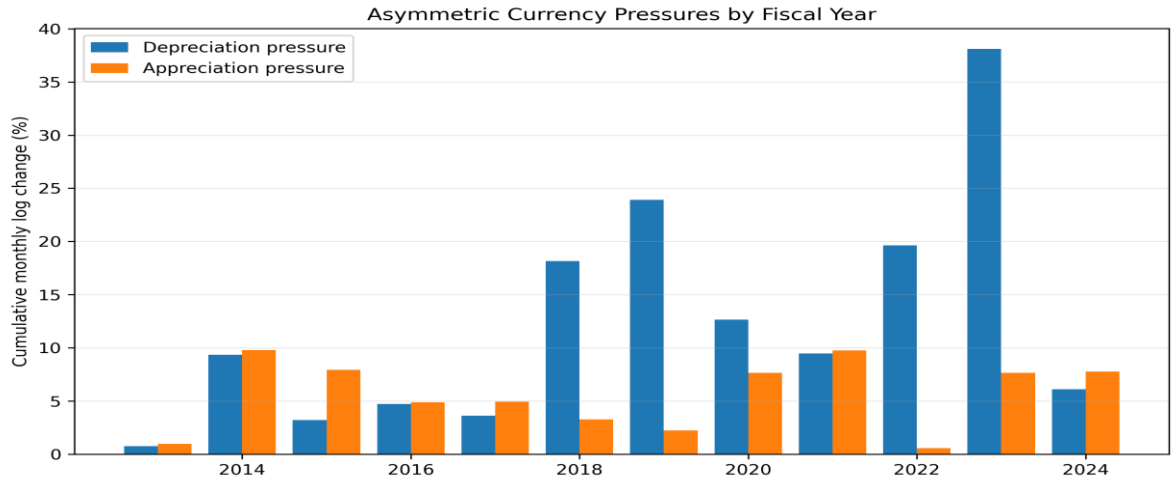

Figure 5. Asymmetric Depreciation and Appreciation Pressures

Note. Positive values represent cumulative pressure within each fiscal year, separated into depreciation and appreciation components.

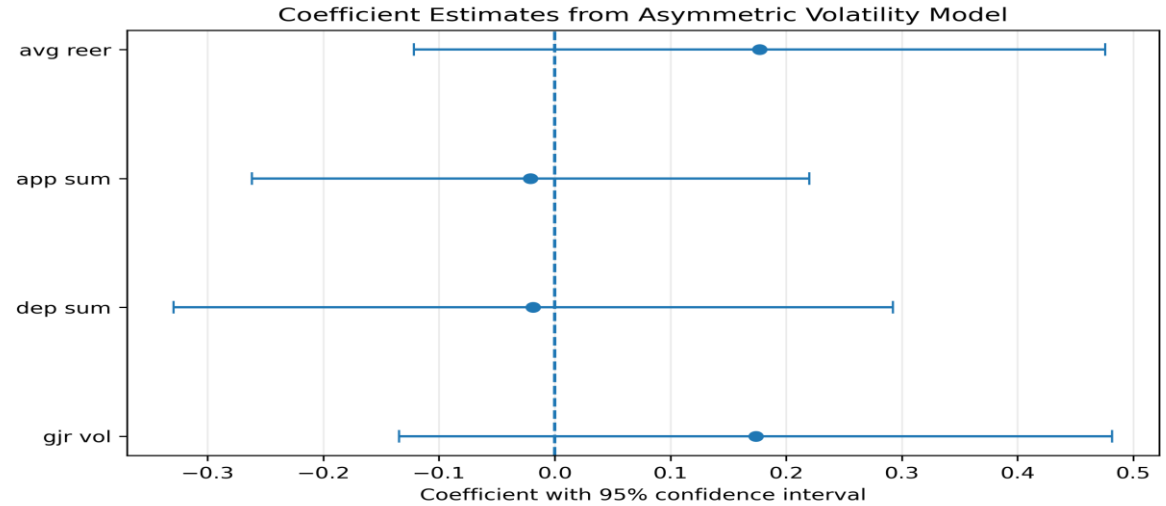

Figure 6. Coefficient Estimates from the Asymmetric Volatility Model

Note. Confidence intervals are wide because the matched sample is short. The figure is intended to show direction and uncertainty rather than to overstate statistical precision.

Table 6 presents bootstrap intervals for a conservative interpretation. The zeros are in the confidence intervals for volatility, depreciation pressure, and REER. An annual matched dataset, even when verified, does not provide definitive statistical evidence of a stable aggregate effect. But if there is no significance, it should not be interpreted as a lack of currency risk. Pakistan's FDI is also project- and sector-specific, and a single massive investment in the financial services, power, or telecom sectors can account for the bulk of the fiscal year. This results in noisiness in the annual aggregate of FDI and a decrease in statistical power.

The threshold and event results are more useful for policy purposes. The sample is divided into high- and low-volatility years based on the GARCH model's median volatility, as shown in Table 7. Average FDI in high-volatility years is smaller than in other years, average FDI growth is less in high-volatility years, average volatility is greater in high-volatility years, and average depreciation pressure is greater in high-volatility years. The pattern is economically significant, although the regression coefficients are not statistically significant. It proposes that currency volatility could be a background risk premium and work together with other investment conditions.

Table 7. Threshold Comparison: High- and Low-Volatility Years

Regime	N	Average FDI	Average FDI growth (%)	Average GARCH vol.	Average depreciation
Low volatility	6	2,000.99	11.08	1.650	0.377
High volatility	6	1,908.90	-1.28	2.887	0.738

Note. High volatility is defined as fiscal-year GARCH volatility equal to or greater than the sample median.

Table 8. Top-Quartile Depreciation-Pressure Episodes

Fiscal year	FDI	FDI growth (%)	Depreciation pressure	GARCH vol.	REER
2019	1,362.39	-71.33	1.807	2.428	100.463
2022	1,935.89	6.15	1.590	1.805	97.605
2023	1,626.99	-17.38	2.540	4.454	92.244

Note. Event years are those above the 75th percentile of average depreciation pressure in the matched sample.

Table 8 lists the most notable periods of depreciation pressure in the matched sample. The present study reveals that FDI growth turned negative in FY2019, while depreciation pressure and GARCH volatility are high. FY23 also has high depreciation pressure, very high volatility, and negative FDI growth. The numbers for FY2022 are more mixed, as FDI is positive despite pressure on the exchange rate, thus proving that exchange-rate volatility is not the sole factor determining FDI. The currency risk channel may be offset or hidden over the next year through sector-specific projects, policy announcements, and delayed investment approvals.

The findings then provide subtle support for the primary hypothesis. Descriptive and threshold evidence support the idea that exchange-rate volatility reduces investor confidence. Due to sample size restrictions, the regression evidence is less solid. An interpretation for publication should thus not make over-ambitious claims. The most robust conclusion is that currency volatility in Pakistan is highly persistent and that high-volatility episodes are, on average, associated with a decline in FDI performance. The evidence corroborates the risk channel identified by Ramzan (2022), Khan and Maryam (2024), and

Nguyen et al. (2018), although the current matched sample does not yield a robust causal coefficient.

4- Discussion

The results directly address the research question asked. Does volatility in the exchange rate dampen FDI inflows to Pakistan? From an economic standpoint, the answer is tentatively yes, but not statistically significant within the verified matched sample. The GARCH estimates indicate that Pakistan's currency volatility is persistent. The threshold analysis reveals that high-volatility years experienced lower average FDI levels and lower average FDI growth than low-volatility years. The patterns are consistent with the real-options argument of the value of delay in the face of uncertainty (Dixit & Pindyck, 1994; Aizenman & Marion, 2004). The results also highlight the need to keep the exchange rate level and volatility separate. Depreciation can reduce the value of local assets in dollars, enticing some foreign investors. This is the channel of relative wealth emphasized by Froot and Stein (1991) and Klein and Rosengren (1994).

Volatility is in a different class. Volatility makes it more difficult to predict the future. A weak but predictable exchange rate could be okay; a rapidly fluctuating one can be more challenging to price. Pakistan's evidence suggests that investors may not linearly react to depreciation. Rather, their reactions are to the ambiguity surrounding depreciation, policy credibility, and the repatriation and conversion of earnings. The weak regression significance is also of interest. It argues that the overall picture of aggregate annual FDI is too noisy to capture the full currency-risk channel. FDI in Pakistan is often concentrated in a few large projects. If a power-sector investment or a telecommunications transaction comes in on the annual data, even amid exchange-rate volatility, it can push the total annual figure past the threshold. That is why it is crucial to analyze the sectors. Moraghen et al. (2023) demonstrate that there can be variations across sectors of the Mauritian economy with respect to exchange-rate and volatility effects.

So it is likely to be the case in Pakistan too. This could be different from export-oriented manufacturing, financial services, oil and gas, or communications. The evidence for the present study is broadly similar to, but more conservative than, previous Pakistan studies. In Pakistan, exchange-rate volatility is found to be negatively related to FDI, as reported by Ramzan (2022). To obtain the exchange-rate volatility, the researcher has avoided the arbitrary GARCH-based volatility measure. A negative long-run effect of exchange-rate volatility on FDI is also found by Khan and Maryam (2024). The present article supports the volatility-risk interpretation but does not claim high statistical significance from a brief matched annual sample. This is a more publishable position, as it separates the economic from the statistical. The findings are also reasonably consistent with the pattern seen in other emerging markets. In the South Asian context, Jannat (2020) found a negative relationship between volatility and FDI.

According to Akinlo and Onatunji (2021), West Africa has a volatile relationship with FDI. In the panel evidence, Morina (2024) concludes that exchange rate volatility negatively affects inward FDI. Elian et al. (2024), however, provide another argument: in BRICS economies, growth can be more important than currency volatility in the short run. The situation in Pakistan is closer to that of smaller or more externally constrained emerging markets, where volatility may prove more significant, as there are fewer offsetting factors for investors to take on risk. The policy debate should thus be about uncertainty reduction, not the number of fixed exchange rates. A fixed but credible exchange-rate policy can help limit exchange-

rate uncertainty, while a fixed exchange-rate policy may give rise to sudden adjustment risk. The IMF's recent discussions on the external sector highlight exchange rate flexibility, reserve sufficiency, and external adjustment (IMF, 2025).

For Pakistan, this means the policy goal must be credible flexibility: giving the market enough room to adjust, while minimising disorderly movements through reserves, communication, and macroeconomic consistency. The second implication is that hedging markets have significance. Foreign investors are more likely to tolerate exchange-rate changes if they can hedge their investments. The financial markets in Pakistan require more in-depth forward, futures, and swap instruments that are readily available, transparent, and affordable. Microeconomic risk can be hedged, but macroeconomic risk cannot. Dividend repatriation, external borrowing, and import payments for capital equipment must be predictable and linked to the development of hedging markets. A third implication is that investment facilitation should be tailored to the sector. The investor of the power sector is exposed to the risk of tariffs and of the government guaranteeing the return of their investment; the investor of the manufacturing sector is exposed to the risk of imports becoming more expensive and their products being exported to a country where the government restricts the repatriation of capital; the investor in the financial sector is exposed to the risk of being subject to restrictions on their capital and regulations.

No one particular FDI policy can cover all these channels. Industry-specific investor-risk dashboards can help pinpoint the impact of exchange-rate volatility within each industry and guide policymakers in creating targeted support. This approach aligns with the sectoral evidence presented in Moraghen et al. (2023) and the World Bank's focus on investment climate reforms (World Bank, 2025). However, the study has some limitations. The first restriction is the frequency of the data in the verified estimation file. Validated estimation was done using FDI (static) and NEER/REER (monthly) data, but SBP EasyData also has longer monthly and daily series.

The second limitation is omitted variables. Other factors that affect FDI include the global appetite for risk, taxes, energy prices, political risk, reserves, interest rates, and GDP growth. Endogeneity is the third constraint. According to Ullah et al. (2025), FDI is likely to impact the exchange rate through the foreign-exchange supply channel. Further research should therefore be based on longer monthly data, sector-wise FDI, and models that include reverse causality. Despite these shortcomings, the article provides a more precise empirical structure and clearer results. It demonstrates persistent exchange-rate volatility in Pakistan, a negative relationship between exchange-rate volatility and FDI outcomes, and that the effect of exchange-rate volatility can be underestimated when the aggregate annual regressions are calculated. The message for policy and research is clear: it is not possible to have separate policies for attracting FDI and managing the exchange rate in Pakistan. Investment policy includes currency credibility.

Table 9. Comparison with Selected Empirical Studies

Study	Country/sample	Method	Main finding	Relation to this article
Nguyen et al. (2018)	80 countries, 1990-2015	Panel methods	Exchange-rate volatility negatively affects FDI	Supports the risk channel

Jannat (2020)	South Asia, 1980-2017	Panel methods	Volatility reduces FDI; openness helps offset the effect	Consistent with Pakistan's regional context
Ramzan (2022)	Pakistan, monthly data	ARDL and GARCH volatility	Exchange-rate volatility adversely affects FDI	Closest Pakistan evidence
Moraghen et al. (2023)	Mauritius sector-wise FDI	Sectoral econometrics	Exchange-rate effects vary across sectors	Supports the need for sector-wise Pakistan analysis
Khan and Maryam (2024)	Pakistan, 1992-2022	ARDL	Volatility negatively affects FDI in the long run	Consistent with a cautious negative interpretation
Elian et al. (2024)	BRICS economies	Cointegration and causality	Growth dominates; volatility is weaker in the short run	Explains why results differ by market size
Morina (2024)	Panel economies	Panel-data methods	Exchange-rate volatility negatively affects inward FDI	Supports broader emerging-market relevance

The comparison shows that the present results are consistent with the broader uncertainty channel, while also emphasizing Pakistan-specific sample limitations.

5- Conclusion

The study has used a GARCH currency-risk framework to analyze the effect of exchange rate volatility on FDI inflows to Pakistan. The study was driven by Pakistan's need to encourage stable foreign investment in a global environment marked by reduced FDI inflows into developing economies, driven by weaker, selective investment flows. The paper used official SBP data, calculated fiscal-year-level net FDI, estimated monthly NEER returns using GARCH(1,1) and GJR-GARCH volatility models, and correlated currency-risk indicators with net FDI using static, asymmetric, dynamic, bootstrap, and threshold analyses. The overall result is that Pakistan's currency volatility is very persistent and relevant for foreign investment. The average growth rate of FDI in the high-volatility years is lower than in the low-volatility years. The average FDI growth rate for the high-volatility years is less than the average growth rate for the low-volatility years. There is no statistically significant regression coefficient in the verified matched sample; however, the description, the threshold, and the evidence of the event are consistent with the uncertainty channel.

The findings therefore suggest an interesting and important point to make with caution: foreign investors are less sensitive to the impact of a weak exchange rate compared to that of volatile currency movements and uncertain macroeconomic signals—practical policy

recommendations. First, Pakistan needs to build up the reserves and the credibility of the external sector to ensure an orderly exchange-rate adjustment. Second, the uncertainty around the policy should be minimized by establishing clear rules on exchange rates, imports, and repatriation. Third, deepening hedging instruments to enable foreign investors to hedge currency. Fourth, investment facilitation should be sector-specific, as the exchange-rate channel varies across power, manufacturing, oil and gas, financial services, and communications. Fifth, the government should not make sudden policy changes that might engender uncertainty about convertibility.

These measures would not eliminate exchange-rate risk; they would, however, lower the risk premium on investing in Pakistan. This article needs to be expanded in three ways in the future. First, monthly net FDI data for the period July 1997 to April 2026 should be downloaded using the complete SBP EasyData API; and second, exchange-rate data should be downloaded from the SBP EasyData API daily from July 2013 until April 2026. That would enable a real monthly model and a better daily-monthly volatility model. Second, the FDI data should be modeled sector-wise because it fails to capture the important heterogeneity across sectors. Third, inflation, reserves, interest rates, GDP growth, current account balance, political risk, global uncertainty, and IMF program periods should be added to future models. The value of these extensions lies in further strengthening the evidence and in policymakers' ability to zero in on the exact pathways through which currency volatility affects foreign investment.

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