

Currency Risk and Stock Market Returns in the Original BRICS Economies

A monthly comparison across five emerging markets, 2006–2025

This report estimates how domestic-currency movements coincide with local equity index returns in Brazil, Russia, India, China, and South Africa. It combines country-level exposure estimates with a peer-market sensitivity model, rolling estimates, event-window descriptions, and explicit source documentation.

Sample	January 2006–December 2025
Frequency	Monthly
Return observations	972 country-months
Market group	Original five BRICS economies
Data sources	Yahoo Finance historical charts; Moscow Exchange ISS
Prepared	October 2026

The empirical file contains observed historical index and exchange-rate levels. It is not a simulation. Bloomberg data was not used: this project had no Bloomberg terminal or licensed API access. Results are descriptive, are not investment advice, and do not identify a causal effect.

Abstract

This study examines the contemporaneous relationship between exchange-rate changes and equity index returns in the five original BRICS economies over a monthly sample spanning January 2006 through December 2025. The panel begins with 1,077 matched monthly equity and foreign-exchange level pairs. Requiring consecutive observations to compute log changes and refusing to bridge missing months leaves 972 country-month returns: 197 for Brazil, 196 for Russia, 181 for India, 199 for China, and 199 for South Africa.

The baseline model regresses local-currency equity index log returns on changes in local currency units per US dollar. All five estimated slopes are negative. Brazil’s estimate is -0.463 (Newey–West standard error 0.156), India’s is -0.950 (0.260), and China’s is -1.266 (0.379); each is statistically different from zero using a two-sided large-sample normal approximation. Russia’s estimate (-0.190) and South Africa’s (-0.136) are not statistically significant at five percent. Baseline R^2 ranges from 1.9 to 11.8 percent.

A sensitivity model adds the equal-weight average return of the other available BRICS indexes in the same month. The FX coefficients become smaller in absolute magnitude in all five countries. They remain significant in Brazil (-0.398 , $p = 0.024$), India (-0.698 , $p < 0.001$), and China (-0.961 , $p = 0.005$), while the Russia and South Africa estimates remain imprecise. The control is a regional co-movement proxy, not an external world-market benchmark. This comparison does not solve simultaneity or establish causality.

The report contributes an auditable source panel, descriptive analysis, event-window summaries, and 60-month rolling coefficients. It documents limitations arising from price-only indexes, different market calendars, vendor conventions, structural breaks, sparse tail windows, and restricted Russian market access. The results support heterogeneous currency-return associations, not a single BRICS-wide exposure rule.

Keywords: currency exposure; stock returns; BRICS; emerging markets; Newey–West; exchange-rate depreciation.

Executive Summary

Question

When domestic currencies depreciate against the US dollar, do broad local equity indexes rise or fall in the same month? The answer is not mechanically determined. Export revenue may gain value in local currency, while imported inputs, foreign-currency debt, inflation risk, capital outflows, and higher discount rates can work in the other direction. Aggregate indexes combine these effects and also respond to common market news.

What was measured

Monthly log changes are calculated from local-currency equity price indexes and exchange rates quoted as domestic currency per US dollar. Positive FX changes mean depreciation. The sample is the original five-country BRICS group, not the expanded membership. Index closes and currency rates are paired by month. Missing months are excluded from return construction rather than imputed. A country-specific OLS regression estimates the same-month FX slope; standard errors use a three-lag Newey–West correction.

Main findings

- The baseline FX slope is negative in all five markets. The association is statistically significant for Brazil, India, and China, but not for Russia or South Africa.
- Currency movements alone explain a limited share of monthly index-return variation: baseline R^2 is between 1.9% and 11.8%.
- Adding a same-month peer-market return proxy reduces the absolute FX coefficient in every market and raises in-sample fit. Brazil, India, and China remain significant; Russia and South Africa do not.
- The period averages conceal substantial time variation. Rolling 60-observation slopes change across countries and episodes; they should be read as descriptive estimates, not precise timing signals.
- Local-currency index performance is not the same as a USD investor’s price return. Currency conversion changes the performance path, while dividends are excluded from both calculations.

How to read the report

Chapters 1–4 set out the research question, institutional context, prior literature, hypotheses, and measures. Chapters 5–6 document sources and estimation. Chapters 7–10 present descriptive patterns, baseline estimates, sensitivity checks, and event windows. Chapter 11 discusses interpretation

and limitations; Chapter 12 concludes. Appendices provide a data dictionary, calculation details, country-by-country profiles, and a replication checklist. Source observations, figure-generation code, and LaTeX source accompany the PDF.

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Introduction and Research Context

1.1 Motivation

Exchange rates translate foreign-currency cash flows into domestic currency, change the local value of overseas assets and liabilities, and transmit shifts in global risk appetite. For listed companies, a depreciation can improve export competitiveness and raise the domestic-currency value of overseas earnings. The same movement can increase the cost of imported energy, machinery, components, and intermediate goods; it can also make foreign-currency liabilities more burdensome. At the aggregate market level, the observed stock response reflects the net of these firm-level channels and broader changes in inflation expectations, monetary policy, financing conditions, and investor risk tolerance.

This is why currency exposure is not inferable from the direction of the exchange rate alone. A country may export commodities and still have an equity market that falls when its currency weakens. Domestic firms can rely on imported inputs, local investors may sell risky assets during the same shock, and the currency may be responding to news that also lowers expected cash flows. The empirical relationship can therefore be positive, negative, weak, or unstable over time.

The original BRICS economies provide a useful comparative setting because they combine large domestic markets with varied trade composition, capital-market structure, policy regimes, and exchange-rate histories. The common acronym should not be mistaken for a common exposure. This study estimates country-specific monthly slopes, reports their uncertainty, and explores whether they change when shared BRICS equity movements are controlled for.

1.2 Research question and scope

The primary question is: *What is the contemporaneous association between domestic-currency depreciation and local-currency equity index returns in Brazil, Russia, India, China, and South Africa?* The unit of analysis is the country-month. The dependent variable is a broad national price index return, and the FX variable is the change in domestic currency per US dollar. The period covers twenty complete calendar years, subject to the start date of each index and the availability of consecutive observations.

The analysis is not a forecast exercise and does not test a tradable hedge. It does not estimate firm-level operating exposure, long-run cointegration, or structural causal effects. A negative coefficient means that depreciation and local index losses tended to occur together in this sample and specification; it does not imply that depreciation caused a loss. A low R^2 is expected when one monthly variable is used to explain an aggregate equity market that reacts to many kinds of news.

1.3 Why retain the five original members?

Using the initial five members keeps country identity constant through the sample. Later invitations and accessions change the group definition and create a different research question. The five-member panel also provides a manageable comparison while retaining material variation in market institutions. South Africa and Brazil are both exposed to globally traded commodities, but their index compositions and currency dynamics differ. China has a large domestic investor base and a managed currency framework. India’s selected market benchmark begins later than the other series. Russia’s sample includes a period of extraordinary market restrictions and limited convertibility after 2022. These contrasts make country-specific estimates preferable to an unqualified pooled “BRICS beta.”

1.4 Contribution and organization

The report contributes four practical elements. First, it publishes the actual monthly observations used in calculations and explains how each series was chosen. Second, it makes the exchange-rate quote convention explicit so that the sign of depreciation is unambiguous. Third, it compares the baseline FX-only estimate with a matched-date model that includes an equal-weight mean return from the other available BRICS indexes. Fourth, it supplies descriptive plots and rolling estimates so that a single full-sample slope is not treated as a timeless constant.

The intended contribution is modest and reproducible. The coefficients are descriptive exposure proxies at the index level. The analysis is useful as a starting point for understanding cross-market differences, identifying stress periods, and motivating more complete models with external market benchmarks, interest rates, commodity prices, and firm-level data.

Institutional Setting and Economic Channels

2.1 The exchange-rate exposure mechanism

A firm with net foreign-currency revenue may benefit from depreciation when foreign sales are converted into more domestic currency. The sign reverses for a firm with net foreign-currency costs or debt. Exposure also depends on pricing behavior: exporters may cut foreign-currency prices to preserve market share, while firms with pricing power can retain the exchange-rate gain. Hedging, natural offsets, and the currency denomination of contracts further complicate the relation between the spot rate and expected cash flows.

At the aggregate index level, a cash-flow channel competes with discount-rate and balance-sheet channels. Depreciation can raise expected inflation or prompt tighter monetary policy, increasing discount rates. It can signal fiscal or external stress and widen risk premia. When depreciation accompanies a global flight to safety, both local equities and the currency can fall even if the currency move itself is not the causal driver. The regression coefficient consequently captures a reduced-form contemporaneous association.

2.2 Country heterogeneity

The selected indexes do not represent identical sectors or firm populations. The Ibovespa has substantial exposure to commodities and domestic financials. The MOEX index is concentrated in large Russian listed firms and is affected by sanctions and investability restrictions during the later sample. The Nifty 50 reflects large Indian companies and starts in September 2007 in this source series. The Shanghai Composite includes a broad domestic listing set with market institutions unlike those in the other countries. The FTSE/JSE Top 40 includes large South African and cross-listed firms, and exchange-rate exposure can arise from overseas operations as well as domestic sales.

These market descriptions motivate heterogeneity but are not directly tested here. The study does not claim that commodity exposure, capital controls, or sector weights explain any particular coefficient. They are plausible channels for follow-up work using industry weights or firm-level accounts. Keeping this distinction between measured results and economic interpretation is important for avoiding causal overstatement.

2.3 The role of common shocks

International finance provides several channels for co-movement across emerging markets: changes in US interest-rate expectations, commodity-price movements, global volatility, investor funding constraints, and shifts in portfolio flows. A peer-market control is introduced later as a deliberately simple sensitivity check. It captures contemporaneous common movement among the other available BRICS indexes, but it cannot distinguish a global shock from direct cross-market transmission. It also does not convert the peer indexes into a common-currency world benchmark.

Literature Review

3.1 Defining currency exposure

International diversification research established that exchange rates matter when investor wealth is measured across currencies. Solnik (1974) explained why international diversification can change risk relative to a purely domestic portfolio. Adler and Dumas (1983) defined currency exposure as sensitivity to exchange-rate changes and emphasized that exposure is an estimable relationship between asset values and currency movements. This framing motivates a regression slope while also clarifying that the slope depends on the chosen numeraire, asset return, and conditioning variables.

3.2 Firm-level evidence and model structure

Firm-level studies show that exposure is heterogeneous and can be difficult to detect with a single specification. Jorion (1990) examined the exchange-rate exposure of US multinationals. Bodnar and Wong (2003) demonstrated that estimates can vary with the structure of the empirical model and the treatment of market returns. Dominguez and Tesar (2006) documented cross-country and cross-firm variation in exposure and highlighted that measured exposure can change through time. These studies warn against reading a national index beta as a structural property of every company listed in that market.

3.3 Industry and aggregate return findings

At the industry level, Griffin and Stulz (2001) found that exchange-rate shocks explain a limited share of many international industry returns. This result is consistent with offsetting corporate channels and common macroeconomic shocks. It also makes explanatory power a relevant outcome in the current report: statistical significance can coexist with a low R^2 , meaning that the FX term is associated with returns but accounts for little of their total variation.

The exchange-rate exposure literature also highlights choices about market controls, whether returns are measured in local or foreign currency, lag structure, and sample frequency. A benchmark market return can absorb common equity movements; however, the benchmark must be interpreted correctly. In this study, the added variable is not MSCI World or a global factor. It is the equal-weight same-month return of the other available BRICS indexes. It provides a transparent sensitivity check without external data, at the cost of being a regional and potentially endogenous proxy.

3.4 Emerging-market evidence and remaining gap

Emerging-market currencies can adjust sharply during capital-flow reversals, changes in commodity prices, domestic policy uncertainty, and changes in global financing conditions. These environments can amplify both cash-flow and discount-rate channels. The five original BRICS economies are not institutionally identical, so a comparative design should allow separate slopes and preserve each market's own return currency.

This report's contribution is therefore a transparent country-by-country comparison over a common twenty-year calendar period. It emphasizes observed monthly series, quote direction, standard-error construction, and a matched-sample alternative model. It does not claim a novel structural theory or a definitive explanation of why coefficients differ. The empirical gap addressed is practical: presenting a replicable, up-to-date comparison with visible data provenance and sensitivity results in one report.

Objectives, Hypotheses and Estimands

4.1 Objectives

The study has five objectives:

1. Estimate the contemporaneous association between changes in local currency per US dollar and local-currency equity index returns in each of the five original BRICS markets.
2. Compare coefficient size, standard error, correlation, and model fit across markets.
3. Examine whether the FX coefficient persists after adding a same-month peer-market return proxy, using the same observations in both specifications.
4. Describe how rolling and subperiod estimates vary, and characterize selected historical event windows without presenting them as causal events.
5. Document the sources, transformations, and limitations sufficiently for independent reproduction.

4.2 Hypotheses

H1 (currency association). Monthly domestic-currency depreciation is associated with the same-month local equity index return in at least one original BRICS market, conditional on the baseline bivariate model.

H2 (cross-market heterogeneity). The magnitude and statistical precision of the currency-return association differ across the five markets.

H3 (common-return sensitivity). Adding the same-month average return of the other available BRICS indexes changes the estimated FX coefficient or explanatory power, indicating that co-movement matters to the baseline association.

No directional sign is imposed for H1. Export competitiveness could support a positive coefficient, whereas FX debt, imported inputs, inflation risk, capital flight, and shared negative news could produce a negative coefficient. H2 is evaluated by comparing country-specific estimates; no formal equality test is conducted. H3 is evaluated as a robustness comparison, not a causal test.

4.3 Estimands and interpretation

For country i , the primary estimand is the OLS slope β_i in a regression of monthly percentage log equity returns on monthly percentage log depreciation. A one-unit increase in the FX regressor is a one-percentage-point increase in local currency per US dollar. Thus, $\beta_i = -0.5$ means that a 1% depreciation is associated with a 0.5 percentage-point lower same-month local equity return, on

average in the fitted linear model.

The estimand is sample- and specification-specific. It does not measure the effect of a permanent devaluation, the long-run sensitivity of corporate cash flows, or the foreign-currency return of an investable index fund. Reported p-values use a two-sided asymptotic normal approximation. Given five countries and several comparisons, conventional thresholds should be treated as descriptive; no family-wise multiple-testing correction is applied.

Data, Coverage, and Provenance

5.1 Observation window and panel construction

The raw panel contains 1,077 monthly matched levels over the January 2006–December 2025 calendar window. Each country-month record includes the equity index close, local currency units per US dollar, ticker or instrument code, and source label. The first return requires a prior monthly observation. A return is retained only when the month-to-month gap equals exactly one calendar month; missing months are not bridged. This yields 972 usable return observations.

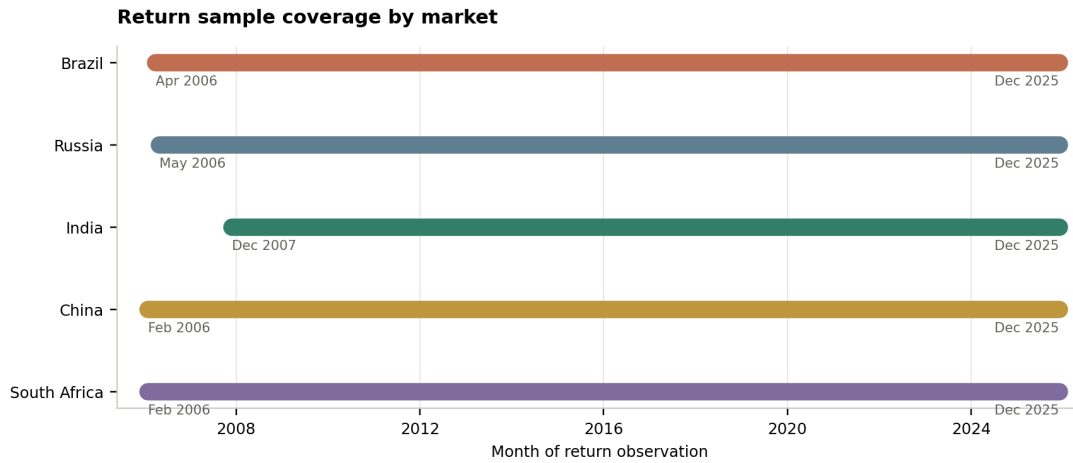


Figure 5.1: Coverage of derived monthly return observations. The plotted interval starts with the first month for which consecutive market and FX levels permit a return.

India begins later because the Nifty 50 source history starts in September 2007, with the first valid return in December 2007 after requiring an adjacent observation in both index and currency series. Other markets begin in early 2006. Country-specific coverage is visible in Figure 5.1 and is reflected in the country-level sample counts.

5.2 Series selection and data sources

Table 5.1: Equity and exchange-rate series used in the panel

Economy	Equity benchmark	FX code	Quote	Source
Brazil	Ibovespa ($\sim$ BVSP)	BRL=X	BRL per USD	Yahoo Finance
Russia	MOEX Index (IMOEX)	RUB=X	RUB per USD	MOEX ISS; Yahoo Finance
India	Nifty 50 ($\sim$ NSEI)	INR=X	INR per USD	Yahoo Finance
China	Shanghai Composite (000001.SS)	CNY=X	CNY per USD	Yahoo Finance
South Africa	FTSE/JSE Top 40 ($\sim$ J200.J0)	ZAR=X	ZAR per USD	Yahoo Finance

Yahoo Finance monthly chart observations are used for the four non-Russian equity series and for all exchange rates. Russia’s IMOEX monthly closes are retrieved from the Moscow Exchange Information and Statistical Server (ISS), interval 31. The source CSV and collector script are included with this project.

Yahoo Finance chart history was collected using its public chart endpoint for the symbols listed in Table 5.1. This is a convenient public historical source, not a licensed institutional feed. For Russia, the index data are sourced from the official MOEX ISS candles endpoint: <https://iss.moex.com/iss/engines/stock/markets/index/securities/IMOEX/candles.json>. MOEX is the source of the IMOEX monthly candles; Yahoo Finance supplies the RUB-per-USD exchange-rate history. Retrieval and processing logic is documented in `scripts/collect_data.py`. The frozen raw source levels are in `data/brics-monthly.csv`.

Bloomberg was not used. No Bloomberg terminal, Bloomberg Data License, or licensed API credentials were available for this work. The report therefore makes no claim that Yahoo Finance or MOEX observations are identical to a Bloomberg field, adjustment, or historical snapshot. Any use requiring formal publication-grade vendor licensing should obtain and cite the authorized series directly.

5.3 Quote convention, return currency, and price-index scope

Exchange rates are expressed as units of domestic currency per US dollar. If $E_{i,t}$ rises, more units of country i ’s currency are needed to buy one dollar, so the local currency has depreciated. The sign convention is applied uniformly across all five markets.

Equity prices are broad local market price indexes, not total-return indexes. Cash distributions are not included. The baseline dependent variable remains denominated in local currency, which isolates the relationship between domestic equity prices and the FX change. A supplementary USD price-return series is calculated as local equity log return minus the depreciation rate; it illustrates currency translation for a USD holder but is not a dividend-inclusive fund return.

5.4 Source quality and limitations by market

Monthly frequency reduces daily calendar mismatch but does not eliminate it. The local exchange’s final trading date in a month may differ from the currency observation represented in the same

vendor bar. Index construction, treatment of suspensions, and update schedules are vendor-specific. The observation date is treated as a month identifier rather than a synchronized timestamp across time zones.

Russia deserves special caution. The sample covers the February 2022 invasion of Ukraine, exchange closure and reopening, sanctions, capital controls, and restrictions on market access. A reported historical price is not proof that an international investor could trade at that price. The MOEX index remains in the descriptive panel to preserve the stated country scope, but estimates involving this period should not be interpreted as investable returns.

Variables and Econometric Methodology

6.1 Return construction

For country i in month t , the stock-market variable is the continuously compounded percentage change in the equity index close $P_{i,t}$:

$$r_{i,t} = 100 [\ln(P_{i,t}) - \ln(P_{i,t-1})]. \quad (6.1)$$

The exchange-rate variable is the continuously compounded percentage change in domestic currency units per US dollar $E_{i,t}$:

$$f_{i,t} = 100 [\ln(E_{i,t}) - \ln(E_{i,t-1})]. \quad (6.2)$$

A positive $f_{i,t}$ represents depreciation. These percentage log changes are close to ordinary percentage changes for small moves but remain additive through time. Extreme monthly observations are not winsorized in the principal estimates because they may represent actual crisis movements; their influence is discussed as a limitation.

A USD price-return translation is

$$r_{i,t}^{USD} = r_{i,t} - f_{i,t}, \quad (6.3)$$

which follows from valuing the local equity index in dollars. It excludes dividends and local taxes and is not a total-return measure.

6.2 Baseline country regression

For each market, the baseline model is estimated separately:

$$r_{i,t} = \alpha_i + \beta_i f_{i,t} + \varepsilon_{i,t}. \quad (6.4)$$

The coefficient β_i is the contemporaneous FX exposure proxy. The intercept permits a non-zero average stock return when the FX change is zero. The ordinary least-squares estimator is

$$\hat{\beta}_i = \frac{\sum_t (f_{i,t} - \bar{f}_i)(r_{i,t} - \bar{r}_i)}{\sum_t (f_{i,t} - \bar{f}_i)^2}, \quad \hat{\alpha}_i = \bar{r}_i - \hat{\beta}_i \bar{f}_i. \quad (6.5)$$

This is a bivariate model: no domestic market factor, global equity index, interest-rate differential, commodity price, inflation surprise, or policy event dummy is included. That deliberate simplicity supports transparent comparison but leaves omitted common shocks in the residual.

6.3 Peer-market sensitivity model

The alternative model adds the same-month equal-weight mean return of the other available BRICS equity indexes:

$$r_{i,t} = \alpha_i + \beta_i^{(A)} f_{i,t} + \gamma_i \bar{r}_{-i,t} + u_{i,t}, \quad (6.6)$$

where $\bar{r}_{-i,t}$ averages the contemporaneous local-currency index returns for countries other than i that have an observation in month t . No currency conversion is applied to this peer proxy. It is therefore a regional equity co-movement control rather than a theoretical global market portfolio. The baseline is re-estimated on the exact same matched dates as Equation 6.6; the coefficient comparison does not confound the added variable with a change in the date sample.

The control can absorb common regional movements, but it can also be endogenous: another BRICS market may react to the same global news or transmit shocks through portfolio flows. The sensitivity model is not a causal identification strategy and is not interpreted as a fully market-adjusted international asset-pricing model.

6.4 Newey–West inference

Monthly return residuals may exhibit heteroskedasticity and short-range serial dependence. We use heteroskedasticity and autocorrelation consistent standard errors with a Bartlett kernel and three lags, following Newey and West (1987). For a design matrix X , the covariance estimator has sandwich form

$$\hat{V}_{NW} = (X'X)^{-1} \hat{S}_{NW} (X'X)^{-1} \frac{n}{n-k}, \quad (6.7)$$

where k is the number of regressors including the intercept and $\hat{S}_{NW}$ combines the lag-zero score covariance with Bartlett-weighted cross-products through lag three. We report $\hat{V}_{NW}$ -based standard errors and two-sided large-sample normal p-values. Confidence intervals in figures use the approximate coefficient plus or minus 1.96 standard errors.

A three-lag correction is a pragmatic choice for monthly data, not a data-selected optimum. Results could change under alternative bandwidths, prewhitening, or small-sample corrections. There are only five markets, so cross-country clustered standard errors would have too few clusters to support conventional asymptotics; the regressions are estimated by country instead.

6.5 Time variation and event descriptions

Rolling estimates use an expanding chronology of fixed 60-month windows. For each window, the same bivariate OLS slope is re-estimated. Overlapping windows make adjacent estimates highly dependent; the figure is a visualization of coefficient drift, not a series of independent hypothesis tests.

Subperiod regressions split the sample into 2006–2019 and 2020–2025. The second period contains only 60 monthly returns per country, so its standard errors are larger and estimates should be regarded as a sensitivity exercise. Event windows around the global financial crisis, the 2013 emerging-market selloff, the initial COVID shock, the subsequent recovery, and 2022 are descriptive

summaries. They do not identify the causal effect of those events.

Descriptive Data Analysis

7.1 Price and currency paths

Figure 7.1 plots rebased local-currency equity indexes and rebased units of local currency per US dollar. Both panels begin at 100 for each country's first available return observation. Index paths are not directly comparable as investable total returns because local trading calendars, market composition, and dividends differ. The FX panel has an intuitive direction: an index above 100 means the domestic currency has depreciated against the dollar relative to its start month.

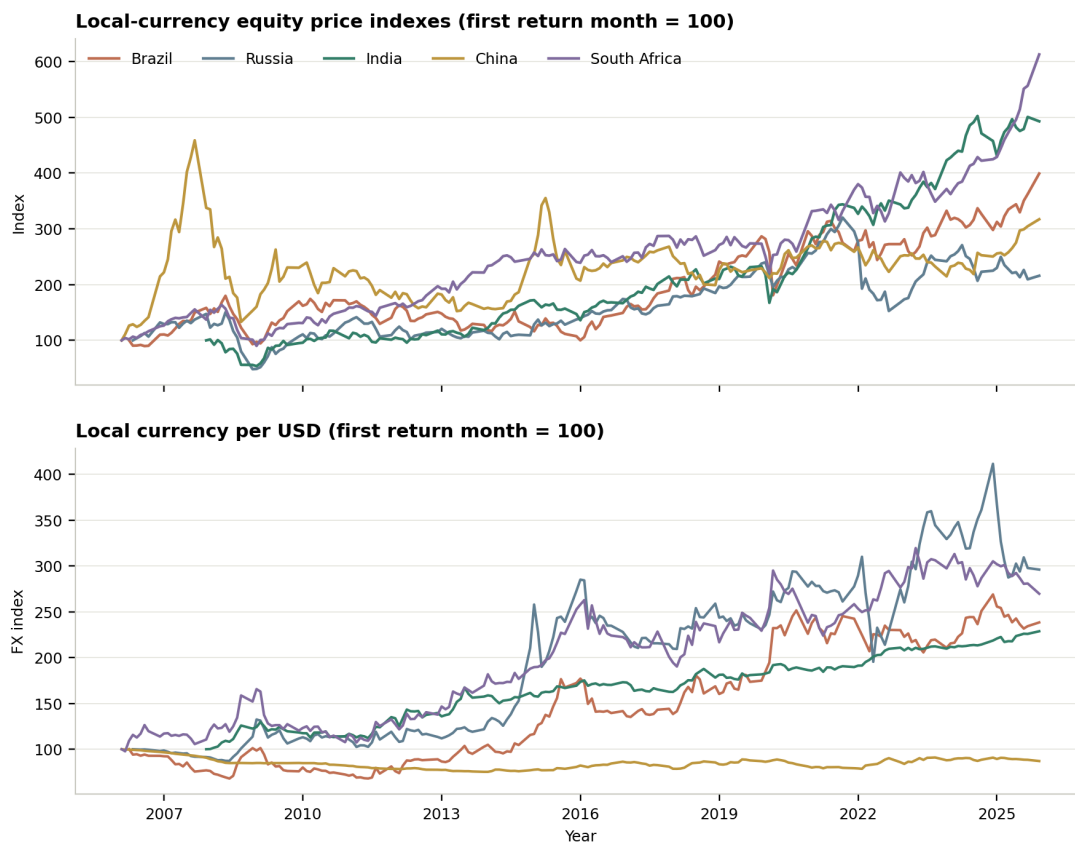


Figure 7.1: Rebased equity price indexes and domestic-currency-per-dollar exchange rates. Each country is rebased at its first usable return observation.

The charts show long swings, not smooth trends. Equity indexes have sharp drawdowns and recoveries, while exchange-rate paths differ in both scale and stability. Because one panel's path is a level and the other a currency quote, their vertical magnitudes should not be compared. Their purpose is to show sample context and the potential for structural breaks.

7.2 Annual return variation

Figure 7.2 reports average monthly stock return within each calendar year. It reveals that full-sample average coefficients are fitted across sharply different years. The heatmap does not estimate an annual FX beta and should not be read as one; it is a descriptive summary of the dependent variable. Annual cells with fewer than twelve observations may arise when a market series has missing months.

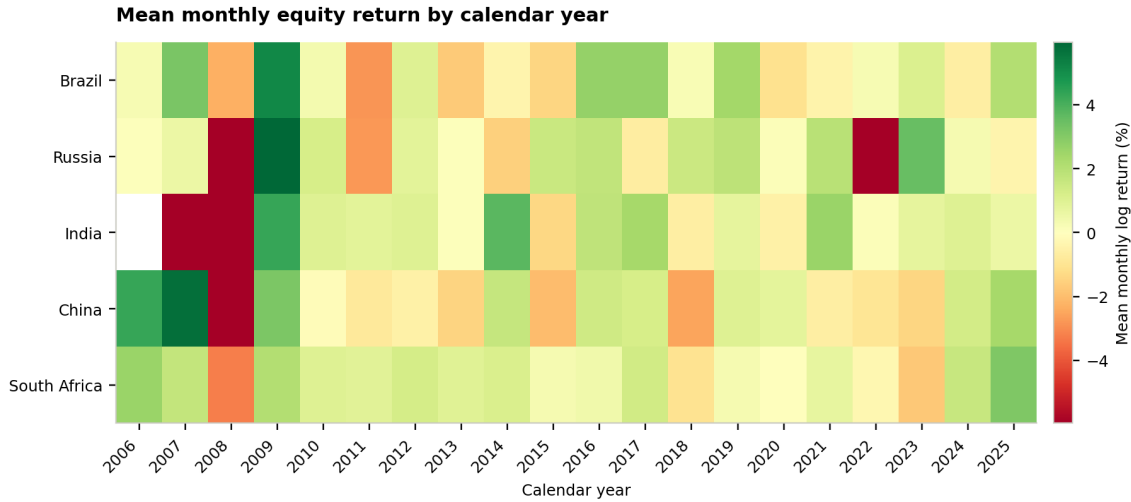


Figure 7.2: Mean monthly local equity index log return by calendar year. Color scale is winsorized at the 95th percentile of absolute cell values for legibility; calculations are not winsorized.

7.3 Descriptive statistics

Table 7.1: Monthly return and currency-change summary statistics

Market	<i>N</i>	Mean stock (%)	Stock SD (%)	Mean FX (%)	FX SD (%)	Corr.	Mean USD price ret. (%)
Brazil	197	0.536	6.302	0.272	4.688	-0.344	0.264
Russia	196	0.232	6.967	0.342	5.590	-0.152	-0.110
India	181	0.585	6.199	0.379	2.201	-0.337	0.205
China	199	0.186	7.240	-0.044	1.150	-0.201	0.230
South Africa	199	0.645	4.605	0.514	4.714	-0.139	0.131

Means and standard deviations are monthly percentage log changes. The FX mean is domestic currency per USD, so positive values represent average depreciation. USD price return equals local price return less FX depreciation and excludes dividends.

Equity-return volatility is highest in China at 7.24% per month and lowest in South Africa at 4.61%. Russia's FX-change volatility is the highest in the panel, at 5.59%; the Chinese yuan has the lowest FX volatility at 1.15%. These comparisons depend on the sample and source quote conventions. A descriptive ranking should not be read as a forecast of future risk.

7.4 Distributional shape and currency conversion

All five monthly equity-return distributions contain substantial tails. The sample skewness estimates are negative in each market, ranging from approximately -1.00 in Brazil to -1.15 in Russia, with excess kurtosis above four in both. These moments indicate that the Gaussian distribution is a poor literal description of monthly returns. Newey–West inference corrects the covariance estimate for heteroskedasticity and short serial dependence, but it does not make the return distribution normal; the large-sample p-values remain approximations.

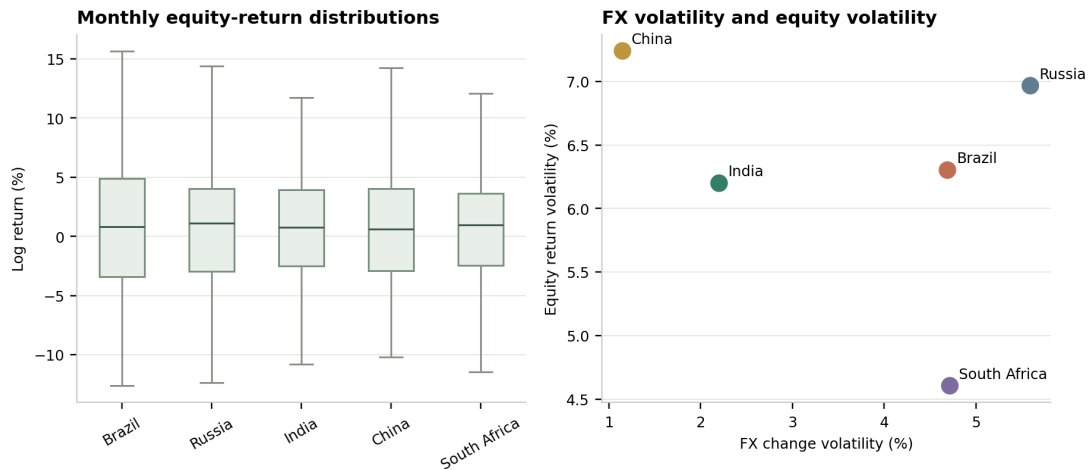


Figure 7.3: Monthly stock-return distributions and the association between sample FX volatility and equity volatility. Boxplot whiskers exclude plotted outliers for readability; outliers remain in all calculations.

Local-market price growth does not equal a USD investor's price return. Figure 7.4 compares the local price index path with the index divided by local currency per USD. Currency conversion reduces the accumulated price-only path for several markets; it can raise it in periods when the domestic currency appreciates. The comparison still excludes dividends, withholding tax, investability restrictions, and trading costs.

Currency conversion changes the path for a USD investor

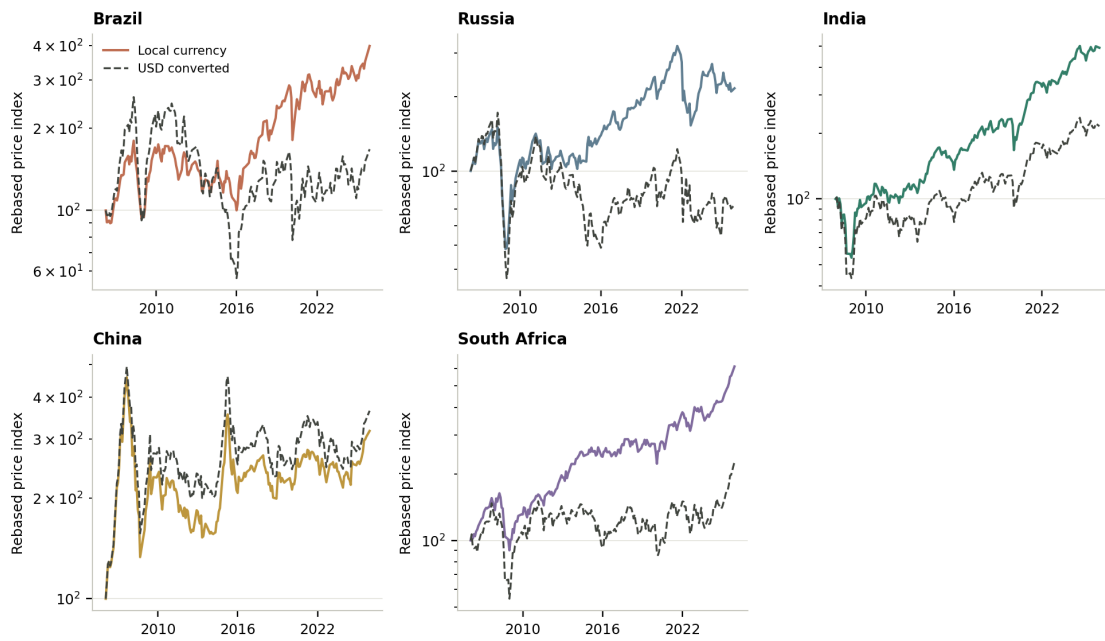


Figure 7.4: Local-currency and USD-converted price-only equity indexes. Each series is rebased to 100 at the first return observation; log scales allow the long-run paths to remain legible.

Baseline Empirical Results

8.1 Country-level coefficients

The estimated FX coefficient is negative in each market. The magnitude ordering is China, India, Brazil, Russia, and South Africa. A negative coefficient means that depreciation tended to coincide with lower local index returns. It does not establish that depreciation preceded equity losses or caused them. The exact estimates, HAC standard errors, p-values, correlations, and fit statistics appear in Table 8.1.

Table 8.1: Baseline country-by-country OLS estimates

Market	N	$\hat{\beta}_{FX}$	HAC SE	t approx.	p	R^2	Corr.
Brazil	197	-0.463	0.156	-2.96	0.003	0.118	-0.344
Russia	196	-0.190	0.109	-1.74	0.082	0.023	-0.152
India	181	-0.950	0.260	-3.65	< 0.001	0.114	-0.337
China	199	-1.266	0.379	-3.34	0.001	0.040	-0.201
South Africa	199	-0.136	0.094	-1.44	0.150	0.019	-0.139

Dependent variable: monthly local-currency stock index log return. FX variable: monthly log change in local currency per US dollar. HAC standard errors use three lags; p-values use the two-sided standard normal approximation. R^2 is the in-sample OLS coefficient of determination.

Brazil, India, and China reject a zero FX slope at conventional 5% levels in this baseline specification. A 1% monthly depreciation is associated with approximately a 0.46 percentage-point lower Brazilian index return, a 0.95 percentage-point lower Indian return, and a 1.27 percentage-point lower Chinese return. These are linear within-sample associations, not elasticities. The larger absolute slope in China does not imply a stronger currency explanation: China's R^2 is 4.0%, compared with 11.8% in Brazil.

Russia's point estimate is negative but uncertain ($p = 0.082$). South Africa's estimate is small and also uncertain ($p = 0.150$). Failure to reject a zero coefficient is not proof of zero exposure. With samples under 200 observations, the estimates remain compatible with economically meaningful positive or negative values. The p-values are also not corrected for the five country-level tests.

8.2 Return scatter and fitted relationships

Figure 8.1 plots monthly FX changes against local equity returns. Each line is fitted from the bivariate OLS model. The wide dispersion around each line is consistent with modest explanatory power. Crisis outliers have leverage, particularly for returns in Brazil and Russia. Because they are genuine observations in the frozen panel, they remain in the primary estimates; robust regression or winsorized models would answer different questions and are left as possible extensions.

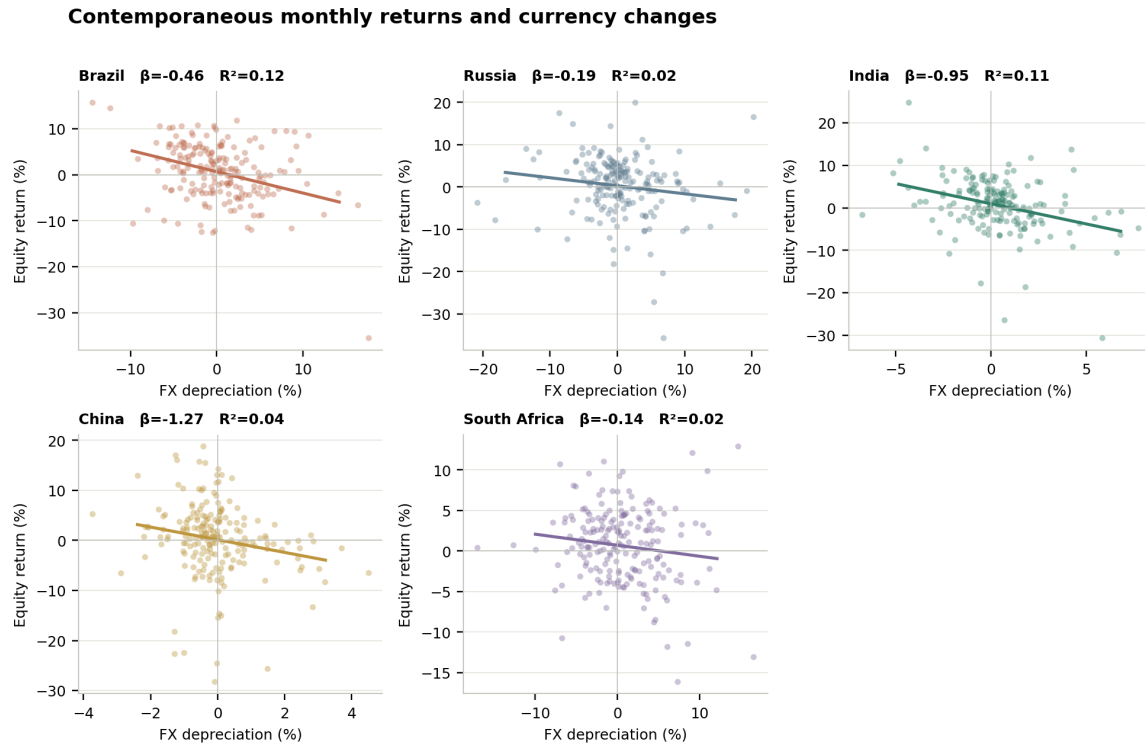


Figure 8.1: Contemporaneous monthly FX depreciation and local equity index return. Lines show the full-sample baseline OLS fit.

The scatter plots illustrate why a single slope should be interpreted cautiously. Currency changes of similar size can accompany very different equity outcomes. Moreover, a currency move may be an endogenous response to the same information that moves equity prices. The plot is a diagnostic of the fitted relationship, not evidence about temporal precedence.

8.3 Uncertainty and economic magnitude

Approximate 95% HAC confidence intervals are calculated as $\hat{\beta} \pm 1.96 SE_{NW}$. Brazil's interval is roughly $[-0.769, -0.156]$, India's $[-1.460, -0.440]$, and China's $[-2.008, -0.523]$. Russia's interval includes zero and extends to approximately $[-0.403, 0.024]$; South Africa's is approximately $[-0.321, 0.049]$. These intervals use a normal critical value and should not be confused with exact finite-sample coverage.

The coefficients are estimated using percent log changes on both sides. Therefore, a one-point FX movement corresponds to a one-percentage-point return change under the linear slope. They are not elasticities, long-run multipliers, or forecasts. The low R^2 values emphasize that the FX variable is one component of monthly return variation, not a sufficient return model.

Sensitivity Analysis and Time Variation

9.1 Matched-sample peer-market comparison

Adding the average return of the other available BRICS indexes improves fit in all five markets. In the matched samples, R^2 rises from 11.8% to 15.0% for Brazil, 2.3% to 6.2% for Russia, 11.4% to 18.7% for India, 4.0% to 18.7% for China, and 1.9% to 11.7% for South Africa. The market-control coefficient is positive in each regression, consistent with contemporaneous regional equity co-movement.

Table 9.1: FX coefficient sensitivity to an other-BRICS return control

Market	N	FX-only $\hat{\beta}$	Controlled $\hat{\beta}$	HAC SE	p	R^2 : baseline $\rightarrow$ controlled
Brazil	197	-0.463	-0.398	0.176	0.024	11.8% $\rightarrow$ 15.0%
Russia	196	-0.190	-0.129	0.106	0.227	2.3% $\rightarrow$ 6.2%
India	181	-0.950	-0.698	0.205	< 0.001	11.4% $\rightarrow$ 18.7%
China	199	-1.266	-0.961	0.342	0.005	4.0% $\rightarrow$ 18.7%
South Africa	199	-0.136	-0.004	0.089	0.968	1.9% $\rightarrow$ 11.7%

Both specifications use the exact same months for each country. HAC(3) standard errors and two-sided normal p-values. The peer-market variable is the average local-currency equity return of the other available original BRICS markets.

The FX slope moves toward zero in every market. The primary negative associations remain statistically significant for Brazil, India, and China, though the estimated magnitude falls by about 14%, 27%, and 24%, respectively. South Africa's coefficient is close to zero after the control is added. The persistence in three markets suggests that regional equity co-movement does not fully account for the FX association in this specification. It does not exclude an omitted global factor, feedback between currencies and equities, or common news.

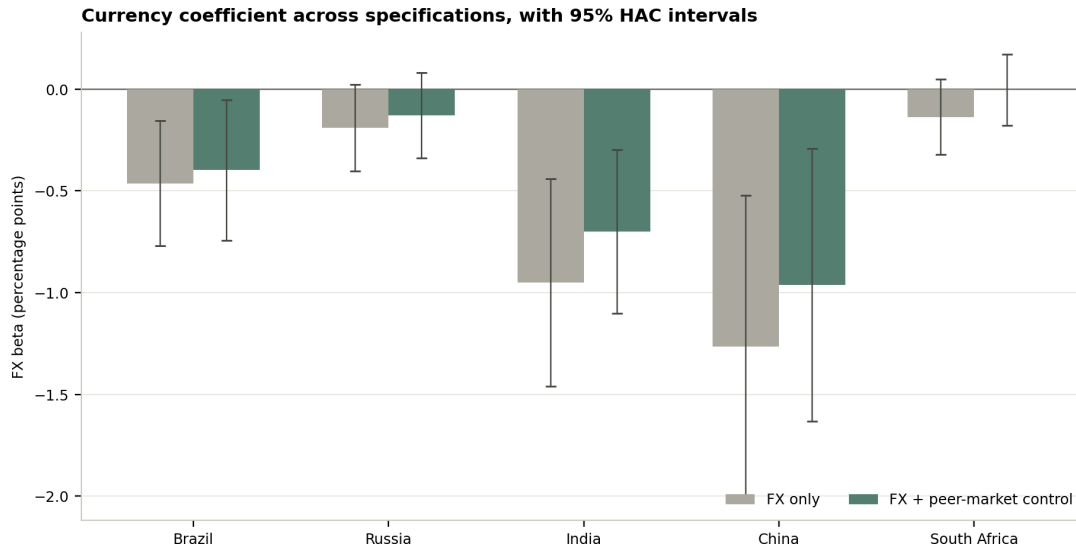


Figure 9.1: Baseline and peer-market-controlled FX coefficients with approximate 95% Newey–West intervals. The baseline bar is estimated on the matched dates used by the controlled model.

9.2 Subperiod estimates

Table 9.2 splits the sample at the end of 2019. The early period contains 137–139 observations in the markets with longer history and 121 in India; the 2020–2025 period contains 60 monthly returns for each market. The later estimates are consequently imprecise, particularly for India and South Africa.

Table 9.2: FX slope by subperiod

Market	2006–2019			2020–2025		
	<i>N</i>	Beta	<i>p</i>	<i>N</i>	Beta	<i>p</i>
Brazil	137	−0.299	0.012	60	−0.989	0.011
Russia	136	−0.189	0.228	60	−0.190	0.195
India	121	−0.989	< 0.001	60	−0.578	0.381
China	139	−1.396	0.053	60	−1.158	< 0.001
South Africa	139	−0.104	0.334	60	−0.270	0.245

Separate bivariate OLS regressions; HAC(3) standard errors and two-sided normal *p*-values. Splitting at 2020 is descriptive and does not constitute a structural-break test.

Brazil’s estimated negative slope is larger in absolute value after 2019, while India’s is smaller and less precise. China’s remains negative and statistically significant in both periods, though the early period is borderline at 5%. The Russian and South African coefficients remain uncertain. A formal break test with an interaction term and correction for selection of the break date would be needed to test coefficient stability. The table should therefore be read as a sensitivity analysis, not a test that regimes changed in exactly 2020.

9.3 Rolling exposure estimates

A rolling coefficient reveals whether full-sample averages hide periods of sign or magnitude change. Figure 9.2 uses 60 consecutive retained return observations at each endpoint, approximately five years. A skipped return month can make a window span more than 60 calendar months. The windows overlap in 59 months, so visually smooth neighboring values do not represent independent evidence. A rolling beta can also be unstable when FX changes show little variation in a particular window.

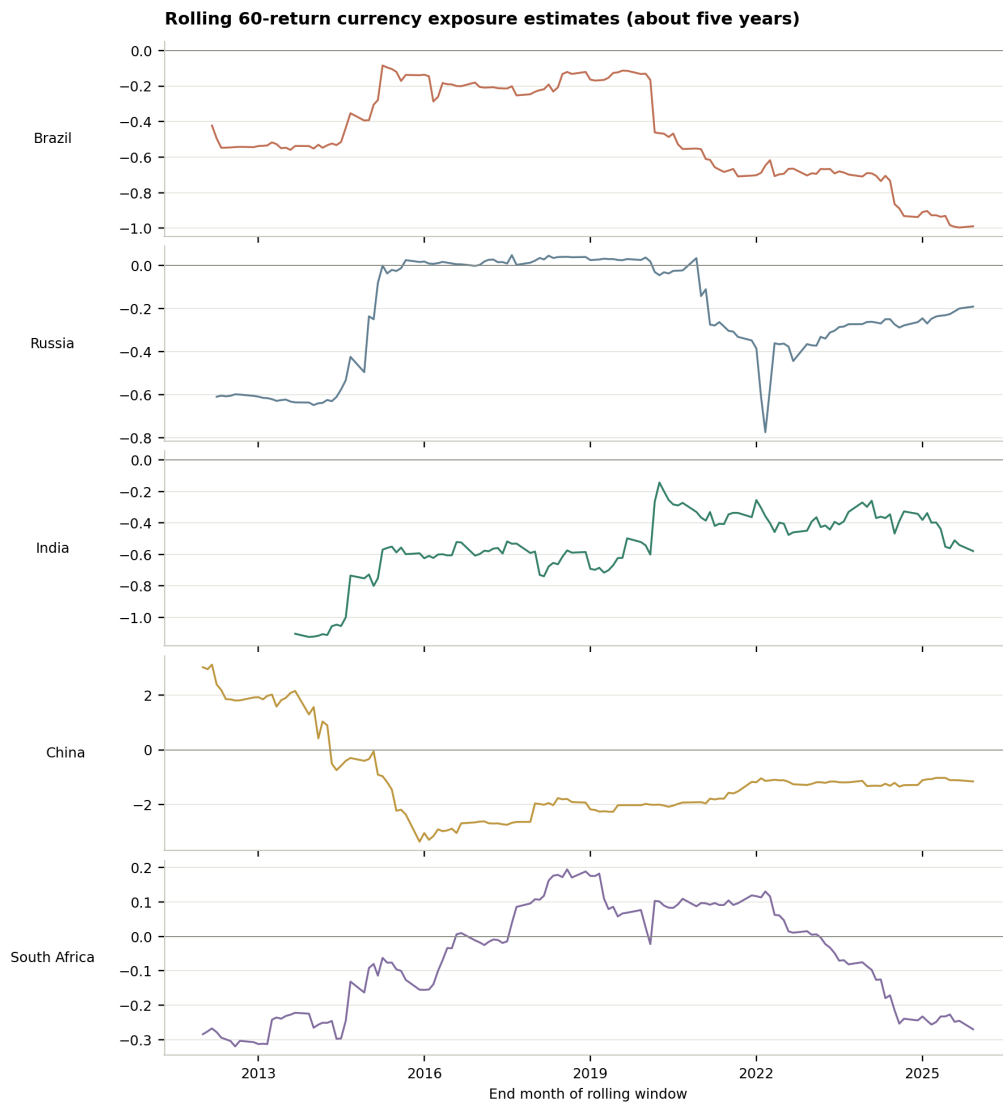


Figure 9.2: Rolling 60-observation OLS slope of local equity return on FX depreciation (approximately five years). No interval bands are shown; overlapping rolling estimates are descriptive.

The figure demonstrates why the phrase “the BRICS currency beta” is misleading. Each market has its own coefficient path, and each path moves through time. Rolling slopes can respond to real shifts in operating exposure, changing index constituents, market regimes, unusual observations entering or leaving a window, or common shocks. The available data cannot separate those mechanisms.

9.4 Alternative model interpretations

A fully market-adjusted exposure regression would ideally include a broad world or regional equity benchmark measured in a consistent currency, alongside FX changes and potentially lagged effects. The peer control used here is chosen for reproducibility and comparability with the five-country sample, not because it is the preferred benchmark in asset pricing. Its improvement in R^2 indicates shared return movement but may partly reflect simultaneous trading and common global information.

The coefficient comparison is thus best interpreted as a robustness question: do the bivariate negative slopes disappear when contemporaneous returns in other BRICS markets are considered? They do not disappear for Brazil, India, or China, but they attenuate. This finding narrows one concern about regional co-movement without eliminating the broader concerns about endogenous regressors and omitted common factors.

Selected Stress Windows

10.1 Purpose and construction

Event-window summaries provide context for high-volatility episodes in the monthly panel. Five windows were selected before examining country-level coefficient outcomes: the global financial crisis period from September 2008 through June 2009, the May–December 2013 emerging-market selloff, February–April 2020 as the initial COVID shock, May 2020–December 2021 as a recovery period, and February–December 2022 as a geopolitical and market-policy shock window. Windows are descriptive and not exhaustive.

For each country and window, the report computes the arithmetic mean of monthly log returns and the compounded price-index change over the observed months. FX changes are summarized using the same formula. The compounded results are price-only and do not include dividends. Because several windows contain few months, and event dates can affect markets at different times, country comparisons are not causal.

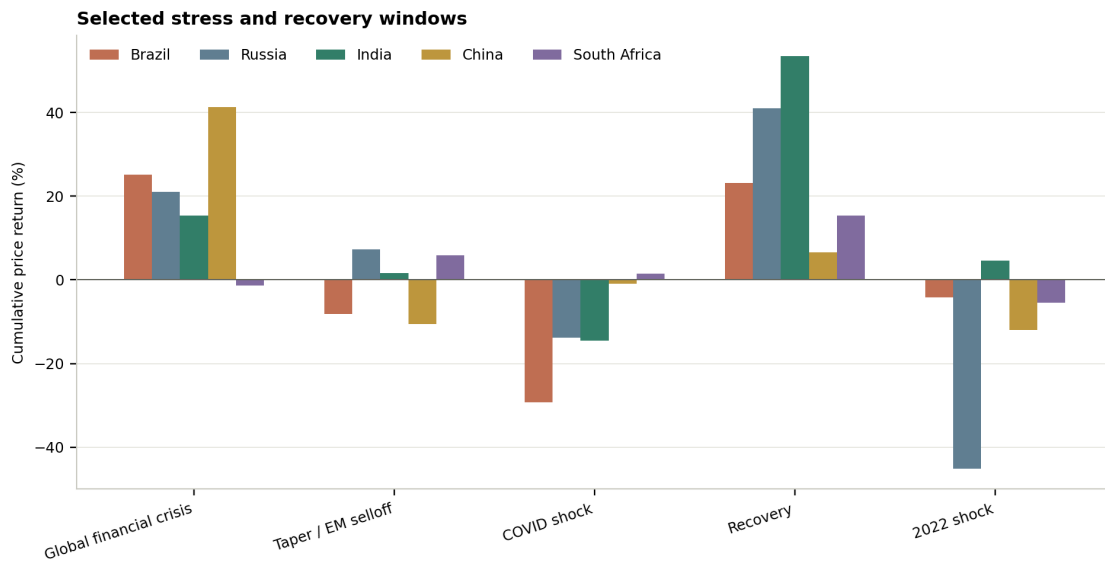


Figure 10.1: Compounded local equity price returns in selected historical windows. Each bar compounds observed monthly log returns available for the country and window.

10.2 Monthly average returns in stress periods

Table 10.1: Mean monthly stock return in selected event windows

Window	Brazil	Russia	India	China	South Africa
Global financial crisis (8 months)	2.80	2.39	1.78	4.32	−0.17
2013 EM selloff (6 months)	−1.41	1.18	0.27	−1.86	0.94
COVID shock (3 months)	−11.53	−4.97	−5.21	−0.33	0.50
Recovery (16 months)	1.30	2.14	2.68	0.40	0.89
2022 shock (9 months)	−0.48	−6.66	0.50	−1.41	−0.62

Mean monthly local-currency equity log return in percent. The COVID-shock window has only three observations per country; the 2022 window has nine. These averages are descriptive.

The selected windows illustrate how common labels can conceal different local experiences. During the three-month COVID window, the local indexes in Brazil, Russia, India, and China record negative mean monthly returns, while South Africa’s observed mean is slightly positive. The nine-month 2022 window includes a sharp average monthly Russian decline, while the other markets show smaller moves in either direction. These figures are sensitive to endpoint choices and should not be attributed solely to currency or geopolitical channels.

The global financial crisis window contains eight observations and does not show a uniformly negative mean in every local index. This is partly a reminder that event windows selected using familiar global dates do not necessarily align with the local market’s worst months. The 2013 window is included because emerging-market currency stress affected several countries, yet monthly average equity outcomes differ. A future event study should use daily or weekly data, pre-specified event dates, benchmark returns, and event-specific hypotheses.

Results and Discussion

11.1 What the estimates say

The central result is a negative same-month FX coefficient in each of the five markets. Three coefficients are statistically distinguishable from zero in the baseline model and remain so after adding the peer-market control. The signs are consistent with depreciation coinciding with local equity weakness, but they do not identify a corporate cash-flow mechanism. A common adverse shock can weaken the currency and lower the index at the same time.

The coefficient sizes differ materially. China and India have the largest baseline absolute slopes. In the sensitivity model, both remain negative and significant, while India's slope shrinks from -0.950 to -0.698 and China's from -1.266 to -0.961 . Brazil similarly moves from -0.463 to -0.398 . This attenuation is economically relevant: part of the baseline relationship appears to move with a same-month regional equity factor. The remaining association is not necessarily an independent currency effect.

Russia's coefficient is negative but imprecise in both specifications. Its observed market data are especially difficult to interpret as investor opportunity after 2022 because of sanctions and restrictions. South Africa's FX-only slope is small and becomes nearly zero after the peer-return control. The latter change illustrates the importance of common market movements, but does not prove that South Africa has no firm-level currency exposure.

11.2 Hypothesis assessment

H1 receives support in Brazil, India, and China under the stated country-level models. It is not supported at conventional significance levels for Russia and South Africa. H2 is supported descriptively: point estimates, standard errors, correlations, and explanatory power differ across the markets. The study does not perform a formal Wald test of coefficient equality, so the cross-country differences should not be described as statistically proven differences.

H3 receives descriptive support. The peer-market term raises R^2 for all five countries and reduces the magnitude of every FX coefficient. In three markets, the currency slope remains significant. Because the added factor is endogenous and regional, H3 does not establish that global market movements have been fully controlled.

11.3 Economic channels and caution

A depreciation-associated decline in an aggregate index can arise through foreign-currency liabilities, imported input costs, lower real purchasing power, monetary tightening, or changes in foreign investor demand. The data do not include firm balance sheets or trade exposures, so these expla-

nations remain plausible mechanisms rather than findings. Likewise, exporter competitiveness may offset these channels for some firms even when the broad market coefficient is negative.

Index composition is another source of heterogeneity. A national index is weighted toward large listed firms, which may have international operations and natural hedges unlike the median domestic company. The sample's price indexes omit dividends, which vary by market and over time. An investor who converts returns to dollars faces both local price movements and FX translation, as shown in Figure 7.4; an investable total-return comparison would additionally require licensed total-return data and a consistent reinvestment assumption.

11.4 Practical interpretation

The results do not support a simple rule that BRICS currency depreciation is good or bad for all local stocks. Instead, the sign in this historical panel tends to be negative, the signal explains only a modest part of monthly variation, and the estimated magnitude differs across countries. The peer-market check leaves three negative associations intact but shows attenuation. This may inform further risk analysis, but the model is not a portfolio optimizer, hedge ratio recommendation, or forecast.

Limitations and Further Research

12.1 Identification and omitted variables

Exchange rates and equity values are jointly determined. The bivariate model omits global market returns, interest-rate surprises, commodity prices, volatility, inflation, and policy events. A global risk shock can increase dollar demand and reduce equity values across emerging markets, generating a negative contemporaneous correlation even without a direct FX-to-cash-flow effect. The peer return control absorbs part of common BRICS equity movement but does not replace an external benchmark or a structural instrument.

Potential extensions include a market-adjusted model with MSCI World or a broad investable global index, domestic short rates and US yields, relevant commodity-price indexes, and lagged FX movements. Such controls would need aligned histories, clear currency denomination, and a pre-specified model. Including many regressors in a 181–199 observation panel also consumes degrees of freedom and can increase multicollinearity.

12.2 Measurement and market access

Yahoo Finance chart histories are public and reproducible for this prototype, but they are not a formally licensed institutional feed. Historical adjustments may change and source vendors can revise bars. MOEX ISS provides official historical index candles, but observed prints do not ensure that a foreign investor could transact during restrictions. Russia’s 2022-era values therefore need separate investability checks before portfolio conclusions.

Monthly closes reduce noise but obscure the sequencing of FX and stock movements within each month. National holidays and timezone conventions may produce asynchronous measurement. Daily or weekly source data would allow closer synchronization but would require careful holiday matching, much larger data validation, and potentially stronger heteroskedasticity corrections.

12.3 Index composition, returns, and currency conversion

Price index returns omit cash distributions and may not be comparable with total-return benchmarks. Index composition changes over two decades. The report does not adjust for inflation and does not compare real equity returns. The supplementary USD price return is a currency translation, not a total return and not a transaction-cost-adjusted investor experience.

The currency pairs also reflect the vendor’s FX market and quote conventions. Some currencies, particularly the Russian ruble in the later period, may face administered prices, capital controls, or parallel markets. A single market quote may not capture the marginal rate available to investors or firms.

12.4 Inference and data mining

Newey–West HAC(3) is one defensible monthly correction, not a unique choice. Alternative lag bandwidths, finite-sample corrections, bootstrap inference, and residual diagnostics could be reported. The large-sample normal approximation may be optimistic with fewer than 200 observations and heavy-tailed returns. Five baseline tests plus several sensitivity comparisons create a multiple-testing concern; p-values are reported transparently without adjustment.

Rolling-window estimates overlap heavily and are not independent tests. Event windows are selected to describe well-known periods and may invite hindsight. Subperiod breaks at 2020 are convenient but not statistically selected. A confirmatory study would pre-register break dates or use formal structural stability tests and adjust for selection.

12.5 Research agenda

The highest-value extensions are: (i) use total-return indexes and an external global-market benchmark; (ii) estimate firm-level exposure with FX revenue, input, and debt characteristics; (iii) distinguish appreciation from depreciation using asymmetric terms; (iv) test lagged and cumulative FX responses; (v) estimate regime-dependent or rolling coefficients with uncertainty bands; (vi) report event studies based on synchronized daily data; and (vii) examine whether the Russia sample can be separated into investable and non-investable periods. An expanded BRICS sample should be a separate design that explicitly handles changing membership.

Conclusion

This report analyzes twenty years of monthly observed equity index and exchange-rate data for Brazil, Russia, India, China, and South Africa. Under a consistent domestic-currency-per-US-dollar quote, local-currency depreciation is positively coded and the estimated contemporaneous FX slope is negative in all five baseline regressions. Brazil, India, and China have statistically significant negative estimates under the stated HAC(3) and normal-approximation procedure; Russia and South Africa do not.

A matched-date sensitivity model adds an equal-weight return proxy made from the other available BRICS indexes. The FX coefficient attenuates in every country, and in-sample fit rises. Brazil, India, and China remain significant, while the Russian and South African estimates remain uncertain. The extra control shows that regional co-movement matters but is not a causal solution or an independent global-market benchmark.

The principal conclusion is heterogeneity, not a single BRICS rule. Monthly currency changes account for only a modest part of equity index return variation. Results should be treated as descriptive evidence using public price-index data, not as causal effects or investment advice. Better synchronized data, total-return series, external benchmarks, firm-level exposures, and formal break tests are needed for stronger claims.

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Data Dictionary and Series Audit

The delivered raw file, `data/brics-monthly.csv`, has ten fields. The table below records the meaning of each field and its role in processing. All rows are observed source levels; return columns are generated by the analysis code rather than stored in the raw source file.

Table A.1: Raw monthly panel field definitions

Field	Definition and use
<code>country</code>	English market name: Brazil, Russia, India, China, or South Africa.
<code>code</code>	Two-letter internal key: BR, RU, IN, CN, ZA.
<code>currency</code>	ISO currency code: BRL, RUB, INR, CNY, ZAR.
<code>index</code>	Yahoo symbol or internal MOEX instrument label used to identify the equity series.
<code>fx</code>	Yahoo currency symbol for domestic currency per US dollar.
<code>index_source</code>	Series provenance label, including index provider/market.
<code>fx_source</code>	Provenance label for the exchange-rate observation.
<code>month</code>	Month identifier stored as the first calendar day of the monthly bar; it is not a claim that the market closed on that date.
<code>index_close</code>	Monthly close of the price index in its native convention.
<code>local_per_usd</code>	Number of domestic currency units quoted per one US dollar.

The collector requests maximum available monthly history for the Yahoo symbols and monthly candles for IMOEX from the MOEX ISS endpoint, then restricts the raw extract to 2006–2025. It intersects available equity and FX months within each country. Return construction requires adjacent calendar months; a gap of two or more months causes the later observation to be dropped from the return panel for that transition. The 1,077 raw matched levels therefore produce 972 returns, not 1,072, because month gaps and first differences remove additional transitions.

Additional Country Profiles

B.1 Brazil

Brazil contributes 197 monthly returns from April 2006 through December 2025. Mean monthly local index return is 0.536%, with a 6.30% standard deviation. The average monthly BRL-per-USD change is 0.272%, with 4.69% standard deviation. The full-sample baseline association is moderately negative, $\hat{\beta} = -0.463$, with HAC standard error 0.156 and $R^2 = 11.8\%$. On matched dates, the peer-market model estimates -0.398 with standard error 0.176. These statistics indicate that FX variation and market-wide return shocks coexist in the Brazilian sample; they do not identify which balance-sheet or trade channel drives the relationship.

B.2 Russia

Russia contributes 196 returns from May 2006 through December 2025. Mean monthly local index return is 0.232%; return volatility is 6.97%. RUB-per-USD volatility is 5.59%, the highest currency dispersion among the five. The baseline slope is -0.190 and not significant at five percent. The controlled slope is -0.129 . The data window contains periods in which access and price formation were materially affected by official restrictions and sanctions. These sample averages should not be taken as an investable foreign portfolio experience.

B.3 India

India contributes 181 returns from December 2007 through December 2025. Average monthly Nifty 50 return is 0.585%, with 6.20% standard deviation. INR-per-USD volatility is 2.20%. The baseline FX slope is -0.950 (HAC SE 0.260), and the peer-controlled slope is -0.698 (0.205). The later start reduces the number of observations relative to the other markets; any direct cross-country comparison should acknowledge this difference in historical coverage.

B.4 China

China contributes 199 returns from February 2006 through December 2025. Average monthly Shanghai Composite return is 0.186%, with 7.24% standard deviation. FX volatility is 1.15%, the lowest in the panel. The baseline slope is -1.266 (SE 0.379); after the peer return is added it is -0.961 (SE 0.342). The slope's magnitude should not be directly compared with that of another index without accounting for index composition, market institutions, and exchange-rate management.

B.5 South Africa

South Africa contributes 199 returns from February 2006 through December 2025. Average monthly FTSE/JSE Top 40 return is 0.645%, with 4.61% standard deviation. ZAR-per-USD changes have 4.71% standard deviation. The baseline slope is small (-0.136) and uncertain. In the peer-market specification it is essentially zero (-0.004), while R^2 increases from 1.9% to 11.7%. This is evidence that the cross-market return proxy is correlated with South African index returns, not evidence that firm-level FX exposure is absent.

Calculation Notes and Replication Protocol

C.1 Regression calculations

For a country with n retained observations, construct the vector $y = (r_1, \dots, r_n)'$ and a baseline design matrix $X = [\mathbf{1}, f]$. The OLS coefficient vector is $(X'X)^{-1}X'y$. Residuals are $\hat{u} = y - X\hat{\beta}$. The peer-market design adds a third column $m_t = \bar{r}_{-i,t}$ and is estimated on the matched date set. The variance estimator uses score vectors $s_t = x_t\hat{u}_t$ and Bartlett weights $w_\ell = 1 - \ell/(L+1)$, $L = 3$:

$$\hat{S}_{NW} = \sum_t s_t s_t' + \sum_{\ell=1}^3 w_\ell \sum_{t=\ell+1}^n (s_t s_{t-\ell}' + s_{t-\ell} s_t'), \quad (\text{C.1})$$

$$\hat{V}_{NW} = (X'X)^{-1} \hat{S}_{NW} (X'X)^{-1} \frac{n}{n-k}. \quad (\text{C.2})$$

The approximate test statistic is $z_j = \hat{\beta}_j / \widehat{SE}_{NW,j}$ and the reported two-sided probability is $2\Phi(-|z_j|)$. This calculation is transparent and matches the dashboard, but an independent replication should compare alternative HAC implementations and small-sample reference distributions.

C.2 Reproducing the analysis

A researcher can reproduce the report from the project root as follows:

1. Install the JavaScript dependencies with `npm ci` to run the app and server-side endpoint.
2. Inspect the frozen raw observations in `data/brics-monthly.csv`; verify country, ticker, month, and source labels against Table 5.1.
3. Run `python scripts/build_report_assets.py` in an environment with Python, pandas, NumPy, SciPy, and Matplotlib to rebuild the figures and generated summary file.
4. Compile `REPORT.tex` twice using XeLaTeX or pdfLaTeX so the contents, figure list, references, and cross-references settle.
5. Compare the baseline and peer-model tables against `/api/analysis?years=20` and the included result summary before changing any source observations.

The collector in `scripts/collect_data.py` requires network access to the public source endpoints and may return revised historical bars if vendors update their records. Rebuilding the original frozen sample exactly therefore requires retaining the committed CSV, rather than assuming a future endpoint response will be byte-identical.

Further Robustness Designs

The peer-market sensitivity model controls only for contemporaneous returns of the other available BRICS indexes. A more complete model could include a broad world return $r_{W,t}$:

$$r_{i,t} = \alpha_i + \beta_i f_{i,t} + \delta_i r_{W,t} + \varepsilon_{i,t}, \quad (\text{D.1})$$

where the benchmark is preferably total-return and denominated consistently. A model with local market, global market, and currency terms would separate some common market movement while preserving a country-specific FX coefficient. It would still be observational and could retain endogeneity.

An asymmetric specification could distinguish depreciation from appreciation:

$$r_{i,t} = \alpha_i + \beta_i^+ \max(f_{i,t}, 0) + \beta_i^- \min(f_{i,t}, 0) + \varepsilon_{i,t}. \quad (\text{D.2})$$

This tests whether the response differs by sign, but estimates in a 181–199 observation sample would be imprecise, especially after adding controls. Nonlinear terms should be motivated in advance rather than added until a significant coefficient appears.

A distributed-lag model could include $f_{i,t-1}$ and $f_{i,t-2}$, allowing a currency shock to precede equity adjustment. The contemporaneous slope is not a full dynamic exposure measure. Lagged relationships should be interpreted with caution because FX and equities trade asynchronously and monthly time aggregation can reverse apparent timing.

Finally, structural change can be assessed with pre-specified break dates, Chow-type tests, or rolling coefficient intervals. The split at 2020 in this report is exploratory. A formal study would account for searching across candidate break dates and would verify stability across alternative source vendors and index variants.

Research Integrity and Interpretation Checklist

Before using the coefficients for a decision, a reader should answer the following:

1. Is the currency quote local currency per dollar, and does a positive value mean depreciation? Yes, as defined in Equation 6.2.
2. Are the equity returns price-only or total-return? Price-only; dividends are excluded.
3. Is each market measured over the same dates? The calendar window is common but usable start dates and observation counts differ.
4. Does the regression establish causality? No. The estimated slopes are contemporaneous associations.
5. Does the peer-market model use an external world benchmark? No. It uses an average of other available BRICS index returns.
6. Are p-values adjusted for multiple testing? No. They use a two-sided asymptotic normal approximation.
7. Is Bloomberg data included? No. Public Yahoo Finance history and official MOEX ISS history are used.
8. Are Russian prices necessarily investable? No. The report explicitly warns about post-2022 market-access restrictions.

These checks are integral to the empirical result. A clear coefficient without its quote convention, sample, source, or inference method is easy to misread. The accompanying dashboard keeps source notes visible and allows a reader to move between a selected market, the model comparison, and the report. For research reuse, the raw data, collector, analysis implementation, figures, and LaTeX source are included with the project.