Exchange Rate Risk and Renewable Infrastructure Project Failures in Emerging Economies.

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Abstract

We estimate Poisson models of project activity and discrete-time hazard models of failure to study how exchange rate risks affect renewable infrastructure investments in emerging markets. Using project-level data from 2005 to 2025, we find that exchange rate risk has no systematic effect on project entry but strongly increases failure rates. The effect is driven by tail risk rather than average depreciation and is highly nonlinear, rising sharply in adverse states. Exposure is short-lived and concentrated in recent periods. These results identify a state-dependent financing constraint arising from currency mismatch in project finance.

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Keywords: Exchange Rate Risk, Infrastructure Investment, Project Failure, Currency Mismatch, Tail Risk, Financial Constraints, Renewable Energy

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1. Introduction

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Recent global needs assessments estimate that emerging and developing economies (EMDEs) will require between USD 2 and 2.4 trillion in climate-related investment annually by 2030, with renewable energy infrastructure accounting for the largest share of this pipeline (Songwe et al., 2022; UNEP, 2022).[1] Mobilising capital at this scale requires long-tenor financing in environments characterised by volatile exchange rates and underdeveloped domestic capital markets. In practice, infrastructure projects in these economies are frequently financed with foreign-currency debt, while revenues are denominated in local currency, creating a structural currency mismatch. The resulting asset-liability mismatch implies that exchange rate movements can significantly erode debt service capacity, tighten covenant constraints, and impair refinancing conditions. In such scenarios, currency risk is not merely a pricing input but a potential constraint on project viability and warrants a more detailed discussion on how exchange rate risk translates into project-level outcomes.

Exchange rate risk may affect infrastructure investment along several dimensions. It may influence project entry or instead operate through project failure over the project lifecycle. It may also depend on the relevant risk dimension, namely whether exposure is captured by average exchange rate movements, broader volatility, or downside tail risk. A further consideration is the temporal dimension, that is, whether exchange rate risk reflects persistent macroeconomic conditions or short-horizon dynamics tied to project timing.

The literature on exchange rate risk has largely developed along three related strands. First, asset pricing studies examine the compensation for currency risk in financial markets and link exchange risk exposure to excess returns, sovereign spreads, and time-varying bond risk premia (Lustig et al., 2011; Du & Schreger, 2016; Della Corte et al., 2016). Second, corporate finance research focuses on how firms manage exchange rate exposure through hedging and balance sheet adjustments. This strand of literature shows that derivative use can stabilise cash flows and support firm valuation (Geczy et al., 1997; Allayannis & Weston, 2001; Bartram et

[1] EMDE countries - other than China - require the largest increase in investment: these regions currently have low investment levels, significant development needs, and are projected to contribute over 50% of global emissions by 2030. (https://www.lse.ac.uk/granthaminstitute/publication/raising-ambition-and-accelerating-delivery-of-climate-finance/).

al., 2011). Third, more recent work highlights a direct pricing channel, whereby exchange rate risk feeds into borrowing costs, particularly in emerging markets and green debt segments (Moro and Zaghini, 2025).

However, these strands do not establish how exchange rate risk translates into project-level investment and failure outcomes in renewable energy infrastructure, particularly in EMDE contexts where currency mismatches are structural and hedging markets incomplete. Under such conditions, the mechanisms identified in the corporate and asset pricing literature may not operate effectively. When hedging is constrained, exchange rate risk may neither be fully priced nor diversified, but instead transmitted through financing constraints that affect project viability. Against this backdrop, exchange rate exposure becomes inherently asymmetric. Large depreciations increase the domestic currency value of foreign-currency liabilities, while appreciations provide limited offset. When hedging is constrained, exchange rate exposures remain on the project balance sheet and the distribution of exchange rate movements becomes central. Evidence shows that exchange rate risk in EMDEs exhibits pronounced crash-risk tails (Chernov et al., 2018), implying that large adverse realizations are economically relevant. As a result, variance-based measures of exchange rate risk may fail to capture the relevant exposure faced by infrastructure projects.

This paper studies how exchange rate risk affects renewable infrastructure projects in EMDEs using project-level data on utility-scale wind and solar projects from 2005 to 2025. We focus on two margins of adjustment: the extensive margin of project entry and the survival margin of project failure. Methodologically, we combine aggregate Poisson pseudo-maximum likelihood (PPML) models of project counts with project-level discrete-time hazard models of failure. This empirical strategy allows us to distinguish between ex ante investment responses and ex post project viability, and to link country-level variation in exchange rate risk to the timing of project-level outcomes.

We document three main findings. First, exchange rate risk does not systematically reduce project entry. Rather, it is strongly associated with higher project failure rates. This asymmetry implies that FX risk operates primarily through a survival rather than entry margin. This pattern is akin to an adjustment process at the initiation stage through pricing, selection, or policy support. In contrast to the entry margin, exchange rate risk has large and nonlinear

effects on project failure. The effects strengthen in adverse states and do not reflect a discrete structural break. Second, the effects of exchange rate risk are nonlinear and concentrated in adverse states. Tail risks emerge as the most robust predictor of failure, while variance-based measures such as volatility are less informative. Third, the impact of exchange rate risk is short-lived and tied to project timing. The effect is primarily driven by the first lag. Higher-order lags provide limited incremental explanatory power.

Our results show that exchange rate risk affects infrastructure outcomes through nonlinear, state-dependent effects that operate on project failure rather than entry and are concentrated at short horizons. This has important implications for both economic interpretation and policy design. Policies that mitigate tail risks may not substantially increase project origination but can significantly improve completion rates and reduce capital loss. Moreover, risk management frameworks that focus on average volatility may overlook the economically relevant dimension of exchange rate risk, which is concentrated in tail events.

The use of project-level data introduces several advantages for identification and empirical analysis. Unlike firm-level balance sheet data, project-level observations allow for a direct mapping between currency shocks and realised investment outcomes, while preserving heterogeneity across technologies, sponsors, and institutional environments. They also enable precise identification of investment timing through project-level event dates. In addition, project finance settings are characterised by limited risk diversification at the asset level, making them particularly well-suited for isolating the real effects of exchange rate risk on investment behaviour.

This paper makes two contributions. First, exchange rate risk operates through project failure rather than project entry. Second, the effect of FX risk is nonlinear and driven by downside tail exposure, implying that variance-based measures are insufficient to capture economically relevant risk.

The policy implications follow directly. Addressing FX risk in EMDE infrastructure requires mechanisms that target downside currency exposure and provide short-term financial resilience. This includes hedging facilities, contingent guarantees, and liquidity support mechanisms designed to mitigate large depreciations and funding shocks.

2. Data

Our primary dataset combines project-level information on renewable energy infrastructure projects with country-level macroeconomic and exchange rate variables. Project data are obtained from Bloomberg New Energy Finance (BNEF) and cover utility-scale wind and solar projects in EMDEs, excluding China.[2] The raw dataset contains 46,822 project observations corresponding to 10,970 unique projects across 142 countries. We clean and deduplicate the data to construct an entry sample of 544 projects across 50 EMDE countries from 2005 - 2025. Projects in the dataset evolve through different lifecycle stages. Projects in the sample are either under abandoned, mothballed, on standby, suspended or decommissioned. Figure 1 presents countries where renewable infrastructure projects are located. Brazil, India, Mexico, South Africa and Vietnam are the five countries with the most projects in our sample.

We define project failure as transitions into the adverse statuses: abandonment, suspension, or mothballing, which reflect a breakdown in project viability prior to or during operation. These failure events are treated as absorbing states. This classification allows us to capture economically meaningful distress events while abstracting from projects that have successfully entered operation or reached the end of their economic life (decommissioning). Table 1 provides summary information on the data construction process. In contrast entry is defined by financial close.

Unless otherwise stated, the empirical analysis is conducted at the country–year–sector level (wind and solar). Project-level information is aggregated to construct counts of (i) project entry, defined as the number of projects reaching financial close in a given country–year–sector, and (ii) project failure, defined as the number of projects that are abandoned, suspended, or mothballed. This aggregation yields a balanced panel of 2,100 country–year-sector observations. Our final sample for baseline estimations comprises 1,584 project observations across 46 countries for both entry and failure regressions. In Table 1, the data sample is sparse, with 92.4% of country–year-sector observations exhibiting zero entry and 86.0% zero failure events.

[2] First, utility-scale renewables in China are financed almost entirely with on-shore RMB at subsidized, policy-bank rates so face limited cross-border, hard-currency project finance exposure in principle. Second, we exclude China for reasons of outlier weight and sample balance. Renewable infrastructure projects from China constitute more than 50% of the raw unprocessed dataset.

We measure foreign exchange (FX) risk along three dimensions that capture distinct aspects of currency exposure relevant for infrastructure investment. First, *FX Depreciation* captures the level effect of currency movements and reflects changes in the domestic currency value of foreign-currency liabilities and imported capital costs. We proxy this dimension of FX risk by the annual percentage change in the nominal exchange rate. Second, *FX Volatility* uses the dispersion of exchange rate movements over time to proxy general uncertainty in currency markets, which may affect financing conditions and hedging costs. FX volatility is computed as the rolling standard deviation of monthly log exchange rate returns over a 12-month window. Third, FX tail risk captures downside risk. It is defined as the negative of the 10th percentile of monthly log FX returns over a rolling 12-month window. This measure isolates extreme downside movements that are relevant for project viability. Currency mismatches between foreign-currency debt and local-currency revenues amplify the impact of large depreciations on project balance sheets. These FX risk proxies distinguish between level effects, overall uncertainty, and extreme downside risk. All FX variables are constructed at the country level, lagged by one year, and winsorised at the 1% level to limit the influence of outliers. Summary statistics for FX variables are reported in Panel A of Table 2. FX risk varies across countries and over time. FX Depreciation exhibits moderate dispersion, while FX Volatility and FX Tail Risk display tighter distributions but remain economically meaningful. The median values of all FX risk metrics are close to zero. This suggests relatively stable exchange rates overall over our sample period, punctuated by episodic shocks. Macroeconomic controls include inflation, government debt as a share of GDP, the current account balance as share of GDP, political risk, and real interest rates. All control variables are measured at the country–year level, lagged by one period, and winsorised at the 2% level.

In Table 3, Panel A reports the distribution of within-country standard deviations for each FX measure, while Panel B presents cross-correlations. FX Volatility and FX Tail Risk are positively correlated. On the other hand, FX Depreciation is only weakly correlated with FX Tail risk. This suggests that these FX risk measures capture overlapping but reasonably distinct dimensions of exchange rate dynamics.

3. Empirical Approach

Exchange rate risk and project entry–failure dynamics

We estimate the relationship between exchange rate risk and renewable infrastructure activity using a country–year–sector panel of entry and failure counts. The dependent variables, therefore, are non-negative count variables with a large mass at zero (Tables 1 & 2). This distributional feature motivates the use of Poisson pseudo-maximum likelihood (PPML) estimation. PPML is well-suited to this setting for two reasons. First, it accommodates excess zeros without requiring distributional assumptions beyond the correct specification of the conditional mean. Second, it provides consistent estimates under general forms of heteroskedasticity, which are common in cross-country investment data. PPML is widely used in applied work involving sparse count outcomes and multiplicative models of economic activity (Berg et al., 2016; Silver & Tenreyro, 2006; 2011; Wooldridge, 2010). Our baseline specification follows:

$$E[y_{cst} \mid X_{ct}] = \exp\left(\beta\, FX_{c,t-1} + \gamma' Z_{c,t-1} + \mu_c + \lambda_t + \theta_s\right) \qquad (1)$$

where y_{cst} denotes the number of projects (entry or failure) in country c, sector s, and year t; $FX_{c,t-1}$ is a vector of exchange rate risk measures (depreciation, volatility, or tail risk); $Z_{c,t-1}$ is a vector of lagged macroeconomic controls; μ_c, λ_t, and θ_s denote country, year, and sector fixed effects. All explanatory variables are lagged by one period to reduce contemporaneous feedback from project outcomes to macroeconomic conditions. Country fixed effects (μ_c) absorb time-invariant cross-country differences in investment environments, while year fixed effects (λ_t) capture global shocks affecting all countries simultaneously. Sector fixed effects (θ_s) account for structural differences between wind and solar investments. Identification relies on within-country variation in exchange rate risk over time. The estimates, therefore, capture how changes in exchange rate risk within a given country are associated with changes in project entry and failure. We interpret the coefficients as semi-elasticities of expected project counts with respect to exchange rate risk. Throughout, results refer to conditional associations rather than causal effects.

To allow for nonlinear responses to exchange rate risk, we estimate flexible specifications using spline-based transformations of the FX variables within the PPML framework. Specifically, we model:

$$E[y_{cst} \mid X_{ct}] = \exp\left(f(FX_{c,t-1}) + \gamma' Z_{c,t-1} + \mu_c + \lambda_t + \theta_s\right) \qquad (2)$$

where $f(\cdot)$is a quadratic B-spline with three degrees of freedom applied to the standardized FX variable. This approach allows the relationship between exchange rate risk and project outcomes to vary across different regions of the FX distribution without imposing priori thresholds. We report predicted conditional means at the 25th, 50th, and 75th percentiles of each FX variable to quantify economically meaningful differences in outcomes.

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Standard errors in (1) and (2) are clustered at the country level.

Project level hazard models

To complement the aggregate analysis, we estimate project-level discrete-time hazard models that capture the timing of project failure. We construct a panel of project–year observations from the year of financial close until failure. This allows us to exploit within-project variation in exposure to macro-financial conditions over time. The baseline hazard specification follows:

$$P(\text{failure}_{ict} = 1 \mid X_{ct}) = 1 - \exp\left(-\exp\left(\beta\, FX_{c,t-1} + \gamma' Z_{c,t-1} + \delta_d + \lambda_t + \theta_s\right)\right) \qquad (3)$$

where: $\text{failure}_{ict}$is an indicator equal to one if project i in country c fails in year t; $\delta_d$captures duration dependence through discrete duration fixed effects; all other variables have their usual meanings. We estimate Equation (3) using a complementary log-log (cloglog) link, which is appropriate for discrete-time approximations to continuous-time hazard processes (Campbell et al., 2008; Cameron & Trivedi, 2013). Standard errors are clustered at the country level.

The hazard framework provides a micro-founded complement to the aggregate PPML estimates. While the latter capture how exchange rate risk affects the number of projects

entering or failing in a given country-year, the hazard model captures how such risk affects the individual project failure likelihoods at a given point in its lifecycle.

Dynamic and robustness specifications

We assess persistence in FX risk by augmenting the hazard model with lagged FX measures:

$$\text{failure}_{ict} = f(FX_{c,t-1}, FX_{c,t-2}, Z_{c,t-1}) \qquad (4)$$

and also consider moving averages of FX risk in alternate tests. These specifications allow us to distinguish between transitory shocks and more persistent stress episodes. To evaluate the role of macro-financial conditions, we estimate specifications including real interest rates. Because exchange rate movements and domestic monetary conditions are jointly determined, we construct orthogonalized FX measures by residualizing each FX metric with respect to real interest rates. This approach isolates the component of FX risk that is not mechanically linked to domestic interest rate dynamics.

The combination of aggregate PPML estimates and project-level hazard models provides a coherent empirical framework. The PPML specification captures how exchange rate risk relate to project activity at the country–year level, incorporating both the likelihood of observing any projects and the number of projects conditional on activity. The hazard model, in turn, exploits within-project variation to capture how exchange rate risk affects the timing of project failure over the lifecycle.

4. Results

Exchange rate risk and project failure (baseline PPML)

We begin by examining results on how exchange rate risk is associated with renewable infrastructure project failure at the country–year–sector level. Table 4 reports the baseline PPML estimates. The results reveal a clear and economically meaningful pattern across alternative measures of exchange rate risk. FX Tail Risk exhibits a strong positive association with project failure, with an estimated coefficient of approximately 0.57 ($p < 0.01$). A one standard deviation increase in FX Tail Risk is associated with a roughly 75–80 percent increase

in expected project failures. FX Volatility (0,510) also enters significantly, with a coefficient of about, corresponding to an approximately 65% increase in expected failures. In contrast, FX Depreciation is small and statistically insignificant, indicating no systematic relationship with failure rates.

The contrast across FX measures is economically informative. While FX Depreciation captures the average trend of currency movements, it does not differentiate between gradual adjustments and extreme events. FX Volatility reflects the dispersion of exchange rate movements, while FX Tail Risk isolates the lower ten percent of the return distribution. The results show that it is these extreme downside realizations, rather than average currency movements, that are most closely associated with project failure.

From a financial intermediation perspective, these findings suggest balance sheet and currency mismatch mechanisms. Renewable infrastructure projects in emerging and developing economies are frequently financed in foreign currency—through syndicated loans, project finance structures, or development finance—while generating revenues in local currency. Under such structures, moderate and anticipated exchange rate movements can often be accommodated through pricing adjustments, contractual indexation, or partial hedging. However, large and abrupt depreciations can sharply increase the local-currency value of foreign liabilities, compress debt service coverage ratios, and trigger covenant breaches. These dynamics can lead to refinancing constraints, forced restructuring, or project failure.

The positive association between FX Volatility and failure reinforces this interpretation. High volatility levels increase uncertainty around future cash flows and debt servicing capacity, which can lead financial intermediaries to tighten credit conditions ex post. In practice, this may take the form of higher required spreads, shorter maturities, or reduced rollover capacity, all of which raise the probability that marginal projects fail.

The absence of a marginal effect of FX Depreciation on failure rates is significant. Exchange rate risk – failure correlations do notes not operate through gradual or predictable currency movements. Instead, the results point to a non-linear exposure in which downside shocks disproportionately affect project viability. Overall, the evidence in Table 4 establishes a central empirical result: exchange rate risk is strongly associated with renewable infrastructure project failure, but this relationship is driven by extreme and volatile currency

movements rather than average depreciation. This finding motivates the subsequent analysis, which examines whether these effects extend to project entry or instead reflect mechanisms specific to project survival.

Entry vs Failure: asymmetric effects of exchange rate risk

We now contrast the effects of exchange rate risk on project entry with failure to assess whether currency risk operates symmetrically across the investment lifecycle. This comparison explains whether exchange rate fluctuations primarily affect the extensive margin of investment initiation or the ex post viability of projects once a project reaches financial close. Table 4 reports baseline PPML estimates for project failure, while Table 5 presents the corresponding results for project entry.

A clear asymmetry emerges across specifications. In Table 5, the evidence is selective and tightly concentrated in one dimension of exchange rate risk. FX Depreciation enters with a negative and statistically significant coefficient (−0.256). A one standard deviation increase in FX Depreciation is associated with a sizeable reduction in project entry. In contrast, both FX Volatility (0.135) and FX Tail Risk (0.089) are statistically insignificant and economically small. The patten is reversed in Table 4 (project failures). FX Volatility and FX Tail Risk are the dominant predictors of failure, with large and statistically significant coefficients, while FX Depreciation is weak and not systematically related to failure outcomes. The FX dimensions that matter for failure are precisely those that do not matter systematically for entry.

This divergence points to a lifecycle asymmetry in how exchange rate risk operates. At the entry stage, depreciation affects investments through forward-looking cost-of-capital and balance-sheet channels. A depreciating currency raises the expected domestic currency burden of foreign-denominated debt, increases the cost of imported capital goods, and tightens financing conditions for projects that rely on external funding. These effects are priced at the initiation stage, leading to a reduction in project entry when depreciation risk is elevated. In this sense, depreciation captures a first-order shift in expected financing costs, which directly enters investment decisions.

In contrast, volatility and tail risks do not appear to deter entry. A plausible reason could be the presence of option value and contractual flexibility at the investment stage.

Sponsors can delay commitments, renegotiate terms, or rely on contingent financing structures, which attenuates the immediate impact of uncertainty on project initiation. As a result, higher-order risks do not bind tightly at the entry margin. Once projects move beyond financial close, however, the nature of exposure changes. The failure results in Table 4 suggest that exchange rate risk operates primarily through ex post financial constraints and realized balance sheet stress. Volatility increases uncertainty around cash flows and refinancing conditions, while tail risk captures discrete adverse currency movements. These shocks are difficult to hedge in many emerging markets and can trigger liquidity stress, covenant violations, or project failure.

The asymmetry between entry and failure, therefore, reflects a mechanism in which anticipated currency movements affect investment decisions ex ante, while realised currency risk governs project survival ex post. This interpretation aligns with a broader finance literature showing that firms' responses to macro-financial shocks depend on balance sheet exposure and financing constraints (Kalemli-Ozcan et al., 2022; Alfaro et al., 2019).

These mechanisms are particularly relevant in settings like emerging markets where hedging markets are incomplete. Bartram et al. (2011) and Géczy et al. (1997) show that the use and effectiveness of derivative-based hedging depend critically on market depth and access. As a result, project sponsors may be unable to fully insure against exchange rate exposure. At the same time, volatility alone is not a sufficient proxy for exchange rate risk. Chernov et al. (2018) show that higher moments of the return distribution, including skewness and tail risk, are economically significant in currency markets. This implies that exposure to exchange rate risk is inherently asymmetric, with large downside moves having disproportionate financial consequences.

Timing of exchange rate risk and project failure

We next examine the timing of exchange rate risk in relation to project failure using project-level discrete-time hazard models. If failure risk reflects the cumulative effect of macroeconomic deterioration, we could expect exchange rate conditions over past periods to matter. On the other hand, if failure is driven by financial constraints tied to current balance-sheet exposure or near-term funding needs, then recent realizations of exchange rate risk should dominate. To distinguish between these possibilities, we extend the hazard specification to

include other lagged measures of exchange rate risk. Table 6 introduces first and second lags of FX variables, while Appendix Table A2 considers alternative constructions, including lagged-only and smoothed measures. Our objective is to assess whether older or average exchange rate conditions contain predictive information beyond the most recent realization.

Our results show that the effect of exchange rate risk is strongly concentrated in the most recent period. In Table 6, lagged FX Tail Risk (t−1) reports a positive and statistically significant effect on failure risk (0.161). When both lags are included jointly, the coefficient on the first lag increases to 0.246, corresponding to an increase in the failure hazard of approximately 28% for a one-standard-deviation increase. In contrast, FX Depreciation and FX Volatility remain small and insignificant.

We find no evidence that longer-dated adverse exchange rate conditions add explanatory power.[3] The second lag of tail risk is close to zero when entered on its own and remains insignificant in the joint specification. Appendix Table A2 confirms this result across alternative specifications. The coefficient on FX Tail Risk (t-2) is statistically indifferent from zero. When both lags are included, the FX Tail Risk (t-1) remains large and significant (0.537), while the second lag remains indistinguishable from zero (−0.022). A smoothed measure of tail risk yields a large but highly imprecise estimate (1.081) and hence provides no statistically meaningful evidence that lower-frequency or averaged exchange rate conditions drive failure outcomes.

During periods of stress, disruptions in credit markets translate into sharp tightening of financing constraints, particularly for firms reliant on external funding (Kargar et al., 2021). Firms' ability to absorb shocks depends on access to liquidity and refinancing at the time obligations become due, rather than on average conditions over longer horizons (Li, Strahan, and Zhang, 2020). In open-economy settings, exchange rate movements further amplify these

[3] Although renewable infrastructure projects are long-duration investments, the hazard estimates indicate that failure risk is primarily associated with recent adverse exchange rate realizations rather than lagged or averaged FX conditions. This suggests that distress operates through a constraint-based mechanism: projects can absorb moderate or persistent currency movements within existing financial structures, but large depreciations—particularly tail events—can trigger binding constraints such as debt-service coverage or refinancing thresholds. Accordingly, exchange rate exposure affects failure through the realization of discrete shocks rather than through gradual accumulation, even though longer-term exposure may increase the likelihood of such events occurring over the life of the project.

effects through currency mismatches in balance sheets (Bruno and Shin, 2020). Our results support a mechanism in which the timing of adverse shocks relative to financing needs, rather than their gradual accumulation, governs distress outcomes.

Nonlinearities in exchange rate risk and project outcomes

The baseline specifications impose a linear relationship between exchange rate risk and project outcomes. This may be restrictive in EMDE contexts. Exchange rate processes in emerging economies are characterised by asymmetric dynamics, including prolonged periods of relative stability punctuated by sharp depreciations and episodic stress (Table 2). From a financing perspective, this implies that the economic impact of exchange rate risk is unlikely to be constant across its distribution. Instead, one would expect limited sensitivity in normal times and stronger responses as risk moves into adverse states. We estimate flexible spline-based specifications and report predicted entry and failure outcomes at different points of the exchange rate risk distribution. Table 7 summarizes the implied effects by comparing expected project activity at the 25th, 50th, and 75th percentiles of each FX risk metric.

Table 7 shows a non-linear amplification in failure risk, with relatively muted effects at low levels of exchange rate risk and substantially larger effects as risk increases. For FX Volatility, expected failures increase from 0.007 at the 25th percentile to 0.025 at the 75th percentile, corresponding to a 243.6% increase. A similar pattern emerges for FX Tail Risk, where predicted failures rise from 0.017 to 0.047, a 178.7% increase. FX Depreciation, which is generally weak in linear specifications, reports a 35.7% increase in expected project failure rates across the inter-quartile range of the depreciation distribution. The entry margin departs from prior expectations. The negative association between FX Depreciation and entry in the baseline does not survive the nonlinear specification. FX Depreciation is weakly positive (6%), while FX Volatility and FX Tail Risk increase along the knots. For example, expected entry rises for FX Volatility (0.034 to 0.052) and FX Tail Risk (0.015 to 0.031) between the 25th and 75th percentiles.

We can think of three scenarios where these entry results could hold. First, these results would hold in an environment where exchange rate risk is priced rather than quantity-rationed at the entry stage. Second, projects may still proceed under higher risk, but at adjusted terms—

through higher required returns or contractual protections—rather than, say being abandoned. Second, selection effects may partly result in only preferred sponsors or better-structured projects entering under higher-risk conditions. Third, the entry results could reflect policy or countercyclical investment dynamics, particularly in environments where infrastructure investment is supported despite adverse macro-financial conditions. This stands in contrast to the failure margin, where the effects of exchange rate risk effects are both larger and strongly non-linear. These patterns are consistent with a state-dependent response to exchange rate risk framework where marginal effects strengthen as conditions deteriorate.

We do not interpret our results as evidence of a discrete structural break. Rather, the relationship varies across the risk distribution, and effects become more pronounced in adverse states. From a financing perspective, this is intuitive. In low-risk environments, exchange rate movements can be absorbed through pricing, hedging, or contractual buffers. As risk rises, these mechanisms lose effectiveness. Financing conditions deteriorate, while unhedged currency exposures become more binding. Under these conditions, incremental increases in exchange rate risk can have disproportionately large effects on project viability. The spline results, therefore, complement the baseline findings by showing that the impact of exchange rate risk is not only concentrated in tail realizations but also amplified at higher levels of risk.

Robustness tests

Across a battery of alternative specifications in Table 8 (and in the Appendix), we assess the robustness of the core finding that higher exchange rate risk — particularly volatility and tail risk — is associated with increased project failure, with no corresponding robust effect on project entry.

Table 8 examines whether the baseline failure results are sensitive to sample composition or the definition of failure. First, baseline failure results may be influenced by countries with very limited event exposure. In Panel A, we restrict the sample to countries with at least five observed failure events over the sample period. The core pattern remains intact. FX Depreciation is small and insignificant, while FX Volatility and FX Tail Risk remain positive and statistically significant.

Panel B restricts the outcome to pre-operational failure which we define as realised failure events prior to project commissioning. This isolates early-stage project distress, where financing and construction risks are most salient and projects are most exposed to funding conditions rather than realised cash flows. The results remain stable. FX Depreciation misses conventional significance, while FX Volatility (0.510) and FX Tail Risk (0.569) remain positive and significant. This suggests that the baseline findings are not driven by operational failures but are already present at the pre-operational stage.

Appendix Table A1 provides additional project-level validation using discrete-time hazard models. Panel A considers any project failure, defined as the first occurrence of abandonment, construction suspension, or mothballing at any point in the project lifecycle. The pattern is consistent with the aggregate PPML evidence and align with baseline results. FX Depreciation remains insignificant, FX Volatility is positive but imprecise (0.283), while FX Tail Risk remains statistically significant (0.472).

Panel B shows that the hazard results are not sensitive to the choice of link function. Under both clog-log and logit specifications, FX Depreciation remains insignificant, while FX Volatility and FX Tail Risk are positive and statistically significant at the 1% level.

Panels C and D address the important question of whether FX risk simply proxies domestic monetary conditions. In same-sample real-rate specifications, FX Volatility remains significant with or without real interest rates (0.447 versus 0.446), while FX Tail Risk also remains significant (0.468 versus 0.530). Orthogonalizing FX risk with respect to real interest rates leads to the same conclusion. Orthogonalized FX Depreciation remains insignificant (−0.046), while orthogonalized FX Volatility (0.294) and orthogonalized FX Tail Risk (0.382) retain statistically significance. This indicates that the exchange rate risks are not subsumed by real interest rate variation.

The robustness tests support our core findings. The association between FX risk and project failure is not driven by inactive countries, alternative failure definitions, hazard link-function choices, or real interest rate confounding. Across both aggregate PPML and project-level hazard specifications, the most stable result is that volatility and especially tail risks are associated with higher project failure.

Broader economic implications and applications

Our results point to three implications for how exchange rate risk shapes infrastructure investment in emerging and developing economies.

First, exchange rate risk operates primarily through the survival margin rather than project initiation. While entry does not respond systematically to FX risk, failure rates increase markedly, particularly for volatility and tail risk. From a policy perspective, reducing FX risk is unlikely to generate large increases in project origination, but can materially improve completion rates and reduce capital loss. Second, the effects of exchange rate risk are nonlinear and intuitively driven by tail events. Tail risk emerges as the most robust predictor of failure, while variance-based measures are less informative. This indicates that exchange rate risk in EMDE contexts reflect asymmetric, downside exposure rather than symmetric fluctuations. From a policy perspective, interventions aimed at stabilising average volatility are likely to be insufficient. More effective interventions are likely those that mitigate large downside sides — through hedging facilities, contingent guarantees, or multilateral risk-sharing mechanisms — targeted at extreme states rather than average conditions. Third, exchange rate risk operates through a short-horizon financing channel. The dynamic evidence shows that the impact of FX shocks is concentrated at short lags and is already present before projects become operational. This suggests that risk becomes binding when it coincides with financing needs, such as drawdowns or refinancing events, rather than through long-run accumulation. Policies aimed solely at long-term macro stability may therefore be insufficient. What matters is the availability of continuing short-term financial resilience, including liquidity provision and refinancing support during periods of stress.

5. Conclusion

How does exchange rate risk affect renewable infrastructure investment in emerging economies? This paper addresses this question by studying two project-level margins: entry into the investment pipeline and failure after commitment. Using country–year–sector PPML models and project-level hazard models, we find that exchange rate risk does not systematically reduce project entry. Instead, it is strongly associated with project failure.

The evidence points to an asymmetric transmission mechanism. Average depreciation has limited explanatory power for failure, while volatility and tail risk are strongly associated with adverse project outcomes. Nonlinear estimates show that failure risk rises sharply in adverse regions of the FX distribution. Project-level hazard models further show that the effect is concentrated in recent realizations, with little additional explanatory power from longer lags.

These findings imply that exchange rate risk is not only priced at financial close. In currency-mismatched project finance, FX risk remains on the balance sheet after commitment. Large depreciations increase the domestic-currency value of foreign liabilities, weaken debt-service capacity, and raise failure risk. The relevant margin is therefore not only whether projects are originated, but whether committed projects remain viable through execution.

This distinction matters for climate finance. Investment-volume measures capture project origination but miss losses that occur when projects fail after commitment. Reducing FX risk may therefore have limited effects on the number of projects entering the pipeline, but large effects on completion rates and capital preservation. Policies aimed at EMDE infrastructure finance should therefore target downside currency exposure and short-horizon refinancing risk, rather than average volatility alone.

The broader implication is that currency risk is a project-survival risk in EMDE infrastructure finance. Scaling renewable infrastructure requires more than increasing capital commitments. It requires financial structures that protect committed capital from tail exchange-rate shocks and allow projects to reach operation. Without such structures, currency mismatch can turn investment pipelines into failed assets. This is the central role of FX risk in the clean-energy financing gap

6. References

Acemoglu, D., Aghion, P., Bursztyn, L., & Hemous, D. (2012). The environment and directed technical change. *American Economic Review, 102*(1), 131-166.

Alfaro, L., Asis, G., Chari, A., & Panizza, U. (2019). Corporate debt, firm size and financial fragility in emerging markets. *Journal of International Economics*, *118*, 1-19.

Allayannis, G., & Weston, J. P. (2001). The use of foreign-currency derivatives and firm market value. *Review of Financial Studies*, 14(1), 243-276.

Ameli, N., Kothari, S., & Grubb, M. (2021a). The misallocation of climate finance: Why multilateral development banks should finance more renewable energy projects in developing countries. *Energy Policy, 149*, 111965.

Ameli, N., Drummond, P., Bisaro, A., Grubb, M., & Chenet, H. (2022). The macroeconomic impact of climate-related financial policies. *Journal of Environmental Economics and Management, 112*, 102585.

Aguiar, M., & Gopinath, G. (2007). Emerging Market Business Cycles: The Cycle Is the Trend. *Journal of Political Economy, 115*(1), 69-102.

Ang, A., & Timmermann, A. (2012). Regime changes and financial markets. *Annu. Rev. Financ. Econ*., 4(1), 313-337.

Avramov, D. (2002). Stock Predictability and Model Uncertainty. *Journal of Financial Economics, 64*(3), 423-458.

Baldwin, E., Cai, Y., Kuralbayeva, K., & Marrouch, W. (2020). Renewable energy cost declines and adoption dynamics: Lessons from 20 years of solar PV learning. *Energy Economics, 92*, 104875.

Bartram, S. M., Brown, G. W., & Fehle, F. R. (2009). International evidence on financial derivatives usage. *Financial Management*, *38*(1), 185-206.

Bekaert, G., Harvey, C. R., & Lundblad, C. (2005). Does financial liberalization spur growth? *Journal of Financial Economics, 77*(1), 3-55.

Bernanke, B. S., Gertler, M., & Gilchrist, S. (1999). The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics*, *1*, 1341-1393.

Berg, T., Saunders, A., & Steffen, S. (2016). The total cost of corporate borrowing in the loan market: Don't ignore the fees. *The Journal of Finance*, *71*(3), 1357-1392.

Beveridge, S., & Nelson, C. R. (1981). A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the 'business cycle'. *Journal of Monetary Economics, 7*(2), 151–174.

Bloom, N. (2009). The impact of uncertainty shocks. Econometrica, 77(3), 623–685.

Breiman, L. (2001). Random forests. *Machine Learning, 45*(1), 5-32.

Buchner, B., Oliver, P., Wang, X., Carswell, C., Meattle, C., & Mazza, F. (2021). Global landscape of climate finance 2021. *Climate Policy Initiative Report*.

Burger, J. D., & Warnock, F. E. (2006). Local currency bond markets. *IMF Staff papers*, *53*(Suppl 1), 133-146.

Burke, M., & Emerick, K. (2016). Adaptation to climate change: Evidence from US agriculture. *American Economic Journal: Economic Policy, 8*(3), 106-140.

Burnside, C., Eichenbaum, M., & Rebelo, S. (2011). Carry trade and momentum in currency markets. *Annu. Rev. Financ. Econ*., 3(1), 511-535.

Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (No. 53). Cambridge university press.

Campbell, J. Y., Hilscher, J., & Szilagyi, J. (2008). In search of distress risk. *The Journal of finance*, *63*(6), 2899-2939.

Carranza, L. J., Galdón-Sánchez, J. E., & Gómez Biscarri, J. (2003). Exchange rate volatility and economic performance in developing countries: A reassessment. *Economics Letters, 78*(3), 307-311.

Chernov, M., Graveline, J., & Zviadadze, I. (2018). Crash risk in currency returns. *Journal of Financial and Quantitative Analysis*, *53*(1), 137-170.

Chernov, M., Dahlquist, M., & Lochstoer, L. (2023). Pricing currency risks. *Journal of Finance*, *78*(2), 693-730.

Dell, M., Jones, B. F., & Olken, B. A. (2014). What do we learn from the weather? The new climate-economy literature. *Journal of Economic Literature, 52*(3), 740-798.

Della Corte, P., Ramadorai, T., & Sarno, L. (2016). Volatility risk premia and exchange rate predictability. *Journal of Financial Economics*, 120(1), 21–40.

Dixit, A., & Pindyck, R. (1994). Investment under Uncertainty. *Princeton University Press*.

Du, W., & Schreger, J. (2022). Sovereign risk, currency risk, and corporate balance sheets. *Review of Financial Studies*, 35(10), 4587-4629.

Egli, F., Steffen, B., & Schmidt, T. S. (2022). A dynamic analysis of financing conditions for renewable energy technologies. *Nature Energy, 7*(3), 216-224.

Eyraud, L., Clements, B., & Wane, A. (2013). Green investment: Trends and determinants. *Energy Policy*, 60, 852–865. https://doi.org/10.1016/j.enpol.2013.04.039.

Forbes, K., Hjortsoe, I., & Nenova, T. (2018). International evidence on shock-dependent exchange rate pass-through. *Journal of International Money and Finance, 58*, 150-171.

Géczy, C., Minton, B. A., & Schrand, C. (1997). Why firms use currency derivatives. *Journal of Finance*, *52*(4), 1323-1354.

Hassan, T. A., Mertens, T. M., & Zhang, T. (2021). Currency hedging and capital flows. *Journal of Finance*, 76(4), 1665–1706.

Hsiang, S. M., & Jina, A. S. (2014). The causal effect of environmental catastrophe on long-run economic growth: Evidence from 6,700 cyclones. *NBER Working Paper No. 20352*. *National Bureau of Economic Research*. https://doi.org/10.3386/w20352.

Kahn, M. E., Mohaddes, K., Ng, R. N. C., Pesaran, M. H., Raissi, M., & Yang, J. C. (2021). Long-term macroeconomic effects of climate change: A cross-country analysis. *Energy Economics*, 104, 105624. https://doi.org/10.1016/j.eneco.2021.105624.

Kalemli-Özcan, Ş., Laeven, L., & Moreno, D. (2022). Debt overhang, rollover risk, and corporate investment: Evidence from the European crisis. *Journal of the European Economic Association*, *20*(6), 2353-2395.

Kargar, M., Lester, B., Lindsay, D., Liu, S., Weill, P. O., & Zúñiga, D. (2021). Corporate bond liquidity during the COVID-19 crisis. *The Review of Financial Studies*, *34*(11), 5352-5401.

Li, L., Strahan, P. E., & Zhang, S. (2020). Banks as lenders of first resort: Evidence from the COVID-19 crisis. *The Review of Corporate Finance Studies*, *9*(3), 472-500.

Lustig, H., Roussanov, N., & Verdelhan, A. (2011). Common risk factors in currency markets. *Review of Financial Studies*, 24(11), 3731–3777.

MacKinnon, J. G., & Webb, M. D. (2017). Wild bootstrap inference for wildly different cluster sizes. *Journal of Applied Econometrics*, 32(2), 233-254.

Maggiori, M., Neiman, B., & Schreger, J. (2020). International currencies and capital allocation. *Journal of Political Economy*, 128(6), 2019-2066.

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., & Zhou, B. (2021). Climate change 2021: the physical science basis. *Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change*, *2*(1), 2391.

Moro, A., & Zaghini, A. (2025). The green sin: how exchange rate volatility and financial openness affect green premia. *Review of Finance*, rfaf024.

Polzin, F., Sanders, M., & Täube, F. (2019). A diverse and resilient financial system for investments in the energy transition. *Energy Research & Social Science, 54*, 147-158.

Rajan, R., & Zingales, L. (1998). Financial development and growth. *American economic review*, *88*(3), 559-586.

Rickman J., S. Kothari, & N. Ameli (2025). The hidden cost of sustainable debt financing in emerging markets. *Working Paper. Available at: https://www.researchgate.net/publication/385005186_The_'Hidden_Cost'_of_Sustainable_Debt_Financing_in_Emerging_Markets*.

Silva, J. S., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 641-658.

Silva, J. S., & Tenreyro, S. (2011). Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economics Letters*, *112*(2), 220-222.

Steyerberg, E. W. (2016). FRANK E. HARRELL, Regression Modeling Strategies: With Applications, to Linear Models, Logistic and Ordinal Regression, and Survival Analysis, *Heidelberg: Springer*.

Songwe, V., Stern, N., & Bhattacharya, A. (2022). Finance for climate action: Scaling up investment for climate and development. *London: Grantham research institute on climate change and the environment, London school of economics and political science*.

United Nations Environment Programme (UNEP). (2022). *Adaptation Gap Report 2022*.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Wright, J., & Nystrom, S. (2020). Renewable energy finance in developing markets: Cost of capital, risk perception, and policy effectiveness. *Energy Policy, 144*, 111609.

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Data availability

The proprietary project level dataset underlying this paper cannot be shared publicly.

Figure 1. Renewable energy projects by country.

The data sample spans the period 2005 – 2025. The figure shows the number of unique projects per country in the final dataset. Projects must be from developing countries and have commissioning, decommissioning and project pre-operation failure date information. China is excluded. The resulting project data is matched against macro, project-specific and climate risk variable proxies on country and year-month.

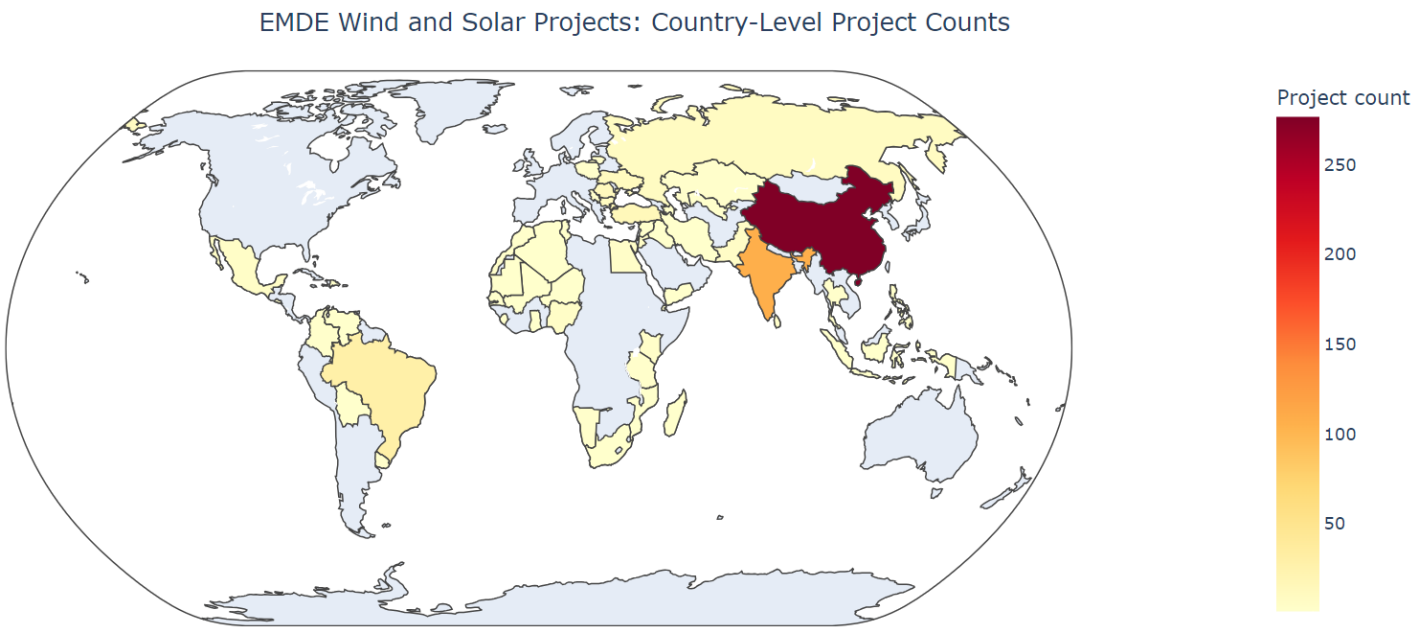


Table 1. Infrastructure Project Failures Data Construction.

Category	Measure	Value
Project dataset (raw)	Project observations	46822
	Unique projects	10970
	Countries	142
Project dataset (cleaned / entry sample)	Entry projects (deduplicated)	544
	Countries	50
	Solar projects	308
	Wind projects	236
Panel construction	Entry panel observations	2100
	Entry panel countries	50
	Status panel observations	2100
	Status panel countries	50
Event distribution (panel level)	Entry zero share	0.924
	Total entry events	544
	Positive entry country–years	159
	Failure zero share	0.860
	Total failure events	3275
	Positive failure country–years	293
Model-ready samples	Entry (Depreciation / Volatility / Tail) observations	1584
	Entry countries	46
	Failure (Depreciation / Volatility / Tail) observations	1584
	Failure countries	46

Notes: Table 1 summarises the construction of the EMDE country–year–sector panel and underlying project-level dataset for wind and solar investments. Project-level data are used to construct entry and failure outcomes, which are deduplicated prior to aggregation. Macroeconomic and exchange rate variables are merged at the country–year level. "Zero share" denotes the fraction of panel observations with zero events, and "positive country–years" the number of observations with at least one event. Model-ready samples vary across specifications due to lag structure and data availability.

Table 2. Summary Statistics.

Variable	N	Mean	SD	P25	Median	P75
Panel A: FX risk variables						
FX Depreciation	1618	0.049	0.108	−0.011	0.014	0.083
FX Volatility	1618	0.022	0.021	0.007	0.019	0.032
FX Tail Risk	1618	0.016	0.018	0.001	0.012	0.026
Panel B: Macro controls						
Inflation (t−1)	1990	2.313	1.089	1.809	2.409	2.948
Government Debt / GDP (t−1)	1938	47.238	26.593	30.046	43.394	60.27
Current Account / GDP (t−1)	1972	−2.879	7.992	−6.336	−2.623	0.68
Political Risk (t−1)	2000	−0.634	0.819	−1.120	−0.562	−0.140
Real Int. Rate (t−1)	1378	1.527	1.992	0.788	2.162	2.764

Notes: Summary statistics are reported at the country–year–sector level for outcome variables and at the country–year level for covariates. All explanatory variables are lagged by one year (t−1). FX depreciation is measured as the 12-month percentage change in the exchange rate. FX volatility is computed as the rolling 12-month standard deviation of monthly exchange rate returns. Tail risk is defined as the (negative) 10th percentile of monthly exchange rate returns over a 12-month rolling window, averaged to the annual level. Macroeconomic controls include inflation, government debt as a share of GDP, the current account balance, and real interest rates, all expressed in percentages. FX variables are winsorized at the 1% level, macro controls at the 1% level and Real Int. Rates at 2% level.

Table 3: Within-Country Variation and Cross-Correlations (FX Risk)

Panel A: Within country variation in FX risk metrics

Variable	Countries with variation	Mean within-country SD	SD of within-country SD	Min	P25	Median	P75	Max
FX Depreciation	46	0.089	0.046	0.000	0.060	0.086	0.120	0.215
FX Volatility	46	0.014	0.010	0.000	0.008	0.012	0.021	0.038
FX Tail Risk	46	0.010	0.007	0.000	0.006	0.010	0.013	0.035

Panel B: Cross-correlations between FX risk metrics

Variable	FX Depreciation	FX Volatility	FX Tail Risk
FX Depreciation	1	0.583	-0.140
FX Volatility		1	0.592
FX Tail Risk			1

Panel A reports within-country variation computed as the standard deviation of each variable within country over time. Summary statistics describe the distribution of these within-country standard deviations across countries. Panel B reports pairwise correlations among FX variables based on available observations. Only the upper triangular matrix is shown.

Table 4. FX Risk and Infrastructure Project Failure (baseline PPML).

Variable	(1) FX Depreciation	(2) FX Volatility	(3) FX Tail Risk
FX Risk	0.073	0.508**	0.560***
	(0.142)	(0.215)	(0.200)
Inflation (t−1)	-0.734***	-0.582**	-0.761***
	(0.182)	(0.258)	(0.180)
Debt / GDP (t−1)	0.789**	0.998**	0.842**
	(0.390)	(0.438)	(0.410)
Current Account / GDP (t−1)	-0.600*	-0.420	-0.660**
	(0.325)	(0.320)	(0.295)
Political Stability (t−1)	1.111*	1.103	1.225*
	(0.675)	(0.727)	(0.686)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	1584	1584	1584

Notes: The dependent variable is the country–year failure count. Estimation uses PPML with the log of lagged active project stock as exposure. All FX and macro regressors are standardized; coefficients therefore reflect a one-standard-deviation increase in the regressor. Standard errors clustered at the country level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 5. Entry (PPML Estimates).

	(1) FX Depreciation	(2) FX Volatility	(3) FX Tail Risk
FX Depreciation (t−1)	−0.256**		
	(0.120)		
FX Volatility (t−1)		0.135	
		(0.171)	
FX Tail Risk (t−1)			0.089
			(0.108)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
N	1584	1584	1584

Notes: Table 5 reports Poisson pseudo-maximum likelihood (PPML) estimates of project entry at the country–year level. All specifications include country and year fixed effects. Standard errors are clustered at the country level. FX variables and macro controls are standardised (z-scores), so coefficients represent the effect of a one standard deviation increase. Standard errors are clustered at the country level. The 60-month volatility specification uses a reduced sample due to longer rolling windows. *, **, *** denote significance at the 10%, 5%, and 1% levels.

Table 6. Project Failure Timing and Dynamic FX Risk.

Variable	(1) Depreciation	(2) Volatility	(3) Tail risk	(4) Tail risk lag 2	(5) Tail risk joint lags
Depreciation, lag 1	-0.040				
	(0.180)				
FX volatility, lag 1		0.097			
		(0.074)			
FX tail risk, lag 1			0.161***		0.246**
			(0.056)		(0.113)
FX tail risk, lag 2				-0.017	-0.178
				(0.113)	(0.175)
Observations	2,564	2,564	2,564	2,559	2,559
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table reports discrete-time pre-operational failure hazard models estimated using a complementary log-log link. The dependent variable equals one in the project-year of pre-operational failure and zero otherwise while the project remains at risk. All FX and macro regressors are standardized. Controls include lagged inflation, government debt-to-GDP, current account-to-GDP, and political stability. All specifications include country, year, and sector fixed effects. Standard errors clustered at the country level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 7. Nonlinear Effects of Exchange Rate Risk on Entry and Failure (Spline PPML)

Outcome	FX Metric	Low (25th pct)	Median (50th pct)	High (75th pct)	% Δ Low → High
Entry	FX Depreciation	0.042	0.049	0.044	6.200
	FX Volatility	0.034	0.049	0.052	53.000
	FX Tail risk	0.015	0.025	0.031	111.100
Failure	FX Depreciation	0.013	0.016	0.017	35.700
	FX Volatility	0.007	0.016	0.025	243.600
	FX Tail risk	0.017	0.030	0.047	178.700

Notes: This table reports predicted conditional means from Poisson pseudo-maximum likelihood (PPML) models in which exchange rate variables are modeled using quadratic splines applied to standardized regressors. Reported values correspond to predictions evaluated at the 25th, 50th, and 75th percentiles of each FX variable, holding all other covariates at reference values (modal fixed effects and zero for standardized controls). The dependent variables are project entry and failure counts at the country–year–sector level; failure models include an exposure offset equal to log(1 + lagged active project stock). All specifications include country, year, and sector fixed effects, with standard errors clustered at the country level. The final column reports the percentage change in the predicted outcome between the 25th and 75th percentiles of the FX variable..

Table 7. Robustness: FX Risk and Project Failure.

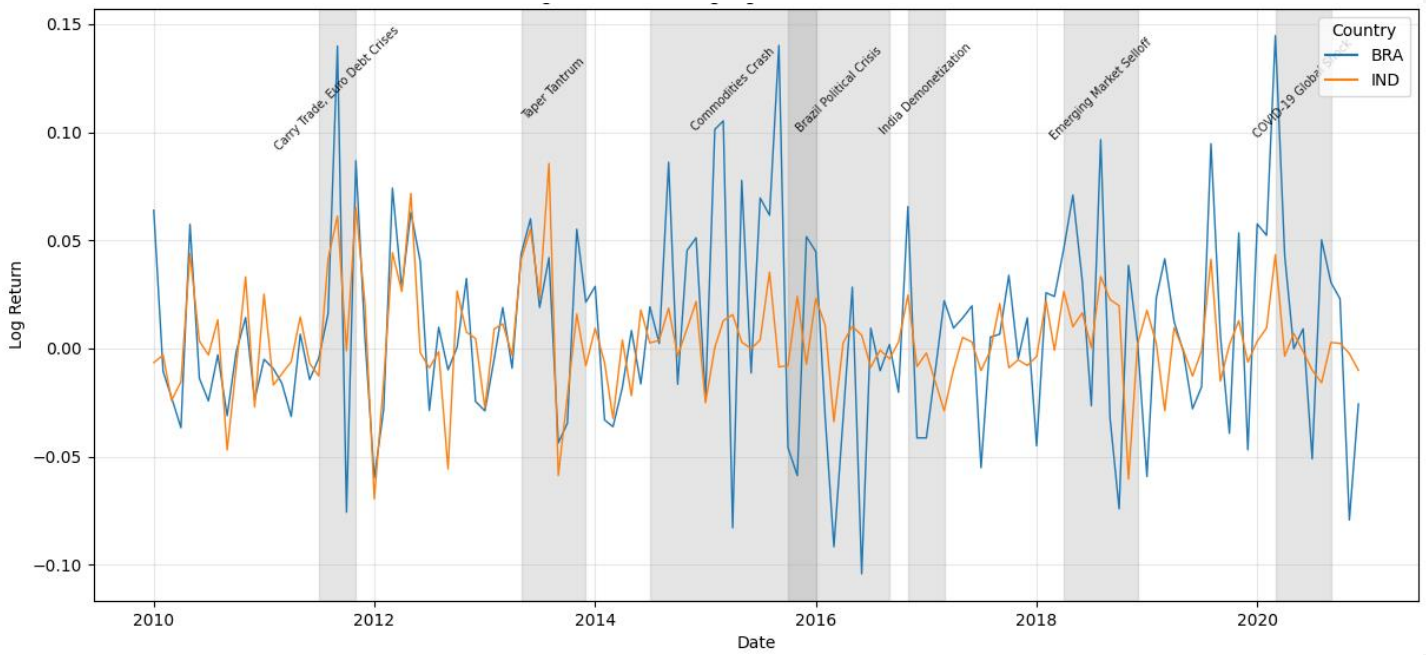
Variable	(1) FX Depreciation	(2) FX Volatility	(3) FX Tail Risk
Panel A : Active-country restriction			
FX Risk	0.058	0.524**	0.590***
	(0.144)	(0.227)	(0.206)
Inflation (t−1)	-0.583**	-0.745***	-0.788***
	(0.266)	(0.191)	(0.188)
Debt / GDP (t−1)	1.057**	0.822**	0.849**
	(0.448)	(0.399)	(0.419)
Current Account / GDP (t−1)	-0.440	-0.670*	-0.757**
	(0.367)	(0.375)	(0.336)
Political Stability (t−1)	1.119	1.117	1.232*
	(0.758)	(0.699)	(0.709)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1060	1060	1060

Variable	(1) FX Depreciation	(2) FX Volatility	(3) FX Tail Risk
Panel B : Pre-operational failure			
FX Risk	0.069	0.510**	0.569***
	(0.141)	(0.219)	(0.203)
Inflation (t−1)	-0.574**	-0.727***	-0.759***
	(0.256)	(0.181)	(0.182)
Debt / GDP (t−1)	0.997**	0.783**	0.834**
	(0.435)	(0.381)	(0.401)
Current Account / GDP (t−1)	-0.422	-0.606*	-0.672**
	(0.322)	(0.327)	(0.295)
Political Stability (t−1)	1.137	1.143*	1.256*
	(0.734)	(0.681)	{0.693)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1584	1584	1584

Notes: Table 7 reports Poisson pseudo-maximum likelihood (PPML) estimates of the relationship between exchange rate (FX) risk and project failure at the country–year–sector level. Panel A restricts the sample to country–years with at least one active project ("active-country restriction"). Panel B focuses on pre-operational project failures. FX risk measures include depreciation, volatility, and tail risk, each entered separately. All explanatory variables are lagged by one year. Regressions include country and year fixed effects. Standard errors (in parentheses) are clustered at the country level.

Appendix

Figure A1. Currency Returns (vs USD) from 2010 – 2020 for Brazil and India.



Notes: Figure A1 shows monthly log returns for the Indian Rupee – USD and Brazilian Real – USD from 2010 – 2020.

Table A2. Project-level Hazard Model Robustness.

Notes: This table reports project-level discrete-time hazard models. Panels A, C, and D use the complementary log-log link. Panel B compares complementary log-log and logit specifications. Duration FE are fixed effects for capped project-spell duration. All specifications include country, time and sector fixed effects. Controls are lagged inflation, government debt/GDP, current account/GDP, and political stability. Standard errors clustered by country are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

Panel A. Any-failure hazard

Variable	(1) Depreciation	(2) Volatility	(3) Tail risk
Panel A : Any-failure hazard			
Depreciation	-0.062		
	(0.212)		
Volatility		0.283	
		(0.183)	
Tail risk			0.472***
			(0.150)
Observations	3,379	3,379	3,379
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Duration FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Panel B. Link-function robustness

Variable	(1) FX Depreciation (cloglog)	(2) FX Depreciation (logit)	(3) FX Volatility (cloglog)	(4) FX Volatility (logit)	(5) FX Tail Risk (cloglog)	(6) FX Tail Risk (logit)
Depreciation	-0.038	-0.046				
	(0.262)	(0.302)				
Volatility			0.422***	0.424**		
			(0.158)	(0.187)		
Tail risk					0.537***	0.584***
					(0.177)	(0.211)
Observations	2564	2564	2564	2564	2564	2564
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Duration FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel C. Same-sample real-rate robustness

Variable	(1) FX Depreciation	(2) FX Depreciation + Real Int. Rates	(3) FX Volatility	(4) FX Volatility + Real Int. Rates	(5) FX Tail Risk	(6) FX Tail Risk + Real Int. Rates
Panel C. Same-sample real-rate robustness						
FX Depreciation	-0.022	-0.064				
	(0.258)	(0.268)				
FX Volatility			0.447**	0.446**		
			(0.202)	(0.208)		
FX Tail Risk					0.468**	0.530**
					(0.226)	(0.242)
Real Int. Rates		-0.268		-0.245		-0.411*
		(0.191)		(0.226)		(0.217)
Observations	2405	2405	2405	2405	2405	2405
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Duration FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel D. Orthogonalized FX-risk robustness

Variable	(1)	(2)	(3)
FX Depreciation (orthog.)	-0.046		
	(0.196)		
FX Volatility (orthog.)		0.294**	
		(0.138)	
FX Tail Risk (orthog.)			0.382**
			(0.175)
Real Int. Rates	-0.281	-0.085	-0.187
	(0.204)	(0.207)	(0.234)
Observations	2405	2405	2405
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Duration FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes