International Capital Inflows and Foreign Exchange Derivative Liquidity under Political Uncertainty in Emerging Markets and Developing Economies.

Abstract

This paper tests the degree to which currency derivatives can increase foreign investment in Emerging Markets and Developing Economies (EMDEs) under varying levels of political uncertainty. Given the relationship between foreign exchange rate fluctuations and political uncertainty, the paper argues that Multilateral Corporations (MNCs) increase their overseas investments even in the face of political uncertainty as a result of a growing foreign exchange derivative turnover.

Using a fixed effects regression model on a compiled panel dataset of currency derivatives and macroeconomic data of 54 countries over the period 1990-2022, I find evidence that while rising political uncertainty induces a fall of foreign direct investments in EMDEs, the use of currency derivatives to hedge against foreign exchange rate fluctuations exerts a positive effect on multinational investment decisions. The robustness checks of the paper's findings were performed using placebo tests for the Difference in Difference Design, propensity score matching and LASSO regression techniques. The robustness tests results support the results from the baseline regression results.

Keywords: Foreign direct investment; Portfolio investments; Currency derivatives; Political uncertainty.

JEL codes: G010; G150; G110. F21; F31.

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1- Introduction

The exchange rate fluctuations in emerging markets expose foreign firms to worsening financial conditions, lower stock prices and thus result in a decrease in investments (Alfaro et al., 2017; Niepmann and Tim, 2019)[1]. Firms that borrow in US dollars but accumulate cash in domestic currency are vulnerable to a depreciation of the domestic currency against the dollar (Bruno and Shin, 2020). A significant depreciation in the exchange rate increases the nominal value of USD-denominated debt owed by foreign firms and gives rise to a currency crisis[2]. For example, following the devaluation of the Thai baht in mid-1997 as a result of an overvalued exchange rate, significant depreciations of the exchange rate in Thailand (-23.2%) and in Korea (-22.2%) caused financial panics and bank runs. The Thailand and Korea crises caused a shock to investor sentiment in Indonesia, Malaysia and the Philippines (Berg, 1999). In 1998, most of the economies of the region entered a severe economic crisis with real GDP declining by 13.7% in Indonesia, 9.4% in Thailand, 6.7% in Malaysia and 5.8% in Korea (Berg, 1999). This Asian financial crisis and the enormous losses of financial assets incurred by foreign firms changed the way multinational corporations do business in overseas markets.

Salomao and Varela (2022) find that only firms with a high marginal product of capital use foreign loans more intensively when faced with exchange rate exposure. This suggests that foreign investors using foreign loans in a fluctuating exchange rate environment could face major financial problems. For example, after the 2008-2009 Global Financial Crisis, Turkey experienced a rapid influx of foreign capital. Most of the debt was dollar-denominated, which meant that Turkey was exceptionally susceptible to the US monetary policy. When the US Federal Reserve raised interest rates in the first half of 2018, the total debt payments of Turkish firms and banks soared. The loss in faith in Turkish economy by global investors contributed to a drastic drop in the demand for the Turkish lira in the foreign exchange markets. In 2018, the Turkish lira (TRY) fell by almost 45% against the US dollar (USD), according to the World Bank data (2019).

Similarly, Venezuela experienced one of the worst economic crises, which started in 2013 as a result of a sharp decline in foreign investments. According to the Berkeley Economic Review, foreign direct investments from the United States dropped from $600 billion in 2011 to below zero in 2019, prompting the Maduro's government to print more bolivars to address the fall in oil income, which led to hyperinflation and a huge exchange rate depreciation. Inflation rate reached more than 2,600 percent in 2017, the highest in the world by a wide margin, and 13,000 percent for 2018 by FMI estimates. And according to the Federal Reserve Economic Data, the exchange rate saw a rapid increase from about 10 bolivars to the dollar in January to about a quarter of a

[1] Alfaro et al. (2017) document large increases in foreign currency borrowing in emerging markets after the Great Recession and a rise in their financial fragility. Niepmann and Tim (2019) show that depreciations increase the probability that a firm becomes past due on its loans.

[2] The vulnerability to currency depreciation comes not from foreign currency debt as such, but from the combination of foreign currency debt and the holding of cash and liquid assets in domestic currency (Bruno and Shin, 2020).

million bolivars by August of 2018. Venezuela's massive exchange rate depreciation was triggered by the destruction of the free market mechanism through massive expropriations across the whole economy and the subjection of the private economy to controls on prices, imports, exchange rates, wages, interest rates (Hausmann, 2019). To the degree that investors believe there is a risk of these political shocks happening again, they will shy away from future investments.

Non-financial firms can reduce exposure to foreign exchange risks and interest rate risks by using financial derivatives (Saunders et al, 2024; Aretz and Bartram; 2010). Previous empirical analyses of hedging as a risk-reduction instrument suggest that foreign firms use hedging to lower interest rate spreads as well as capital expenditure restrictions (Campello et al., 2011), reduce cash flow volatility and, consequently, raise the probability of meeting their interest and principal payment obligations (Saunders et al, 2024). Hedging also diminishes the probability of a firm failure and lowers the costs associated with financial distress and bankruptcy (Froot, Scharfstein, and Stein, 1993; Smith and Stulz, 1985). Thus, the use of financial derivatives to limit foreign exchange risks can induce more foreign investments (Saunders et al, 2024; Aretz and Bartram, 2010; Campello et al., 2011); Alfaro et al., 2019).

Risk management through financial hedging has increased in recent years in connection with heightened foreign exchange rate volatility due to changing expectations about the path of interest rates in major advanced and emerging economies. According to the Bank of International Settlement (BIS), at the end of December 2022, the notional value of outstanding currency derivatives was $217.2 trillion. By comparison, at the end of 2000, total currency derivative contracts stood at $39.8 trillion (see figure 1). Despite higher foreign exchange risks in emerging markets relative to developed markets, studies showed that relative to currency derivative trading in developed markets, currency derivative liquidity level in emerging markets is much lower (Thapa et al., 2018; Henderson, 2002).

Despite the importance of geopolitical factors in shaping macroeconomic outcomes and foreign firms' investment decisions in EMDEs, political uncertainty has not been the subject of systematic empirical analysis in the financial derivative literature. Caldara and Iacoviello (2022) define geopolitical risk as the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political factors that affect the peaceful course of international relations. Hamada et al (2004) identify three main categories of political uncertainty: (1) expropriation of assets or breach of contract, (2) transfer risk, and (3) war and political violence. As observed by Da, 2023; Caldara and Iacoviello, 2022; Yasuda and Kotabe, 2020; Delios and Henisz, 2003; Schneider and Frey, 1985; Nonnenberg and Mendonca, 2004; and Busse and Hefeker, 2005, there is a negative association between foreign direct investment (FDI) and political uncertainty in EMDEs.

This study investigates how currency derivatives impact foreign investments in EMDEs under varying levels of political uncertainty using a sample of 54 countries from 1998 to 2022. The paper hypothesizes that increased currency derivative liquidity boosts foreign investments. The paper further hypothesizes that the expected negative effects of political uncertainty on international

capital inflows in EMDEs are offset by the use of currency derivatives. This suggestion makes sense as a growing currency derivative liquidity lowers the prospects of bankruptcy and asset loss linked to rising political uncertainty and boosts investment confidence.

This paper contributes empirically to the literature on international capital inflows and the use of currency derivatives in three ways. First, the paper explores how growing currency derivative liquidity affects foreign investments given the rising political uncertainty in EMDEs. Second, the paper tests the robustness of the findings using a propensity score matching estimation and placebo tests in a difference-in-difference design. These identification strategies using a treated group and a control group, allow for a better measure of the robustness of the paper's findings. Third, the paper uses additional identification methods based on a double machine learning estimation technique (the LASSO estimation) to estimate the average treatment effects on the treated.

To the best of my knowledge, no literature thus far has used such innovative ways to explore the role of currency derivatives and political uncertainty on international capital inflows. The remainder of the paper is structured as follows: Section 2 presents a related literature. Section 3 describes the methodology and data used in the paper. Section 4 presents the empirical results. Section 5 conducts robustness tests to support the empirical findings in the baseline regression. The last section concludes.

2. Related Literature

This paper is related to a growing literature on the use of operational and financial hedging and MNCs' overseas investments, mostly triggered by the scope and the depth of the financial crises of the Southeast Asian countries in the late 1990s. By incorporating market imperfections[3], the hedging literature outlined two theories explaining why non-financial firms engage in corporate hedging. The first is the shareholder value maximization hypothesis that posits that firms hedge to increase firm value by lowering costs associated with cash flow volatility. These costs include expensive external financing, financial distress, and underinvestment in growth opportunities (Froot et al., 1993; Smith and Stulz, 1985; Caballero, 2021). The second theory relates to the managerial utility maximization hypothesis that sees hedging to be driven by managers' personal interests to reduce their risk exposure or to signal managerial abilities to the labor market (Smith and Stulz, 1985).

These theories propose a positive relationship between hedging and firms' ability to raise funds: hedging reduces the expected costs associated with financial distress and bankruptcy (Smith and Stulz, 1985; Stulz, 1990). Financial derivatives are used to mitigate the consequences of

[3] In their theory of capital structure, Modigliani and Miller (1958) argue that the composition of capital structure of the company has no influence on the value of the company under efficiently functioning markets. They later corrected the theorem in 1963 to account for real world conditions. Markets are not functioning efficiently. Companies pay taxes, face transaction, bankruptcy and agency costs and information is asymmetrical.

deterioration of financial conditions (Alfaro et al., 2019; Niepmann and Tim, 2022) and stock price decline (Bruno and Shin, 2020). Currency derivatives are used to hedge against unexpected changes in exchange rates by both foreign and local investors. Zhou and Wang (2013) indicate that multinational companies use currency derivatives to enhance their investment returns by reducing the potential harmful effects of foreign exchange exposure. Local entities use the same instruments to manage foreign exchange risks associated with external borrowing4.

The literature also emphasized that the use of currency derivatives is more prevalent in firms with exchange rate exposure (Mexico, Stein et al., 2021; Colombia, Alfonso-Corredor., 2018; Korea, Bae et al.,2018; Chile, Miguel., 2016; Brazil, Rossi-Júnior., 2012 among others). Duffie et al. (2010) suggest that if used responsibly, currency derivatives provide an important risk management and liquidity benefits to the financial system as well as non-financial corporations and other market participants. For example, a company A is considering to investing $50 million dollars in a Venezuelan company, but fears that the upcoming election could result in a significant depreciation in the Venezuelan currency, thus reducing the value of its investment. However, the company can purchase forward contracts in which it locks in the exchange rate (dollar/bolivar) for a future transaction.

The empirical literature finds a positive association between hedging and investments. Allayannis, Ihrig and Weston (2001) and Carter, Rogers, and Simkins (2008), for example, find that hedging is associated with a 5% to 10% increase in firm value. In the same vein, Guay (1999) finds that firms that are derivative users experience significant reductions in their stock return volatility, and lower interest and exchange rate risks, compared to firms that do not use derivatives. Alfaro, Varela and Calani (2021) show that currency derivatives are primarily used by firms to hedge larger amounts. Other studies, however, report mixed results (see Jin and Jorion, 2006). If a firm is a non-hedger, this might either be driven by its explicit decision against hedging or the absence of risk exposure (Geyer-Klingeber et al, 2019).

Relatedly, researchers have found evidence that firms using financial derivatives are subject to better funding conditions. For example, Campello et al. (2011) shows that U.S. firms using currency and interest rate derivatives get more favorable bank loan terms. Thapa et al. (2018) show that foreign portfolio investors allocate more wealth in countries that provide liquid and cost-effective opportunities for using currency derivatives.

The main contribution of this paper is to explore how growing currency derivative liquidity affects the investments of MNCs under varying levels of political uncertainty in EMDEs. The global political environment affects the profitability of foreign firms in the foreign exchange market (Filippou et al, 2018). What has not been studied is the degree to which currency derivatives can

[4] Other types of financial derivatives include is credit derivatives and interest rate derivatives, used to increase capital flows to emerging markets. Credit derivatives allow creditors/lenders to minimize their exposure to default/bankruptcy risks by transferring some of the risks to a third party with a payment of a premium. Interest rate swaps allow the borrower with a floating interest rate loan/bond to hedge the interest rate risk by swapping floating rate payments with fixed rate payments.

offset political uncertainty, thus increasing investment or reducing the negative impact of political uncertainty on investment.

3. Methodology and Data

3.1 Methodology

Following the empirical method used by Campello et al. (2011) to examine the effects of hedging on the cost of debt financing, the paper estimates the effects of currency derivatives on international capital inflows under varying levels of political uncertainty in EMDEs. Given significant differences among the countries that make the sample of 30 countries, the paper uses a linear fixed effects model to estimate the following baseline model:

$$FDI_{it} = \alpha + \beta_1 CUDER_{it} + \beta_2 VEER_{it} + \beta_3 Pol_uncertainty_{it} + \beta_4 CUDER_{it} \times Pol_uncertainty_{it} + \beta_5 CUDER_{it} \times VEER_{it} + \beta_6 CONTROLS_{it} + \omega_t + \theta_i + \varepsilon_{it} \quad (1)$$

Where FDI_{it} denotes the log of foreign direct investment inflows in million USD in a country i at a year t. $CUDER_{it}$ denotes the log value of the daily average turnover of over-the-counter (OTC) currency derivatives of country i most commonly used as a hedging variable. It represents the notional amount[5] of the daily average of total currency derivative contracts in a given currency.

$VEER_{it}$stands for the variability of the real effective exchange rate. The variability of the real effective exchange rate (VEER) is defined as the standard deviation of the monthly percentage change in the real effective exchange rate. The calculations were carried out using monthly real effective exchange rate data from January 1990 through December 2022 from the Brussels European and Global Economic Laboratory (BRUEGEL).

An alternative measure of the real effective exchange rate variability is the variability of the nominal exchange rate to the US dollar. Such a measure is especially useful for assessing changes in the international competitiveness of domestic traders. The calculations were carried out using Bank of International Settlements (BIS) monthly bilateral exchange rate data from January 1990 through December 2022. For countries that choose an exchange arrangement by pegging their currency to the US dollar such as Panama, Bahrain, Jordan, Qatar, etc., they minimize the variability of both VEER and VBER indices. The nominal exchange rate with the U.S. dollar is assumed to be constant, and thus its variability is zero.

$Pol_uncertainty_{it}$ denotes the political uncertainty variable that measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism and is taken from the World Governance Indicators of the World Bank. The country's political

[5] Notional value is a term often used by derivatives traders to refer to the total value of the underlying asset in a contract

uncertainty is in units of standard normal distribution ranging from -2.5 (low political uncertainty) to +2.5 (high risk). The political uncertainty index assesses the level of risk attached to a specific country by examining 17 risk components. These risks include expropriation of assets, transfer risks or currency inconvertibility, international tensions/terrorism threat, social unrest, government stability, corruption, ethnic tensions and climate change related disasters among others.

$CONTROLS_{it}$ is a set of control variables that include macroeconomic variables (e.g. GDP, financial development, capital accumulation, natural resources, market capitalization and the monetary policy interest rate) and geopolitical risk variables (global uncertainty index, and currency crisis).

θ_i are the country fixed effects to capture any time-invariant differences between countries that might affect the mean level of the dependent variable and that need to be controlled to address omitted variable biases; ω_t are time fixed effects to account for any changes through time that might affect FDI.

3.2. Data

The sample spans from 1990 to 2022 and draws from 5 different sources: The World Development Indicators of the World Bank; the Bank of International Settlements (BIS); the International Monetary Fund (IMF); the Brussels European and Global Economic Laboratory (BRUEGEL); the Federal Reserve Economic Data (FRED). The BIS database provides information on the global OTC turnover of currency derivatives, interest rate derivatives and credit derivatives. The currency derivatives refer to the notional amount of foreign exchange derivative instruments trading (currency swaps, outright forwards, spots) for the purposes of hedging and speculation. Currency derivatives provide a measure of currency derivative market liquidity for a given currency. It is the sum of all outstanding currency derivative contracts independent of the exact position (long or short) and is the most commonly used as hedging variable. The currency derivative data are available from 1998 to 2022 for the EMDEs.

Figure 1 shows the size and the structure of global derivative markets over the period 1998-2022; Figure 2 shows the global currency derivative market in millions of USD (daily averages) from 1992-2022. It also shows that firms engage in derivative contracts mostly for risk reduction given that options account only for 7% of the currency derivative contracts.

The variations of the nominal exchange rates computed based on BIS bilateral exchange rates, are available from 1990 to 2022. However, the variations of the real effective exchange rate are computed using the Brussels European and Global Economic Laboratory (BRUEGEL) data from 1990 to 2022.

The World Bank World Development Indicators (WDI) provide data on political uncertainty, GDP, financial development, capital accumulation, natural resources and market capitalization. The foreign direct investment data, however, comes from the United Nations Conference on Trade

and Development. The Coordinated Direct Investment Survey Database of the International Monetary Fund (IMF) provides data on investment positions and equity positions from 2009 to 2022. The monetary policy interest rate information was also provided by the IMF. Data also include a global uncertainty index (GUI) that captures fluctuations in the global market. This index is based on economic and political developments and follows a standardized process and structure. GUI is assumed to negatively impact the flow of international capital and is taken from the FRED.

Table 1 incorporates the summary statistics of the variables and Table 2 shows the pairwise correlations between variables.

3.3. Robustness check: Placebo tests for the DID design, propensity score matching and LASSO estimations

To check the validity of the findings of the baseline regression (Tables 3-7), three robustness exercises have been undertaken to estimate the average treatment effect on the treated: propensity score matching estimation, machine learning Least Absolute Shrinkage and Selection Operator (LASSO) estimation and placebo testing. Placebo tests are tools for assessing the credibility of a research finding (Eggers et al., 2017).

Following Abadie and Gardeazabal (2003), I am using a synthetic control approach to check the validity of my findings relative to the effects of currency derivatives on the inflows of FDI under political uncertainty in EMDEs. The DID design consists of two groups: the treatment group, i.e the derivative users that make a sample of 30 countries and the synthetic control group, i.e the non-derivative users that make a 24-country sample (see Table 15). Derivative users are all emerging market and developing economies with available data on currency derivatives over the period 1998-2022. The non-derivative users are also EMDEs that do not have data on currency derivatives but qualify as synthetic control group units given the availability of data in some key variables of interest such as political uncertainty, variation of real effective exchange rate and FDI.

The DID design also specifies two periods: the pretreatment period spans from 1990 to 1997 and indicates the time preceding the use of currency derivatives in EMDEs and the treatment period going from 1998 to 2022 when currency derivatives data were made available by the BIS Central Bank Triennial Survey.

To carry out these placebo tests, I apply propensity score matching (PSM) to ensure that the covariate characteristics do not confound the results. PSM also controls the selection bias associated with countries that have a developed derivatives market and those that don't.

The DIDPLACEBO estimation of the treatment effects on foreign investments, uses the following model specification:

$$\text{Ln}\,(Y_{it}) = \beta X_{it} + \delta D_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad \text{(i=1,……,N; t=1,……,}T_0, T_{0+1}\text{…..,T)} \qquad (2)$$

Where i and t denote country and time. T_0 is the pretreatment period and T_{0+1},……,T indicates the posttreatment period. Y_{it} denotes FDI, the outcome variable, X_{it} is the vector of control variables. The controls include VEER, political uncertainty, global uncertainty index, GDP, capital accumulation, financial development, and market capitalization. μ_i represents the country fixed effects, while λ_t denotes time fixed effects. ε_{it} is for the idiosyncratic error term.

D_{it} is the treatment variable. It differentiates treated units from untreated ones.

$$D_{it}=\begin{cases}1 \; if \; i \; \in treatment \; group, i.e \; derivative \; users \\ 0 \; otherwise\end{cases} \quad (3)$$

For the standard DID design, the treatment variable D_{it} is customarily written in the form of an interaction term, i.e., $D_{it} = treat_{it} \times post_t$, where $treat_{it}$ is an indicator for the treatment group, while $post_t$ is an indicator for the treatment period.

In a placebo test, the researcher seeks to use the observed estimate of $\hat{\delta}$ to test the null hypothesis of No Average Treatment Effect, or NATE: δ = 0. NATE simply states that the treatment has no average effect on the outcome in the placebo analysis.

3.3.1 Propensity score matching estimation method

Given the risk of reverse causation between FDI and currency derivatives, the regression results from equation (1) may suffer from some selection bias. To solve the reverse causation, the paper employs a propensity scores matching technique to assess the impact of the decision to hedge (versus not to hedge) on FDI. Propensity scores matching models allow to balance a large number of covariates between two groups (the treated population and the untreated) by balancing the propensity scores. Propensity score balancing is crucial because in observational studies, treatment selection is often influenced by subject characteristics. As a result, baseline characteristics of treated subjects often differ systematically from those of untreated subjects (Austin, 2011). Rosenbaum and Rubin (1983) define the propensity score as the probability of a subject receiving a treatment contingent on that subject's observed baseline characteristics.

Following Allayannis et al, 2001, I define a currency derivative dummy set equal to 1 when currency derivatives data exist and 0 otherwise. Since the BIS Triennial Survey provides currency derivatives data every three years since 1992 through 2022, I assume that data is available between years of surveys if data is reported during the years of surveys. In this case, the years between surveys take 1. Conversely, if derivative data is not reported triennially over the period 1992-2022, all years take 0. In the pretreatment period (1990-1997), all 54 EMDEs in the full sample take 0 for currency derivatives. This assumption of No currency derivatives data in EMDEs during the period 1990-1997 is built on the virtual absence of currency derivatives trading in EMDEs during the period. According to the BIS data, global currency derivatives were extremely low in the 1990s and amounted to $0.88 trillion in 1992 and $1.15 trillion in 1995 in daily average (see figure 2). The Emeging Market and developing economies' currencies combined accounted for only 5% of the global currency derivative trading in 1995.

To estimate the average treatment effect on the treated, I use a propensity score matching method to estimate the following probit equation:

$$\text{Ln}\,(FDI_{it}) = \propto + \theta Derivatives_{it} + \gamma X_{it} + \omega_t + \mu_i + \vartheta_{it} \qquad (4)$$

Where i and t denote country and time. FDI_{it} is the outcome variable. $Derivatives_{it}$ is a binary variable that takes 1 when currency derivative data exists and 0 otherwise. X_{it} is the vector of covariates that include variation of real effective exchange rate, political uncertainty, GDP, financial development, capital accumulation, natural resources, market capitalization and monetary policy interest rate. μ_i represents the country fixed effects, while λ_t denotes time fixed effects. ε_{it} is for the idiosyncratic error term.

4. Results

4.1 Baseline results

Multinational corporations (MNCs) exposed to foreign exchange rate fluctuations adjust differently depending on their level of exposure to foreign markets and the opportunities the markets offer. MNCs investing in countries with more developed financial systems may adjust differently.

Eq (1) estimates the effect of currency derivatives (in log of dollar amounts) and foreign exchange rate variations under heterogeneous levels of political uncertainty in EMDEs using only the sample of 30 countries using currency derivatives. Table 3 reports the regression results of currency derivatives, exchange rate variations (VEER), and political uncertainty on foreign direct investment inflows in EMDEs. After controlling for GDP, monetary policy interest rate and fixed effects, column 1 regression results show positive and statistically significant estimated coefficient of currency derivatives at 1% level and negative and statistically significant coefficient for the exchange rate variations at 5% level. These results indicate that a one percent increase in currency derivatives associates with a 0.39% increase in FDI. Column 1 also shows that a one standard deviation increase in real effective exchange rate leads to a 0.86% decrease in FDI in EMDEs (one standard deviation of real effective exchange rate equals to 4.886 multiplied by the coefficient of VEER, which is -0.175, equals 0.86). This finding is consistent with the risk aversion argument linking exchange rate variabilities to foreign investments. As noted by Cushman (1985), higher exchange variability lowers the certainty equivalent expected exchange rate.

In Column 2, I add two interaction terms: currency derivatives interacted with real effective exchange rate variations and currency derivatives interacted with political uncertainty. Column 2 regression results report positive and statistically significant coefficients for currency derivatives and monetary policy interest rate both at 1% levels and negative and statistically significant coefficients for real exchange rate variations and political uncertainty at 1% and 5% respectively. These results suggest a surge in FDI of 0.36% consecutive to a 1% increase in currency derivatives. They also show a fall in FDI of 3.12% and 0.79% as a result of a one standard deviation increase in real exchange rate variations and political uncertainty respectively, all other variables held

constant. The estimated coefficients of both interaction terms are positive and statistically significant and stable across specifications, suggesting that countries with foreign exchange rate exposure and political uncertainty still experience a surge in FDI when currency derivatives are used.

Columns 3-5 include market capitalization (column 3), both market capitalization and financial development (column 4) and include both and natural resources (column 5). The regression results in these three columns remain unchanged when compared with column 2. Of all the control variables, only monetary policy interest rate, financial development and natural resources appear to have a positive and statistically significant effect on FDI. The positive association between monetary policy rate and FDI signals that multinational corporations take advantage of interest rate arbitrage opportunities in EMDEs.

In summary, Table 3 regression results indicate a positive and significant association between currency derivatives and FDI. It also reports as expected negative and statistically significant coefficients for the variation in the real effective exchange rate[6] and political uncertainty. However, the positive and statistically significant coefficients of the interaction terms between currency derivatives and real effective exchange rate and currency derivatives and political uncertainty in columns 2-5 indicate that even countries with political uncertainty and exchange rate exposure still experience a surge in FDI when currency derivatives are used to hedge against potential risks. These results provide support to the hypothesis that currency derivatives boost foreign direct investments in EMDEs. The positive and significant interaction terms in columns 2-5 mean that the positive effect of currency derivatives offsets the deleterious effects of political uncertainty and foreign exchange exposure.

4.2. Baseline regression using alternative measures of foreign direct investment

There are two kinds of international capital movements: Direct investment and portfolio investment (equity investment). If the investor directly controls the foreign enterprise, his investment is called a direct investment[7]. If he does not control it, his investment is a portfolio investment (Hymer, 1960). Foreign direct investors take controlling positions in domestic firms and participate in management. FDI can take shape in the form of capital investment and/or providing management expertise, technology, and equipment. All other investments in corporations not controlled by the investor or investment in foreign government bonds are classified as portfolio investments (such as equity investment). Investment positions represent the value of the stock of direct investments held at the end of a reference period (typically a year

[6] Blonigen (1997) argues, however, that real exchange rate depreciations of the foreign currency will lead to enhanced FDI into the foreign economy because currency movements may affect relative valuations of different assets. Foreign exchange depreciations in EMDEs allows foreign firms to bid aggressively for assets overseas.

[7] The United States Department of Commerce, for example, considers a foreign enterprise to be American controlled if at least 25% of the equity ids held by an American or a group of affiliated Americans.

or quarter). While FDI and equity investment are flow variables, investment positions are a stock variable.

Table 4 shows the regression results of currency derivatives (in log of dollar amounts), exchange rate volatility and political uncertainty on equity positions in EMDEs. The estimated coefficients of currency derivatives are statistically significant at least at 10% level in columns 1-4. After controlling for monetary policy interest rate, column 1 results indicate that an increase in currency derivatives of 1% is associated with 0.4 % increase in equity investments. In columns 2-3, equity investment surges by 0.36% (in column 2) and 0.34% (in column 3), consecutive to a 1% uptick in currency derivatives. Although the table shows negative coefficients of exchange rate variations in all columns, they are not statistically significant. While the interaction term between real exchange rate variations and currency derivatives is positive in all columns, it is not statistically significant. Political uncertainty and the interaction terms between political uncertainty and currency derivatives do not appear to have statistically significant impacts on equity investments. The results also indicate a slightly small increase in equity investments of 0.009% and 0.01% respectively in columns 4 and 5 as a result of a basis point increase in the monetary policy interest rate. This outcome shows that interest rate arbitrage is a determining factor in equity investments but at a much lower magnitude relative to currency derivatives. Of all the control variables, only financial development and GDP appear to have a positive and statistically significant effect on equity investments.

Contrary to FDI, equity investments appear not sensitive to foreign exchange rate variations and political uncertainty because of the safety of those investments. First, foreign firms feel more secure when investing in government bonds for example knowing that even in the extreme case of a government collapse, the International Monetary Fund may step in to provide financial support to the government as it was the case in the aftermath of the Asian financial crisis and the devaluation of West African CFA franc by 50 percent in foreign currency terms in January of 1994 following an overvalued exchange rate.

Table 5 reports the regression results of currency derivatives (in log of dollar amounts), exchange rate variations and political uncertainty on investment positions. Column 1 regression results include monetary policy interest rate and show a positive and statistically significant coefficient for currency derivatives at 1% level, but quantitatively larger in magnitude. In particular, a one percent increase in currency derivatives associates with a 0.54% increase in investment positions. The real effective exchange rate coefficient, however, is negative and statistically significant. A one standard deviation increase in real effective exchange rate leads to a decline in investment positions of 0.18% (one standard deviation of real effective exchange rate equals to 4.886 multiplied by the coefficient of VEER which is -0.0369 equals -0.18).

Column 2 includes two interacted terms (currency derivatives & VEER and currency derivatives & political uncertainty) and shows that only the coefficient of currency derivatives remains statistically significant and similar in size. (0.52%). In columns 3-5, more controls are added: financial development (column 3); financial development and GDP (column 4); both variables and market capitalization (column 5).

In column 3-5, the increases in investment positions consecutive to a 1% surge in currency derivatives remain relatively stable with 0.5%; 0.46% and 0.41% in columns 3, 4 and 5 respectively. Variations in real effective exchange rates lead to a decline in investment positions by 0.19%. Table 5 also shows an increase in FDI of 0.009% and 0.013% and 0.15% respectively in columns 3, 4 and 5 as a result of a basis point increase in the monetary policy interest rate. This result suggests that foreign monetary authorities can boost foreign investments by using interest rate adjustments. Of all of the control variables, financial development and GDP show positive and statistically significant coefficients at 1% and 10% respectively.

In summary, Tables 4 & 5 results show that hedging through currency derivatives has a positive and significant effect on equity positions and investment positions although the magnitude of the effect is larger with investment positions. The findings in Tables 3; 4; and 5 are consistent with respect to the effect of currency derivatives on foreign investments and bring support to the claim that increased currency derivative liquidity boosts foreign investments. Table 3 findings further show that the use of currency derivatives lowers or erases concerns inherent to political uncertainty and real exchange rate fluctuations and boosts foreign investment in EMDEs. This finding suggests that a growing currency derivative liquidity boosts investment confidence and lowers expectations of asset loss linked to rising political uncertainty and foreign exchange rate exposure.

4.3. Baseline results using an alternative measure of exchange rate variation

Exchange rate variations are an important driving factor for FDI. Stein and Froost (1991) explained the importance of exchange rates for FDI. The theory stresses that FDI takes place not because of cost-of-capital differences but because certain domestic assets are worth more under foreign control. To the extent that foreigners hold their wealth in currencies other than the US dollar, a depreciation of the dollar increases the relative wealth position of foreigners and as a result, allows them to bid aggressively for US assets. That said, exchange rate depreciations in emerging markets sometimes dubbed as competitive currency manipulations lower the relative cost of foreign assets and trigger international capital inflows in the country. How do firms measure exchange rate fluctuations?

Firms use two main measures of exchange rate: the real effective exchange rate and the bilateral exchange rate. The latter is mainly expressed as the exchange rate to the USD.

Previous regression results (in Tables 3, 4 and 5) used variations of the real effective exchange rate. While the real effective exchange rate accounts for the consumer price index of the country, the bilateral exchange rate only reports the nominal exchange rate of the domestic currency to the US dollar.

Using an alternative measure of exchange change variation, Table 6 reports the regression results of currency derivatives (in log of dollar amounts), political uncertainty and the variability of the bilateral exchange rate on FDI. Column 1 regression results show currency derivatives with a positive and statistically significant coefficient and with a larger magnitude than it was in Table 3

using real effective exchange rate instead. Column 1 also reports a negative and statistically significant coefficient for the variation of the bilateral exchange rate. A one standard deviation increase in the bilateral exchange rate associates with 1.92% decline in investments, more than two times as large when compared with the fall in FDI induced by one standard deviation increase in the real effective exchange rate in Table 3.

Columns 2-5 report similar coefficients for currency derivatives, variations of the bilateral exchange rate, political uncertainty. On average, a one percent increase in currency derivatives leads to an uptick in FDI of 0.4%. As for the variation of the bilateral exchange rate, a one standard deviation increase lowers FDI by 3.69% in columns 2 and 3; 3.83% in column 4 and 3.9% in column 5. The regression coefficient for political uncertainty in columns 2-5 remains stable, statistically significant and equals to -1.1. That means that a standard deviation in political uncertainty is associated with 0.94% decline in FDI in columns 2-5. However, the coefficient of the interaction term between currency derivatives and political uncertainty is positive and statistically significant at 1% in models 2-5. The positive and statistically significant coefficients of the interacted term signify countervailing influence exerted by the use of currency derivatives as a hedging mechanism over the concern for political uncertainty. This result bolsters the hypothesis that hedging boosts foreign investments even in the face of political uncertainty in EMDEs. Table 6 results using a different measure of the exchange rate variations (the bilateral exchange rate) are consistent with the findings in Table 3 although the magnitude of the effect on FDI is much larger with the bilateral exchange rate.

4.4. Baseline regression using full sample and currency derivatives as a dummy variable

This analysis of the effect of currency derivative use on FDI is intended to measure how derivative users compare to the non-derivative users in foreign investment outcomes. To achieve that, currency derivatives are proxied by a dummy variable set to 1 when currency derivatives are reported in the country and zero otherwise. Table 7 shows a positive and statistically significant coefficient for the derivative dummy at least at 10% level. Column 1 of table 7 shows that on average, using currency derivatives leads to a 127% increase in FDI in derivative-using countries compared to their fellow non-derivative users after controlling for GDP and monetary policy interest rate. Column 2 results indicate that derivative users experience on average, an increase in FDI inflows by 97% after further controlling for market capitalization. The two remaining columns (3 & 4) show similar magnitude level increase in FDI consecutive to the use of derivative contracts by foreign firms to hedge against foreign exchange risks and political uncertainty after controlling for financial development and financial development as well as natural resources respectively. Table 7 results show that derivative users experience significant increases in foreign investments, compared to those that do not use derivatives.

Overall, whether currency derivatives are used in dollars amounts or as a decision to hedge versus not to hedge, the results from Tables 3-7 show that derivative use is associated with a 30% to 127% surge in volume of foreign capital in EMDEs.

5. Robustness analysis

5.1 Propensity Score Matching and LASSO estimation results

Typically, the extent of hedging is modeled by a continuous variable denoting the amount of derivative contracts (e.g., Graham and Rogers, 2002) or the percentage of the underlying exposure that is hedged (e.g., Carter, Rogers, & Simkins, 2008). Conversely, when measuring hedging through the decision to hedge or not, studies equate hedging to one when currency derivatives are reported in the country. Otherwise, hedging is equal to zero for countries without derivative holdings. This approach has been adopted in some papers using derivative data (e.g., Geczy et al. (1997), Allayannis and Weston (2001), and Purnanandam (2008)).

Using a propensity score matching estimation (PSM) method, the paper estimates the effects of currency derivatives on international capital inflows under varying levels of political uncertainty in EMDEs. The PSM is a statistical technique that allows to estimate the effect of a treatment or a policy by accounting for the covariates that predict receiving the treatment. PSM is a powerful tool for adjusting for confounding variables and reducing treatment selection bias. The LASSO estimation, however, is a much powerful tool given its ability to enhance the prediction accuracy through the selection of the most relevant covariates and regularization.

Table 8 shows the summary statistics of the confounders in treated and untreated groups. The summary statistics show that the treated and untreated countries differ by about 1.6 standard deviation (SD) in GDP; 1.5 SD in financial development; 1.3 SD in market capitalization. However, treated and untreated countries are more simailar in variations of the real effective exchange rate (VEER), variations of the bilateral exchange rate (VBER), political uncertainty (PU), global uncertainty index (GUI), in monetary policy interest rate (MPIR) and natural resources. The SD difference in VEER, MPIR, natural resources is about zero and the difference in SD for VBER, PU, and GUI is less than 0.3.

Figure 3 shows the distribution of the log odds of the propensity score before and after matching, rather than the propensity score itself, since it tends to be more normally distributed. The apparent normal distribution of propensity scores in derivative users and non-derivative users suggests that the matching of characteristics between both groups has been successful. One way to determine which variable is causing the poor fit in the propensity model is to plot the lines corresponding to the observed and predicted proportions of subjects treated at each level of the confounder to ensure that they are parallel. Figure 4 illustrates how natural resources and monetary policy interest rate contribute to the poor fit in the propensity model and shows how they compare to other variables. Therefore, both variables were removed from the regression model. Additional testing for possible matches finds that global uncertainty index as well as the square value of the variations of the real effective exchange rate improve the fitness of the propensity model.

Given the importance of covariate balance in the matched sample, it is recommended to assess the absolute standardized differences between groups for each covariate. Table 9 shows the absolute standardized differences (ASD) before and after propensity score matching. Covariate balancing is commonly measured by comparing absolute standardized differences to a threshold

of 10% (Morgan, 2017). All covariates in table 9 have ASD falling within 0.1 SD except for GDP and financial development that fall within 0.12 SD. These results suggest that the covariate balancing between derivative users and non-derivative users has been successful.

5.1.1 Estimation of the average treatment effect of currency derivatives on FDI

Following a successful covariate balancing, I use a probit model to estimate the average treatment effects (ATT) of derivatives on FDI. All estimations include the following controls: variations of real effective exchange rate (VEER), the square of VEER, political uncertainty, global uncertainty index, GDP, capital accumulation, financial development, and market capitalization. Table 10 shows the propensity score estimates of the average effects of currency derivative use on FDI in EMDEs and Table 11 shows

The kernel density estimate of the ATT in column 1 of table 11 shows that derivative users experience a 94% increase in FDI relative to their non-derivative users counterparts. This naïve assessment of the treatment effect shows that the inflow differential in FDI between treated group and untreated is likely driven by the use of currency derivatives to mitigate foreign exchange risks and political risks in foreign markets. This estimation did not include common support and could have important biased estimates.

The second kernel density estimation in column 2 of Table 10 restricts the analysis of the balancing property to all treated plus those controls in the region of common support. This estimation leaving out 273 observations off support (i.e 26% of the obs.), finds an average treatment effect (ATT) associated with the use of currency derivatives equal to 93%, a little lower than the ATT shown in column 1. These results suggest that failing to exclude subjects outside of the common support can potentially lead to biased estimates.

Even within the common support, there may be untreated subjects with very high propensity scores or treated with very low propensity scores. These cases of unmeasured confounding can lead to biased estimates. To solve the issue, trimming subjects with particularly high or small propensity scores is recommended. This option allows to further remove subjects that are likely to be more untreated than treated at the lower end of the propensity range and more treated than untreated at the higher end. Column 3 of Table 10 using a linear matching with trimming at the 5th centile shows an ATT of 1.023, suggesting that currency derivative users experience an increase of 102%% in FDI inflows compared with the non-derivative users. The paper's findings are not directly comparable with other findings in the literature given the paucity of papers investigating the political uncertainty and foreign exchange risk mitigation potential of the use of currency derivatives. However, a meta-analysis of the effects of international investment agreements for the protection of foreign investors on foreign direct investment using 2107 estimates drawn from 74 studies finds evidence that the effects of international investment agreements is so small as to be considered zero (Brada and Drabek, 2021).

Additional propensity score matching estimations include stratification and nearest neighbor matching. Using stratification is more useful because il removes most of the confounding. Column

4 of Table 10 shows the results of an analysis of the effect of treatment, stratifying the propensity score in 5 strata. 5 strata will remove about 90% of confounding. Column 4 results show an ATT of 0.695 using a linear matching with stratification in 5 strata. As for the nearest neighbor matching, the ATT estimate is 0.38, the lowest estimate among the ATT shown in Table 10, column 5. This result indicates that on average, the use of currency derivatives is associated with an increase in FDI by about 38% for derivative users after propensity score matching.

Overall, the propensity score matching estimation techniques find a positive impact of currency derivatives on the inflows of FDI in EMDEs. Estimates suggest that on average, the treated group using currency derivatives see an increase in FDI between 38% to 102%. Although these results support the findings in the baseline regression, one caveat is that some of these ATT estimates may have some level of bias given that there is an imbalance between treated and untreated subjects. In the nearest neighbor matching for example, there are 649 treated subjects to match with only 125 untreated. This can result in an incomplete matching. Incomplete matching occurs when there are treated subjects for whom no appropriate untreated subjects are identified (Rosenbaum and Rubin, 1985). To address the incomplete matching or poor pairing between treated and untreated subjects, there is a need to insist that matched pairs cannot differ by more than a fixed amount referred to as a caliper. This will limit the number of matches and ensure that the matches are good. Column 6 of table 10 presents fixed effects regression matching results with a caliper set at 0.15, which allows matching of treated and untreated within 0.15 SD. The regression results show an ATT of 0.62, similar to the ATT in the stratification matching of 0.695. Overall, the propensity score matching estimates of the average treatment effects are between 0.38 and 1.02. However, the stratification of the propensity scores in 5 strata and the matching technique using a caliper appear to be the most reliable ATT estimates of the propensity score matching estimation.

5.1.2 Estimation of treatment effects using the LASSO estimation.

In Table 10, Panel B, I use double machine learning estimation methods to estimate the average treatment effects of currency derivatives on the inflows of FDI in emerging markets and developing economies over the period 1998-2022. One advantage of double machine learning Least Absolute Shrinkage and Selection Operator (LASSO) is that it allows the selection of more variables in the models while ensuring the validity of the estimates. Therefore, the sparsity condition, which allows only a few variables to be selected in LASSO, is relaxed in double LASSO and still maintain valid estimates.

The LASSO estimation results presented in column 1 of Table 10, Panel B, show an ATT of 0.48. This estimation using a probit model indicates that on average, the use of currency derivatives is associated with an increase in FDI inflows by about 48% in the treated group. This regression allows sample splitting and performs cross-fitting. In column 2 of Table 10, Panel B, the use of a logit model to repeat the same estimation yields an ATT of 0.57, suggesting that compared with the non-derivative users, derivative users experience a surge of 57% in FDI inflows associated with the use of currency derivatives.

Both PSM and the LASSO estimators show positive and significant ATT between 38% and 102%. However, the ATT results from the LASSO estimation methods are close in magnitude to those of the stratification matching and the matching using a caliper. These results support the hypothesis that an increase in currency derivative liquidity leads to more foreign investment inflows in EMDEs. While the PSM estimations used bootstrapped standard errors, the linear estimation models use robust standard errors.

5.2. Placebo tests

To probe the robustness of the findings in the baseline regression, I performed three placebo tests using the DID command: the in-time placebo test, in-space placebo test and the restricted mixed placebo test. The DIDplacebo command implements placebo tests by estimating difference-in-differences (DID) models, where treatment may be synchronized or staggered. While the in-time placebo test is run to estimate the effect of a fake treatment called placebo on an outcome variable, the in-space placebo test and the restricted mixed placebo tests are used to test the effects of an actual treatment on an outcome variable. The DiDplacebo command performs in-time placebo tests using fake treatment times, in-space placebo tests using fake treatment units (randomly selected), and mixed placebo tests using both fake treatment units and times (both randomly selected). Chen and Yan (2023) introduce the term "mixed placebo test" to refer to the type of placebo test where both fake treatment time and fake treatment units are used simultaneously. However, mixed placebo tests represent a more complete randomizing process in which both treatment status and treatment time are randomly selected.

To ensure that the covariate characteristics do not confound my results, I applied the covariate balancing property results from the propensity score matching. This is important because it guarantees the parallel trend assumption between the treatment group and the control group. Following Cao and Chen (2022), I used a panel dataset of 54 countries over 1990-2022 to estimate a standard DID model, where the treatment group consists of 30 countries using currency derivatives and the control group includes the remaining 24 countries where no derivative data were reported (see Table 15). The two-way fixed effects (TWFE) estimation results of equation 2 using the command reghdfe are reported in Table 12. The results show that the coefficient for the treatment variable (Dit) is 0.757 and is significant at 1% level. These results suggest that the treatment is associated with an increase in FDI inflows in EMDEs. These results are saved for later use.

Next, I run in-time placebo test using a fake treatment time prior to the actual treatment time to estimate the effect of the placebo. The actual treatment started in 1998 when currency derivatives were used by foreign firms to hedge against foreign exchange risks and political uncertainty in emerging markets and developing economies. Thus, the in-time placebo assumes no currency derivative use in EMDEs during the pretreatment period (1990-1997). According to the BIS data, global currency derivatives were extremely low in the 1990s and amounted to $0.88 trillion in 1992 and $1.15 trillion in 1995 in daily avarage (see figure 2). The Emeging Market and developing economies' currencies combined accounted for only 5% of the global currency derivative trading in 1995 (BIS).

Table 13 shows the results of in-time placebo implemented by shifting the treatment period ahead of the actual treatment by 6 periods. The results show the estimated placebo effects, as well as the corresponding standard errors and the p-values. Since all p-values are greater than 0.1, the null hypothesis of "No placebo effects" cannot be rejected. Therefore, the placebo (or the fake treatment) has no significant effect on FDI in EMDEs over the period 1990-1997.

Now, I turn to the in-space placebo. To run in-space and mixed placebo tests, I define the treatment period as 1998-2022 during which currency derivative data were reported in EMDEs. 1998 is the start of the treatment period with growing currency derivative data reported in emerging economies following the Asian financial crisis (1997-1998). Daily global currency derivative turnover reached $1.53 trillion in 1998. The Emeging Market currencies combined accounted for 5%, 8.45% and 7.7% of the daily currency derivative trading respectively in 1998, 2001 and 2004. US dollar has held the largest share of the derivative tradings. In 2001 for example, US dollar accounted for 45.15% of the total currency derivative trading; Euro at 18.8%; the Yen at 11.35% and the Pound at 6.6% in 2001 and all emerging maket economies combined made 8.45% of the currency derivative trading.

Table 14 shows the results of in-space and mixed placebo tests. The results show that the two-sided p-value and the right-sided p-value for in-space placebo are 0.066 and 0.026 respectively, indicating positive statistical significance at 10% and 5% and allowing to reject the null hypothesis of no treatment effect. The results of the mixed placebo test for the DID design show that the two-sided p-value and the right-sided p-value are 0.006 and 0.004, which is statistically significant at 1% and allow to reject the null hypothesis of no treatment effect.

The placebo generated graphs show that the estimated treatment effect (shown as a solid vertical line) is located towards the right-tail of the distribution of placebo effects; see Figure 5. Since the vertical solid line is in the right tail of the distribution of placebo effects and statistically significant, then this is evidence against the null hypothesis of no currency derivative effect. While the mixed placebo tests deliver two graphs (the unrestricted mixed placebo and the restricted mixed placebo), the restricted mixed placebo is the most suitable of both given that it maintains the cohort structure.

Overall, the placebo tests conducted using the covariate balancing condition from the propensity score matching show a statistically significant treatment effect of 0.757. The placebo test results indicate that on average, currency derivative use is associated with a 75.7% increase in FDI for derivative users. The results in in-time placebo, in-space placebo and restricted mixed placebo allow to reject the null hypothesis of no treatment effect.

Furthermore, the treatment effect of 0.757 in the placebo analysis falls in the range of the PSM and LASSO estimates of the average treatment effects which are between 0.38 and 1.02. The placebo ATT is pretty similar to the ATT from the linear matching with stratification in five 5 strata, fixed effects linear matching using a caliper and the double LASSO logit estimation method. Therefore, the robustness test results are consistent with the findings in the baseline regression,

and they support the claim that an increase in currency derivatives used as a risk mitigating tool against foreign exchange risks and political uncertainty is associated with a surge in FDI in EMDEs.

6. Conclusion

This paper quantifies the response of international capital inflows to currency derivative liquidity under varying levels of political uncertainty in EMDEs using a sample of 54 countries from 1990 to 2022.

The paper finds that the growth of currency derivative liquidity is associated with an increase in international capital inflows in the receiving EMDEs. The baseline results report a surge in international capital inflows ranging between 0.323% and 1.27% consecutive to a 1% increase in currency derivative liquidity. The results also show positive and statistically significant coefficients for the interaction variables between currency derivatives and political uncertainty and currency derivatives and real exchange rate variations. This outcome suggests that the investment confidence boosted by the use of currency derivatives outweighs concerns over political uncertainty and foreign exchange risk exposure.

Furthermore, the paper conducted placebo tests and used a double machine learning estimation method (the LASSO estimation) to check the robustness of the findings in the baseline regression. To ensure that the covariate characteristics do not confound the robustness results, I applied the covariate balancing property results of the Propensity Score Matching (PSM). The average treatment effects (ATT) from the placebo analysis and the LASSO estimation method using a logit model appear similar to those in the PSM estimations using linear matching with stratification and linear fixed effects matching using a caliper. These findings are consistent with those in the baseline regression and lend credence to the hypothesis that a growing currency derivative liquidity would lead to more foreign investments in EMDEs.

These findings have important policy implications. Foreign exchange risks in EMDEs expose foreign firms to important risks of financial distress and bankruptcy. The rising political uncertainty in EMDEs exposes firms to expropriation of assets or breach of contract and transfer risk (Hamada et al, 2004). To mitigate these potential risks, MNCs purchase currency derivatives as a safety mechanism. The need to use currency derivatives to hedge against foreign exchange risks and political uncertainty has the potential to siphon funds from actual investment.

Host countries need to create an environment that fosters political stability and the enforcement of the rule of law in order to reduce the global economic uncertainty and ensure minimal fluctuations in the foreign exchange rate. To achieve such a goal, there is a need for a global effort to promote world peace by reducing the geopolitical tensions, by promoting economic development, enhancing democracy and international cooperation.

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Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Ln (FDI)	1782	7.534	2.14	.665	12.676
Ln (Investment positions)	606	11.086	1.748	6.137	15.478
Ln (Equity positions)	606	10.893	1.823	5.014	15.396
Ln (Currency derivatives)	270	8.734	1.978	3.727	13.38
Derivatives dummy	1782	.421	.494	0	1
Variation of real effective exchange rate	1710	2.14	4.886	.102	137.92
Variation of the bilateral exchange rate	1742	2.994	17.255	0	633.565
Political uncertainty	1458	.149	.859	-1.599	2.81
Global uncertainty index	1661	.161	.143	0	1.343
Currency crisis	1584	.129	.346	0	2
Monetary policy interest rate	823	7.913	12.417	0	183.2
Ln (GDP)	1782	11.487	1.65	7.156	16.608
Ln (Financial development)	1781	10.274	2.194	2.901	18.978
Ln (Capital accumulation)	1749	9.729	1.891	2.472	15.859
Ln (Natural resources)	1780	6.936	3.086	-1.363	13.271
Ln (Market capitalization)	1515	10.202	2.582	.142	16.485

FDI denotes the value of foreign direct investment in million USD. Currency derivatives refer to the value of OTC daily average turnover of foreign exchange derivatives by currency. Equity positions represent portfolio investments made by foreign investors in a year in a country. Investment positions denote the stock of foreign direct investment and portfolio investments in a country at a given period. The variation of real effective exchange rate (VEER) reflects the real exchange rate risk and is measured as a standard deviation of the percentage change of monthly real effective exchange rates. And the variation of bilateral exchange rate (VBER) is measured as a standard deviation of the percentage change of monthly bilateral exchange rates. The political uncertainty index measures perceptions of the likelihood of political instability. GDP is the value of constant gross domestic product in the country. Financial development (FD) denotes the volume of credit to private sector by banks in the country. Natural resources are the value of natural resources rents (in million USD) in the country. The Global Uncertainty Index (GUI) is based on economic and political developments and follows a standardized process and structure. A higher number means higher uncertainty and vice versa.

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Currency derivatives	1.000											
(2) VEER	-0.052	1.000										
(3) VBER	-0.017	0.319*	1.000									
(4) Political uncertainty	0.006	0.163*	0.033	1.000								
(5) Global uncertainty index	-0.073	0.089*	0.006	0.140*	1.000							
(6) Currency crisis	-0.100	0.185*	0.307*	0.042	0.097*	1.000						
(7) Monetary policy rate	-0.244*	0.287*	0.222*	0.152*	0.069	0.455*	1.000					
(8) ln (GDP)	0.595*	-0.054*	0.003	0.298*	0.083*	0.107*	0.037	1.000				
(9) ln (Financial development)	0.680*	-0.137*	-0.053*	0.143*	0.078*	-0.035	-0.168*	0.861*	1.000			
(10) ln (Capital accumulation)	0.674*	-0.110*	-0.031	0.218*	0.060*	0.012	-0.062	0.945*	0.916*	1.000		
(11) ln (Natural resources)	0.203*	-0.005	0.023	0.318*	0.079*	0.063*	0.005	0.639*	0.498*	0.617*	1.000	
(12) ln (Market capitalization)	0.714*	-0.157*	-0.092*	0.133*	0.061*	-0.132*	-0.209*	0.765*	0.827*	0.811*	0.445*	1.000

Currency derivatives are positively correlated with GDP, financial development, natural resources and market capitalization. VEER stands for variation of real effective exchange rate and is positively correlated with the variation of the bilateral exchange rate (VBER) and political uncertainty, and negatively correlated with GDP. Political uncertainty is positively correlated with global uncertainty index (GUI) and the monetary policy interest rate. Increases in the domestic interest rate are likely to affect the interest payment obligations and thus, the debt obligations of foreign firms that borrow in domestic financial markets to reduce exposure to foreign exchange risks.

Table 3: Baseline results. Regression results of currency derivatives, exchange rate variations and political uncertainty on FDI

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Currency derivatives (CUDER)	0.391***	0.365***	0.365***	0.342***	0.320**
	(0.140)	(0.113)	(0.113)	(0.118)	(0.116)
Variation of real exchange rate	-0.175**	-0.638***	-0.638***	-0.645***	-0.649***
	(0.0716)	(0.0781)	(0.0779)	(0.0789)	(0.0765)
Political uncertainty	-0.117	-0.925**	-0.923**	-0.900**	-0.902**
	(0.153)	(0.388)	(0.399)	(0.401)	(0.325)
Ln (GDP)	0.753	0.877	0.873	0.811	0.456
	(0.513)	(0.571)	(0.557)	(0.559)	(0.587)
Monetary policy interest rate	0.00175	0.0152***	0.0152***	0.0158***	0.0144***
	(0.00643)	(0.00458)	(0.00463)	(0.00460)	(0.00468)
CUDER×Political uncertainty		0.100**	0.100**	0.0975*	0.0945**
		(0.0470)	(0.0476)	(0.0480)	(0.0401)
CUDER×VEER		0.0543***	0.0543***	0.0549***	0.0552***
		(0.00915)	(0.00918)	(0.00927)	(0.00853)
Ln (Market capitalization)			0.00263	-0.0442	-0.00915
			(0.0961)	(0.0747)	(0.0686)
Ln (Financial development)				0.128**	0.126**
				(0.0565)	(0.0572)
Ln (Natural resources)					0.117**
					(0.0424)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	200	200	200	200	199
R-squared	0.770	0.822	0.822	0.829	0.837
Number of countries	26	26	26	26	26

Note. This regression uses the sample of derivative users only. The dependent variable is the log value of the annual inflow of foreign direct investment in the host country. The independent variables of interest are currency derivatives (CUDER), variation of real effective exchange rate (VEER) and political uncertainty. CUDER denotes the daily average of currency derivative liquidity in the currency of the host country. VEER denotes the foreign exchange rate variations. The controls in the regression include monetary policy interest rate, GDP, financial development, natural resources and market capitalization. The constant is not included. All regressions include time fixed and country fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Baseline results. Regression results of currency derivatives, exchange rate variations and political uncertainty on equity positions.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Currency derivatives (CUDER)	0.398***	0.360**	0.341**	0.302*	0.248
	(0.141)	(0.150)	(0.158)	(0.156)	(0.150)
VEER	-0.0465	-0.300	-0.253	-0.205	-0.238
	(0.0301)	(0.303)	(0.278)	(0.280)	(0.283)
Political uncertainty	-0.148	-0.140	0.811	1.329	1.219
	(0.186)	(1.193)	(1.248)	(1.185)	(1.173)
Monetary policy interest rate	0.00172	0.00234	0.00430	0.00865*	0.0111**
	(0.00465)	(0.00455)	(0.00426)	(0.00430)	(0.00495)
CUDER×Political uncertainty		-0.00265	-0.0843	-0.124	-0.109
		(0.119)	(0.118)	(0.113)	(0.112)
CUDER×VEER		0.0239	0.0204	0.0175	0.0215
		(0.0282)	(0.0260)	(0.0261)	(0.0263)
Ln (Financial development)			0.368***	0.367***	0.369***
			(0.0433)	(0.0441)	(0.0450)
Ln (GDP)				1.519**	1.389*
				(0.642)	(0.676)
Ln (Market capitalization)					0.379
					(0.224)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	113	113	113	113	113
R-squared	0.510	0.514	0.617	0.651	0.668
Number of countries	23	23	23	23	23

Note. This regression uses the sample of derivative users only. The dependent variable is the log value of equity positions in the host country. The key independent variables are CUDER, VEER and political uncertainty. CUDER denotes the daily average of currency derivative liquidity in the currency of the host country. VBER stands for variation of the bilateral exchange rate and denotes nominal exchange rate volatility. The controls in the regression include monetary policy interest rate, GDP, financial development, natural resources and market capitalization. The constant is not included. All regressions include time fixed and country fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Baseline results. Regression results of currency derivatives, exchange rate variations and political uncertainty on investment positions.

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Currency derivatives	0.538***	0.517***	0.495***	0.461***	0.414***
	(0.128)	(0.134)	(0.152)	(0.151)	(0.141)
VEER	-0.0369*	-0.156	-0.100	-0.0579	-0.0864
	(0.0207)	(0.279)	(0.275)	(0.277)	(0.279)
Political uncertainty	-0.159	-0.477	0.650	1.106	1.012
	(0.173)	(1.147)	(1.023)	(0.966)	(0.983)
Monetary policy interest rate	0.00617	0.00669	0.00901**	0.0129***	0.0150***
	(0.00412)	(0.00396)	(0.00380)	(0.00398)	(0.00464)
CUDER×Political uncertainty		0.0311	-0.0656	-0.101	-0.0880
		(0.115)	(0.0989)	(0.0942)	(0.0966)
CUDER×VEER		0.0111	0.00691	0.00431	0.00784
		(0.0258)	(0.0255)	(0.0255)	(0.0255)
Ln (Financial development)			0.436***	0.435***	0.437***
			(0.0416)	(0.0436)	(0.0439)
Ln (GDP)				1.341*	1.229*
				(0.677)	(0.709)
Ln (Market capitalization)					0.328
					(0.205)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	113	113	113	113	113
R-squared	0.548	0.549	0.688	0.712	0.725
Number of countries	23	23	23	23	23

Note. This regression uses the sample of derivative users only. The dependent variable is the log value of investment positions in the host country. The independent variables of interest are currency derivatives, VEER and political uncertainty. VEER stands for variation in the real effective exchange rate and denotes the standard deviations of the monthly percentage changes in the real effective exchange rate. The controls in the regression include monetary policy interest rate, GDP, financial development, natural resources and market capitalization. The constant is not included. All regressions include time fixed and country fixed effects. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Baseline results. Dependent variable is log FDI and key independent variables are currency derivatives, variation of bilateral exchange rate and political uncertainty

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5
Currency derivatives (CUDER)	0.449***	0.412***	0.412***	0.390***	0.369***
	(0.133)	(0.112)	(0.112)	(0.116)	(0.113)
Variation of bilateral exchange rate	-0.111***	-0.214**	-0.215**	-0.222***	-0.226***
	(0.0195)	(0.0784)	(0.0776)	(0.0736)	(0.0679)
Political uncertainty	-0.0400	-1.125***	-1.119***	-1.096***	-1.099***
	(0.141)	(0.359)	(0.372)	(0.377)	(0.301)
Ln (GDP)	0.774	0.827	0.812	0.762	0.412
	(0.514)	(0.570)	(0.561)	(0.561)	(0.613)
Monetary policy interest rate	0.00467	0.0131***	0.0131***	0.0137***	0.0123***
	(0.00622)	(0.00378)	(0.00390)	(0.00399)	(0.00411)
CUDER×Political uncertainty		0.126***	0.125***	0.122**	0.119***
		(0.0435)	(0.0444)	(0.0450)	(0.0372)
CUDER×VBER		0.0140	0.0141	0.0150	0.0154
		(0.0108)	(0.0107)	(0.0102)	(0.00924)
Ln (Market capitalization)			0.0127	-0.0294	0.00550
			(0.0872)	(0.0786)	(0.0716)
Ln (Financial development)				0.119**	0.117**
				(0.0517)	(0.0520)
Ln (Natural resources)					0.118**
					(0.0435)
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	200	200	200	200	199
R-squared	0.792	0.818	0.818	0.824	0.832
Number of countries	26	26	26	26	26

Note. This regression uses the sample of derivative users only. The dependent variable is the log value of annual inflow of foreign direct investment in the host country. The independent variables of interest are currency derivatives, VBER and political uncertainty. Currency derivatives denote the daily average of currency derivatives in the currency of the host country. VBER stands for variation of the bilateral exchange rate and denotes the standard deviations of the monthly percentage changes in the nominal exchange rate. The controls in the regression include the monetary policy interest rate, GDP, financial development, natural resources and market capitalization. All regressions include time fixed and country fixed effects. The constant is not included. Robust standard errors in parentheses. ***, ** and * indicate statistical significance levels at 1%, 5% and 10%, respectively.

Table 7: Baseline results. Full sample regression using currency derivatives as a dummy variable

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Derivatives dummy	1.266***	0.969*	0.907*	0.913*
	(0.449)	(0.501)	(0.497)	(0.489)
Variation of real exchange rate	-0.112**	-0.107**	-0.113**	-0.113**
	(0.0436)	(0.0452)	(0.0449)	(0.0449)
Political uncertainty	-0.231	-0.223	-0.225	-0.230
	(0.152)	(0.150)	(0.138)	(0.138)
Ln (GDP)	1.405***	1.463***	1.190***	1.133***
	(0.343)	(0.371)	(0.371)	(0.373)
Monetary policy rate	-0.00975**	-0.00903*	-0.00843*	-0.00850*
	(0.00433)	(0.00501)	(0.00454)	(0.00451)
Ln (Market capitalization)		0.123	0.0979	0.0986
		(0.116)	(0.103)	(0.103)
Ln (Financial development)			0.197**	0.197**
			(0.0788)	(0.0789)
Ln (Natural resources)				0.0301
				(0.0430)
Year fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	794	720	720	719
R-squared	0.576	0.613	0.627	0.628
Number of countries	38	34	34	34

Note. This regression uses the full sample of derivative users and non-users. The dependent variable is log value of foreign direct investment inflows the host country. The independent variables of interest are currency derivative dummy, VEER and political uncertainty. Derivative dummy is set to 1 for countries with currency derivative data and 0 otherwise. VEER stands for variation of the real effective exchange rate and denotes the standard deviations of the monthly percentage changes in the real effective exchange rate. The controls in the regression include the monetary policy interest rate, GDP, financial development, natural resources and market capitalization. All regressions include time fixed and country fixed effects. The constant is not included. Robust standard errors in parentheses ***, ** and * indicate statistical significance levels at 1%, 5% and 10%, respectively.

Table 8: Summary statistics (Checking balance of confounders between treated and untreated)

	Mean in treated	Mean in untreated	Difference in terms of standard deviations
Variations of the real exchange rate	1.75	1.75	-0.001
Variations of the bilateral exchange rate	2.41	1.55	0.280
Political uncertainty	0.17	-0.04	0.252
Global uncertainty index	0.18	0.15	0.205
Monetary policy interest rate	6.71	7.08	-0.044
Ln (Natural resources)	8.29	8.30	-0.004
Ln (GDP)	12.89	11.39	1.581
Ln (Financial development)	12.20	10.43	1.470
Ln (Capital accumulation)	11.39	9.94	1.349
Ln (Market capitalization)	12.12	9.8	1.268

The summary statistics show that the treated and untreated groups differ by about 1.6 SD in GDP; 1.5 SD in financial development; 1.3 SD in capital accumulation and market capitalization. However, they are more simailar in variations of the real effective exchange rate (VEER), variations of the bilateral exchange rate (VBER), political uncertainty (PU), global uncertainty index (GUI), monetary policy interest rate (MPIR) and natural resources. The SD difference in VEER, MPIR, natural resources is almost zero and the difference in SD for VBER, PU, and GUI is less than 0.3.

Table 9: Covariate balancing statistics using a probit specification

	Means after matching			
	Means in treated	Means in untreated	SD after matching	SD before matching
VEER	1.77	1.78	-0.008	0.057
VEER squared	5.62	5.90	-0.015	0.042
Political uncertainty	0.16	0.13	0.035	-0.070
Global uncertainty index	0.18	0.18	0.025	0.184
Ln (GDP)	12.82	12.69	0.111	1.659
Ln (Capital accumulation)	11.26	11.12	0.106	1.513
Ln (Financial development)	12.03	11.85	0.120	1.492
Ln (Market capitalization)	11.82	11.65	0.083	1.257

Note. This table reports absolute standard differences (ASD) before and after propensity score matching.

Table 10: Estimation of propensity Score using probit model

VARIABLES	(1) Model 1
Variation of real exchge. rate	-0.238***
	(0.0844)
Variation of real exchge. Rate2	0.0111*
	(0.00613)
Political uncertainty	-0.662***
	(0.0707)
Global uncertainty index	1.060***
	(0.387)
Ln (GDP)	1.825***
	(0.164)
Ln (Financial development)	0.416***
	(0.102)
Ln (Capital accumulation)	-0.682***
	(0.141)
Ln (Market capitalization)	-0.172***
	(0.0485)
Observations	1,061
Pseudo R2	0.503
F-Test	712.53

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The constant is not included. The region of common support is [.08496802, 1] and the balancing property is satisfied.

Table 11: Propensity score matching & LASSO estimates of the effects of treatment on FDI in EMDEs

Panel A: Propensity score matching, and regression estimates of the effects of derivatives on FDI in EMDEs						
	Kernel matching	Kernel matching with common support	Linear matching with Trimming at the 5th centile	Linear matching with stratification in five strata	Nearest neighbor matching with common support	Fixed effects regression matching with caliper (=0.15)
	0.936***	0.931***	1.023***	0.695***	0.383*	0.620***
	(0.193)[b]	(0.201)[b]	(0.110)	(0.114)	(0.213)[b]	(0.126)
Obs	1350	1350	615	1061	1350	340
Treated	750	649			649	170
Controls	600	244			125	170
Replications	100	100			100	
R^2			0.124	0.536		0.126

Note. This panel shows estimates of currency derivatives on FDI inflows over 1998-2022. The matching and regression estimates control for variation of real effective exchange rate (VEER), $VEER^2$, global uncertainty index, GDP capital accumulation, financial development and market capitalization. b stands for bootstrapped standard errors. The linear matching methods used robust standard errors.

Panel B: LASSO estimates of the effects of derivatives on FDI in EMDEs		
	LASSO regression (Probit)	LASSO Regression (Logit)
ATT	0.475***	0.570***
	(0.0850)	(0.0999)
POMean	8.827***	8.732***
	(0.0873)	(0.102)
Observations	1061	1061

Note. This panel shows estimates of currency derivatives on the inflows of FDI over 1998-2022 using a double machine learning estimation technique. Standard errors are reported in parentheses. Control variables are the same as in panel A. One advantage of double machine learning is that it relaxes the the sparsity condition, which allows only a few variables to be selected. Adding the option xfold(5) allows to split the sample into five groups and perform cross-fitting and the resample(5) option allows to repeat the cross-fitting procedure with three samples. Cross-fit estimation fits the nuisance parameters and parameter of interest in different samples.

Table 12: High-Dimensional Fixed Effects (HDFE) linear regression results of the treatment variable on FDI. The dependent variable is the log-value of FDI.

VARIABLES	(1) Model 1
Treatment variable (Currency derivatives)	0.757***
	(0.274)
Variation of real effective exchange rate	-0.0896**
	(0.0398)
Variation of real effective exchange rate squared	0.00258
	(0.00288)
Political uncertainty	-0.278*
	(0.143)
Global uncertainty index	-0.419**
	(0.175)
Ln (GDP)	0.0861
	(0.473)
Ln (capital accumulation)	0.420***
	(0.131)
Ln (Financial development)	0.187**
	(0.0693)
Ln (Market capitalization)	0.171***
	(0.0614)
Constant	-1.312
	(4.927)
Year fixed effects	Yes
Country fixed effects	Yes
Observations	1,141
R-squared	0.898

The results show that the Two- way fixed effects (TWFE) estimate of treatment is positively significant at the 1% level, which implies that currency derivatives use is associated with an increase in FDI inflows in EMDEs. These results are stored to be used later. Robust standard errors clustered at the country level are reported in parentheses.

Table 13: Results of in-time placebo test using fake treatment times by shifting the treatment time forward by 6 periods.

Treatment variable (D_{it})	Coefficient	Std. err	z	P>|z|
F1	.0255179	.2002512	0.13	0.899
F2	.1445949	.2413225	0.60	0.549
F3	.3837052	.238279	1.61	0.107
F4	.190542	.21235	0.90	0.370
F5	.5306433	.3674311	1.44	0.149

Table 13 reports the point estimates of in-time placebo effects, as well as the corresponding standard errors and p-values. In this placebo test, I am testing the null hypothesis of no placebo effect in the period preceding the policy shock, i.e the use of currency derivatives to boost foreign investments in EMDEs. All p-values are greater than 0.1. Decision: We fail to reject the null hypothesis of "No placebo effects in the period preceding the treatment (1990-1997).

Table 14: Results of in-space and mixed placebo tests

Placebo tests	Treatment variable	Coefficient	P-value		
			Two-sided	Left-sided	Right-sided
Results of in-space placebo test for standard DID	Derivatives	0.757	0.066	0.974	0.026
Results of a mixed placebo test for standard DID	Derivatives	0.757	0.006	0.996	0.004
Number simulations			500		

The results of in-space placebo tests show that the two-sided p-value and the right-sided p-value are 0.066 and 0.026, indicating statistical significance at 10% and 5% and allowing to reject the null hypothesis of no treatment effect.

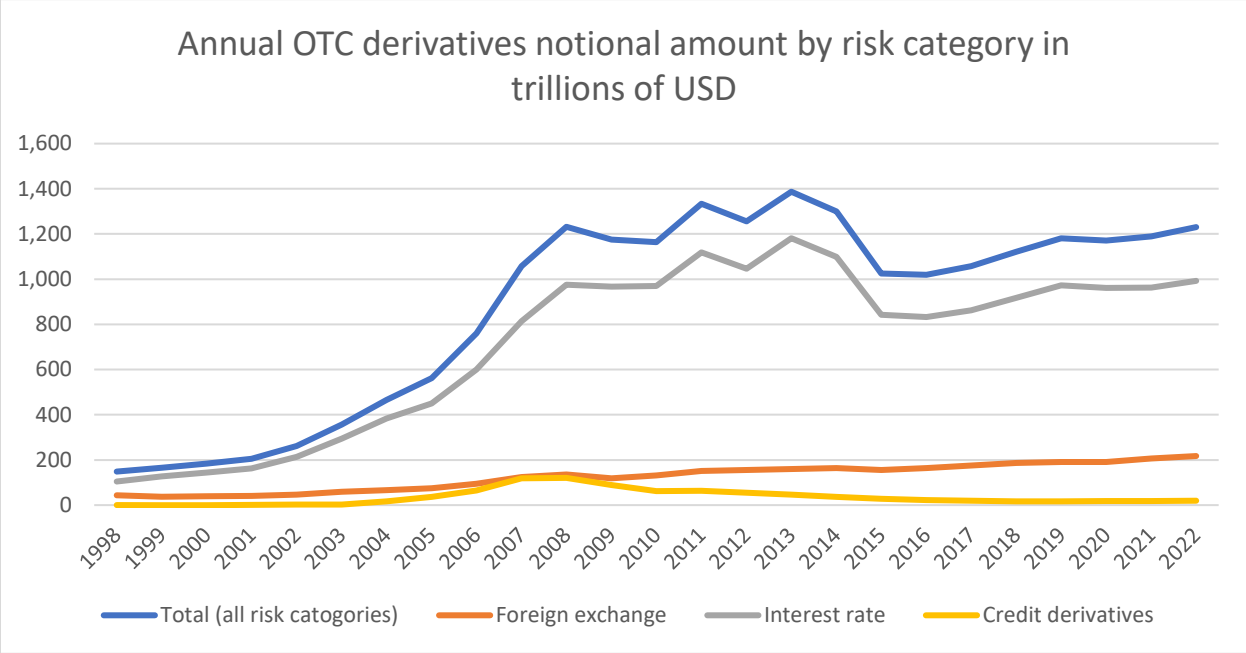
The results of mixed placebo test for the DID design show that the two-sided p-value and the right-sided p-value are 0.006 and 0.004, which is statistically significant at 1% and allows to reject the null hypothesis of no treatment effect. The mixed placebo tests suitable for standard DID delivers two graphs: the unrestricted mixed placebo and the restricted mixed placebo. The restricted mixed placebo is the most suitable of both given that it maintains the cohort structure.

Table 15: List of countries in the sample and dates of currency crises

Derivative users	Dates of currency crises	Non-Derivative users	Dates of currency crises
Argentina	2002; 2013-2016; 2018	Botswana	
Bahrain		Egypt	2003; 2016-2017
Brazil	1999; 2002; 2008; 2015	Guatemala	
Bulgaria		Honduras	
Chili		Iran	2013
China		Jordan	
Columbia	2015	Kazakhstan	
Czechia		Kuwait	
Estonia		Lebanon	
Hong Kong		Mauritius	
Hungary		Moldova	1998-1999; 2015
India		Mongolia	
Indonesia	1998; 2000	Morrocco	
Israel		Namibia	2001; 2008; 2015
Korea, Rep.	1998	Nicaragua	
Latvia		Nigeria	1999; 2016
Lithuania		Pakistan	
Malaysia	1998	Panama	
Mexico		Paraguay	2001-2002
Peru		Qatar	
Philippines	1998	Rwanda	
Poland		Tunisia	
Romania	1999	Ukraine	1998-1999; 2008-2009; 2014-2015
Russia	1998-1999; 2014-2015	Uruguay	2012
Saudi Arabia			
Singapore			
Slovak Republic			
South Africa	2001; 2008; 2015		
Thailand			
Turkey	1999; 2001; 2008; 2018		

This table shows the group of derivative users and non-derivative users. It also reports the currency crises that have occurred over the period 1998-2022.

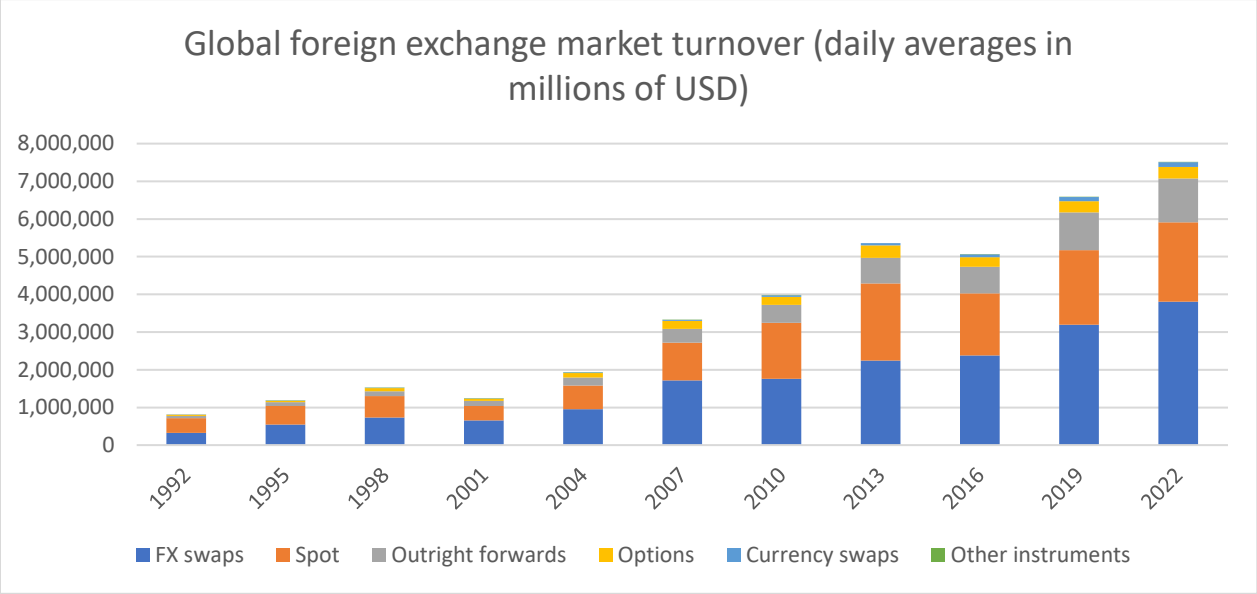
Figure 1: Notional amounts of OTC derivatives contracts by risk category



Source: BIS OTC derivatives statistics

On average, interest rate derivatives account for 80% of the OTC derivative deals in all markets over the period 1998-2022. The graph shows that interest rate derivatives and currency derivatives became a flash point during the Great Financial Crisis (2007-2008). It also shows that financial derivative trading was low during the Asian financial crisis in 1997. Global financial events (such as the Asian financial crisis, the Global financial crisis) and the rising uncertainties prompted by the war in Ukraine are feeding the trend of financial derivative contracts.

Figure 2: Global currency derivative market turnover in millions of USD (daily averages)

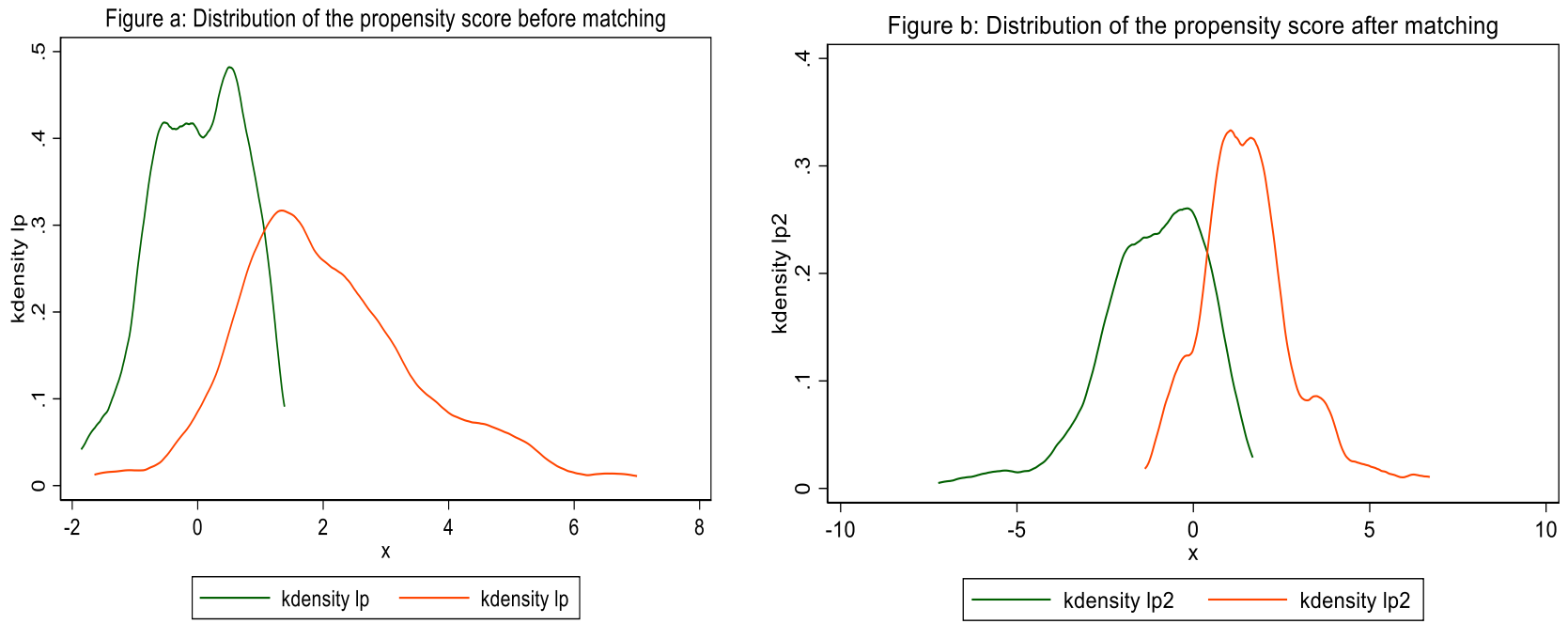


Source: BIS Central Bank Triennial Survey

Figure 2 shows the global foreign exchange market turnover in millions of USD (daily averages)8. It shows that the trading of foreign exchange instruments has paced up at an extraordinary speed. Overall, turnover averaged 7.5 trillion USD per day in 2022, a volume that is 14% higher than in 2019 and more than 125% the level reached in 2007. Currency swaps, spot and outright forwards represent the most traded currency derivatives.

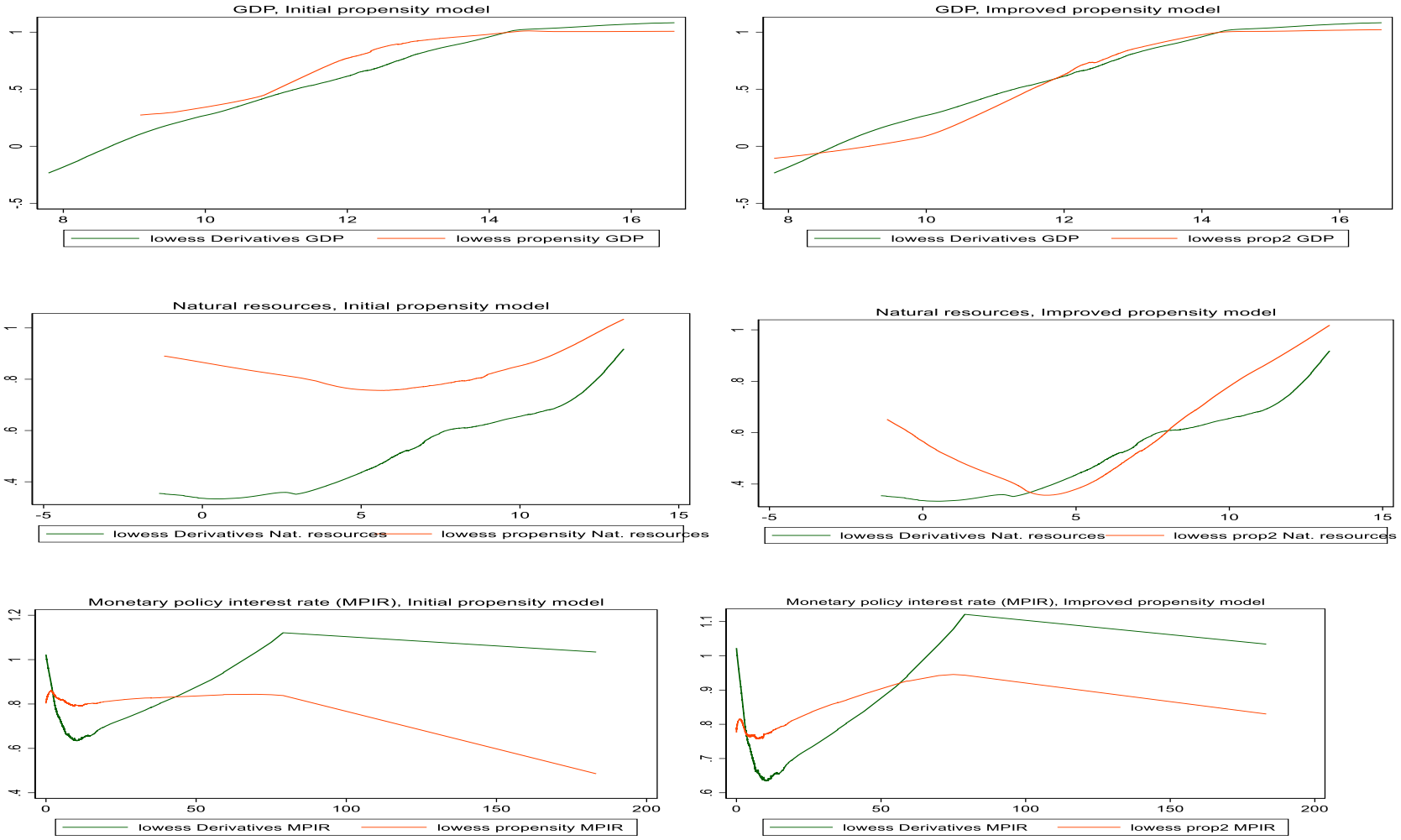
[8] The BIS Triennial Central Bank Survey of Foreign Exchange and Over-the-counter (OTC) Derivatives Markets shows that USD accounts for 44% of the daily foreign exchange deals in 2022 and Euro represented 15.5% of the deal notional amounts. The renminbi which was the fifth currency used in the trading represented only 3.5% of the global exchange. The turnover of OTC interest rate derivatives by currency shows that USD holds a similar position with a 44% of the daily notional amounts and Euro came second with 34%. The renminbi came as a distant 10th with only 1% of the daily trading. The monopolization of just a few currencies (USD, euro, British pound, Australian dollar, Japanese yen and the Canadian dollar) limits the share of the trading of emerging markets economies currencies and poses a continued problem for those borrowing in dollar or euro and investing in a different currency and then repaying back in dollar or euro.

Figure 3: Distributions of log odds of propensity Score



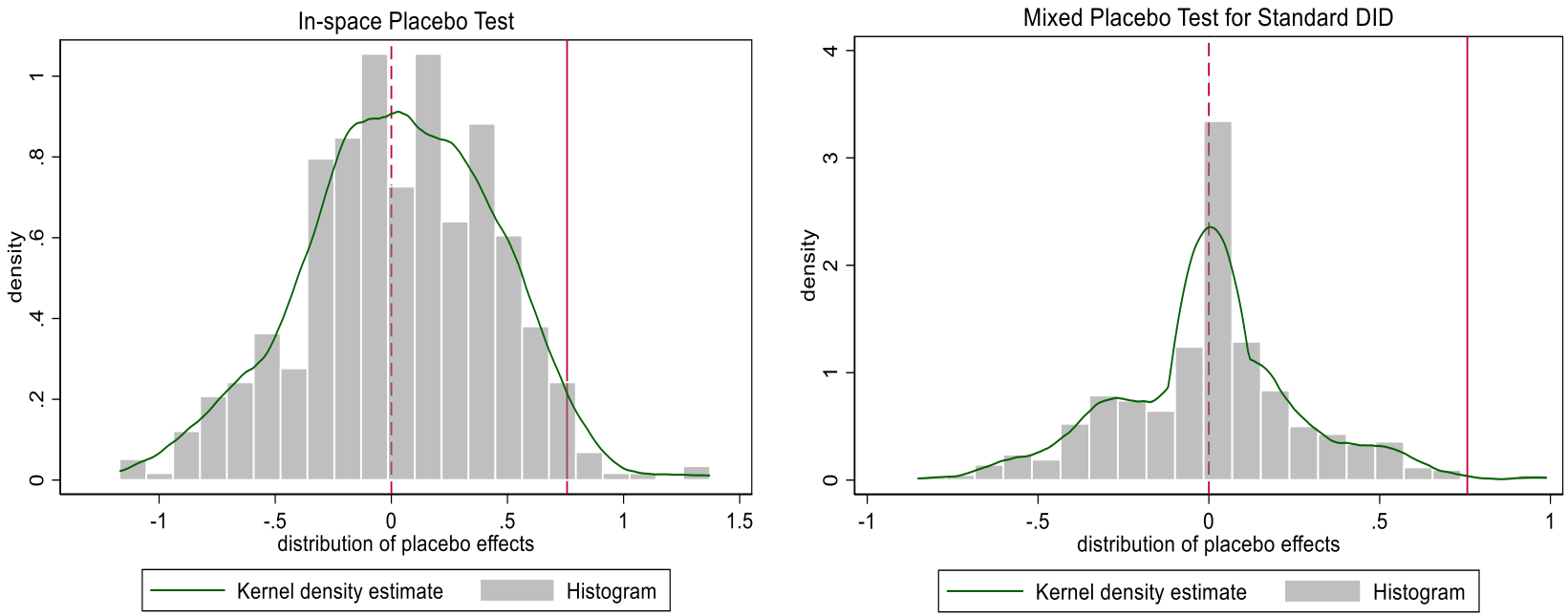
Note. The log of the odds of the propensity score (called the linear predictor, lp), rather than the propensity score itself is used here since it tends to be more normally distributed. Propensity scores tend to be higher in the treated than the untreated after matching.

Figure 4: Analysis of the parallel trend assumption: Comparison of observed and predicted associations between confounders and treatment



Note. The graphs show that the plots are parallel in GDP, making it a good fit in the propensity model. However, the plots in the initial and improved propensity models show that natural resources and monetary policy interest rate are causing the poor fit in the propensity model. As a result, both variables were removed.

Figure 5: Distribution of placebo effects in in-space and mixed placebo tests for the standard DID design (TWFE)



In-space placebo test randomly assigns treatment status to all units in the sample. Therefore, the distribution of placebo effects from in-space placebo tests is conditional on the actual treatment time. A mixed placebo test, however, represents a more complete randomizing process since both treatment status and treatment time are randomly selected. The estimated treatment effect (shown as a solid vertical line) is located towards the right-tail of the distribution of placebo effects. The p-values in both in-space and mixed placebo tests are less than 0.1, showing statistical significance of the treatment effect at at least 10% level.

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