Currency Risk Under Capital Controls

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Abstract

Currencies in emerging markets with stricter capital controls exhibit lower average returns, unexplained by standard currency risk factors. This relation is pronounced in debtor countries with high foreign currency liability shares. Capital controls mitigate currency risk by preventing depreciation during market turmoil. We propose an intermediary asset pricing model incorporating an occasionally binding credit constraint for borrowing countries. Capital controls lower crises probability and reduce currency crashes. The model replicates the empirical findings and quantifies the financial impact of pecuniary externality. Based on the model, currency risk premia serve as a tool for policy evaluation.

Key words: Capital control, Currency risk, Risk premia, Emerging markets

JEL classification: F31, F38, G15

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1 Introduction

Capital account liberalization and financial integration were once considered as a panacea for the development of emerging market (EM) economies. Free capital flows can support productive investment and consumption smoothing. However, this view has been challenged by frequent financial crises in EM along the financial development over the past three decades, which are often accompanied by large capital outflows. In the recent two decades, the literature made both theoretical and empirical advances on the use of capital control policies as an optimal macroprudential policy to correct for inefficiencies and mitigate excessive macroeconomic and financial instability.[1] Specifically, capital controls reduce the severity of financial crises, current account reversals, and asset price crashes.

This paper studies an often neglected aspect of capital control policies: their impact on currency risk premia. We find that currencies with stricter capital controls tend to exhibit lower average returns in emerging markets, unexplained by standard risk factors. Moreover, capital controls decrease the risk exposure of currencies to global financial risk measured by the change of VIX. These findings support the risk-return tradeoff in the currency market, consistent with the literature on the asset pricing approach of exchange rates (Lustig et al., 2011). While most of this literature mainly considers the advanced economy (AE) currencies or a mix of AE and EM currencies, we specifically focus on the set of EM currencies and study the effect of policies related to capital flows.

We utilize the capital control indices constructed from the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAER) by Fernández et al. (2016). There is considerable variation in capital control policies in the cross section of countries. In the time-series dimension, capital controls are persistent, acyclical, and don't vary much over time. We construct four currency portfolios by sorting on countries' lagged capital control measure. Average currency returns decline from 6.13 percent per annum for the lowest-control portfolio to 1.83 percent for the highest-control portfolio. Buying the

[1]See Bianchi and Lorenzoni (2022) for a comprehensive survey.

lowest-control currencies and selling highest-control currencies leads to a sizable average excess return of 4.31 percent and a Sharpe Ratio of 0.71. In numerous tests, we confirm that these excess returns cannot be explained by the standard currency risk factors or characteristics associated with currency risk premia. We demonstrate the distinction between capital control sorted portfolios and carry trades through correlation analyses, double sorts, time-series asset pricing tests, and panel regressions. Contrary to the literature that has largely found elusive evidence on how capital controls affect exchange rates (Fernández et al., 2015), we find robust evidence that capital controls reduce currency risk premia. The key difference is that we focus on the expected currency return and risk premia rather than the contemporaneous exchange rate overvaluation/undervaluation and their changes.

Why do capital controls reduce currency risk premia, and are they effective under all economic conditions? Theoretical literature suggests that a country's external liability is a key factor determining the effect of capital controls. Countries with high debt levels are more prone to financial crises, causing their exchange rates to depreciate sharply during adverse economic conditions. When we analyze the interaction between capital controls and a country's external liability structure, we find that the impact of capital controls on currency risk premia is significantly more negative for debtor nations. Another important factor to consider is the currency composition of the liability. Reliance on foreign currency debt can create a currency mismatch between assets and liabilities, consequently compromising financial stability. Our findings confirm that the impact of capital controls is primarily concentrated on countries with higher foreign currency liabilities. In addition, we provide direct evidence that capital controls reduce currency depreciation in response to global financial risk measured by a hike in implied volatility, which has been shown as a primary risk factor in currencies (Lustig et al., 2011; Menkhoff et al., 2012a). The reduced risk exposure translates into a lower risk premia required by global investors to invest in these currencies.

In addition to the full-sample analysis, we present three case studies to provide more tangible evidence. First, we zoom in two notable episodes of crises during the Great Recession and the COVID-19 pandemic, using daily data and focusing on days with significant VIX changes. On days with large VIX spikes, exchange rates depreciate three times as much as in the full sample regression, and capital control policies prove more effective in preventing such depreciation. In contrast, a substantial reversal in VIX has a milder effect on exchange rate appreciation, and the presence or absence of capital control policies appears to make little difference. These findings suggest a nonlinear effect of capital controls in preventing exchange rate depreciations during crisis times. Second, we analyze the dynamics of the Brazilian Real in response to multiple foreign investment tax rate changes between 2008 and 2013. These tax rate shifts serve as well-identified changes in the intensity of capital control policies. Consistent with our primary results, average currency returns are lower on days with more stringent capital controls. When the Brazilian government announces a tax rate increase, the Brazilian Real appreciates on impact due to reduced risk premia. Lastly, we investigate the exchange rates of five East Asian currencies during the 1997-98 financial crisis. Notably, countries with more stringent capital control policies experienced less severe depreciations when the crisis struke.

One concern for our analysis is the potential endogeneity of capital control policies. Over time, capital controls may respond to macroeconomic and financial conditions. In the cross-section, countries implementing capital controls could be those exposed to larger risks. We acknowledge that there lack ideal exogenous shocks to capital control policies for multiple countries over a long period of time. Thus, we are cautious in interpreting the evidence as "causal". Nonetheless, we conduct a series of analysis to attempt to mitigate such concerns.

Recent literature found that capital controls are sticky and acyclical (Fernández et al., 2015). We affirm that GDP growth, current account, net foreign liability, and forward discount have no significant power to systemically explain the variation of capital control policies. The results also do not support the hypothesis that countries select their capital control policies based on their riskiness.

Although endogeneity is a concern in contemporaneous regressions, our tests on expected returns can partially mitigate this issue, as exchange rates are inherently challenging to predict systematically. To further address this concern, we change the sorting variable of capital control measure in the prior year to the full-sample average, the beginning of the sample value, or rolling three-year average. Our findings remain robust.

When examining the East Asian crisis, we also find that changes in capital controls are minimal and unrelated to the exchange rate changes. In addition, we conduct a conditional test using the full sample by categorizing observations into four quadrants based on the pair of signs in capital control and exchange rate changes to capture different possible endogenous relationships. For instance, quadrant 1 includes observations with more stringent capital controls and an appreciated currency, which represent possibilities that policy tools are used to control an inflow surge. Our analysis reveals that the relationship between capital control and currency risk premia exhibits insignificant differences across the four quadrants.

We conclude the empirical section by repeating the portfolio sorting exercise for AE currencies. Generally, AE have fewer capital controls in place, both in levels and their variations. Our findings reveal no significant difference in currency average returns across portfolios with varying capital control policies. This contrasting result aligns with the notion that capital controls are primarily advocated for emerging markets, as these economies tend to be more vulnerable to fluctuations in capital flows because of the lack of financial development, credit constraint, currency mismatch, etc.

We present an equilibrium intermediary-based asset pricing model to study the effect of capital control policies on currency risk and returns. In the model, a small open economy borrows from the rest of the world subject to an occasionally binding credit constraint. The borrower of the small open economy block resembles the canonical model of macroprudential policy (Bianchi, 2011). In cases where a country is heavily indebted and the constraint is close to binding, a negative shock to either the output or the tightness of the constraint may lead to a financial crisis characterized by a sharp decline in consumption, a reversal in the current account, and an exchange rate depreciation. This depreciation further tightens the constraint, causing the currency to depreciate even more. The resulting spiral of exchange rate depreciation exposes global investors to significant currency crashes when the constraint is triggered to bind. The model exhibits a nonlinear feature wherein more pronounced effects are observed in situations of negative shocks and high-debt states, which is consistent with our empirical findings.

In contrast to the macro literature, we model the lender as risk-averse global intermediaries that are exposed to two sources of risk: global macroeconomic risk and financial risk following the intermediary asset pricing literature, e.g., Du et al. (2023). These intermediaries require a larger risk premium to hold local currency bonds if their exchange rates depreciate during bad times. The model features both priced and unpriced risk as in Chernov et al. (2024).

Capital control policies increase the cost of borrowing and discourage debt accumulation, reducing the likelihood of a binding constraint and sharp currency depreciation when output is low or the borrowing constraint is tight. Thus, capital control reduces exchange rate exposures to global recession and financial conditioning tightening. As a result, global intermediaries demand lower risk premia to hold local currency bonds issued by countries implementing capital control policies.

The calibrated model is capable of quantitatively matching the business cycle moments of the borrowing country, the SDF dynamics of intermediaries, and the currency risk premia for countries with different degrees of capital controls. Both macro risk and financial risk are important for currency risk premia.

Exchange rate policies can alter the covariance of exchange rates with the marginal utility of global investors to make a currency safer (Hassan et al., 2023). Unlike these state-contingent exchange rate stabilization, we demonstrate that a simple, constant capital control tax can effectively change the covariance of exchange rates with investors' marginal utility in a similar fashion, resulting in a safer currency. A simple policy can offer adequate welfare improvement while encountering fewer implementation challenges, legislative constraints, and time consistency issues.

Evaluating capital control policies has typically been difficult. Our model proposes a financial approach to assess the welfare implication of capital controls using information about currency returns. Since the welfare improvement of capital controls arises from the risk reduction of the economy, risk premium is a natural tool to assess the welfare gain. In this regard, our macro-finance model provides new insights into welfare analysis that go beyond those offered by traditional macroeconomic models."

In an extension of the model, we introduce local currency debt and show the capital control's effect on currency risk premia declines with local currency debt.

Overall, the model quantifies the financial impact of pecuniary externality and the effectiveness of capital control policies.

Literature review. This paper bridges the two growing literature: currency risk premia in international asset pricing and capital controls in international macroeconomics.

Currency risk premia are determined by a variety of factors (Lustig et al., 2011; Menkhoff et al., 2012b, 2017; Della Corte et al., 2016; Verdelhan, 2018; Kremens and Martin, 2019; Colacito et al., 2020; Della Corte et al., 2023; Chernov et al., 2023; Della Corte et al., 2022). We identify a distinct source of currency risk associated with a country's capital control policy. The capital control mitigates the crash risk, which is priced in the currency returns (Farhi et al., 2009; Chernov et al., 2018). Unlike most literature focusing on AE or a broad set of currencies, we specifically examine EM currencies, where capitol controls play a pivotal role. The finding supports a risk-based view of EM exchange rates. Bansal and Dahlquist (2000) and Chernov et al. (2024) specifically study the EM currency premium.

Several equilibrium models have been proposed to explain currency risk premia through various economic mechanisms, such as aggregate demand (Pavlova and Rigobon, 2007), country size (Hassan, 2013), commodity trade (Ready et al., 2017), long-run risk (Colacito et al., 2018), trade centrality (Richmond, 2019), intermediary leverage (Fang, 2021), fiscal cyclicality (Jiang, 2022), cyclicality of wealth transfers (Dahlquist, Heyerdahl-Larsen, Pavlova, and Pénasse, 2022), among others. Unlike most complete market models, our approach focuses on a novel policy mechanism in an incomplete market with frictions. Currency risk studies in incomplete markets are usually characterized in a general setting without a full quantitative equilibrium model (Lustig and Verdelhan, 2019; Maurer and Tran, 2021; Jiang, 2023; Korsaye et al., 2023). Furthermore, we consider the intermediaries as marginal pricers and find that global financial risk contributes to a significant portion of the total premium, highlighting the importance of intermediaries as noted in prior research (Gabaix and Maggiori, 2015; Du et al., 2018; Fang and Liu, 2021; Du et al., 2023).

A vast body of literature has debated the advantages and disadvantages of capital account liberalization. Bianchi (2011) and Bianchi and Mendoza (2018) demonstrate that a pecuniary externality emerges when an emerging economy faces a credit constraint, and capital control policies are useful to achieve welfare improvement. Additionally, alternative microfoundations have been presented for the optimal use of capital control policies, such as aggregate demand externalities (Farhi and Werning, 2016; Schmitt-Grohé and Uribe, 2016), and terms of trade manipulation (Costinot et al., 2014). Rebucci and Ma (2019) and Bianchi and Lorenzoni (2022) provide comprehensive survey of the literature.

Our mechanism aligns well with the micro evidence concerning the effects of capital controls. Forbes (2007) and Alfaro et al. (2017) report that capital controls raise the cost of capital. Countries with capital controls in place exhibit growth resilience in crises (Ostry et al., 2012) and improved financial stability (Forbes et al., 2015). Keller (2019) and Bacchetta et al. (2023) show that capital controls alter the currency composition of foreign borrowing. However, the literature has provided limited evidence on the impact of capital controls on exchange rates (Fernández et al., 2015; Forbes et al., 2015; Rebucci and Ma, 2019). Our study makes progress on this front by adopting an asset pricing approach to study expected returns, rather than focusing solely on contemporaneous exchange rate levels.

Besides capital control policies, foreign exchange interventions (Hassan et al., 2023; Fratzscher et al., 2019) and foreign reserve policies (Bianchi and Lorenzoni, 2022) can also influence exchange rate dynamics. Benigno et al. (2016) theoretically compare the welfare effect of exchange rate policies and capital control policies. Our finding suggests that capital controls and other policies are not highly correlated or substitutable in the data, and capital controls have a distinct effect on currency risk, independent of other policies.

The remainder of the paper is structured as follows. Section 2 discusses the data we use and report the summary statistics. Section 3 presents the main empirical results. Section 4 lays out the model and its quantitative implications. Section 5 concludes the paper.

2 Data and Summary Statistics

In this section, we provide an overview of the data source and offer an initial examination of the capital control data.

2.1 Capital Controls

Capital controls are policies designed to limit capital account transactions. They are commonly implemented through taxes, reserve requirements, quantitative limits, restrictions, prohibitions, and authorizations. Since capital controls have various aspects and practices differ across countries, obtaining a precise measure of capital controls is challenging. In our study, we use the most comprehensive measure of capital control to date, as constructed by Fernández et al. (2016). Here, we briefly describe the essential features of the capital control measures relevant to our study and refer the reader to Fernández et al. (2016) for more details.

The capital control measure is based on raw data from the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAER). The AREAER provides de jure legal restrictions and regulations for international transactions by asset categories for both inflows and outflows. Fernández et al. (2016) use the narrative description in the AREAER to determine the presence of restrictions on international transactions and interpret the narrative information according to a set of rules. They generate a binary indicator for each transaction and aggregate these indicators to a capital control index ranging between 0 and 1. A higher index value represents a greater breadth, comprehensiveness, and intensity of controls. There are ten asset classes in total, including money market instruments, bonds, equities, collective investments, derivatives, financial credits, commercial credits, guarantees, real estate, and direct investments. Each category has an inflow and outflow control measure. All indices are at an annual frequency and span from 1995 to 2020.

The capital control measure has some caveats. First, a higher capital control measure represents the presence of control for more asset categories but does not reflect the policy's intensity. We assume that the extensive margin of capital control correlates with its intensive margin, meaning that a country that imposes controls on broader asset categories is more likely to impose more stringent controls. Second, the de facto implementation of the policies can be more complicated than the de jure measure.

Our sample covers a wide range of 30 currencies to capture policy variations across different regions. We begin with EM currencies commonly used in the literature (Lustig et al., 2011). We include liquid and widely traded currencies with daily turnovers exceeding 1 billion US dollars[2], as documented in the BIS Triennial Central Bank Survey of foreign exchange, and currencies of mid-sized countries with GDP above 50 billion dollars. The EM currencies include Brazil, Chile, China, Czech, Egypt, Hungary, India, Indonesia, Israel, Kuwait, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Thailand, Turkey, Ukraine, Romania, Argentina, Kazakhstan, Peru, Colombia, Morocco, Pakistan, Vietnam, Sri Lanka, Ghana, and Tunisia. The other currencies are either subject to data availability or are economically less important.[3]

[2]The BIS Triennial Central Bank Survey of foreign exchange uses the criteria of 1 billion US dollars.

[3]In an early draft, we only study a set of 19 EM countries frequently studied in the literature. We also report these results in the appendix.

The G10 AE currencies are Australia, Canada, Euro/Germany[4], Japan, New Zealand, Norway, Sweden, Switzerland and United Kingdom.

The appendix provides detailed sources for other price and quantity data used in our empirical analysis.

2.2 Summary statistics

Table 1 presents the summary statistics of capital controls of countries in the sample, along with the averages for the EM and AE groups. Capital control policies are widely employed in EM, with an average capital control index of 0.59 and an average time-series standard deviation of 0.12. There is significant heterogeneity across countries. Some EM countries consistently maintain high levels of controls, such as China, India, Malaysia, Philippines, and Tunisia. Some countries utilize lower controls, such as Egypt, Israel, and Peru. Capital control measures exhibit high annual persistence of 0.75, which translates into a monthly persistence of 0.98.

EM have stricter capital controls than AE, as AE display small degrees of deviation from free capital mobility. In AE, the capital control indices have an average of 0.11 with a standard deviation of 0.06. The level of controls varies across countries. While Japan, UK, Norway, and Canada are close to perfect capital mobility, the capital controls of Australia, Germany, and Switzerland are around 0.2. The stark contrast between AE and EM motivates our separate analysis of these two groups of countries.

2.3 Exchange Rates

We gather monthly spot rates and one-month forward rates from Reuters and Barclays through Datastream.[5] We exclude turmoil episodes when data are deemed unreliable, fol-

[4]We use the Germany capital control index for Eurozone after the Euro was adopted.

[5]We use the standard source of forward rates from Datastream. In the appendix, we discuss the deliverable features of forwards and show the robustness of the results.

lowing the approach of Lustig et al. (2011).[6] Both spot and forward rates are defined as US dollars per unit of currency. Consequently, an increase in an exchange rate indicates an appreciation of the currency and a depreciation of the dollar.

Currency excess returns are calculated using future spot rates and current forward rates as follows:

$$rx_{t+1} = S_{t+1}/F_t - 1,$$

where rx_{t+1} denotes currency returns earned by investors who short the dollar and long foreign currency at time t. S_{t+1} is the next-period spot exchange rate; F_t is the forward rate.

3 Capital Controls and Currency Returns

3.1 Portfolio Sorting

To evaluate the relationship between capital controls and currency returns, we sort currencies into four portfolios based on their capital control indices. Since capital controls data are available only at an annual frequency, the sorting is performed once a year in September. We choose September as the cutoff month to avoid look-ahead bias. The annual AREAERs describe the status of capital control policy during their respective coverage periods. Before 2004, the coverage includes the previous year and the early current year, with no clear indication of the ending month. After 2004, the coverage includes the previous year and January through August (June/July for some years) of the current year. Therefore, selecting September as the cutoff month is a conservative choice.

Table 2 displays the average annualized returns for portfolios sorted on capital controls for EM. Countries with higher capital controls exhibit lower average currency returns. Average excess returns decrease monotonically from 6.13% for the lowest-control portfolio to 1.83% for the highest-control portfolio. Taking a long position in low-control currencies and a short position in high-control currencies, on average, generates a sizable and significant 4.31%

[6] In the appendix, we show that results are robust to the inclusion of the COVID-19 period.

excess return. This long/short strategy yields a Sharpe ratio of 0.71, which is comparable to the classic carry trade and other currency strategies. In Section 3.6, we further explore different sorting approaches and find robust results.

There is considerable heterogeneity in capital controls among the four portfolios. The least controlled portfolio has an average capital control index of 0.15, which is close to the average value for advanced economies. The most controlled portfolio has a control level of 0.90, indicating that almost all instruments face capital controls. To avoid the impact of outliers on the results, we exclude each currency and form the portfolios. The results are robust and are presented in the appendix.

To assess the extent to which capital controls reflect information in other country characteristics associated with currency returns, we present the average country characteristics of currencies across the four portfolios in Table 3.

Notably, currencies with higher capital controls exhibit lower forward discounts. While this may initially suggest that our findings are subsumed by the classic carry trade, further analysis proves otherwise. In the final column, we sort currencies by forward discount, create a long-short portfolio, and compute its correlation with the long-short portfolio sorted by capital controls. The low correlation of 0.09 between the two implies that they capture distinct risk factors. In contrast, many currency strategies are highly correlated with carry trades (Sarno et al., 2022). This distinction is supported by a panel regression analysis discussed in Section 3.3.

To further investigate the relationship between capital controls and carry trades, we perform a double sort by first sorting on forward discounts and then on capital controls. For high-interest-rate currencies, portfolios sorted by capital controls yield an average high-minus-low return of 6.47 percent. The impact of capital controls on low-interest-rate currencies is insignificant. Consequently, capital controls and carry trades are distinct return factors with some interactive effects. We report the detailed results in the appendix.

In our analysis, we take into account various characteristics that have been linked to currency risk premia in previous literature, such as net foreign liability (NFL) (Della Corte et al., 2016) and sovereign risk (Della Corte et al., 2022). However, we do not observe a systematic pattern of NFL or sovereign risk across the portfolios. Other characteristics we examine include the deviation from covered interest rate parity (CIP) (Du et al., 2018)[7] and the bid-ask spread as a liquidity measure. Neither of the two characteristics display a significant pattern across the four portfolios.

Governments often employ a combination of capital flow management and foreign exchange (FX) intervention policies to achieve their objectives. We separately examine these policies to investigate their impact on currency risk and return. Thanks to recent advancements in empirical literature, we can now more accurately measure different policies and distinguish their impacts. As shown in Table 3, there does not appear to be a correlation between the exchange rate regime and the degree of capital control. We utilize two measures of foreign exchange intervention: a binary variable that equals 1 for a sale or purchase of foreign exchange and 0 for no intervention, and the quantity of foreign currency purchases. Our analysis does not reveal a clear, systematic pattern in the joint use of FX intervention and capital control policies. The distinct roles of policies and their interactions are studied in Benigno et al. (2016) and Bianchi and Lorenzoni (2022), and in reality, may be influenced by political and legislative forces. We leave a comprehensive analysis of the interactive policy impacts on currency risks to future research.

We construct long/short portfolios based on the additional characteristics discussed above. The correlations between each long/short portfolio and the capital control-sorted long/short portfolio are low, with the highest correlation being 0.32 for the CDS spread. These findings reinforce our conclusion that we have identified a previously unrecognized source of currency risk associated with capital control policies.

[7]The CIP deviations are measures as the dollar interest rate minus the synthetic dollar interest rate, based on Libor rates. Unlike the CIP deviations in AE that are mostly negative, those of EM change signs frequently in the sample. To assess the amount of derivations, we focus the absolute values.

3.2 Standard Currency Risk Factors

Having established the negative correlation between capital controls and currency excess returns, we explore whether these excess returns can be accounted for by existing currency risk factors identified in the literature.

First, we examine the most widely used risk factors in the currency market, the dollar and carry factors (Lustig et al., 2011). Table 4 presents the results of time-series asset pricing tests. Panel A provides the alphas of each portfolio, adjusted for exposure to the dollar and carry factors. The alphas and high-minus-low return maintain a similar magnitude and remain significant. The exposure of the four portfolios to the carry factor does not show any clear patterns. This suggests that the returns of the portfolios sorted by capital control cannot be explained by the dollar and carry factors alone. This outcome further reinforces the distinction between capital control and carry.

Next, we incorporate the momentum factor (Menkhoff et al., 2012b). Sarno et al. (2022) summarize that these three factors - the dollar, carry, and momentum - are the most relevant for currency pricing. We also employ the latent three-factor model, constructed by Sarno et al. (2022) using state-of-the-art econometric methodology. The average alphas remain significant when these three factors are controlled for.

Lastly, contrary to the common practice of using the full AE-EM sample, we construct the factors from the EM currencies in our sample. These factors could potentially provide more accurate pricing information specific to emerging market economies. Within the sample, the dollar, carry, and momentum factors demonstrate reasonable performance with average returns of 3.25%, 9.20%, and 5.07% respectively. In the asset pricing test, we continue to reject the null hypothesis of zero mean for the high-minus low portfolio.

3.3 Foreign Liability

In this section, we investigate whether the impact of capital controls on currency risk premia depends on a country's external imbalance. We opt for a panel regression approach by regressing currency i's excess returns $rx_{i,t+1}$ on the country's lagged capital control indices $CC_{i,t}$, country characteristics $X_{i,t}$, and their interactions, as illustrated in the following equation:

$$rx_{i,t+1} = \alpha + \beta_1 CC_{i,t} + \beta_2 X_{i,t} + \beta_3 CC_{i,t} \times X_{i,t} + u_{i,t} \tag{1}$$

Note that the regression is predictive in its nature so that variations in capital control capture the expected excess return of currency. The first column of Table 5 presents the panel regression results with only $CC_{i,t}$. We find that more stringent capital controls significantly predict lower future currency returns, which is consistent with our findings from the portfolio sorts. Regarding the magnitude, when an emerging market's control index increases from 0 to 1, its average currency return decreases by 3.90 percent per annum, which is similar to the return spread between the highest and lowest control portfolios.

The second column adds the control of forward discount as $X_{i,t}$ and shows the coefficient of capital control remains negative and significant. The magnitude of this effect has been reduced by approximately a quarter. This finding further validates that capital controls and carry are two largely separate phenomena, which is consistent with earlier evidence derived from the low correlation between carry and capital control sorted portfolios, double sorts, and time-series asset pricing tests.

From the macroprudential perspective, capital controls are typically implemented to prevent excessive borrowing or capital inflows during boom periods and to reduce the risk of capital flow reversals and exchange rate depreciation in bad times. Highly indebted countries are more susceptible to capital flow reversals, and their currency risk premia should decrease more when capital control policies are in place. In contrast, creditor countries do not have the same concerns about capital flow reversals. The third column of Table 5 supports this hypothesis when we use a dummy indicator for country indebtedness as $X_{i,t}$ and include its interaction with capital controls. This dummy takes a value of 1 when the country has a positive net foreign liability and 0 otherwise. The positive coefficient on the dummy is in line with the intermediary theory of Gabaix and Maggiori (2015) and the evidence in

Della Corte et al. (2016), which suggests that currencies of debtor countries have higher returns on average. Furthermore, the negative and statistically significant coefficient of the interaction term indicates that capital controls reduce currency risk premia more in debtor countries than in creditor countries. Capital controls do not reduce currency risk premia for countries with large positive net foreign assets.

In the fourth column, we replace the dummy with the ratio of a country's foreign currency liabilities to its total external liabilities (L^{FC}) to examine the impact of currency composition. Based on canonical models of macroprudential policy (Bianchi, 2011), the presence of foreign currency liabilities makes an economy fragile and cause the exchange rate to depreciate sharply during adverse times and capital controls can reduce currency risk more effectively. The coefficient on the interaction term is negative and statistically significant, validating this hypothesis. The marginal effect of capital controls on currency risk premia is larger if a country's foreign currency share in its liabilities increases.

3.4 Quantities of the Global Risk

The previous analysis demonstrates that capital controls reduce currency risk premia, particularly for countries with external debt in foreign currency. According to a risk-based explanation, a decrease in risk premia must be attributed to either a reduced risk exposure (quantity of risk) or a reduced price of risk. The capital control policies in an EM country is unlikely to change the price of risk of a global investor. In this section, we provide direct evidence that capital controls decrease exchange rate exposures to global risk measures, i.e., the quantity of risk.

We use the CBOE Volatility Index (VIX) as a measure of global risk, following the approach of Lustig et al. (2011). The VIX captures stock market volatility as well as overall risk appetite of households and financial intermediaries. To examine exchange rate risk exposures, we employ the following regression:

$$rx_{i,t+1} = \alpha + \beta_1 \Delta VIX_{t+1} + \beta_2 \Delta VIX_{t+1} \times CC_{i,t} + u_{i,t} \tag{2}$$

Table 6 presents the results, which show that currencies generally depreciate against the US dollar when the VIX increases. On average, if there is no capital control, a currency will depreciate by 2.72 percent in response to a 1 percent increase in VIX. Tighter capital controls help mitigate depreciation during times of VIX spikes. In terms of magnitude, a currency with a capital control index of 1 will depreciate by 0.95 percent less in response to a one-percent VIX increase. In the second column, we use an alternative measure from the global currency market, the JP Morgan G7 currency implied volatility (VXY) and find similar results.

3.5 Case Study

The analysis of capital controls and currency risk premia is based on a panel of 30 countries over 25 years. In this section, we examine several particular episodes and countries that are typical for our setting as case studies to make our argument more tangible.

3.5.1 Global Crises

Section 3.4 demonstrates that currencies with higher capital controls tend to depreciate less when global risk is elevated. This phenomenon is most pronounced during crisis periods. In this analysis, we specifically focus on two global crisis episodes: the 2007-08 Global Financial Crises (GFC) and the COVID-19 episode in 2020. We use high-frequency daily data to rerun the regression in Equation (2).

Table 7 presents the results. The first column replicates the regression using daily data for the entire sample, yielding results similar to the monthly findings displayed in Table 6. The second and third columns limit the sample to days in 2008 (GFC) and 2020 (COVID) when the VIX experiences a significant increase of more than 5 compared to the previous day.

In both instances, the coefficients of VIX change and the interaction term are substantially larger in magnitude than the full-sample estimate in the first column. During the GFC, a surge in VIX has more than twice the impact on exchange rate depreciation as compared to the full sample. The effect of capital control in mitigating depreciation during the GFC is more than three times larger, suggesting that capital controls are particularly effective on days marked by considerable market turmoil. Similar results are observed for the COVID-19 episode. Conversely, the last two columns indicate that a decrease in VIX has an exchange rate effect comparable to the full sample, with capital control being insignificant in reducing the exchange rate response.

The asymmetric effect of capital control during turmoil and cooling episodes is useful for understanding the underlying mechanisms. In the latter part of the paper, we introduce a model featuring occasionally binding credit constraints that can generate nonlinear effects of capital control policies. In this model, a negative shock that triggers a crisis has a disproportionately larger impact because it activates the binding of the constraint, resulting in a sharp exchange rate depreciation. Following the binding constraint and the deleveraging process, a subsequent positive shock does not restore the balance sheet to its pre-crisis level, resulting in a more moderate effect.

3.5.2 Brazil

This section investigates the case of capital controls in Brazil. From 2008 to 2013, Brazil frequently implemented tightening and easing capital control policies through altering the Imposto Sobre Operacoes Financeiras (IOF) tax rates, a discriminatory tax imposed on foreign investments. Alfaro et al. (2017) demonstrate that the capital controls announcements surprised most market participants. With well-documented and identifiable policy changes, this case presents an ideal opportunity to study the effects of capital controls on exchange rates and enhance our research with an intensive measure of capital controls. This analysis complements our full-sample analysis that relies on a comprehensive measure of capital control policy on the extensive margin.

Utilizing the documented days of capital control policy changes identified in Alfaro et al. (2017), we analyze the average excess return of the Brazilian Real under various tax rates. This is done by regressing the daily excess returns of the Brazilian Real on the debt IOF tax rates. The resulting coefficient is -1.68 and statistically significant with a t-statistic of -1.85. This finding indicates that when Brazil imposes a higher capital control tax, the subsequent average currency return is lower.

Next, we examine the announcement effect of capital control changes on the Brazilian Real exchange rate. As documented by Alfaro et al. (2017), the aim of changing capital control policy is to prevent excessive inflow of foreign capital. According to the conventional view of direct contemporaneous effect, an increase in capital control tax should reduce the inflow and depreciate the currency. However, under our currency risk channel, higher capital controls actually decrease the risk premium and appreciate the exchange rate instantaneously. Figure 1 illustrates the relationship between changes in capital control tax rate and exchange rate changes over a 3-day window. When the government announces an increase in the capital control tax rate, we observe an appreciation of the Brazilian Real within this short window following the announcement.[8] The exchange rate behavior upon announcement of policy changes supports our currency risk channel.

3.5.3 Asian Financial Crisis

Our final case study focuses on the Asian Financial Crisis of 1997-98. This crisis stands as a notable event in international financial history, characterized by significant capital outflow and currency depreciation. We aim to investigate the conduct of capital control policies and their effects.

In Figure 2, we plot the exchange rate changes during the crisis for five emerging market currencies: Korean Won, Philippine Peso, Malaysian Ringgit, Indian Rupee, and Indonesian

[8] The relationship is robust to a window length of 1 day or 2 days.

Rupiah. The time window spans from June 1997 to January 1998, a period when all five currencies experienced sharp depreciations. In the left panel, the horizontal axis represents these countries' pre-crisis capital control levels in early 1997. The results show that countries with more stringent capital controls before the crisis experienced relatively less currency depreciation during the crisis. The cross-section fit is at a high level, which implies the degree of capital control policies before the crisis largely explains the magnitude of currency depreciation during the crisis. This finding suggests that capital control policies adopted before a crisis may help to mitigate the severity of currency crashes when a crisis hits.

In the right panel, we replace the horizontal axis with the capital control change during the crisis and examine its correlation with exchange rate depreciations. The correlation is weak, suggesting that it is unlikely that the countries adjust the controls in response to the currency depreciation.

3.6 The Endogeneity of Capital Controls

One natural concern about our findings is the endogeneity that capital control policies may respond to exchange rate fluctuations. For instance, in the time series, if capital controls are enacted in anticipation of capital outflow and significant depreciation, it would be expected to observe that currencies with high control yield lower average returns. In the cross-section, countries that adopt capital controls could be those facing significant risks and benefit the most from such policies. Ideally, it requires well-identified exogenous shocks to capital control policies to study their impacts of currency risk premia. While such shocks are present for certain episodes in specific countries (such as Brazil in the previous section), there lacks exogenous shocks to capital control policies that cover multiple countries for a long period of time. Therefore, we are cautious in interpreting our findings as "causal" evidence. However, on the other hand, we conduct a series of analysis that attempts to rule out potential endogeneity concerns.

The recent international macroeconomics literature finds that capital controls are sticky and acyclical to the output gaps, capital flows, and exchange rates (Fernández et al., 2015). We confirm and expand their results in our sample. We project capital controls on various macroeconomic, external, and financial conditions in panel regressions and report results in Table 8. We address both the endogeneity in the cross-section and the time series with different specifications of fixed effects. The results show that capital controls are unlikely to respond to cyclical economic and financial factors. Most of the regressors, such as GDP growth, current account, net foreign liability and forward discount have no significant power to systemically explain the variation of capital control policies. Capital control policies are usually the outcome of idiosyncratic political and policy decisions in the cross-section and sticky over time.

A potential concern for endogeneity is the possibility that countries select their capital control policies based on their riskiness. Countries with higher risk profiles are more likely to enforce strict capital controls. However, with regard to currency risk, Table 8 indicates that greater FX volatility is associated with fewer capital controls. This suggestive evidence is inconsistent with the selection hypothesis. Rather, the negative relationship is more likely a reflection of the effect of capital control policies. That is, stringent controls lead to reduced volatility.

The potential concern for selection even strengthen our results on the effect of capital controls. For another type of risk, sovereign risk, Table 8 indicates that countries with a higher CDS spread enforce stricter capital controls. Such selection would suggest that currencies with high capital control have higher risk premia (Della Corte et al. 2022), which is opposite to our data findings. Therefore, our benchmark result may even underestimate the effect of capital controls on reducing currency risks.

The endogeneity concerns in the time series can be mitigated due to the empirically acyclical nature of capital control and other factors. On one hand, exchange rates are infamously hard to predict, rendering it unlikely for capital control policies to respond to expected exchange rates. On the other hand, the direction of changes in capital control policy is ambiguous. Controls are often implemented in anticipation of both stopping capital outflows and depreciation or preventing hot money inflows and appreciation. Therefore, even if countries could react to expected currency appreciation or depreciation, the implied relationship between capital control and currency return would remain ambiguous.

We employ various approaches to alleviate these concerns, demonstrating that our findings are unlikely to be influenced by the endogenous response of capital control policies to exchange rates. The case of Brazil offers an example of exogenous policy variations within a country. The absence of systemic policy responses during the Asian Financial Crisis suggests that capital control policies are sluggish and inactive. In this section, we present additional evidence to address the endogeneity issue.

3.6.1 Unconditional Sorts

As we show in Table 1, capital controls tend to persist over time. Consequently, the annual rebalanced portfolios are more likely to capture the cross-sectional heterogeneity of capital control policies across countries rather than the time-series variation. To validate this hypothesis, we create currency portfolios based on a one-time sorting. In the first and second panels of Table 9, we sort currencies into four portfolios based on the sample average level of capital controls and the average of the first three years of capital controls.

The sample average sorted portfolios are likely to better capture a country's average characteristics, although they cannot be implemented in real time. The sorts based on the first three-year average can be executed in real time, but they may not accurately represent a country's overall capital control policy over two decades. With both unconditional sorts, the composition of portfolios remains constant throughout the entire sample period, and the results are consistent across these two sorts as well as the benchmark annual rebalanced portfolios. In the fixed portfolio sorts, countries with higher capital controls exhibit lower currency returns. The spread between high- and low-control currencies is -2.85% for the sample average and -2.96% for the average of the first three years. These findings confirm that the relationship between capital control and currency risk premiums is primarily cross-sectional and stems from a country's slow-moving capital control practices.

3.6.2 Lagged-Capital Control Sorts

To further investigate the potential time-series dynamics, we include additional lags for the capital control policy in our portfolio sorting process to account for potential delays in policy response. The more lagged the capital control policy is, the less likely it is to react to expected exchange rates in the distant future. We rearrange portfolios based on (i) capital control levels from two years prior, and (ii) a rolling average of capital controls over a three-year window. The results are displayed in Panel C and D of Table 9. For both sorting approaches, the findings align with our benchmark results.

3.6.3 Conditional Tests

To further address the endogeneity concerns, we test the benchmark results conditional on different relationships between capital control and currency returns. We classify all observations into four quadrants. Quadrant 1 includes observations with more stringent capital controls and an appreciated currency, i.e., $\Delta CC > 0, \Delta S > 0$. These observations potentially represent cases of endogenous policy tools being used to control an inflow surge. Quadrant 2 contains observations with $\Delta CC < 0, \Delta S > 0$, representing cases of accommodative policies for inflows. Similarly, quadrant 3 contains observations with $\Delta CC < 0, \Delta S < 0$ and quadrant 4 contains observations with $\Delta CC > 0, \Delta S < 0$. Each of the four quadrants indicates one possible direction of endogeneity. We examine whether the relationship between capital control and currency return exhibits significant differences across these four quadrants by including four dummy variables: quad1, quad2, quad3, and quad4. These variables take the value of one if an observation falls into the respective quadrant.[9]

Table 10 displays the results. As the base group, when capital control does not change

[9]We categorize observations into four quadrants once a year at the end of August. The changes are measured over the past 12 months.

and all four dummy variables quad1, quad2, quad3, and quad4 are zero, a country with a capital control of 1 has a 4.13% lower return per annum than a country without capital control. For observations in quadrant 1, where capital controls are intensified and the exchange rate appreciates, the interaction term of CC and quad1 is insignificant. This indicates that the relationship between capital control and currency return does not change. The interaction terms are also insignificant for the other three dummy variables. Consequently, the association between higher capital controls and lower currency returns is not a phenomenon concentrated in any subsample with potential endogenous relationships between capital control changes and exchange rate changes.

3.7 Capital controls on inflow, outflow and different asset markets

So far, our results have been based on a comprehensive aggregate capital control measure for each country. This measure is the average of capital controls for capital inflows (kai) and outflows (kao) across 10 asset markets, including equity (eq), bonds or other debt securities (bo), money market instruments (mm), collective investment securities (ci), derivatives and other instruments (de), commercial credits (ccs), financial credits (fc), guarantees, sureties, and financial backup facilities (gs), direct investment (di), and real estate transactions (re). While the aggregate measure accurately reflects a country's overall policy stance, it does not capture the distinct impacts of control policies on different asset classes and flow directions. In this section, we delve deeper into the effects of capital controls within these subcategories on currency returns.

The upper panel of Table 11 displays the cross-sectional correlations between the 13 capital control indices. Cross-sectional correlations are first calculated across countries for each year and then averaged over time. Capital controls for inflows (kai) and outflows (kao) exhibit a high correlation of 0.81. The second panel of Table 11 presents the results for panel regressions of currency returns on each capital control subcategory. EM with higher capital controls for either inflows or outflows experience lower average currency returns. The direction of capital flows with capital controls does not make a significant difference. Apart from the fact that controls tend to comove in both directions, another potential reason for this result is that inflows are likely to flow out subsequently, especially in the case of short-term portfolio investments.

We further examine the 10 asset markets separately. Capital controls on equity, bonds, money markets, collective investment securities, derivatives, financial credit, and real estate have significant negative effects on currency returns. In contrast, capital controls on direct investments (di), commercial credit (ccs), guarantees (gs) do not significantly impact currency returns. These findings are reasonable, as direct investments generally have a longer-term focus and are less affected by fluctuations in both domestic and global economic environments. Moreover, commercial credit and guarantees are more closely associated with business activities rather than financial investments.

3.8 Advanced Economies

To conclude our empirical analysis, we shift our attention to the advanced economy currencies. Since AE generally have much lower levels of capital controls than EM, we treat them as two distinct groups of currencies that require separate analysis. We sort the G10 currencies into three portfolios based on their capital controls, following a procedure similar to the one in Table 2. We display in Table 12 that the returns of the three portfolios are almost identical and statistically indistinguishable from each other. This result is not surprising, as most AE adopt lenient capital control policies, and the majority of capital control studies have focused on EM. The macroprudential view of capital controls is primarily applicable to EM. The resilience of AE to capital flows is higher for various possible reasons, such as more developed domestic financial markets, less stringent credit constraints on external borrowing, and less currency mismatch on external liabilities. We also report panel regressions of AE in the appendix.

4 Model

The empirical analysis demonstrates that capital control policies reduce currency risks and returns, particularly for countries with significant foreign currency liabilities. In this section, we propose a quantitative equilibrium model to rationalize these facts. In the model, a small open economy borrows in an incomplete financial market facing currency mismatch and occasionally binding collateral constraints. This model serves as a standard framework in recent work (Mendoza, 2010; Bianchi, 2011; Bianchi and Lorenzoni, 2022). The framework successfully accounts for business cycles and financial crisis episodes in emerging market economies, offering a valuable quantitative laboratory for macroprudential policy analysis. Capital control policies reduce borrowing incentives for the small open economy, stabilizing net foreign asset adjustments and exchange rate fluctuations.

Our approach differs from the macro literature by incorporating risk-averse global intermediaries subject to constraints as marginal investors and emphasizing the currency risk premium effects of capital control policies. The model can reproduce our primary empirical findings that capital control policies reduce currency risk premium. Furthermore, the model indicates that exchange rate depreciation in response to a tightening of global financial conditions is mitigated by capital controls. Based on the model, currency risk premia serve as a tool for policy evaluation and welfare analysis.

4.1 The Small Open Economy

The setting of the small open economy mainly follows Bianchi (2011). There is a continuum of representative households that consume two goods: tradable and nontradable good. The total consumption is a CES aggregation of tradable and nontradable goods as

$$C_t = \left[\omega (C_t^T)^{-\eta} + (1-\omega)(C_t^N)^{-\eta}\right]^{-\frac{1}{\eta}} . \tag{3}$$

ω is the share of tradable consumption in aggregate consumption, and $\frac{1}{1+\eta}$ is the elasticity between tradable and nontradable good consumption. The optimization problem of the representative household is

$$E_0 \sum_{t=0}^{\infty} \beta^t u(C_t), \tag{4}$$

$$s.t. : q_t B_{t+1} + C_t^T + P_t^N C_t^N = B_t(1+\tau) + Y_t^T + P_t^N Y_t^N + T_t, \tag{5}$$

$$q_t B_{t+1} \geq -\kappa_t (P_t^N Y_t^N + Y_t^T). \tag{6}$$

Equation (5) represents the budget constraint. Following the convention in the literature, B_{t+1} is the face value of debt and q_t is the price of debt in tradable goods, equal to $1/R_t$, where R_t is the exogenous world interest rate. Households only issue non-state-contingent bonds denominated in the tradable good. This assumption will be relaxed in a subsequent extension.

Capital controls are implemented through a tax on external position at a rate of τ. For simplicity, we impose the capital control tax on borrowers; however, similar results would be obtained if the tax was imposed on lenders. Taxes are rebated to the consumers in a lump-sum fashion, i.e., $T_t = -B_t \tau$. When the tax rate is zero, the economy experiences free capital mobility. Y_t^T and Y_t^N are exogenous endowments of tradable and nontradable goods. To emphasize the global risk, we assume $y_t^N \equiv \log Y_t^N$ and $y_t^T \equiv \log Y_t^T$ follow the following exogenous AR(1) processes:

$$y_t^T = \rho_y y_{t-1}^T + \sigma_y \varepsilon_{y,t}. \tag{7}$$

$$y_t^N = \rho_n y_{t-1}^N + \sigma_n \varepsilon_{n,t} \tag{8}$$

Equation (6) describes the credit constraint that sets the borrowing limit for households. Households can borrow up to a proportion κ_t of their current income. The income level depends on the price of nontradable good or the real exchange rate P_t^N. A depreciation of the real exchange rate results in lower total income and a tightened borrowing limit. The stochastic nature of κ_t reflects the time-varying global financial condition and constraint tightness (Jermann and Quadrini, 2012; Boz and Mendoza, 2014). It follows an AR(1) process.

The optimality conditions of this small open economy consist of the following equations:

$$q_t u_{T,t} = E_t[\beta u_{T,t+1}] + q_t \mu_t, \tag{9}$$

$$P_t^N = \left(\frac{1-\omega}{\omega}\right)\left(\frac{C_t^T}{Y_t^N}\right)^{\eta+1}, \tag{10}$$

$$\mu_t \left[q_t B_{t+1} + \kappa_t (Y_t^T + P_t^N Y_t^N)\right] = 0, \mu_t \geq 0, q_t B_{t+1} + \kappa_t (Y_t^T + P_t^N Y_t^N) \geq 0, \tag{11}$$

Equation (9) represents the intertemporal Euler equations, where $u_{T,t}$ is the marginal utility of tradable consumption and μ_t is the Lagrangian multiplier associated with the credit constraint. Equation (10) characterizes the substitution between the two goods: tradable good consumption increases when nontradable price and the real exchange rate increases. Equation (11) is the complementary slack condition for the borrowing limit: if the constraint binds, $\mu_t > 0$, and the borrowing is determined by the credit constraint. Otherwise $\mu_t = 0$, and the borrowing and consumption are jointly determined by the Euler equation.

4.2 Global Intermediary Investors and the Currency Risk Premia

There exists a representative global intermediary that lends to the emerging economy. The intermediary has its SDF that takes the form

$$M_{t+1} = \exp(\mu_{m,t} - \lambda_y (y_{t+1}^T - y_t^T) - \lambda_\kappa (\kappa_{t+1} - \kappa_t)),$$

where y_t^T is the tradable good shock of the emerging economy. Generally, the global intermediary will not face the same macroeconomic shock as the emerging economy but only the common component contributes to the risk premia. Therefore, we abstract from the macroeconomic risk that is orthogonal to the emerging economy's tradable endowment shock.

Recent developments in international finance has emphasized the importance of global financial conditions and intermediary constraints in determining exchange rates. Therefore, we incorporate both the macroeconomic risk and financial risk in the stochastic discount factor. The factor κ_{t+1} enters the global intermediaries' SDF because the constraint faced by the emerging market is correlated with the global financial conditions. $\lambda_\kappa(\kappa_{t+1} - \kappa_t)$ reflects the intermediaries' concern about future financing frictions. Du, Hébert, and Huber (2023) derive an SDF in this form from a micro-founded intermediary asset pricing model. In the model, intermediaries invest risky assets on behalf of households subject to delegation frictions and regulatory constraints. The intermediary solves a constrained portfolio choice problem with an intertemporal hedging motive. A binding constraint increases the investment opportunities and thus the marginal utility of wealth.[10]

In this specification, during a global financial crisis, global intermediaries face a funding liquidity dry-up, which is also when the emerging economy struggles to borrow from the rest of the world using a given collateral value. If the currency depreciates more significantly in bad times—either when y^T_{t+1} is low or when κ_{t+1} is low—the currency offers a higher risk premium to the global intermediary.

We specify y^N as idiosyncratic shocks to the small open economy. Therefore, the fluctuations of y^N do not command a risk premium. Chernov et al. (2024) show that a large fraction of emerging market currency volatility is unpriced and is not compensated with risk premia. The inclusion of y^N reflects such unpriced risk. The y^N shock accounts for about equal share of real exchange rate fluctuations as the contribution of priced risk y^T. The share of unpriced risk in the model is thus similar to that discovered by Chernov et al. (2024) for EM currencies.

Let R^*_t denote the interest rate on the local currency bond (denominated in nontradable goods). The global intermediary's Euler equations for the foreign currency and local currency

[10]We refer readers to their paper for the microfoundation of such an SDF.

bonds are as follows:

$$E_t M_{t+1} R_t = 1, E_t M_{t+1} \left(\frac{R_t^* P_{t+1}^N}{P_t^N} \right) = 1 \tag{12}$$

4.3 Model Calibration

We solve the model by a global method of policy function iteration. The exogenous AR(1) process of y_t^T, y_t^N and κ_t are discretized to a Markov chain consisting of 125 states.

The small open economy block of the model's calibration follows Bianchi (2011), where parameter values are chosen to target the business cycle and financial crisis characteristics of a typical emerging market economy. Table 13 displays the parameter values. The persistence of the constraint tightness shock κ_t is based on the calibration of Boz and Mendoza (2014), and its unconditional volatility is calibrated at a conservative value of 0.01.

The model includes an additional global intermediary investor block that emphasizes the risk premia effect of capital control policies. As such, we need to calibrate the two prices of risks, λ_y and λ_κ. λ_y can be interpreted as the relative risk aversion coefficient and is set to be 5. The calibration of λ_κ poses a challenge due to the lack of clear guidance on the price of changing intermediary constraints in asset pricing literature. An exception is Du, Hébert, and Huber (2023). They construct a portfolio that unwinds the long-term covered interest arbitrage position after one period, which precisely exposes the investor to the risk of changing financial constraints. Therefore, the return of such portfolio reflects the compensation required by investors for taking the risk of future change in financial constraints. We calibrate λ_κ so that the variance of $\lambda_\kappa(\kappa_{t+1} - \kappa_t)$ matches its empirical equivalent in Du, Hébert, and Huber (2023).

4.4 Debt, Consumption, and Crisis

Figure 3 illustrates the decisions of the next-period debt B_{t+1} and tradable consumption C_t^T as a function of the current-period debt B_t, and demonstrates the occurrence of a financial crisis triggered by a negative shock. Due to the credit constraint, $B_{t+1}(B_t; y_t^T, y_t^N, \kappa_t)$ exhibits non-monotonicity with respect to both y_t^T and κ_t. When the current-period debt level is sufficiently high, the constraint becomes binding and B_{t+1} declines with B_t. The kink occurs at the point where the constraint shifts from being slack to binding. When debt levels are not too high and the constraint is slack, the consumption moderately decreases with debt level. However, when the constraint becomes binding, consumption drops significantly. The kink increases with y^T and κ, i.e., a higher value of y^T and κ both make the constraint less likely to bind.

The upper panel of the two figures depicts a crisis triggered by a negative endowment shock. The blue line represents the decision of B_{t+1} and C_t as a function of B_t fixing y^T and κ at their average values. In contrast, the red line displays the decision of B_{t+1} and C_t when y^T is at a low value. A crisis emerges when a negative y^T shock impacts the economy while B_t is close to the binding level, as indicated by the arrow in the figure. This binding constraint diminishes the maximum borrowing capacity, resulting in reduced consumption and a currency depreciation. The consequent low exchange rate further decreases the borrowing limit, leading to a downward spiral.

Similarly, the lower panels depict the occurrence of a crisis initiated by a negative financial shock. The red line displays the decisions of B_{t+1} and C_t when κ_t is at a low value. A crisis is triggered when a negative shock to κ_t impacts the economy at a high level of borrowing, as indicated by the arrow in the figure. This crisis is associated with a significant reversal in borrowing and reduction in consumption.

The model features strong nonlinearity and state dependence. In a low-debt state when the constraint is slack, the same shocks have minimal effect on borrowing and consumption.

4.5 Exchange Rate Risk and the Role of Capital Controls

Figure 4 showcases the exchange rate dynamics in response to a negative shock. The top two panels depict the change in the real exchange rate as it reacts to an endowment shock, assuming the economy begins with average values of y^T and κ. The upper left panel represents a low initial level of debt, while the right panel represents a high initial level of debt. We present solutions for two economic scenarios: one decentralized equilibrium without any capital control tax, and another economy with a consistent tax rate of four percent.

In general, reduced tradable output leads to lower tradable consumption for households and depreciation of the domestic currency. In a highly indebted economy, a negative shock can trigger a crisis and currency crash in a nonlinear fashion.

The real exchange rate depreciates less under capital control. Because of the state dependency, this protective effect is more pronounced in the high debt state. Capital control lowers the probability of constraint binding and the likelihood of a crisis. Additionally, there is a precautionary motive channel, where households are less concerned about the future possibility of a binding constraint, causing them to consume more today and strengthen the currency.

The two lower panels show the change in the real exchange rate in response to a financial shock. When the constraint tightens, agents reduce their consumption either due to the binding constraint or concerns that the constraint might bind in the future. Consequently, in both low and high debt states, the real exchange rate depreciates less in response to a negative shock to κ_t under capital control. We interpret κ_t as a shock to global financial conditions, such as the VIX. This result aligns with the empirical finding that the exchange rate depreciates in response to a VIX increase, and capital controls are effective in reducing the exposure.

The prior analysis demonstrates that capital control policies decrease exchange rate depreciations in response to negative shocks at specified debt levels. Furthermore, capital control alters the unconditional currency risk premium by changing the ergodic distribution of debt. Figure 5 displays the ergodic distribution of debt from simulations. Under capital control policies, households are discouraged from borrowing, causing the ergodic distribution to shift to the right. As exchange rate is more sensitive to shocks in high debt states, the likelihood of sharp real exchange rate depreciations occurring in the economy is reduced.

4.6 Moments

Table 14 presents the key macroeconomic moments of the model. The first two columns correspond to the economy with and without capital control, and the third column corresponds to the social planner's solution. A standard set of moments are reported, including consumption volatility, average debt-to-GDP ratio, current-account-to-GDP volatility, and the frequency of financial crises. A financial crisis satisfies two criteria: the credit constraint binds, and the current-account-to-GDP ratio exceeds two standard deviations above its mean. The economy with no control exhibits similar macro moments to those found in the literature, such as Bianchi (2011).

Capital control reduces the volatility of tradable consumption. When the economy is far from a binding constraint, capital control taxes increase the cost of borrowing, and households engage less in intertemporal consumption smoothing. As the economy approaches a binding constraint, the higher borrowing cost discourages households from increasing their debt, which in turn reduces the likelihood of encountering a binding constraint accompanied by a drastic consumption reduction and exchange rate depreciation in the future. The volatility of the current account decreases from 2.6 percent in the decentralized equilibrium to 1.4 percent under capital control. The last two rows of Panel A show the frequency of a binding constraint and the frequency of crises. The probability of experiencing a crisis without capital control is 4.5 percent, which is considerably higher than the 1.4 percent under capital control.

Table 15 presents the cross-section of currency returns. We have simulated four economies with capital control taxes of 0, 0.013, 0.027, and 0.04 respectively. Panel A reports the characteristics of currency returns in these four economies, each with different levels of capital controls. The currency with the least control shows the highest excess return, while the currency with the most control has the lowest excess return. The spread is significant, at approximately 3 percent, which is close to what we've observed in our data. The interest rate differential also decreases from 5.85 percent to 2.55 percent.

The currency excess return is determined by the covariance between the global intermediary's SDF and exchange rate change. There are two sources of risk: macro risk and financial risk. The real exchange rate depreciates when the endowment is low and when the credit constraint is tight, both of which correspond to unfavorable conditions for the global intermediary. As a result, the real exchange rate of the small open economy is risky, and the investor requires a risk premium to hold the local currency bond. In the economy without capital control policies, global intermediaries demand a substantial, positive average excess return of 5.56 percent per annum. Capital control policies discourage households from borrowing, which in turn reduces the likelihood of a binding constraint and sharp currency depreciation. Implementing a strict capital control in P4 lowers the currency risk premium to 2.61 percent.

In Panel B, we recompute the currency risk premia setting $\lambda_\kappa = 0$. When macro risk is the sole source of risk that necessitates compensation, the average return spread is one percent, which is approximately one-third of the return spread observed in the previous analysis. This highlights the importance of considering both macro risk and financial risk when examining currency risk premia.

In Panel C, we sort currencies by interest rates (i.e., the carry trade portfolios) and report currency excess returns that increase with interest rate. The carry trade generates an excess return of 2.69 percent, while the interest rate differential is much larger at 12.74 percent. The model generates a carry trade because countries close to constraint binding have high interest rate and high risk premium.

Capital control policies decrease the exchange rate risks, risk premia, and thus the interest rate of the small open economy. Therefore, capital control is correlated with the domestic interest rate. When comparing Panel A and C, we observe significant differences in average interest rate differentials among the two high-minus-low portfolios. This suggests that sorting based on capital controls is not the same as sorting based on interest rates. Economically speaking, capital control policy is one of the factors determining a country's interest rate through its effect on exchange rate risk. However, other shocks all drive the endogenous interest rate. The correlation between the two high-minus-low portfolios is 0.43. The model leaves out many other sources of risk and cross-country heterogeneity documented in the carry trade literature. Introducing these factors would further separate carry and capital control and reduce the correlation to its data counterpart. Thus, while capital control policies are correlated with interest rates, they are not the only factors driving interest rates. Capital controls and interest rates are different determinants of the currency premium.

Furthermore, we perform the panel regressions in the empirical sections using model-simulated data in Table 16. Capital controls predict future currency returns. Even when controlling for the interest rate differential, the magnitude is only reduced by 20%, just like its data counterpart. We use $-\kappa$ as a proxy for VIX in the data, scaled to match the coefficient of $-\Delta\kappa_{t+1}$. The interaction term is positive and matches the data. Countries with stricter capital controls see their exchange rates depreciate less when global financial conditions tighten. Thus, the model and empirical results are tightly linked.

The analysis here is based on a model where all borrowing of the small open economy is denominated in the tradable good (foreign currency). This is prevalent among emerging market economies, who have long faced the challenge of being unable to easily issue debt in their local currencies, a phenomenon referred to as "original sin". In the recent years, the size of local currency borrowing increases gradually. To incorporate this effect, we extend the model by allowing the small open economy to borrow in both domestic and foreign currencies. We show that a higher local currency debt endogenously reduces the currency risk in the economy and thus mitigates the effect of capital controls in reducing currency risk premia. The appendix reports the detailed analysis.

4.7 Welfare Analysis

We evaluate the welfare gains of various capital control policies.

It is well-known that models with price-dependent credit constraint feature inefficiencies due to the presence of pecuniary externality (Bianchi, 2011; Bianchi and Mendoza, 2018). Agents fail to take into consideration the impact of their decisions on current and future real exchange rates, which determines the tightness of the credit constraint. The social planner's Euler equations are different from the decentralized equilibrium. The detailed characterization of the social planner's solution is in the appendix. The last column of Table 14 reports the moments under the social planner's solution. The social planner's solution features significant consumption reduction when the constraint is expected to bind in the future. Current account volatility is reduced to 1.0 percent and crisis probability is 0.8 percent.

Under the social planner's solution, the welfare gain reaches its highest value at 0.07 percent of permanent consumption. This relatively small figure reflects the minor welfare cost of business cycles. The welfare gains for flat capital control taxes, ranging from 1 to 5 percent, are illustrated in Figure 6. The welfare gain follows a hump-shaped pattern, peaking at a 3 percent tax. The welfare gain of a constant tax policy at the peak is approximately two-thirds of the social planner level. A simple policy can offer adequate welfare improvement while encountering fewer implementation challenges, legislative constraints, and time consistency issues (Bianchi and Mendoza, 2018).

Capital controls in reality are difficult to be mapped to a single constant tax rate, which complicates the process of matching models to data and assessing policies. Our model proposes an alternative approach based on currency returns. The lower panel displays the return spread under various degrees of capital controls. By examining the relationship between welfare gains and currency returns, we can use information on currency returns to assess the desirability of capital controls. Based on the calibration, our results suggest that a return spread of 2.1 percent represents the optimal degree of capital controls.

Exchange rate policies can alter the covariance of exchange rates with the marginal utility of global investors to make a currency safer, offer lower risk premia, and encourage capital accumulation (Hassan et al., 2016, 2023). Such policies require the manipulation of exchange rates in a state contingent fashion. We demonstrate that a simple, constant capital control tax can effectively change the covariance of exchange rates with investors' marginal utility in a similar fashion as Hassan et al. (2023), resulting in a safer currency. Our finding indicates some substitutability in capital control policies and exchange rate policies in changing exchange rate risk properties.

4.8 Capital Flows and Exchange Rates Dynamics

The conventional wisdom considers capital control affecting exchange rates through capital flows. When capital exits a country, the currency depreciates, while it appreciates when capital enters. Capital control policies affect inflows and outflows and thus exchange rates. The effect of capital controls on exchange rates depends on the direction of the flow from marginal investors that price the currency, which may differ from the actual capital flow. Therefore, it is not surprising that the literature finds elusive evidence on the contemporaneous relation between capital controls and exchange rates.

Our model not only confirms the conventional implications but also sheds new light on the relationship between capital flows, exchange rates, and capital control policies. The model proposes an additional explanation for why capital control policies impede capital flows, aside from increasing borrowing and lending rates. Specifically, capital control policies prevent the economy from amassing excessive debt and decrease the likelihood of encountering a binding constraint, thereby mitigating the risk of abrupt capital outflows.

The model highlights that the most significant period of capital outflow occurs during times of crisis. We conduct an event analysis of crisis episodes. We define $t = 0$ as the period when the crisis occurs. We calculate the average current account and exchange rates in these episodes (relative to period $t-1$) and illustrate the crisis dynamics in the first row in Figure 7. In the absence of capital control policies, the current account exhibits a significant reversal accompanied by a substantial capital outflow during the crisis period, causing the exchange rate to depreciate sharply. With capital control policies in place, both capital outflows and exchange rate depreciations are less severe. The behavior of capital flow and exchange rate during crisis periods aligns with the conventional view that currencies depreciate when capital exits, and capital controls help mitigate capital outflow and prevent exchange rate depreciation in these situations. More importantly, the probability of experiencing a crisis is much lower with capital controls, as shown in Table 14.

Exchange rates and capital flows exhibit fluctuations not only during crisis periods but also in normal times. The second and third rows of Figure 7 expands the event analysis to cover the entire sample of model simulations. We classify the sample path into periods with capital outflows and capital inflows. Similar to the crisis dynamics, we depict the behavior of capital flows and exchange rates for two periods before and after the event. By construction, capital flows out during the outflow event at period 0 and flows in during the inflow event at period 0. As the conventional wisdom, the exchange rate depreciates (appreciates) when capital flows out (in).

Capital control policies decrease the magnitude of capital flows for reasons previously discussed. Exchange rate movements are significantly muted. As a result, capital control policies weaken the contemporaneous correlation between exchange rates and capital flows. The effect of capital controls mitigates exchange rate depreciation (appreciation) when capital flows out (in). This pattern suggests that a contemporaneous relationship between capital controls and exchange rate is hard to discover.

5 Conclusion

Capital controls are a two-edged sword. It impedes consumption smoothing and the financing of investment opportunities, potentially affecting the capital formation and growth of an economy. Meanwhile, it reduces drastic capital flows and improves financial stability. From an asset pricing perspective, this paper provides evidence and theory that countries under tighter capital controls have lower average currency returns in emerging markets. We find that the capital control effect is concentrated in debtors countries, especially those with a high share of debt in foreign currencies. These countries are more prone to financial crisis and currency crashes. We further show that capital controls indeed reduce the currency exposure to global systemic risk. We propose an equilibrium intermediary asset pricing model that demonstrates the exposure of currencies to global financial risks and the beneficial effect of capital controls on mitigating this risk. The model quantitatively matches our empirical findings.

The empirical and theoretical results are largely consistent with the macroprudential view of capital controls. In fact, the views on capital controls have gradually shifted from being a market friction to a macroprudential tool. The IMF, who used to be an important advocate for free capital flow, stated in the taxonomy of capital flow management: "There is no presumption that full liberalization is an appropriate goal for all countries at all times." Our evidence lends further support to the use of capital controls especially for countries with low resilience to global shocks.

With the rising adoption of the capital control policy, it becomes an increasingly important determinant of exchange rates. While the effect of capital controls on the macroeconomy has been extensively studied, we bring the insight of this literature to understanding the risk and returns of currencies. The consequential effect of risk premia can feed back into the macroeconomy and have rich implications on capital flow management. Future work can study the optimal policy in a production economy taking into account the documented effects on currency risk. Potentially, the joint dynamics of capital controls and the exchange rate can serve as a barometer to evaluate the resilience of the economy to capital flows and guide the policy designs. The interaction between capital controls, currency intervention, and reserve management is worth more investigation. Furthermore, a richer model with gross position in different asset classes, such as Dou and Verdelhan (2015), can be used to study different types of capital controls. Empirically, the portfolio-based demand system approach in Jiang et al. (2023) can be a useful and coherent laboratory to further study the effect of capital controls on flows and asset prices.

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Table 1: Summary statistics: capital controls

	mean	sd	high	low	ac(1)	cc=0 (%)
EM Average	0.59	0.12	0.80	0.41	0.75	0.04
AE Average	0.11	0.06	0.19	0.04	0.73	0.26
EM:						
Argentina	0.51	0.33	0.90	0.06	0.80	0.00
Brazil	0.63	0.17	0.88	0.28	0.76	0.00
Chile	0.39	0.27	0.93	0.23	0.94	0.00
China	0.96	0.06	1.00	0.80	0.80	0.00
Colombia	0.63	0.10	0.82	0.48	0.51	0.00
Czech Republic	0.29	0.14	0.48	0.05	0.68	0.00
Egypt	0.17	0.07	0.25	0.03	0.81	0.00
Ghana	0.52	0.21	0.88	0.33	0.91	0.00
Hungary	0.24	0.28	0.75	0.00	0.83	0.08
India	0.97	0.02	1.00	0.95	0.86	0.00
Indonesia	0.64	0.06	0.70	0.50	0.65	0.00
Israel	0.13	0.17	0.55	0.00	0.82	0.32
Kazakhstan	0.48	0.20	0.81	0.08	0.89	0.00
Kuwait	0.35	0.07	0.45	0.11	0.76	0.00
Malaysia	0.81	0.05	0.88	0.72	0.61	0.00
Mexico	0.60	0.08	0.94	0.53	0.17	0.00
Morocco	0.76	0.03	0.78	0.67	0.63	0.00
Pakistan	0.73	0.08	0.88	0.63	0.69	0.00
Peru	0.01	0.01	0.05	0.00	0.71	0.76
Philippines	0.85	0.07	0.98	0.75	0.80	0.00
Poland	0.72	0.15	1.00	0.55	0.81	0.00
Romania	0.32	0.33	0.85	0.05	0.96	0.00
Russia	0.61	0.21	1.00	0.20	0.87	0.00
South Africa	0.65	0.05	0.75	0.58	0.90	0.00
Sri Lanka	0.99	0.02	1.00	0.95	0.85	0.00
Thailand	0.73	0.06	0.83	0.58	0.78	0.00
Tunisia	0.99	0.02	1.00	0.90	0.82	0.00
Turkey	0.46	0.18	0.70	0.23	0.96	0.00
Ukraine	0.80	0.05	0.94	0.75	0.78	0.00
Vietnam	0.89	0.11	0.95	0.39	0.17	0.00
AE:						
Australia	0.27	0.07	0.35	0.13	0.71	0.00
Canada	0.06	0.02	0.10	0.05	0.79	0.00
Germany	0.19	0.14	0.30	0.00	0.91	0.24
Japan	0.00	0.01	0.05	0.00	-0.04	0.96
New Zealand	0.10	0.01	0.13	0.10	0.91	0.00
Norway	0.05	0.03	0.08	0.00	0.87	0.28
Sweden	0.09	0.07	0.23	0.00	0.61	0.12
Switzerland	0.19	0.13	0.35	0.05	0.90	0.00
UK	0.02	0.04	0.13	0.00	0.88	0.72

Note: The table reports the summary statistics of the capital control indices of each country and the cross-country average in EM and AE. Data are annual from 1995 to 2020.

Table 2: Portfolio sort: capital controls

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
mean	6.13	2.74	2.40	1.83	-4.31
s.e.	1.49	2.14	1.65	1.00	1.21
t-stat	(4.11)	(1.29)	(1.46)	(1.83)	(-3.57)
sd	7.46	10.68	8.25	4.99	6.03
SR	0.82	0.26	0.29	0.37	-0.71
cc	0.15	0.46	0.69	0.90	0.76

Note: The table shows the summary statistics of portfolios sorted on capital controls. Means (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2021:8.

Table 3: Portfolio characteristics

	P1 (low cc)	P2	P3	P4 (high cc)	corr
capital control	0.15	0.46	0.69	0.90	
sd(cc)	0.09	0.06	0.02	0.03	
forward discount	10.10	7.05	6.12	5.19	0.09
net foreign liability(NFL)	0.06	-0.13	0.35	0.29	0.01
sd(NFL)	0.56	0.33	0.12	0.08	
credit default swap spread	2.41	2.10	3.14	1.93	0.32
bid-ask spread	0.14	0.22	0.17	0.15	0.03
abs(CIP)	228.29	124.96	162.57	189.20	0.27
exchange rate regime	2.68	2.74	2.75	2.19	-0.26
intervention (dummy)	0.22	0.11	0.11	0.16	0.02
intervention (quantity)	0.12	0.10	0.05	0.17	0.00
foreign reserve	0.19	0.15	0.16	0.19	0.10

Note: The table shows the average of country characteristics in portfolios sorted on capital controls. The characteristics include: means and standard deviations of capital controls, the forward discount, the means and standard deviations of the net foreign liability (NFL), the means of the credit default swap spread, the bid-ask spread, the absolute value of CIP deviation, the exchange rate regime, the intervention dummy and quantity measures, and the foreign reserves. The correlations between returns of the high-minus-low portfolios sorted on capital controls and other country characteristics are reported in the last column (corr). Data are monthly from 1996:9 to 2021:8.

Table 4: Asset pricing test

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
A. Dollar and Carry					
α	5.89	2.29	2.09	1.58	-4.31
	(6.12)	(1.25)	(1.56)	(2.11)	(-3.84)
β dollar	0.70	0.68	0.60	0.39	-0.31
	(19.28)	(9.78)	(12.03)	(13.83)	(-7.27)
β carry	0.08	0.11	0.07	0.08	-0.01
	(2.85)	(2.00)	(1.88)	(3.40)	(-0.17)
B. Dollar, Carry and Momentum					
α	5.91	2.35	2.04	1.62	-4.29
	(6.09)	(1.27)	(1.52)	(2.15)	(-3.80)
β dollar	0.70	0.67	0.60	0.38	-0.32
	(19.09)	(9.52)	(11.69)	(13.45)	(-7.43)
β carry	0.08	0.12	0.08	0.08	0.00
	(2.68)	(2.11)	(2.01)	(3.62)	(0.11)
β momentum	0.02	-0.07	-0.05	-0.05	-0.07
	(0.59)	(-0.95)	(-0.90)	(-1.69)	(-1.63)
C. Sarno et al three latent factor					
α	3.82	-2.11	-0.42	0.50	-3.32
	(3.51)	(-1.04)	(-0.31)	(0.64)	(-2.36)
β factor 1	0.13	0.12	0.10	0.07	-0.06
	(20.87)	(10.72)	(13.58)	(15.99)	(-7.36)
β factor 2	0.07	0.42	0.24	0.14	0.07
	(2.08)	(6.47)	(5.42)	(5.70)	(1.53)
β factor 3	0.03	-0.25	-0.11	-0.14	-0.17
	(0.60)	(-3.24)	(-2.13)	(-4.74)	(-3.07)
D. Dollar, Carry and Momentum EM					
α	2.86	-1.70	-0.99	0.02	-2.85
	(2.96)	(-1.61)	(-1.14)	(0.03)	(-2.39)
β dollar	0.97	1.28	1.09	0.67	-0.30
	(21.86)	(26.26)	(27.51)	(25.64)	(-5.46)
β carry	-0.08	0.13	-0.01	-0.06	0.02
	(-2.73)	(3.81)	(-0.32)	(-3.38)	(0.59)
β momentum	0.17	-0.18	-0.02	0.04	-0.14
	(7.14)	(-6.74)	(-0.77)	(2.64)	(-4.52)

Note: The table reports the results of asset pricing tests. In Panel A, the factors are the dollar and carry factors from Lustig et al. (2011). In Panel B, the factors are dollar, carry and momentum. Momentum factor is from Asness et al. (2013). In Panel C, the factors are the three latent factors in Sarno et al. (2022). In Panel D, the dollar, carry and momentum factors are constructed in the EM sample. Each panel shows the α and β from the asset pricing test and the associated t-statistics (t-stat). Data are monthly from 1996:9 to 2021:8.

Table 5: Capital controls and foreign liability

	rx_{t+1}			
CC_t	-3.90	-2.87	5.25	-7.26
	(-3.10)	(-2.29)	(2.06)	(-4.28)
fd_t		0.39		
		(2.63)		
NFL_t			6.60	
			(3.18)	
$CC_t \times NFL_t$			-10.89	
			(-3.89)	
L_t^{FC}				0.32
				(3.40)
$CC_t \times L_t^{FC}$				-0.35
				(-3.61)
R^2	0.08	1.74	0.16	0.59

Note: The table reports the panel regression results of currency returns on the lagged capital controls and variables related to the foreign investment positions and currency mismatches shown in Equation (1). fd is the forward discount. NFL is a dummy variable that equals to 1 when this country has a positive net foreign liability and 0 otherwise. L^{FC} indicates the ratio of foreign currency liabilities to its total external liabilities. The t-statistics (t-stat) are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table 6: Capital controls and risk exposures

	rx_{t+1}	
CC	-4.04	-3.78
	(-3.26)	(-3.16)
ΔVIX	-2.72	
	(-6.79)	
$CC \times \Delta VIX$	0.95	
	(3.50)	
ΔVXY		-11.35
		(-7.29)
$CC \times \Delta VXY$		4.10
		(3.81)
R^2	7.39	6.14

Note: The table reports the panel regression results of currency returns on the lagged capital controls and variables measuring global shocks which are the contemporaneous change in implied volatility, and their interaction in Equation (2). Implied volatility includes CBOE Volatility Index (VIX) and JP Morgan implied volatility in G7 currencies (VXY). The t-statistics (t-stat) are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table 7: Case study: Crisis

	Full sample	$\Delta VIX > 5$		$\Delta VIX < -5$	
		GFC	$COVID$	GFC	$COVID$
CC	-1.74	-86.30	-82.87	96.02	-11.15
	(-1.20)	(-0.71)	(-2.43)	(0.66)	(-0.14)
ΔVIX	-16.52	-46.10	-26.11	-15.15	-6.48
	(-11.74)	(-3.48)	(-7.03)	(-0.92)	(-0.87)
$CC \times \Delta VIX$	10.35	35.27	13.13	21.74	1.98
	(7.73)	(2.88)	(4.50)	(1.64)	(0.36)
R^2	1.02	9.06	17.59	0.83	0.84

Note: The table reports the panel regression results of change in exchange rates on the lagged capital controls and the contemporaneous change in implied volatility measured by CBOE Volatility Index (VIX), and their interaction. Columns "$\Delta VIX > 5$" and "$\Delta VIX < -5$" show regression results for time periods with positive VIX change exceeding 5 and negative VIX change exceeding -5. For each sample with increasing and decreasing VIX above 5, subsamples regarding the Global Financial Crisis (GFC) and Covid-19 (COVID) are reported respectively. The t-statistics (t-stat) are based on standard errors clustered by month. R^2 are in percentage points. Data are daily from 1996:9 to 2021:8.

Table 8: Capital control and other characteristics

	(1)	(2)	(3)	(4)
GDP growth	0.82	-0.11	1.41	0.05
	(0.98)	(-0.42)	(1.28)	(0.18)
Current account	-0.70	-0.31	-0.60	-0.24
	(-0.93)	(-1.06)	(-0.81)	(-0.83)
NFL	-0.02	0.11	0.01	0.12
	(-0.07)	(1.09)	(0.05)	(1.08)
Forward discount	-0.59	-0.22	-0.55	-0.15
	(-1.39)	(-0.93)	(-1.13)	(-0.66)
Equity Vol	-2.36	1.40	-5.81	1.82
	(-0.43)	(0.88)	(-0.77)	(0.82)
FX Vol	-20.70	-12.12	-20.43	-15.41
	(-1.11)	(-2.63)	(-1.07)	(-3.25)
CDS	1.00	0.22	1.08	0.23
	(2.90)	(1.82)	(3.15)	(2.20)
FE	no	currency	year	currency&year
R^2	11.00	92.80	12.90	93.20

Note: The table reports the results of contemporaneous regression of capital control on country characteristics. GDP growth is the annual change of gross domestic product. Current account is calculated as the net export to GDP ratio. Net foreign liability (NFL) is the difference between a country's foreign liability and foreign asset. Forward discount is the annual average of the difference between forward and exchange rate in the FX market. Equity Vol stands for the volatility of equity and is calculated as the annual average of monthly standard deviations of daily returns of MSCI stock indices in that month. FX Vol stands for the volatility of currency and is calculated as the annual average of daily absolute changes in exchange rates following Menkhoff et al. (2012a) . CDS is the annual average of monthly credit default swap spreads. The t-statistics are based on standard errors clustered by currency and year. R^2 are in percentage points. Data are annual from 1995 to 2020.

Table 9: Unconditional and Lagged Portfolio Sorts

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
		A. Sample average CC			
mean	3.56	6.96	2.79	0.71	-2.85
s.e.	1.43	1.64	1.92	1.40	1.43
t-stat	(2.49)	(4.24)	(1.45)	(0.50)	(-1.99)
sd	7.15	8.15	9.60	7.00	7.15
SR	0.50	0.85	0.29	0.10	-0.40
cc	0.36	0.58	0.73	0.77	0.42
		B. First three-year average CC			
mean	6.03	4.86	3.08	3.07	-2.96
s.e.	1.52	1.70	1.12	1.53	1.28
t-stat	(3.97)	(2.86)	(2.74)	(2.00)	(-2.31)
sd	7.29	8.14	5.38	7.35	6.16
SR	0.83	0.60	0.57	0.42	-0.48
cc	0.46	0.62	0.83	0.84	0.38
		C. Two-year lagged CC			
mean	7.52	2.94	2.39	2.26	-5.26
s.e.	1.56	2.32	1.66	0.97	1.29
t-stat	(4.81)	(1.27)	(1.44)	(2.33)	(-4.07)
sd	7.66	11.37	8.15	4.75	6.34
SR	0.98	0.26	0.29	0.47	-0.83
cc	0.16	0.47	0.69	0.91	0.75
		D. Rolling three-year average CC			
mean	7.11	3.68	4.16	2.57	-4.55
s.e.	1.62	1.90	1.56	0.99	1.26
t-stat	(4.40)	(1.94)	(2.67)	(2.60)	(-3.62)
sd	7.76	9.10	7.47	4.73	6.02
SR	0.92	0.40	0.56	0.54	-0.76
cc	0.16	0.47	0.69	0.91	0.75

Note: The table shows the summary statistics of portfolios sorted on capital controls. In Panel A, currencies are sorted on sample average capital control from 1995 to 2020. In Panel B, currencies are sorted on the average capital control of the first three years from 1995 to 1997. In Panel C, currencies are sorted the two-year-lagged capital control. In Panel D, currencies are sorted on the average capital control of the past three years. The average return (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2021:8.

Table 10: Portfolio sort and panel regression: Endogeneity

	rx_{t+1}				
CC	-3.42	-4.27	-3.91	-4.18	-4.13
	(-2.65)	(-3.14)	(-3.28)	(-3.29)	(-3.13)
$quad1$	9.15				8.28
	(2.52)				(2.23)
$CC \times quad1$	-1.91				-1.19
	(-0.35)				(-0.22)
$quad2$		7.54			7.14
		(1.84)			(1.72)
$CC \times quad2$		3.04			2.90
		(0.51)			(0.49)
$quad3$			-7.52		-7.02
			(-1.69)		(-1.54)
$CC \times quad3$			3.03		3.25
			(0.55)		(0.59)
$quad4$				-7.19	-6.46
				(-1.59)	(-1.42)
$CC \times quad4$				1.57	1.52
				(0.20)	(0.20)
R^2	0.34	0.39	0.24	0.29	0.94

Note: The table reports estimations for capital controls (CC), four dummy variables $quad1$, $quad2$, $quad3$ and $quad4$ and their interactions in a predictive panel regression for currency returns. $quad1 = 1$ refers to annual time periods when contemporaneous changes in capital controls and changes in exchange rates are both positive. $quad2 = 1$ refers to annual time periods when contemporaneous changes in capital controls are negative and changes in exchange rates are positive. $quad3 = 1$ refers to annual time periods when contemporaneous changes in capital controls and changes in exchange rates are both negative. $quad4 = 1$ refers to annual time periods when contemporaneous changes in capital controls are positive and changes in exchange rates are negative. The t-statistics are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table 11: Capital controls: inflow, outflow and different asset markets

	cc	kai	kao	eq	bo	mm	ci	de	ccs	fc	gs	di	re
A. Cross-sectional correlation													
cc	1.00	0.95	0.95	0.89	0.90	0.89	0.86	0.79	0.70	0.85	0.78	0.78	0.60
kai	0.95	1.00	0.81	0.83	0.84	0.85	0.81	0.70	0.71	0.76	0.75	0.77	0.64
kao	0.95	0.81	1.00	0.87	0.87	0.85	0.82	0.80	0.63	0.85	0.75	0.71	0.51
eq	0.89	0.83	0.87	1.00	0.85	0.82	0.81	0.70	0.54	0.74	0.59	0.74	0.43
bo	0.90	0.84	0.87	0.85	1.00	0.87	0.80	0.75	0.54	0.73	0.63	0.68	0.45
mm	0.89	0.85	0.85	0.82	0.87	1.00	0.83	0.71	0.54	0.72	0.63	0.66	0.48
ci	0.86	0.81	0.82	0.81	0.80	0.83	1.00	0.68	0.49	0.68	0.62	0.67	0.40
de	0.79	0.70	0.80	0.70	0.75	0.71	0.68	1.00	0.44	0.69	0.56	0.55	0.31
ccs	0.70	0.71	0.63	0.54	0.54	0.54	0.49	0.44	1.00	0.54	0.58	0.52	0.42
fc	0.85	0.76	0.85	0.74	0.73	0.72	0.68	0.69	0.54	1.00	0.71	0.56	0.46
gs	0.78	0.75	0.75	0.59	0.63	0.63	0.62	0.56	0.58	0.71	1.00	0.46	0.48
di	0.78	0.77	0.71	0.74	0.68	0.66	0.67	0.55	0.52	0.56	0.46	1.00	0.41
re	0.60	0.64	0.51	0.43	0.45	0.48	0.40	0.31	0.42	0.46	0.48	0.41	1.00
B. Panel regression													
	-3.90	-3.86	-3.25	-3.40	-3.35	-2.63	-4.05	-2.60	-0.92	-3.51	-1.66	-1.68	-3.01
	(-3.10)	(-2.78)	(-2.96)	(-2.72)	(-2.72)	(-2.39)	(-3.06)	(-2.09)	(-0.81)	(-3.84)	(-1.71)	(-1.60)	(-2.38)
R^2	0.08	0.08	0.07	0.08	0.09	0.05	0.11	0.06	0.01	0.14	0.03	0.03	0.07

Note: The table reports the cross-sectional correlations between aggregate capital control and capital controls of different subcategories and the panel regression results of regressing currency returns on these capital control measures respectively. Cross-sectional correlations are first calculated in each year and then averaged across time. Cc is the aggregate capital control index. Capital control subcategories include capital control for inflow (kai), outflow (kao), and 10 asset markets covering equity (eq), bonds or other debt securities (bo), money market instruments (mm), collective investment securities (ci), derivatives and other instruments (de), commercial credits (ccs), financial credits (fc), guarantees, sureties, and financial backup facilities (gs), direct investment (di) and real estate transactions (re). Panel B presents the estimation for each regression coefficient of different capital control measures and the t-statistics are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table 12: Portfolio sort: capital controls in AE

	P1 (low cc)	P2	P3 (high cc)	P3-P1
mean	-0.56	0.55	0.69	1.24
s.e.	1.40	1.90	1.87	1.25
t-stat	(-0.40)	(0.29)	(0.37)	(0.99)
sd	6.99	9.48	9.35	6.26
SR	-0.08	0.06	0.07	0.20
cc	0.02	0.08	0.23	0.21

Note: The table reports the summary statistics of portfolios sorted on capital controls in AE. Means(mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2021:8.

Table 13: Calibration

Variable	Symbol	Value
Risk aversion	γ	2
Elasticity of substitution	η	0.20
Time discount factor	β	0.91
Tradable good share	ω	0.32
Constraint tightness	$\bar{\kappa}$	0.32
Constraint persistence	ρ_κ	0.75
Constraint volatility	σ_κ	0.0066
Tradable persistence	ρ_y	0.54
Tradable shock vol	σ_y	0.025
Nontradable persistence	ρ_n	0.61
Nontradable shock vol	σ_n	0.045
Capital control	τ	0, 0.04
Risk-free rate	R	1.04
Price of risk: macro	λ_y	5
Price of risk: financial	λ_κ	191

Note: This table reports the calibrated parameter values.

Table 14: Macroeconomic moments

	w/o control	w/ control	planner
Tradable consumption volatility	0.088	0.058	0.065
debt-to-GDP ratio	-0.304	-0.282	-0.294
Current account volatility	0.026	0.014	0.010
Binding frequency	0.099	0.035	0.027
Crisis frequency	0.045	0.014	0.008

Note: The table reports the macroeconomic moments from model simulations in a model without capital control, a model with capital control, and a social planner solution.

Table 15: Currency returns in the cross-section

	P1	P2	P3	P4	P4-P1
A: Capital-control sorted portfolios					
mean	5.56	4.74	3.73	2.61	-2.95
standard deviation	12.91	11.86	10.67	9.27	11.67
Interest rate differential	5.85	4.89	3.77	2.55	-3.31
B: Capital-control sorted portfolios (macro risk only)					
mean	2.15	1.90	1.58	1.16	-0.99
standard deviation	11.88	11.00	9.97	8.73	10.88
Interest rate differential	2.24	1.90	1.51	1.04	-1.20
C: Carry					
mean	2.83	3.73	4.56	5.52	2.69
standard deviation	9.53	10.68	11.69	12.90	11.23
Interest rate differential	-2.08	2.33	6.15	10.65	12.74

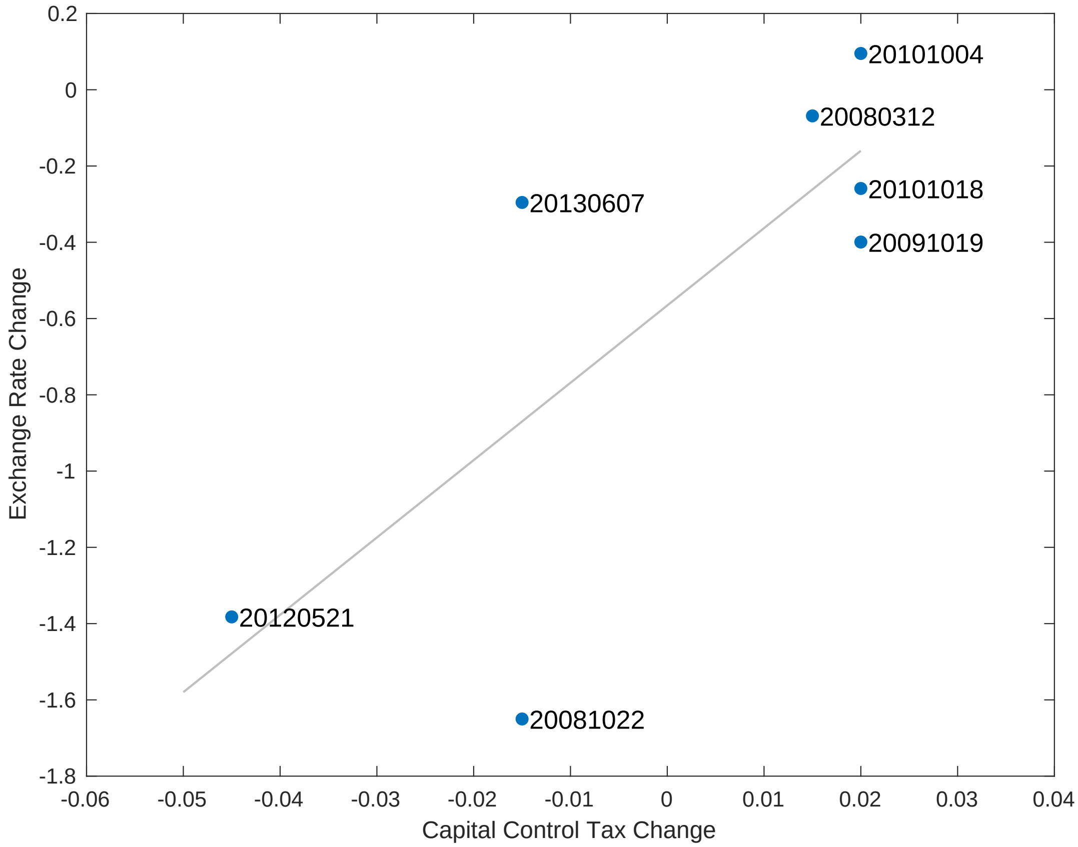
Note: The table reports the currency returns from model simulation. Panel A and B show the capital-control sorted portfolios. In Panel B, the model has only macro risk and $\lambda_\kappa = 0$. Panel C shows the carry trade portfolios.

Table 16: Panel regression using simulated data

		rx_{t+1}	
CC_t	-2.96	-2.47	-2.96
fd_t		0.15	
$-\Delta\kappa_{t+1}$			-2.74
$CC_t \times \Delta(-\kappa_{t+1})$			1.65

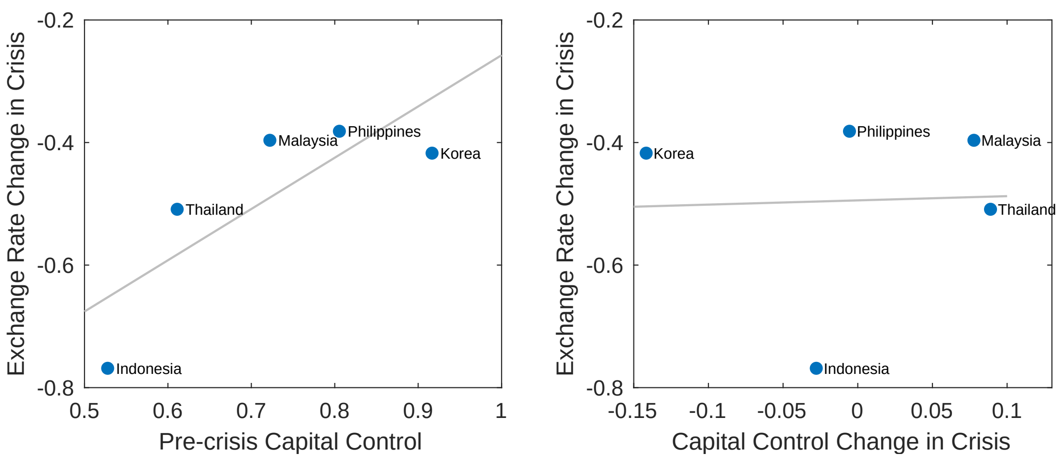
Note: The table reports the panel regressions from model simulation. In the first two columns, we regress future currency returns on capital controls (CC_t) and forward discounts (fd_t). In the third column, we regress currency returns on lagged capital controls, changes of financial constraint $-\Delta\kappa_{t+1}$, and the interaction.

Figure 1: Case study: Brazil



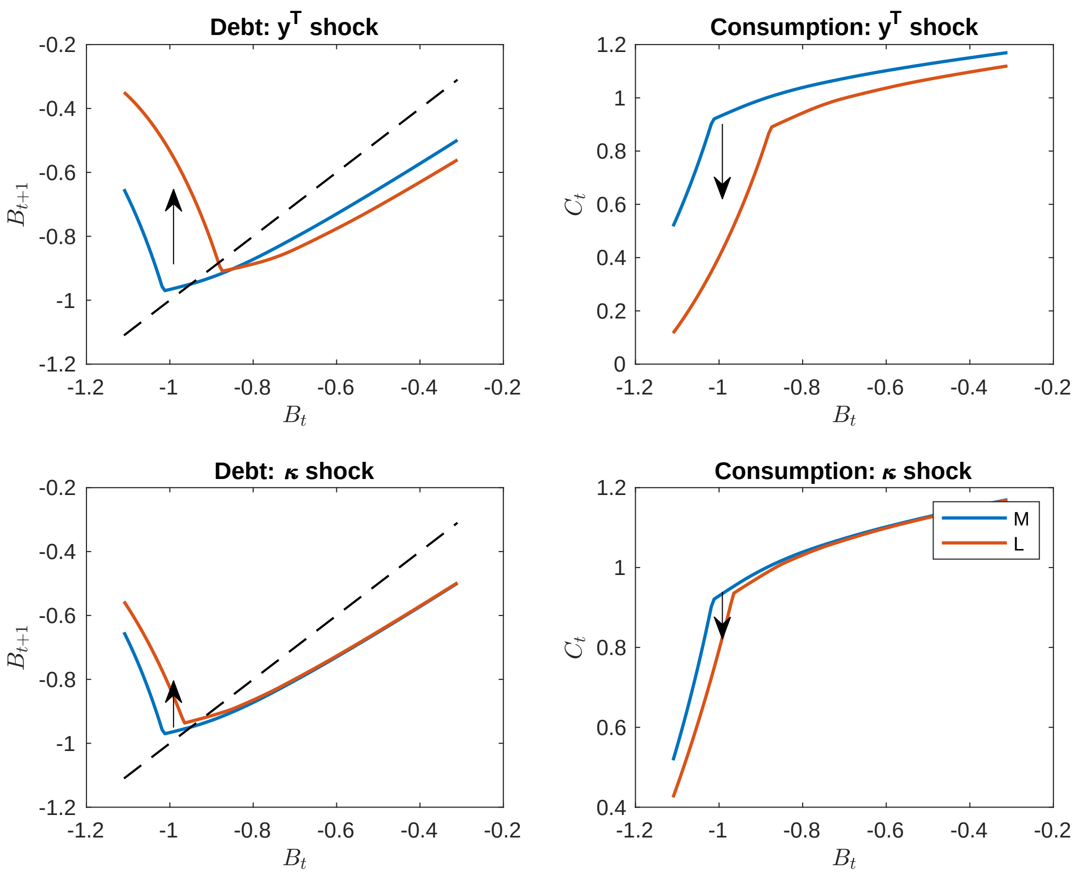
Note: This figure plots the changes in exchange rates of Brazilian Real against US dollar with regard to changes in capital control for Brazil during 2008 to 2013 when the government implements frequent adjustments in capital control tax rates. X-axis indicates changes in capital control tax rate while Y-axis shows the 3-day changes in exchange rates.

Figure 2: Case study: Asian Financial Crisis



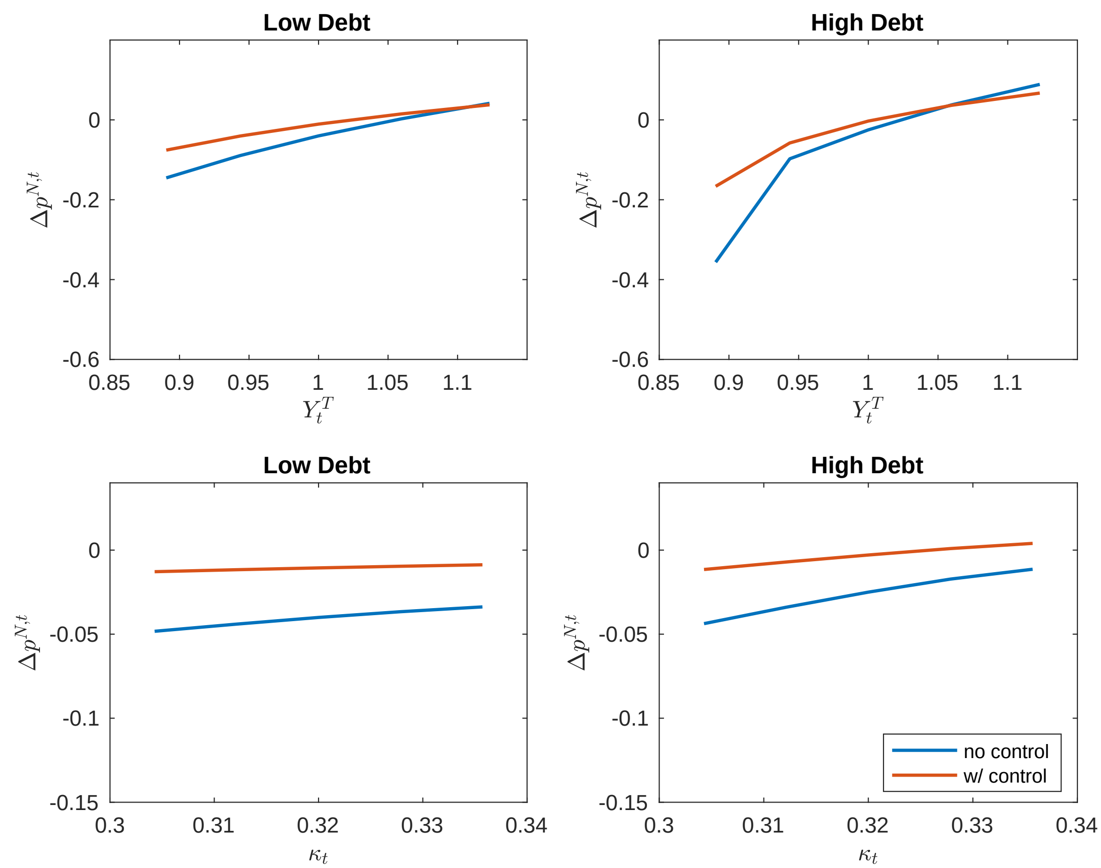
Note: This figure plots the changes in exchange rates of Korean Won, Philippine Peso, Malaysian Ringgit, Indian Rupee and Indonesian Rupiah against US dollar during Asian crisis from 1997:6 to 1998:1 when all five currencies experience consistent large depreciations. X-axis in the left subplot indicates pre-crisis capital control levels in early 1997 while X-axis in the right subplot indicates changes in capital controls from early 1997 to early 1998.

Figure 3: An illustration of a financial crisis



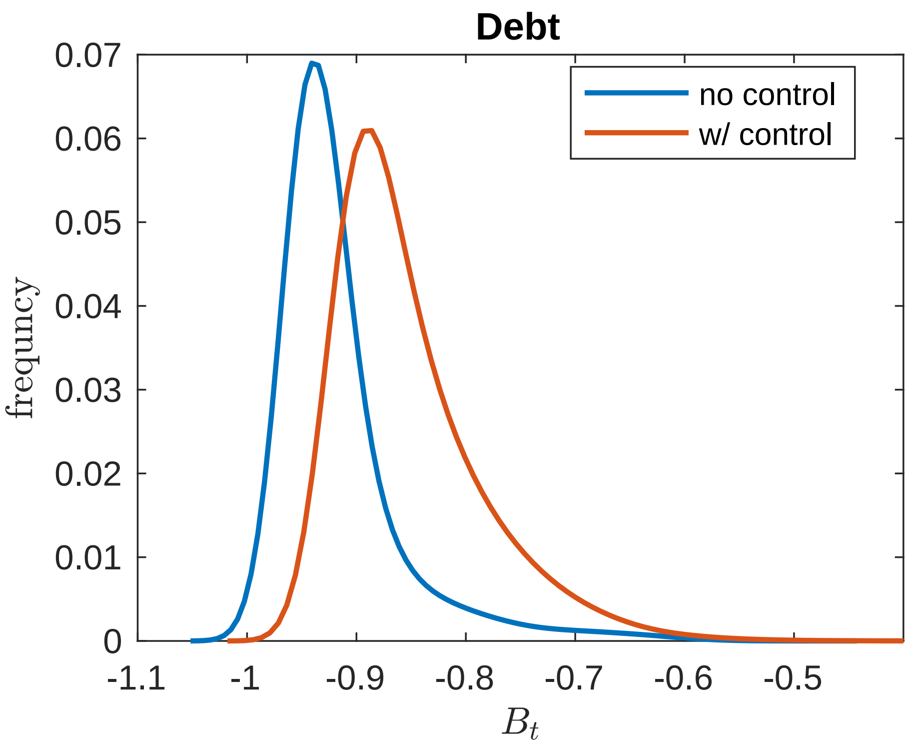
Note: This figure illustrates the occurrence of a financial crisis using the decision rules of borrowing level B_{t+1} and tradable consumption C_t. The horizontal axis is the current debt level B_t. The blue line represents a medium value of y^T and κ, and the red line represents a low value of y^T and κ. y^N is fixed at its average value.

Figure 4: Exchange Rate Dynamics and Capital Control Policy



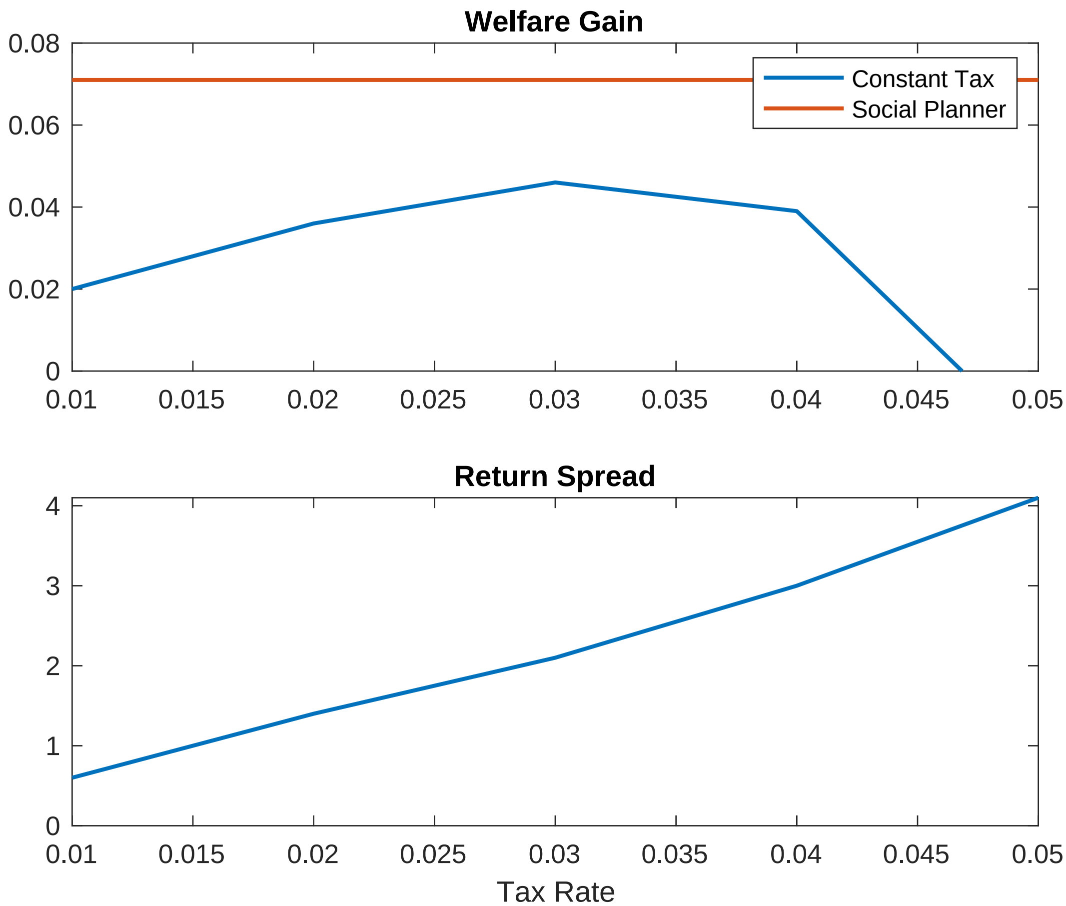
Note: This figure plots the response of exchange rate when the economy moves from $(B_{t-1}, Y^T_{t-1,M}, \kappa_{t-1,M})$ to $(B_t(B_{t-1}, Y^T_{t-1,M}, \kappa_{t-1,M}), Y^T_t, \kappa_t)$ for a low debt level and a high debt level. The red line shows the results with capital control $\tau = 0.04$. The blue line is with no capital controls $\tau = 0$. All figures fix y^N at its mean.

Figure 5: Debt distribution and capital control policy



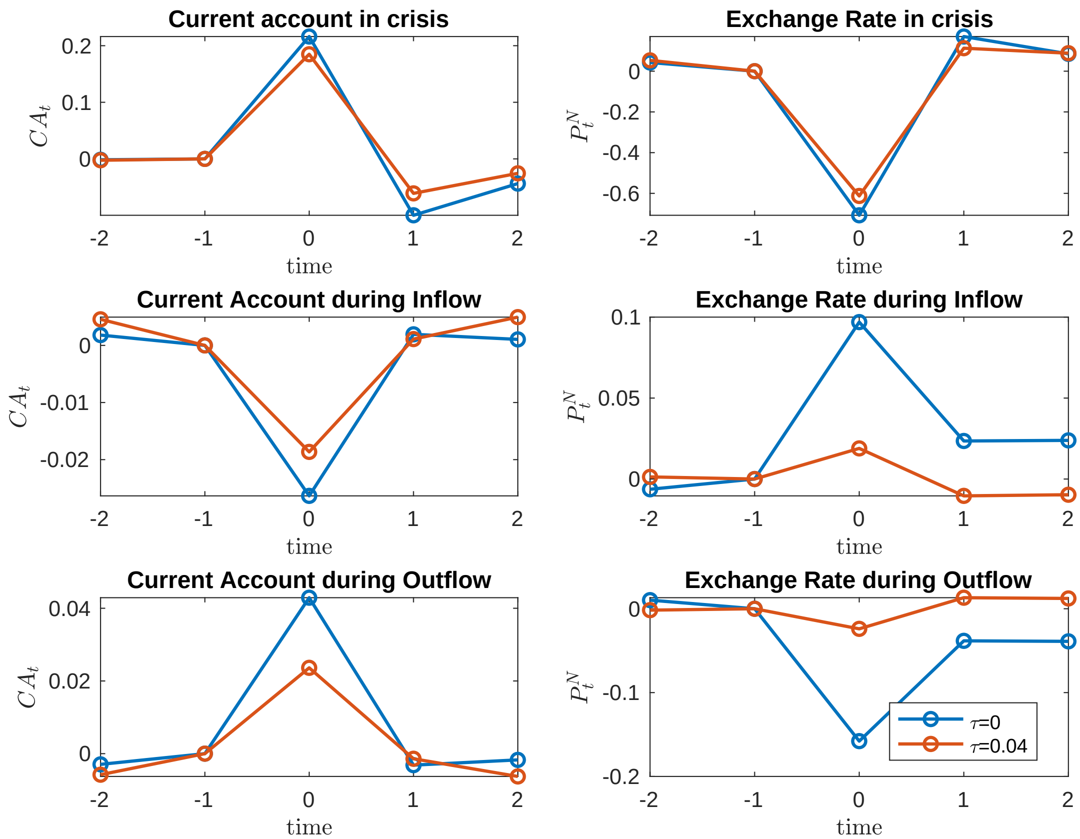
Note: This figure plots the ergodic distribution of debt B_t in two economies with ($\tau = 0.04$) and without capital control policies ($\tau = 0$).

Figure 6: Welfare Gain and Currency Premium



Note: The upper panel of the figure plots the welfare gain of the decentralized equilibrium with a constant capital control tax and the social planner's solution relative to the decentralized equilibrium with capital control. The lower panel plots the currency return spread between decentralized equilibriums without and with capital controls.

Figure 7: Crisis, Capital flow and exchange rate dynamics



Note: This figure plots the exchange rate and current account dynamics around crisis periods, inflow periods and outflow periods with different capital control policies. A crisis is defined as (i) the constraint binds; (ii) capital outflow is higher than 2 standard deviations (of decentralized equilibrium without control) from the mean. The blue solid line plots the pattern in the economy without capital control ($\tau = 0$). The red solid line plots the pattern in the economy with capital control ($\tau = 0.04$). The values in period T-1 are normalized to zero.

Internet Appendix: Currency Risk Under Capital Controls

1 Appendix for Empirical Analysis

1.1 Data sources

Table A1 lists the sources of data used in the main text of the paper.

1.2 Portfolio sorts by removing each currency

In this section, we remove the currencies in our sample one at a time and re-conduct the portfolio sorting analysis. The purpose is to confirm that our results are not driven by any single currency. Table A2 displays the average annualized return of the high-minus-low portfolio when each country in Column 1 is removed. The result shows that excluding any currency in the sample does not change our major results.

1.3 Portfolio sorts in sample of 19 countries

This section reports the portfolio sorting results with a smaller set of currencies. Table A3 shows the average annual returns for portfolios sorted on capital controls for EM in a sample of 19 countries that are commonly studied in the literature: Brazil, Chile, China, Czech, Egypt, Hungary, India, Indonesia, Israel, Kuwait, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Thailand, Turkey and Ukraine. The results remain similar to those presented in the main text.

1.4 Portfolio sorts excluding the COVID-19 period

The Covid-19 period exhibits large exchange rate fluctuations for many EMs. Given the relatively short sample, it is important to ensure our results are not driven by this episode. Table A4 presents the average annualized returns for EM portfolios sorted on capital controls excluding the COVID-19 period. The sample ends at 2020 February.

1.5 Double sort on carry and capital controls

In this section, we double sort currencies based on forward discounts and capital controls. We first sort on the forward discounts and then on capital controls. Table A5 presents the results. The spread between high- and low-capital-control currencies are larger for high-interest-rate currencies. Intuitively, global investors require higher interest rate and risk premia to hold riskier currencies. Therefore, capital controls are more effective in reducing the risk of these currencies.

1.6 Non-deliverable forward

The portfolio returns are constructed using the standard source of forward rates from Datastream, which are widely used in the empirical literature of currency risk premia. Our paper's focus is on emerging market economies, especially those with capital controls. Consequently, currency returns constructed might be affected by the deliverable features of forward rates for an offshore international investor. Cerutti and Zhou (2024) show that the difference between deliverable and non-deliverable forwards rates are negligible for most countries and only matter for a few cases. In this subsection, we use non-deliverable forwards (NDFs) following Cerutti and Zhou (2024) whenever the data are available and cover the cases when the differences are non-negligible.

Table A6 presents our results. The Datastream sample with available NDF rates includes China, India, Indonesia, Malaysia, Philippines, Russia, Thailand, Ukraine and Kazakhstan. Similar to the main results, currencies with higher capital controls earn lower average returns. Bloomberg has a more extensive set of currencies with 3-month NDFs, including Brazil, Chile, Czech Republic, Hungary, Israel, Mexico, Poland, South Africa, and Turkey. We redo our analysis at a 3-month investment horizon and find similar results.

1.7 Panel Regressions for AE

To study the difference between emerging market economies (EM) and advanced economies (AE), we repeat the panel regression in the AE sample. Table A7 and Table A8 show the panel regression results. For AE, capital controls do not change the currency risk premia significantly. When it comes to risk loadings, more controlled AE currencies depreciate even more when VIX spikes, which is opposite to the pattern for EM currencies. Among the AE currencies, typical investment currencies such as Australian dollar have tighter capital controls. This result is likely driven by factors outside of our analysis.

2 Appendix for the Model

2.1 The Social Planner's Problem

It is well-known that models with price-dependent credit constraint feature inefficiencies due to the presence of pecuniary externality (Bianchi, 2011; Bianchi and Mendoza, 2018). Agents fail to take into consideration the impact of their decisions on current and future real exchange rates, which determines the tightness of the credit constraint. The social planner's Euler equations are formulated as follows:

$$q_t(u_{T,t} - \mu_t \frac{\partial P_t^N}{\partial C_t^T}) = E_t \left[\beta(u_{T,t+1} - \mu_{t+1} \frac{\partial P_{t+1}^N}{\partial C_{t+1}^T}) \right] + q_t \mu_t, \tag{A1}$$

The planner considers the effect of appreciating the price of nontradable good and relaxing the borrowing constraint when making decisions on the tradable consumption. The optimal tax schedule is highly state contingent. When debt level is low and the economy is far away from the binding constraint, the optimal tax is zero. When the debt level increases and the economy moves closer to having a binding constraint, the optimal tax is positive and discourages borrowing, effectively internalizing the effect of an additional borrowing on the price of the nontradable good in the next period. Figure A1 plots the optimal tax implied by the social planner's solution as a function of B_t while holding y^T and κ at their average level.

2.2 Local Currency Debt

The analysis in the main text is based on a model where borrowing is in tradable good (foreign currency). While this model offers most of the insights, it has two limitations. Firstly, it is unable to examine the impact of local currency share on capital control's effect on currency risk premia. Secondly, the currency risk premia has no real effect on the economy. To address these issues, we will modify the model to allow for local currency borrowing.

Emerging market economies have long faced the challenge of being unable to easily issue debt in their local currencies, a phenomenon referred to as "original sin". One primary reason for this "original sin" is the credibility of the emerging economy's monetary policy. Over the years, although emerging markets have increasingly issued local currency debt—particularly for sovereign entities—corporate borrowings continue to be dominated by foreign currency (Du and Schreger, 2022). In the extended model, we do not model the endogenous choice between local currency debt and foreign currency debt. Doing so would introduce an additional endogenous state variable, compromising the model's tractability.[1] Instead, we assume that the emerging economy borrows a fixed amount of local currency debt, B_l, which guarantees the payment of one unit of nontradable goods in the subsequent period.

[1] Liu et al. (2021) provides a systemic analysis of currency choice.

Consequently, the budget constraint is modified accordingly.

$$s.t.: q_t B_{t+1} + q_{L,t} B_l + C_t^T + P_t^N C_t^N = B_t(1+\tau_t) + P_t^N B_l (1+\tau_t) + Y_t^T + P_t^N Y_t^N + T_t \quad \text{(A2)}$$

where $q_{L,t}$ is the tradable good price of local currency debt and $\frac{P_t^N}{q_{L,t}}$ is the local currency interest rate. The credit constraint is changed to

$$q_t B_{t+1} + q_{L,t} B_l \geq -\kappa_t (Y_t^T + P_t^N Y_t^N). \quad \text{(A3)}$$

The introduction of local currency debt brings forth several additional channels for exchange rate depreciation effects. First, a depreciation of the real exchange rate alleviates the debt burden associated with local currency debt. Second, it lowers the tradable goods price of local currency debt, thereby easing the borrowing constraint. Third, if local currency depreciation occurs during unfavorable times for global intermediary investors, a high risk premium will raise the cost of local currency borrowing.

Table A9 presents the set of quantitative moments for different values of B_l with and without capital control. Our primary focus is on the currency risk premium spread between the two economies. When $B_l = 0$, the spread is 3 percent, as discussed in previous sections. When B_l increases to -0.05, the spread declines slightly to 2.66 percent. When B_l is further increased to -0.2, which corresponds to a local currency share of about 40%, the spread is lowered to 1.87 percent. The spread declines monotonically with B_l. Furthermore, capitol controls increase the local currency debt share, consistent with the firm-level evidence in Bacchetta et al. (2023). We observe that a higher local currency debt leads to reduced consumption volatility and a lower probability of a crisis, as exchange rate depreciations alleviate the debt burden and ease the borrowing constraint. As a result, a higher local currency debt endogenously reduces the currency risk in the economy and thus mitigates the effect of capital controls in reducing currency risk premia.

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Table A1: Data Sources

Data	Data source
Capital control	Fernández et al. (2016), Uribe's website; IMF: Annual Report on Exchange Arrangements and Exchange Restrictions
Exchange rate	WM/Reuters, Barclays
Forward rate	WM/Reuters, Barclays
Net foreign liability	Lane and Milesi-Ferretti (2017), IMF
Credit default swap	Della Corte et al. (2022), Markit
Interest rate	Du and Schreger (2016) and Du et al. (2018)
Exchange rate regime	Ilzetzki et al. (2019), Ilzetzki's website
FX intervention	Adler et al. (2021), IMF and Fratzscher et al. (2022), Sarno's website
Foreign reserve	IMF
Dollar and carry factor	Lustig et al. (2011), Verdelhan's website
Momentum factor	Asness et al. (2013), AQR website
Liability in DC and FC	Bénétrix et al. (2019), Benetrix's website
VIX	Chicago Board Options Exchange
VXY	Bloomberg

Table A2: Portfolio sort: robustness to each currency

	mean	s.e.	t-stat	sd	SR
Full sample	-4.31	1.21	(-3.57)	6.03	-0.71
Argentina	-3.67	1.18	(-3.11)	5.91	-0.62
Brazil	-4.31	1.22	(-3.52)	6.12	-0.70
Chile	-4.89	1.22	(-4.01)	6.10	-0.80
China	-3.87	1.18	(-3.27)	5.92	-0.65
Colombia	-4.36	1.22	(-3.56)	6.12	-0.71
Czech	-4.91	1.34	(-3.67)	6.70	-0.73
Egypt	-3.75	1.26	(-2.97)	6.30	-0.59
Ghana	-4.31	1.22	(-3.53)	6.10	-0.71
Hungary	-5.73	1.22	(-4.69)	6.11	-0.94
India	-4.02	1.32	(-3.05)	6.59	-0.61
Indonesia	-4.27	1.23	(-3.48)	6.14	-0.70
Israel	-4.81	1.25	(-3.85)	6.25	-0.77
Kazakhstan	-4.74	1.22	(-3.87)	6.12	-0.77
Kuwait	-3.79	1.34	(-2.83)	6.69	-0.57
Malaysia	-4.02	1.24	(-3.24)	6.20	-0.65
Mexico	-4.55	1.25	(-3.64)	6.26	-0.73
Morocco	-4.17	1.26	(-3.32)	6.28	-0.66
Pakistan	-4.27	1.22	(-3.50)	6.10	-0.70
Peru	-4.85	1.27	(-3.82)	6.35	-0.76
Philippines	-4.22	1.22	(-3.45)	6.12	-0.69
Poland	-5.35	1.38	(-3.88)	6.89	-0.78
Romania	-4.85	1.20	(-4.03)	6.01	-0.81
Russia	-4.28	1.22	(-3.51)	6.11	-0.70
South Africa	-4.19	1.24	(-3.39)	6.18	-0.68
Sri Lanka	-4.10	1.21	(-3.41)	6.03	-0.68
Thailand	-4.18	1.22	(-3.43)	6.10	-0.69
Tunisia	-4.10	1.25	(-3.29)	6.25	-0.66
Turkey	-2.63	1.20	(-2.19)	5.99	-0.44
Ukraine	-4.12	1.20	(-3.42)	6.02	-0.68
Vietnam	-4.26	1.21	(-3.52)	6.04	-0.70

Note: The table shows the summary statistics of HML portfolios sorted on capital controls by excluding currencies one at a time. The first column indicates the currency removed from the sample. Means (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR) are reported. Data are monthly from 1996:9 to 2021:8.

Table A3: Portfolio sort: 19 countries

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
mean	6.01	2.78	2.42	1.51	-4.50
s.e.	1.59	2.18	1.98	1.10	1.44
t-stat	(3.78)	(1.27)	(1.22)	(1.36)	(-3.12)
sd	7.94	10.91	9.91	5.52	7.21
SR	0.76	0.25	0.24	0.27	-0.62
cc	0.16	0.45	0.67	0.89	0.73

Note: The table shows the summary statistics of portfolios sorted on capital controls using a sample of 19 currencies, which are Brazil, Chile, China, Czech, Egypt, Hungary, India, Indonesia, Israel, Kuwait, Malaysia, Mexico, Philippines, Poland, Russia, South Africa, Thailand, Turkey and Ukraine. Means (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2021:9.

Table A4: Portfolio sort: excluding the COVID-19 period

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
mean	6.13	2.55	2.53	1.69	-4.45
s.e.	1.55	2.24	1.67	1.05	1.27
t-stat	(3.95)	(1.14)	(1.51)	(1.61)	(-3.51)
sd	7.54	10.87	8.11	5.07	6.14
SR	0.81	0.24	0.31	0.33	-0.72
cc	0.15	0.46	0.69	0.90	0.75

Note: The table shows the summary statistics of portfolios sorted on capital controls excluding COVID-19 period from March 2020. Means (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2020:2.

Table A5: Double sorts on capital control and forward discount

	Low cc	High cc	HML
low fd	0.01	-0.73	-0.74
	(0.00)	(-0.56)	(-0.57)
high fd	10.87	4.40	-6.47
	(-4.89)	(-2.99)	(-3.53)
HML	10.87	5.13	-5.74
	(-5.61)	(-4.11)	(-2.51)

Note: This table shows average returns and t-statistics for double-sorted currency portfolios. Currencies are first sorted on the level of lagged forward discounts into two groups (low fd refers to currencies with low forward discount while high fd refers to those with high forward discount), and then on the lagged capital control levels (low cc refers to currencies with low capital control while high fd refers to those with high capital control)). HML reports the mean return of the corresponding high-minus-low portfolio. Data are monthly from 1996:9 to 2021:8.

Table A6: Portfolio sort: capital controls with NDF

	P1 (low cc)	P2	P3	P4 (high cc)	P4-P1
mean	6.12	2.74	3.02	1.34	-4.78
s.e.	1.49	2.14	1.65	1.00	1.21
t-stat	(4.10)	(1.28)	(1.83)	(1.34)	(-3.95)
sd	7.46	10.68	8.24	5.01	6.05
SR	0.82	0.26	0.37	0.27	-0.79
cc	0.15	0.46	0.69	0.90	0.76

Note: The table shows the summary statistics of portfolios sorted on capital controls when forwards of currencies are replaced with non-deliverable-forwards (NDFs). Means (mean), standard errors (s.e.), t-statistics (t-stat), standard deviations (sd), Sharpe ratios (SR), and average capital controls (cc) are reported. Data are monthly from 1996:9 to 2021:8.

Table A7: Capital controls and foreign liability: AE

	rx_{t+1}			
CC_t	6.59	3.97	4.36	18.84
	(0.93)	(0.58)	(0.28)	(1.73)
fd_t		1.39		0.05
		(2.63)		(0.89)
NFL_t			1.86	1.40
			(1.14)	(1.66)
$CC_t \times NFL_t$			4.18	
			(0.33)	
L_t^{FC}				
$CC_t \times L_t^{FC}$				
R^2	0.04	0.73	0.15	0.46

Note: The table reports the panel regression results of currency returns on the lagged capital controls and variables related to the foreign investment positions and currency mismatches for AE currencies. NFL is a dummy variable that equals to 1 when this country has a positive net foreign liability and 0 otherwise. L^{FC} indicates the ratio of foreign currency liabilities to its total external liabilities. The t-statistics (t-stat) are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table A8: Capital controls and risk exposures: AE

	rx	
CC	8.43	6.29
	(1.28)	(0.92)
ΔVIX	-1.25	
	(-3.83)	
$CC \times \Delta VIX$	-7.59	
	(-4.22)	
ΔVXY		-3.78
		(-2.05)
$CC \times \Delta VXY$		-27.51
		(-4.66)
R^2	10.18	5.52

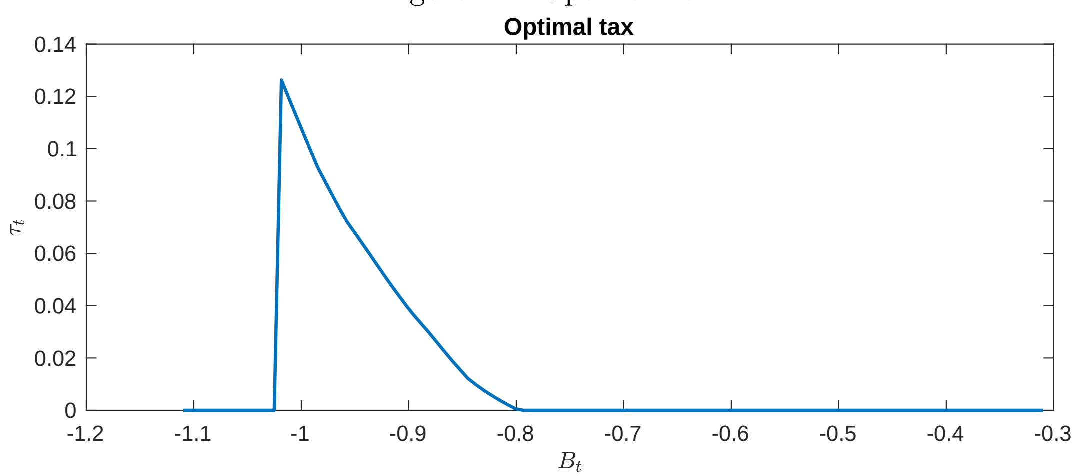
Note: The table reports the panel regression results of currency returns on the lagged capital controls and variables measuring global shocks which are the contemporaneous change in implied volatility, and their interaction for AE currencies. Implied volatility includes CBOE Volatility Index (VIX) and JP Morgan implied volatility in G7 currencies (VXY). The t-statistics (t-stat) are based on standard errors clustered by month. R^2 are in percentage points. Data are monthly from 1996:9 to 2021:8.

Table A9: Aggregate Moments with Local Currency Debt

	$B_l = -0.2$		$B_l = -0.05$	
	no control	w/ control	no control	w/ control
A: Macroeconomic moments				
Tradable consumption volatility	0.065	0.049	0.080	0.055
Average debt to GDP	-0.323	-0.298	-0.311	-0.288
Local currency debt share	0.415	0.455	0.109	0.118
Current account volatility	0.015	0.011	0.021	0.013
Binding frequency	0.234	0.088	0.136	0.051
Crisis frequency	0.029	0.003	0.047	0.012
B: Currency returns				
Currency excess return	3.90	2.03	5.12	2.46
diff w/ and w/o control		1.87		2.66
Currency excess return vol	8.74	7.25	11.69	8.66
Average forward discount	4.18	2.02	5.43	2.42

Note: This table reports the aggregate moments from model simulation with local currency debt $B_l = -0.2$ and $B_l = -0.05$. Panel A lists the macro moments, and Panel B lists the moments related to currency returns and currency risk premia.

Figure A1: Optimal Tax



Note: This figure shows the optimal tax schedule as a function of B_t when y^T, y^N and κ are held at their average levels.