

Cross-Country CIP Deviations *

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Abstract

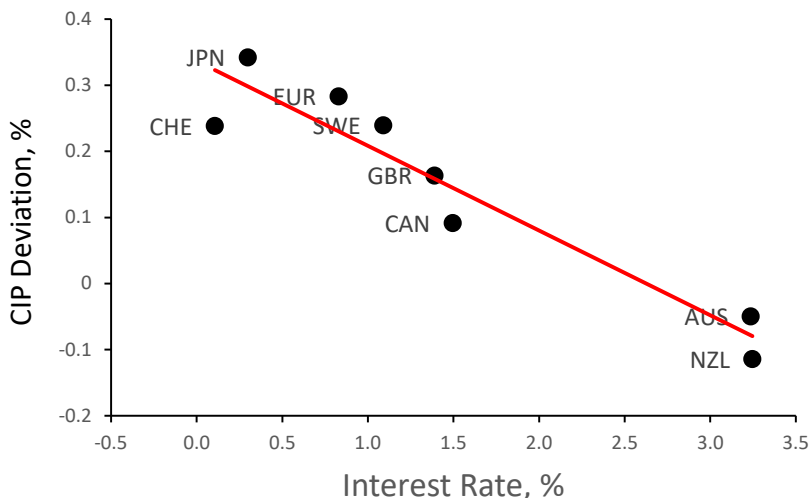
Deviations from covered interest parity (CIP) vary systematically across countries. Countries with high CIP deviations tend to have low interest rates, high net foreign asset positions, high private saving and low investment. We develop a macroeconomic model of the United States and smaller advanced economies in which saving, investment, portfolios, interest rates and hedging are determined jointly. The FX forward market includes CIP arbitrageurs, hedgers and speculators, consistent with evidence on FX derivatives markets. We show analytically that cross-country differences in saving and investment demand both generate the observed relationships. Differences in the supply of safe assets do not.

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1 Introduction

Since the Global Financial Crisis, deviations from covered interest parity (CIP) have become a persistent feature of international financial markets, commonly attributed to limits to arbitrage associated with tighter post-crisis regulation. We define the CIP deviation as the synthetic dollar rate (for example, the euro rate swapped into dollars) minus the dollar cash rate. Several papers have established that CIP deviations vary systematically across countries and are higher for currencies with lower interest rates (Du, Tepper, and Verdelhan, 2018; Amador, Bianchi, Bocola, and Perri, 2020; Du and Schreger, 2022; Dao, Gourinchas, and Itskhoki, 2025).¹ Figure 1 illustrates this relationship, using average CIP deviations and Libor interest rates over 2007-2020 for eight major currencies.²

Figure 1: CIP Deviations vs Interest Rates



Notes: Averages over 2007-2020. The CIP deviation is computed with respect to the USD, using 3-month Libor interest rates. EUR denotes Eurozone countries. The interest rate is the level of the Libor rate.

¹Except for Amador et al. (2020), these papers define the CIP deviation with the opposite sign, so that it is negative for most currencies.

²The CIP deviation is computed with Libor interest rates, as they are available for the eight currencies we consider. Using OIS interest rates gives similar pictures.

A growing literature relates CIP deviations to net hedging pressures in the FX forward and swap markets. With limited arbitrage capacity, a currency in which hedgers sell more dollars forward than they buy has a higher CIP deviation. These hedging pressures depend on a country’s external assets and liabilities and on how much of the associated currency exposure is hedged. Investors hedge foreign currency assets, while borrowers hedge foreign currency debt.

External assets and liabilities in turn depend on saving and investment. A country with high saving has more wealth to invest, part of which is invested abroad. Its savers then hold more dollar assets, which they hedge by selling dollars forward, raising the CIP deviation. A country with high investment needs more financing, part of which comes from abroad. When its firms borrow in dollars, they hedge by buying dollars forward, lowering the CIP deviation. High saving and low investment also lower the interest rate. This suggests that the relationship in Figure 1 originates in saving and investment decisions.

The evidence in Table 1 is consistent with this view.³ First, countries with large net foreign asset (NFA) positions have both low interest rates and high CIP deviations. Similarly, higher private saving is associated with higher CIP deviations and lower interest rates, while the opposite occurs with higher private investment. The private saving minus investment gap is even more strongly associated with both. Private wealth, which reflects past saving and determines the scale of investors’ portfolios, shows correlations similar to those of saving. These correlations suggest that both the supply of saving and the demand for investment matter. This calls for a framework that determines saving, investment, portfolios, interest rates and hedging jointly.

We therefore develop a multi-country model featuring the US and a set of smaller economies, in which saving and investment differ across countries because of differences in saving preferences and productivity. We also consider differences in the supply of safe assets by the government, which correspond to differences in public saving. The model combines households’ saving and portfolio decisions with firms’ investment and financing decisions. Equilibrium is determined simultaneously in the safe asset, corporate bond and FX forward markets. We take limited intermediary arbitrage capacity as a reduced-form constraint, in the spirit of macro models of limited UIP arbitrage (e.g., [Gabaix and Maggiori \(2015\)](#), [Itskhoki and Mukhin \(2021, 2025\)](#)), and examine how differences in saving, investment and

³See Appendix A for variable definitions and data sources and the Online Appendix for scatter plots.

Table 1: Correlation Coefficients

	CIP deviation	Libor interest rate
NFA/GDP	0.73 ^{**}	−0.88 ^{**}
Private Net Saving/GDP	0.69 [*]	−0.61
Private Net Investment/GDP	−0.81 ^{**}	0.76 ^{**}
Private Net Saving-Investment Gap/GDP	0.92 ^{**}	−0.84 ^{**}
Private Wealth/GDP	0.81 ^{**}	−0.77 ^{**}

Notes: Notes: Correlations of the 2007-2020 averages across the 8 countries in Figure 1. ** (*) means significant at the 5% (10%) level. See Appendix A for additional correlations, variable definitions and data sources and the Online Appendix for scatter plots.

safe asset supply generate the positions that these intermediaries must absorb.

The FX forward market in our model has three types of participants: CIP arbitrageurs, hedgers and speculators. This matches the evidence from the London FX derivatives market in Hacıoğlu-Hoke, Ostry, Rey, Rousset Planat, Stavrageva, and Tang (2026). Dealer banks operate as CIP arbitrageurs, hedgers (asset managers, insurers, pension funds, investment funds and firms) hedge foreign currency positions, and hedge funds take speculative positions. In Section 2 we show that CIP arbitrage and speculation alone imply a positive relationship between interest rates and CIP deviations. Accounting for the observed negative relationship therefore requires a hedging motive and an explanation of why countries with lower interest rates have a larger net supply of forward dollars from hedging.

Introducing this hedging motive also requires care in specifying access to assets. Restricting intermediary arbitrage is insufficient if households or other investors can freely combine domestic and foreign safe assets with forward contracts to eliminate CIP deviations. We therefore assume that households invest abroad through mutual funds that combine safe and risky foreign assets. Households cannot take a separate position in the foreign safe asset, while each fund’s investment mandate restricts the assets it can hold. These restrictions prevent unrestricted CIP arbitrage outside the intermediary sector while preserving international investment and the associated demand for currency hedging.

In the baseline model, mutual funds and firms fully hedge their currency exposure. We later allow for partial hedging. The net supply of forward dollars reflects three types of hedg-

ing: foreign mutual funds hedging dollar assets, US mutual funds hedging foreign currency assets, and foreign firms hedging dollar debt. Firms choose between domestic-currency and dollar borrowing, equating their domestic borrowing cost to the hedged cost of dollar debt, consistent with the evidence in [Liao \(2020\)](#).

Differences in saving preferences and in productivity both generate a negative relationship between interest rates and CIP deviations, but through different channels. A country with high saving has a high demand for the domestic safe asset, which lowers its interest rate. Its households also invest more in dollar assets, which are hedged by selling dollars forward. This raises the CIP deviation. A country with low productivity has weak investment demand. Its firms issue fewer corporate bonds, which lowers the corporate spread. Households then shift from corporate bonds to the safe asset, which lowers the interest rate. The lower spread also leads US investors to hold fewer of its corporate dollar bonds. Its firms then buy fewer dollars forward to hedge them. This raises the CIP deviation. In each case, the fundamental affects both the safe asset market and the forward market. The relationship does not arise because the interest rate directly affects the forward market and CIP deviation.

In contrast, differences in safe asset supply cannot account for the evidence. A smaller safe asset supply lowers the interest rate, which lowers the cost of capital and raises investment. The corporate spread rises, so that US investors hold more of the country’s dollar bonds. Its firms then buy more dollars forward, which lowers the CIP deviation.

With full hedging there is no carry trade, since a lower interest rate does not make hedged dollar assets more attractive. When we allow for partial hedging, investors in countries with low interest rates buy more dollar assets, part of which is hedged. This carry trade raises the CIP deviation. At the same time, a smaller part of all foreign positions is hedged, which lowers it. Partial hedging can therefore strengthen or weaken the negative relationship between interest rates and CIP deviations generated by differences in saving.

Related Literature

Most of the literature on CIP deviations focuses on its time-series dimension. For the cross-country relationship between CIP deviations and interest rates discussed above, [Du et al. \(2018\)](#) hypothesize (Prediction 2) that investors from low-interest countries invest more in US dollars and hedge part of their dollar exposure. As discussed above, this carry-trade mechanism is present in our model only when hedging is partial, and it is not needed

for the negative relationship between interest rates and CIP deviations.

Various papers document a positive correlation between the CIP deviation and net dollar positions (as a share of GDP). Examples are [Liao and Zhang \(2025\)](#), [Dao and Gourinchas \(2026\)](#), and [Dao et al. \(2025\)](#). In our model, net dollar positions, the associated hedging and the total NFA are all determined by saving, investment and portfolio decisions.

[Borio, Iqbal, McCauley, McGuire, and Sushko \(2018\)](#) empirically document a significant relationship between FX hedging demand and CIP deviations. [Du and Huber \(2026\)](#) find that countries whose institutional investors hedge more US dollar assets, relative to GDP, have higher CIP deviations.⁴ Our model distinguishes this gross hedging of dollar assets from net hedging. Net hedging is always positively related to the CIP deviation. Gross hedging can be positively related to it under wealth heterogeneity, but not under productivity or safe asset supply heterogeneity (Section 5.4).

Closely related is [Dao et al. \(2025\)](#), who also consider cross-country differences in CIP deviations. Some of their intuition is in line with our analysis. In their view, countries whose investment exceeds saving, and which are therefore net borrowers, have higher interest rates and lower CIP deviations. However, these relationships are postulated rather than derived. They assume that net borrowers have higher interest rates and an excess demand for forward dollars that lowers the CIP deviation. By deriving saving, investment, interest rates and portfolios endogenously in a macroeconomic framework, we identify the conditions under which these relationships arise and show how they depend on the underlying source of cross-country heterogeneity. They need not always hold. For example, when interest rate differences originate in the supply of safe assets, we show that a country with a higher interest rate also has a higher CIP deviation. The same reversal can occur when speculative demand in the forward market is sufficiently strong.

The theoretical literature on FX hedging has focused on how much of a given foreign currency exposure to hedge. In this literature, the demand for FX forwards or swaps can be decomposed into a pure hedging motive and a pure speculative motive. [Glen and Jorion \(1993\)](#) discuss the demand for forwards, relating to the more general framework of [Anderson and Danthine \(1981\)](#). Recent papers with endogenous hedging decisions include [Du and Huber \(2026\)](#), [Liao and Zhang \(2025\)](#), [De Leo, Keller, and Zou \(2025\)](#), [Hacıoğlu-Hoke et al.](#)

⁴They report this as a negative relationship with the cross-currency basis, which is opposite in sign to our CIP deviation.

(2026), [Bräuer and Hau \(2024\)](#), and [Bacchetta, Davis, and van Wincoop \(2026\)](#).

Departing from this literature, which takes currency exposures as given, our emphasis is on how endogenous portfolio allocation determines currency exposures and the associated demand for hedging. In the baseline model, mutual funds and firms fully hedge their currency exposure, while in an extension they hedge a given fraction of it. In both cases the size of the exposure, and hence their forward positions, is endogenous. Since the hedge ratio is the same in all countries, cross-country differences in hedging pressures come from differences in these exposures.

In the Online Appendix, we show that, under the asset-market restrictions discussed in [Section 2](#), the optimal forward position of a mutual fund consists of a full hedge of its currency exposure plus a speculative position. For tractability, we assign the speculative positions to hedge funds, so that mutual funds fully hedge. This division is consistent with the evidence in [Hacıoğlu-Hoke et al. \(2026\)](#) on the role of hedge funds in currency speculation and with [Bräuer and Hau \(2024\)](#), who find that European investment funds' FX derivatives positions are primarily driven by hedging.

We also assume limited arbitrage by global financial intermediaries, in the spirit of [Gabaix and Maggiori \(2015\)](#). Recent papers have considered intermediaries that undertake both CIP and UIP arbitrage, using somewhat different constraints on intermediaries: [Greenwood, Hanson, Stein, and Sunderam \(2023\)](#), [Bacchetta, Benhima, and Berthold \(2026\)](#), [Dao and Gourinchas \(2026\)](#) and [Dao et al. \(2025\)](#). In our specification, financial intermediaries face exchange risk associated with UIP trades and regulatory costs associated with CIP trades.

While households in our model are not CIP arbitrageurs like financial intermediaries, indirectly (through mutual funds) they take forward market positions that depend on CIP deviations. For example, a higher CIP deviation makes it more costly for small country households to invest in hedged US dollar assets. This reduces investment by these households in mutual funds that invest in the US and therefore reduces the supply of forward dollars. [Kubitza, Sigaux, and Vandeweyer \(2025\)](#) provide evidence of this mechanism for European investors in the US.

The rest of the paper is organized as follows. [Section 2](#) discusses the need for a hedging motive in the model and assumptions needed to justify a hedging motive. [Section 3](#) describes the model and [Section 4](#) discusses its equilibrium. [Section 5](#) derives analytical results for the three sources of heterogeneity, and extends them to speculative demand and partial hedging.

Section 6 concludes.

2 FX Forward Market and Hedging Motive

Before we describe the particular model that we will employ, in this section we first discuss more broadly what we can learn from the forward market equilibrium based on the three motives for forward market positions. We argue that the hedging motive is key to accounting for the cross-country relationship between CIP deviations and interest rates.

2.1 Some Notation

Since we are interested in cross-sectional evidence, throughout the paper we assume that the expected change in the spot exchange rate is zero, so that the UIP deviation is also equal to the interest differential.⁵ Without loss of generality, we then set the current log spot rate and expected future log spot rate equal to zero. The CIP deviation for currency i relative to the dollar is then defined as

$$cip_i = r_i + f_i - r_{\$} \quad (1)$$

Here r_i and $r_{\$}$ are the interest rates on the safe country i and dollar assets, while f_i is the (log) forward rate (dollars per currency i). $r_i + f_i$ is the synthetic dollar rate, the rate obtained when swapping the safe country i asset into dollars.

We need to explain why a country with a higher CIP deviation cip_i has a lower interest rate r_i . Note that it follows immediately from the CIP definition that this country also has a relatively high forward rate f_i .

2.2 Forward Market Equilibrium

We will allow demand and supply of forward dollars to be driven by three motives that commonly feature in the literature: CIP arbitrage, speculation, and hedging. If the CIP deviation is positive, it is attractive to borrow in the safe dollar asset and lend dollars

⁵Dao et al. (2025) make a similar assumption, that the nominal exchange rate does not systematically drift in the long run. It is also consistent with the evidence they report when exchange rate expectations are based on survey data.

synthetically by lending in currency i and buying dollars forward. A higher CIP deviation therefore leads to a higher demand for forward dollars due to arbitrage. The speculative motive leads to a demand for forward dollars that depends on the expected profit from buying dollars forward, which is equal to the forward rate f_i minus the expected future spot rate. Since we assume the latter to be zero, a higher forward rate f_i leads to a greater speculative demand for forward dollars.

Denote the demand for forward dollars associated with the CIP arbitrage and speculation as X_i^{arb} and X_i^{spec} . Similarly, denote the net supply of forward dollars in exchange for currency i for currency hedging reasons as X_i^{hedge} . Forward market equilibrium can then be written as

$$X_i^{arb}(cip_i)^+ + X_i^{spec}(f_i)^+ = X_i^{hedge} \quad (2)$$

Here the “+” sign indicates that X_i^{arb} and X_i^{spec} depend positively on respectively cip_i and f_i .

Without a hedging motive, the CIP deviation is positively related to the interest rate. This can be seen by setting $X_i^{hedge} = 0$ and using $f_i = cip_i - r_i + r_{\$}$. The forward market equilibrium is then

$$X_i^{arb}(cip_i)^+ + X_i^{spec}(\overbrace{cip_i - r_i + r_{\$}}^+) = 0 \quad (3)$$

Therefore, a hedging motive is needed if we wish to account for the negative relationship between the CIP deviation and the interest rate. Across countries, the net supply of forward dollars associated with hedging must then be larger where the interest rate is lower. This does not require the hedging supply to depend on the interest rate itself. In the model that follows, both are driven by differences across countries in saving and investment.

2.3 Introducing a Hedging Motive

In contrast to the papers discussed in the literature review that consider optimal hedging for a given portfolio of assets, additional assumptions are needed to motivate hedging when investors make simultaneous hedging and portfolio decisions. We need to introduce risky assets and restrict the assets to which investors have access. The Online Appendix shows that without risky assets, demand for forward dollars is only driven by the CIP arbitrage motive and speculative motive. We will introduce risky assets in the form of corporate bonds.

But we also need to restrict the assets that agents have access to. We show in the Online Appendix that when investors have access to both the safe foreign and domestic asset, the forward market position is driven by CIP arbitrage even with a risky asset. The safe foreign asset, as opposed to the forward market, is then used to offset the exchange rate risk on foreign corporate bonds. One option is to assume that investors do not have access to the safe foreign asset (as in [Du and Huber \(2026\)](#) and [Kubitza et al. \(2025\)](#)) or that they do not have access to the safe domestic asset. In the Online Appendix we show that a true hedging motive arises with these constraints.

Here we choose a slightly different approach of restricting access to assets. We know, for example, that in reality foreign investors hold a lot of safe dollar debt. We allow households from country i to hold safe dollar assets, but only through a mutual fund that invests in US dollar assets. Since the mutual fund invests in a combination of safe dollar assets and risky dollar assets (corporate bonds), households cannot take a separate position in safe dollar assets.

Mutual funds are restricted in that they can only hold foreign assets and, therefore, cannot hold the domestic safe asset. As we show in the Online Appendix, the optimal forward market position of a mutual fund then has two components. The first is a full hedge of its foreign currency exposure. The second is a speculative position. If mutual funds could also hold the domestic safe asset, their forward market position would instead be driven by the CIP arbitrage motive. In the model, we assume for convenience that mutual funds take only the hedging position, and that all speculative positions are taken by hedge funds. This is consistent with [Hacıoğlu-Hoke et al. \(2026\)](#), who find that speculative positions in the London FX derivatives market are mostly taken by hedge funds.

While we need a hedging motive, it is also clear that the speculative motive cannot be too strong if we wish to explain the negative relationship between the CIP deviation and the interest rate. The expected profit from speculation is the sum of the CIP and UIP deviation: $f_i = cip_i + (r_{\$} - r_i)$. Therefore, when speculative demand for forward dollars X_i^{spec} is sufficiently sensitive to the forward rate, from equation (2) we get a counterfactual positive cross-country relationship between the CIP deviation and the interest rate.

3 Model Description

We consider a two-period model with $N+1$ countries: the US and N smaller foreign countries. In each country, there are households that can invest in the domestic safe asset, the domestic corporate bond and mutual funds. Mutual funds choose a portfolio of safe assets and corporate bonds in foreign countries. As discussed in Section 2, we assume that mutual funds fully hedge currency risk. We consider partially hedged mutual funds in Section 5.6.

There are also firms, hedge funds, financial intermediaries that conduct UIP and CIP arbitrage, and safe asset suppliers. Firms in the US issue corporate dollar bonds, while those in the N countries issue both domestic currency and dollar bonds. For now we assume that they perfectly hedge dollar bonds, but we will extend this later as well. Hedge funds take a speculative position in the forward market of each of the N currencies relative to the dollar. Financial intermediaries that conduct UIP and CIP arbitrage have limited arbitrage capacity for the N currencies relative to the dollar. Finally, safe asset suppliers in the US and the N countries, which we interpret as governments, provide an interest elastic supply of safe assets. Table 2 summarizes the assets that each type of agent holds or issues, and its position in the forward market.

We will be relatively vague about the goods market as our focus is on financial markets. We make several assumptions that have implications for relative prices of goods and real exchange rates. Specifically, we assume that period 1 exchange rates are 1 and that period 2 exchange rates have an exogenous distribution. We also assume that central banks target a consumer price index of 1 in the domestic currency in both periods and that endowments and output are in units of the domestic consumption index. In the Online Appendix we show that these assumptions are consistent with goods market equilibrium when we make appropriate assumptions about the composition of goods that make up the endowments and output in each country.

3.1 Assets

In each country, there are safe assets and corporate bonds. We have already described the safe assets in Section 2. We will denote gross interest rates with upper case letters, $R_{\$}$ for the safe dollar bond and R_i for the safe bond from small country i . These are returns from period 1 to period 2.

Table 2: Agents and Assets

Agent	Holds or issues	Forward market
Country i households	Country i safe asset Country i corporate bond in currency i Mutual fund investing in the US	
Mutual fund investing in the US	US safe asset US corporate bond	Sells dollars
US households	US safe asset US corporate bond Mutual funds investing in country i	
Mutual fund investing in country i	Country i safe asset Country i corporate dollar bond	Buys dollars
Country i firms	Issue corporate bonds in currency i Issue corporate dollar bonds	Buy dollars
US firms	Issue corporate dollar bonds	
Financial intermediary	Country i and US safe assets	CIP arbitrage
Hedge funds		Speculative
Safe asset suppliers	Issue safe assets	

Notes: The mutual fund investing in the US hedges its dollar assets. The mutual fund investing in country i hedges the country i safe asset. Country i firms hedge their dollar bonds.

US firms only issue dollar denominated corporate bonds. Firms in country i issue both dollar bonds and bonds in the domestic currency. All bonds have a promised payment of one unit in period 2 in the currency of denomination. The respective yields on US corporate dollar bonds, country i corporate dollar bonds and country i corporate bonds in the country i currency are

$$R_{\$,c} = \frac{1}{P_{\$}} \quad R_{\$,i,c} = \frac{1}{P_{\$,i}} \quad R_{i,c} = \frac{1}{P_i}$$

The prices of the bonds are shown in the denominators.

In addition to currency risk when investing in a foreign currency bond, there is also a risk of default on all corporate bonds. The perceived probability of default varies across agents. Foreign bonds are considered to be riskier than domestic bonds. Both US and foreign

households perceive the probability of default of their domestic firms to be π . Assuming full default in case of bankruptcy, this implies a variance of the return on domestic corporate bonds of $v = \pi(1 - \pi)$, evaluated at bond yields of 1. We assume that mutual funds are just as informed as households of the country in which they invest, and therefore also consider the probability of default to be π .

In contrast, US households perceive the probability of default of firms in each small country to be $\tilde{\pi}$, with $\tilde{\pi} > \pi$, and the corresponding variance of the return as $\tilde{v} = \tilde{\pi}(1 - \tilde{\pi})$. This generates portfolio home bias. Similarly, households in each small country perceive the probability of default of US firms to be $\tilde{\pi}$. We assume that the perceived variance of the return is $\tilde{v}/N$. This is because we can think of the US as of the same size as the sum of N small countries, with uncorrelated default outcomes. We assume that default outcomes are uncorrelated across countries and with the exchange rate.

Exchange rates are dollars per unit of currency i . Period 1 exchange rates are assumed to be 1. The period 2 exchange rate is denoted $S_{i,2}$. The period 1 forward rate for currency i is F_i . If an agent buys 1 dollar forward, the agent receives 1 dollar at time 2 in exchange for $1/F_i$ units of currency i . The expectation and variance of the period 2 log exchange rate $s_{i,2}$ are 0 and σ^2 , so that the expected change in the log exchange rate is zero.

3.2 Mutual Funds

As discussed in Section 2, we first assume that mutual funds fully hedge exchange rate risk. In Section 5.6 we assume that they adopt an exogenous partial hedge ratio. We assume that small country households invest through mutual funds in the US safe dollar asset and US corporate dollar bonds. Consistent with this, [Department of the Treasury \(2025\)](#) shows that over 80% of foreign holdings of US corporate debt is denominated in dollars. At the same time we assume that US households invest through mutual funds in safe debt of the small countries in local currencies as well as corporate debt of the small countries denominated in dollars. Consistent with this, [Department of the Treasury \(2024\)](#) shows that of US holdings of debt of other advanced countries, 88% of government debt is denominated in the local currency, while 83% of private sector debt is denominated in dollars.

Now consider a mutual fund that invests in the US on behalf of households in the small country i . $\mu_{i,m}$ is the share that the fund invests in the US corporate dollar bond, while

$1 - \mu_{i,m}$ is the share that it invests in the safe dollar bond. Exchange rate risk is fully hedged through a forward market position. As shown in Appendix B, after log-linearization the expectation and variance of the return of the mutual fund can be written as

$$\begin{aligned} ER_{i,m} &= 1 + (1 - \mu_{i,m})r_{\$} + \mu_{i,m}(r_{\$,c} - \pi) - f_i \\ var(R_{i,m}) &= \mu_{i,m}^2 v \end{aligned}$$

Here lower case letters for returns and the forward rate denote logs.

Assume that the mutual fund maximizes a standard mean-variance objective with risk-aversion γ_m :

$$E(R_{i,m}) - 0.5\gamma_m var(R_{i,m}) \quad (4)$$

The first-order condition with respect to $\mu_{i,m}$ is

$$\mu_{i,m} = \frac{r_{\$,c} - \pi - r_{\$}}{\gamma_m v} \quad (5)$$

The share invested in the corporate dollar bond depends on the difference between its expected return, $r_{\$,c} - \pi$, and the safe dollar interest rate $r_{\$}$.

We could not address cross-country differences in CIP deviations if we introduced a single mutual fund held by US households that invests in all of the N countries. This fund would conduct perfect cross-currency CIP arbitrage, so that CIP deviations relative to the dollar would be the same for all N currencies. We therefore assume that US households can invest in N separate mutual funds that each invest in the assets of one of the N small countries. The country i fund invests a share $\phi_{i,m}$ in the corporate dollar bond issued by firms of country i and a share $1 - \phi_{i,m}$ in the safe asset of country i . The fund fully hedges the exchange rate risk associated with the safe asset that is denominated in the currency of country i . As shown in Appendix B, after log-linearization the expectation and variance of the return of the mutual fund can be written as

$$\begin{aligned} ER_{i,m,d} &= 1 + (1 - \phi_{i,m})(r_i + f_i) + \phi_{i,m}(r_{\$,i,c} - \pi) \\ var(R_{i,m,d}) &= \phi_{i,m}^2 v \end{aligned}$$

The fund maximizes the mean-variance objective $ER_{i,m,d} - 0.5\gamma_m var(R_{i,m,d})$. The first-

order condition can be written as

$$\phi_{i,m} = \frac{r_{\$,i,c} - \pi - r_i - f_i}{\gamma_m v} \quad (6)$$

The portfolio share allocated to the corporate dollar bond is based on the excess return of the country i corporate dollar bond over the hedged country i safe asset. The expected return on the country i corporate dollar bond is $r_{\$,i,c} - \pi$. The hedged return on the country i safe asset is $r_i + f_i$.

3.3 Households

3.3.1 Small Country Households

In period 1 households in country i start with a real endowment of Z . Let $W_i = Z - C_{1,i}$ be wealth in period 1 after consumption. Utility is

$$\ln(C_{1,i}) + \beta_i \ln [E (C_{2,i})^{1-\gamma}]^{\frac{1}{1-\gamma}} \quad (7)$$

This is the [Epstein and Zin \(1989\)](#) specification with a unit elasticity of intertemporal substitution and relative risk aversion γ . Saving then does not depend on portfolio returns, so that wealth depends only on β_i .

We have $C_{2,i} = (Z - C_{1,i})R_{p,i}$, where $R_{p,i}$ is a stochastic portfolio return. Maximizing utility with respect to $C_{1,i}$ gives $C_{1,i} = \frac{1}{1+\beta_i}Z$, so that

$$W_i = \frac{\beta_i}{1 + \beta_i} Z \quad (8)$$

We allow household wealth W_i to vary across small countries. Countries with high wealth have high household saving as a result of a high time discount factor β_i .

In addition, households maximize

$$[E (R_{p,i})^{1-\gamma}]^{\frac{1}{1-\gamma}}$$

One can show that this can be approximated as maximizing⁶

$$E(R_{p,i}) - 0.5\gamma\text{var}(R_{p,i}) \quad (9)$$

Country i households invest a share $\alpha_{i,c}$ in the country i corporate bond in the country i currency, a share $\alpha_{i,m}$ in the mutual fund that invests in the US, and the remainder in the country i safe asset. As shown in Appendix B, after log-linearization, we have

$$\begin{aligned} ER_{p,i} &= 1 + r_i + \alpha_{i,c}(r_{i,c} - \pi - r_i) + \alpha_{i,m}((1 - \mu_{i,m})r_{\$} + \mu_{i,m}(r_{\$,c} - \tilde{\pi}) - r_i - f_i) \\ \text{var}(R_{p,i}) &= \alpha_{i,c}^2 v + (\alpha_{i,m}\mu_{i,m})^2 \frac{\tilde{v}}{N} \end{aligned}$$

This uses that country i households perceive the expectation and variance of default on corporate bonds to be π and v for domestic bonds and $\tilde{\pi}$ and $\tilde{v}/N$ for US bonds. The last term in the expectation is the expected excess return on the portfolio of hedged US assets that the mutual fund invests in.

The first-order conditions with respect to $\alpha_{i,c}$ and $\alpha_{i,m}$ imply

$$\alpha_{i,c} = \frac{r_{i,c} - \pi - r_i}{\gamma v} \quad (10)$$

$$\alpha_{i,m} = \frac{r_{\$} - r_i - f_i + \mu_{i,m}(r_{\$,c} - \tilde{\pi} - r_{\$})}{\gamma \mu_{i,m}^2 \frac{\tilde{v}}{N}} \quad (11)$$

The share $\alpha_{i,c}$ allocated to domestic corporate bonds is a standard mean-variance portfolio.

The first term in the numerator of the foreign portfolio share $\alpha_{i,m}$ is $r_{\$} - r_i - f_i$. This is the excess return on the hedged US safe asset over the country i safe asset. It is the CIP deviation with the sign reversed. A higher CIP deviation makes it more costly to hedge, leading to lower investment in the US. The second term in the numerator is the expected excess return of US corporate bonds over the US safe asset, multiplied by the fraction that the mutual fund allocates to corporate dollar bonds. If US corporate bonds are expected to deliver a higher return than the US safe asset, it raises the allocation to the mutual fund to

⁶A second-order Taylor expansion gives $(R_{p,i})^{1-\gamma} = (ER_{p,i})^{1-\gamma} + (1-\gamma)(ER_{p,i})^{-\gamma}(R_{p,i} - ER_{p,i}) - 0.5\gamma(1-\gamma)(ER_{p,i})^{-\gamma-1}(R_{p,i} - ER_{p,i})^2$. Taking the expectation, we have $E(R_{p,i})^{1-\gamma} = (ER_{p,i})^{1-\gamma} - 0.5\gamma(1-\gamma)(ER_{p,i})^{-\gamma-1}\text{var}(R_{p,i})$. Taking this to the power $1/(1-\gamma)$, and linearly expanding around $ER_{p,i} = 1$ and $\text{var}(R_{p,i}) = 0$, gives (9).

the extent that it invests in US corporate bonds. The denominator depends on the default risk associated with US corporate dollar bonds.

3.3.2 US Households

Now consider US households. They start period 1 with a real endowment of $Z_d = NZ$, so the same as the aggregate of non-US households. They have the same utility as small country households, with discount factor β_d . Therefore, their period 1 consumption is $Z_d/(1 + \beta_d)$ and wealth is

$$W_d = \frac{\beta_d}{1 + \beta_d} Z_d \quad (12)$$

Their portfolio return is $R_{p,US}$. Similarly to small country households, the utility function implies that they maximize $ER_{p,US} - 0.5\gamma var(R_{p,US})$. Let $\omega_{d,c}$ be the fraction that US households invest in the US corporate dollar bond and $\omega_{i,m}$ the fraction they invest in country i mutual fund with dollar return $R_{i,m,d}$. As shown in Appendix B, after log-linearization we have

$$ER_{p,US} = 1 + r_{\$} + \omega_{d,c}(r_{\$,c} - \pi - r_{\$}) + \sum_{i=1}^N \omega_{i,m} [(1 - \phi_{i,m})(r_i + f_i - r_{\$}) + \phi_{i,m}(r_{\$,i,c} - \tilde{\pi} - r_{\$})]$$

$$var(R_{p,US}) = \tilde{v} \sum_{i=1}^N (\omega_{i,m} \phi_{i,m})^2 + \omega_{d,c}^2 v$$

The optimal portfolios are then

$$\omega_{d,c} = \frac{r_{\$,c} - \pi - r_{\$}}{\gamma v} \quad (13)$$

$$\omega_{i,m} = \frac{r_i + f_i - r_{\$} + \phi_{i,m}(r_{\$,i,c} - \tilde{\pi} - r_i - f_i)}{\gamma \tilde{v} \phi_{i,m}^2} \quad (14)$$

The share allocated to the domestic corporate dollar bond depends on the expected excess return of the domestic corporate bond over the domestic safe asset. Similarly to small country households, the share allocated to the country i mutual fund depends on two expected excess returns. The first is the expected excess return of the hedged country i safe asset over the dollar safe asset, which is the CIP deviation. A higher CIP deviation raises investment in

country i . The second is the the expected excess return of the country i corporate dollar bond over the hedged country i safe asset, times the share the mutual fund allocates to the country i corporate dollar bond.

3.4 Firms

First, consider firms in the N small countries. A firm from country i issues dollar and country i currency bonds that pay respectively 1 dollar and 1 unit of currency i in period 2. Their period 2 output is

$$Y_i = A_i K_i^\nu \quad (15)$$

Assume that the price of capital is 1.⁷ A fraction η_i of capital is financed through dollar bonds. The firm fully hedges currency risk associated with issuing dollar bonds through the forward market. Firm productivity A_i may vary across countries.

Log-linearizing the cost of capital, profits are

$$\Pi_i = A_i K_i^\nu - K_i [1 + \eta_i(r_{\$,i,c} - f_i) + (1 - \eta_i)r_{i,c}] \quad (16)$$

Here $r_{\$,i,c} - f_i$ is the hedged cost of dollar bonds. Maximizing profits with respect to η_i and K_i gives

$$r_{\$,i,c} - r_{i,c} - f_i = 0 \quad (17)$$

$$A_i \nu K_i^{\nu-1} = 1 + r_{i,c} \quad (18)$$

Equation (17) implies arbitrage such that the hedged cost of dollar bonds is the same as the cost of currency i bonds. Liao (2020) has shown that this condition holds well in both cross-section and time series data for corporate bonds. It implies that the difference in the credit spread between the dollar bond ($r_{\$,i,c} - r_{\$}$) and the currency i corporate bond ($r_{i,c} - r_i$) corresponds to the CIP deviation $r_i + f_i - r_{\$}$. (18) equates the marginal return on capital to the cost of capital.

Since profits are linear in η_i , (17) does not determine the share of dollar debt. Firms

⁷We can think of capital as the same index of goods as consumption, whose price index is targeted to be 1 by the central bank.

are indifferent between the two currencies. The share of dollar debt is determined by the demand for corporate dollar bonds by US mutual funds.

US firms only issue dollar bonds. Their output is $Y_d = A_d K_d^\nu$ and they maximize profits $A_d K_d^\nu - R_{\$,c} K_d$. Log-linearizing $R_{\$,c}$ as $1 + r_{\$,c}$, the first-order condition is

$$A_d \nu K_d^{\nu-1} = 1 + r_{\$,c} \quad (19)$$

Similarly to country i firms, this equates the marginal product of capital to the cost of capital.

3.5 Financial Intermediaries

There are financial intermediaries that conduct both UIP and CIP arbitrage. For what follows, it does not matter whether they are located in the US or in the small countries. For simplicity we assume that each intermediary specializes in one currency, so that for each small country i there is a financial intermediary that conducts UIP and CIP arbitrage for currency i relative to the dollar. We return to this assumption below. The intermediary can choose positions in the country i safe asset, the dollar safe asset and the forward market for currency i relative to the dollar. It starts period 1 with zero wealth, so that opposite positions are taken in the two safe assets. Let ψ_i be the period 1 holding of the country i safe asset. Therefore, the holding of the dollar safe asset is $-\psi_i$. Let λ_i be dollars bought forward.

In terms of dollars, the log-linearized period 2 profits of these arbitrageurs are

$$\Pi_i^a = \psi_i (r_i + s_{i,2} - r_\$) + \lambda_i (f_i - s_{i,2}) = B_i^{CIP} (r_i + f_i - r_\$) + B_i^{UIP} (r_i + s_{i,2} - r_\$) \quad (20)$$

Here $B_i^{CIP} = \lambda_i$ is a CIP arbitrage position and $B_i^{UIP} = \psi_i - \lambda_i$ is a UIP arbitrage position.

Assume that these arbitrageurs maximize

$$E(\Pi_i^a) - 0.5 \gamma_a \text{var}(\Pi_i^a) - 0.5 \frac{1}{\Gamma} (B_i^{CIP})^2 \quad (21)$$

The first two terms are the risk-adjusted expected profits, while the last term subtracts a quadratic cost associated with the CIP arbitrage position. Otherwise intermediaries would

conduct perfect CIP arbitrage. These costs are meant to reflect various regulations that have limited CIP arbitrage since 2008.

Maximizing the objective with respect to B_i^{CIP} and B_i^{UIP} implies

$$B_i^{CIP} = \Gamma (r_i + f_i - r_{\$}) \quad (22)$$

$$B_i^{UIP} = \Gamma_a (r_i - r_{\$}) \quad (23)$$

where $\Gamma_a = 1/[\gamma_a \sigma^2]$. Γ_a is what [Gabaix and Maggiori \(2015\)](#) refer to as the risk-bearing capacity of the intermediary, which determines their portfolio response to UIP deviations. Since we assume that the expected period 2 exchange rate is 0, the UIP deviation is $r_i - r_{\$}$. Γ is the CIP arbitrage capacity of the intermediary. The larger it is, the more responsive the intermediary is to the CIP deviation $r_i + f_i - r_{\$}$.

The assumption that intermediaries specialize in one currency is not essential. Suppose instead that CIP arbitrageurs have positions in all currencies. They face costs associated with both their aggregate CIP arbitrage position and their currency specific positions, as in [Davis, He, and van Wincoop \(2026\)](#). Aggregate costs, such as those associated with the leverage ratio, limit the response of the aggregate position to the average CIP deviation. Currency specific costs, such as the capital charge on counterparty risk associated with FX swaps, limit cross-currency arbitrage. Since our analysis is about cross-country differences, only the currency specific costs matter. They are captured by Γ . A large Γ corresponds to strong cross-currency arbitrage.⁸

3.6 Hedge Funds

Hedge funds in country i choose a position h_i in speculative forward trade in currency i relative to the dollar. Specifically, they buy h_i dollars forward. This gives a log-linearized profit of

$$\Pi_h = h_i (f_i - s_{i,2}) \quad (24)$$

⁸In [Davis et al. \(2026\)](#), arbitrageurs maximize $\sum_i cip_i B_i^{CIP} - 0.5\xi \left[\frac{1-\xi^r}{N} (\sum_i B_i^{CIP})^2 + \xi^r \sum_i (B_i^{CIP})^2 \right]$. The first order condition gives $B_i^{CIP} = (cip_i - cip_w) / (\xi\xi^r) + cip_w / \xi$, where cip_w is the average CIP deviation. Cross-country heterogeneity that we consider below leaves world averages, such as cip_w , unchanged to the first order. Therefore the change in B_i^{CIP} equals the change in cip_i divided by $\xi\xi^r$, which is the specification in the text with $\Gamma = 1/(\xi\xi^r)$.

Assume that hedge funds maximize $E(\Pi_h) - 0.5\gamma_h var(\Pi_h)$. This implies

$$h_i = \frac{f_i}{\gamma_h \sigma^2} \quad (25)$$

If there are n_h hedge funds, total demand for forward dollars by hedge funds is

$$H_i = \Gamma_h f_i \quad (26)$$

where $\Gamma_h = n_h/(\gamma_h \sigma^2)$. The extent of speculation in the forward market therefore depends on the number of hedge funds and their risk-aversion.

3.7 Safe Asset Suppliers

Households and mutual funds invest in safe assets, which are provided by safe asset suppliers. We interpret their supply as the net supply of public debt, that is, public debt minus the holdings of the central bank, which is also our measure of public debt in Appendix A. The net supply falls when the government borrows less or when the central bank buys government bonds.

We model the period 1 supply of safe assets in country i as interest-rate elastic,

$$D_i = d_{i,0} - d_1 r_i \quad (27)$$

The intercept $d_{i,0}$ varies across countries, which is the source of safe asset supply heterogeneity in Section 5. Analogously, for the US we assume that the safe asset supply is

$$D_d = d_{\$,0} - N d_1 r_{\$} \quad (28)$$

3.8 Market Clearing

For each country i there are three market clearing conditions. The first is the safe asset market clearing condition:

$$(1 - \alpha_{i,c} - \alpha_{i,m})W_i + \omega_{i,m}(1 - \phi_{i,m})W_d + B_i^{CIP} + B_i^{UIP} = D_i \quad (29)$$

The first two terms are demand of country i safe assets by domestic and US households, the latter through mutual funds. The next two terms are the demand for the country i safe asset by CIP and UIP arbitrageurs. The total demand is equal to the supply D_i by the safe asset suppliers.

The second market clearing condition equates supply and demand for corporate capital of country i :

$$\left(\frac{A_i \nu}{1 + r_{i,c}} \right)^{\frac{1}{1-\nu}} = \alpha_{i,c} W_i + \phi_{i,m} \omega_{i,m} W_d \quad (30)$$

The left hand side is the supply of capital K_i from (18). It is larger the lower the cost of capital (corporate yield) and the higher productivity. The right hand side is the demand for corporate capital by households. The first term is demand by country i households, while the second term is demand by US households (through mutual funds).

Finally, the third market clearing condition is equilibrium in the forward market:

$$B_i^{CIP} + \omega_{i,m} W_d - \alpha_{i,m} W_i + H_i = 0 \quad i = 1, \dots, N \quad (31)$$

The first term is demand for forward dollars by CIP arbitrageurs. The second term is demand for forward dollars associated with investment by the US in country i . This involves the country i safe asset and the country i dollar bond, both held through a mutual fund. The mutual fund buys dollars forward to hedge currency risk associated with the country i safe asset. Firms in country i buy dollars forward to hedge dollar denominated debt held by US households through the mutual fund. The third term is the supply of forward dollars to hedge US dollar assets held by households in country i through a mutual fund. The last term is the demand for forward dollars by hedge funds.

Finally, for the US there are analogous equilibrium conditions for safe assets and corporate capital:

$$\left(1 - \omega_{d,c} - \sum_{i=1}^N \omega_{i,m} \right) W_d + \sum_{i=1}^N \alpha_{i,m} (1 - \mu_{i,m}) W_i - \sum_{i=1}^N B_i^{CIP} - \sum_{i=1}^N B_i^{UIP} = D_d \quad (32)$$

$$\left(\frac{A_d \nu}{1 + r_{d,c}} \right)^{\frac{1}{1-\nu}} = \sum_{i=1}^N \alpha_{i,m} \mu_{i,m} W_i + \omega_{d,c} W_d \quad (33)$$

These $3N + 2$ equilibrium conditions can be used to solve for r_i , $r_{i,c}$, f_i , $r_{\$}$ and $r_{\$,c}$. We also use that $r_{\$,i,c} = r_{i,c} + f_i$ from (17).

3.9 NFA and Hedging

From the forward market clearing condition (31) we can derive some results regarding the net foreign asset position and the net supply of forward dollars associated with hedging. With perfect hedging, we have

$$NFA_i = \alpha_{i,m}W_i - \omega_{i,m}W_d - B_i^{UIP} - B_i^{CIP} = -B_i^{UIP} + H_i = -\Gamma_a(r_i - r_{\$}) + \Gamma_h(cip_i - r_i + r_{\$}) \quad (34)$$

The second equality uses the forward market equilibrium (31). If we can account for the fact that a country with a relatively high CIP deviation tends to have a relatively low interest rate, it follows that this country also has a relatively high net foreign asset position.

A low interest rate leads to net capital outflows by UIP arbitrageurs. When $\Gamma_h = 0$ the net foreign asset position associated with households, $\alpha_{i,m}W_i - \omega_{i,m}W_d$, has no effect on NFA_i . This is because CIP arbitrageurs take the other side. Large holdings of dollar assets by households in country i imply a large supply of forward dollars. When CIP arbitrageurs take the other side, they lend dollars synthetically. This involves a short position in the safe dollar asset and long position in the safe country i asset, implying opposite net inflows into country i . But when $\Gamma_h > 0$, this offset through CIP arbitrageurs is partial. Speculators take the other side as well since $f_i = cip_i - r_i + r_{\$}$ is relatively high.

Since the hedge ratio is 1, the net supply of forward dollars associated with hedging is $X_i^{hedge} = \alpha_{i,m}W_i - \omega_{i,m}W_d$. It follows from the forward market equilibrium (31) that

$$X_i^{hedge} = B_i^{CIP} + \Gamma_h f_i = (\Gamma + \Gamma_h) cip_i - \Gamma_h r_i + \Gamma_h r_{\$} \quad (35)$$

If we can account for the fact that a country with a relatively high CIP deviation tends to have a relatively low interest rate, it follows that this country also has a relatively high net supply of forward dollars associated with hedging. Du and Huber (2026) instead measure gross hedging of dollar assets by foreign institutional investors. Net hedging also subtracts the forward dollars bought by US investors hedging foreign currency assets and by foreign firms hedging dollar debt. We discuss the implications of the model for gross hedging in

Section 5.4.

4 Solution

We first consider a symmetric equilibrium to the model in which all small countries are identical and therefore have the same safe rate, corporate yield and forward rate. In addition, the safe rate and corporate yield are the same in the US as in the small countries and CIP deviations are all zero. Therefore $r_i - r_{\$} = f_i = 0$ and all corporate spreads are the same: $r_{i,c} - r_i = r_{\$,c} - r_{\$}$. We also set parameters such that in the symmetric equilibrium all countries invest the same share h in domestic assets and $1 - h$ in foreign assets, and invest a share c in corporate bonds and $1 - c$ in safe assets within both domestic and foreign asset portfolios. We leave details of the parameterizations associated with the symmetric equilibrium to Appendix C.

We next introduce asymmetries across countries. Section 5 derives analytical results by considering marginal cross-country asymmetries, starting from the symmetric equilibrium.

We derive three types of asymmetric equilibria, with heterogeneity across the small countries in household wealth, firm productivity and safe asset supply. Otherwise we keep parameters the same as in the symmetric equilibrium. These three forms of heterogeneity take the form

$$W_i = W + \epsilon_{i,w} \tag{36}$$

$$A_i = A + \epsilon_{i,a} \tag{37}$$

$$d_{i,0} = d_0 + \epsilon_{i,d} \tag{38}$$

where $\sum_i \epsilon_{i,w} = 0$, $\sum_i \epsilon_{i,a} = 0$ and $\sum_i \epsilon_{i,d} = 0$. While these variables now vary across countries, their average level remains the same as in the symmetric equilibrium.

To obtain analytical results in Section 5, we simply take derivatives of the $3N + 2$ market equilibrium conditions with respect to $\epsilon_{i,w}$, $\epsilon_{i,a}$ and $\epsilon_{i,d}$, evaluated at the symmetric equilibrium where they are zero. It may sound hard to solve $3N + 2$ variables analytically, but ultimately we only need to solve 3 variables. Since nothing changes for the average of the small countries, averages of all variables remain unchanged. This also means that $r_{\$}$ and $r_{\$,c}$ do not change. We can then solve for r_i , $r_{i,c}$ and f_i from the linearized market equilibrium

conditions for country i . Defining $\hat{r}_i$, $\hat{r}_{i,c}$ and $\hat{f}_i$ as the change relative to the symmetric equilibrium, we can solve these as a linear function of $\epsilon_{i,w}$, $\epsilon_{i,a}$ and $\epsilon_{i,d}$.

When discussing the solution, it will be more intuitive to focus on the safe rate r_i , the corporate spread $\delta_i = r_{i,c} - r_i$ and the CIP deviation $cip_i = r_i + f_i - r_{\$}$. Since the safe dollar rate will not be affected by the asymmetry, we have $\widehat{cip}_i = \hat{r}_i + \hat{f}_i$.

5 Analytical Results

This section studies how heterogeneity in wealth, productivity and safe asset supply affects the safe interest rate, the CIP deviation and the other variables of interest, using the solution method described in Section 4. Differences in household wealth correspond to differences in saving, and differences in productivity to differences in investment demand. We first derive results under the following assumption.

Assumption 1 *Mutual funds and firms fully hedge their foreign currency exposure, and hedge funds take no speculative positions ($\Gamma_h = 0$).*

The absence of speculative positions is consistent with the evidence in [Hacıoğlu-Hoke et al. \(2026\)](#), who find that dealer banks take the opposite position of hedgers in the forward market, while the positions of hedge funds are close to zero on average. Section 5.5 considers $\Gamma_h > 0$ and Section 5.6 partial hedging. Proofs of the propositions are in the Online Appendix.

Two parameters that enter the discussion below have not yet been defined. Linearizing (18) gives

$$\hat{K}_i = k_1 \epsilon_{i,a} - k_2 \hat{r}_{i,c} \quad (39)$$

where $k_1 = \bar{K}/[(1 - \nu)A]$ and $k_2 = 1/[A\nu(1 - \nu)\bar{K}^{\nu-2}]$, so that k_2 measures the sensitivity of capital supply to the corporate yield. Second, the net demand for safe assets by UIP arbitrageurs and safe asset suppliers has an interest rate sensitivity $\rho = d_1 + \Gamma_a$.

5.1 Household Wealth Asymmetry

Consider countries with relatively high household saving and therefore relatively high household wealth. Define

$$\bar{k}_2 = \rho c \frac{h\Gamma + (1+h)Q}{(1-hc)\Gamma + [2-c(1+h)]Q}, \quad Q = \frac{NW}{\gamma c^2 \tilde{v}} \quad (40)$$

which is positive.

Proposition 1 *Under Assumption 1, a country with higher household wealth than average has a lower safe interest rate and a higher capital stock. If $k_2 < \bar{k}_2$, it also has a lower corporate spread and a higher CIP deviation.*

Figure 2 illustrates the mechanisms behind Proposition 1. A country with high saving, and therefore high wealth, has a low safe interest rate. The higher wealth raises the demand for the domestic safe asset, which lowers the interest rate. This is shown in the left column of Figure 2.

To understand what happens to the CIP deviation, consider equilibrium in the market for forward dollars. Under Assumption 1 it is

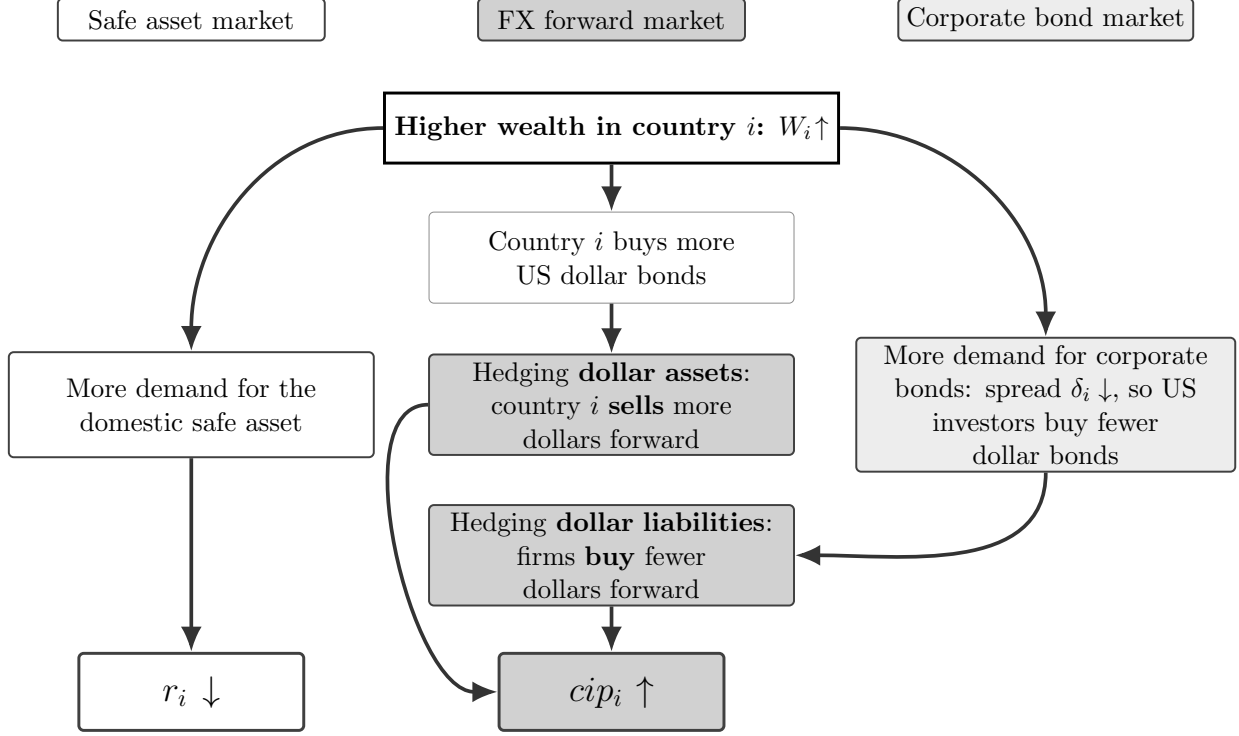
$$\widehat{\Gamma cip}_i = \hat{X}_i^{hedge} \quad (41)$$

The left hand side is the demand for forward dollars by CIP arbitrageurs. The right hand side is the net supply of forward dollars associated with hedging, $X_i^{hedge} = \alpha_{i,m}W_i - \omega_{i,m}W_d$. Mutual funds of country i sell $\alpha_{i,m}W_i$ dollars forward to hedge their US dollar assets. US mutual funds investing in country i , and firms of country i that issue dollar bonds to these funds, together buy $\omega_{i,m}W_d$ dollars forward. Linearizing, the Online Appendix shows that

$$\hat{X}_i^{hedge} = -2 \frac{NW}{\gamma \tilde{v} c^2} \widehat{cip}_i - \frac{W}{\gamma c} \left(\frac{N}{\tilde{v}} - \frac{1-h}{h} \frac{1}{v} \right) \hat{\delta}_i + (1-h)\epsilon_{i,w} \quad (42)$$

The first term reflects the cost of hedging. A higher CIP deviation lowers the hedged return on US assets for households of country i , so they invest less in the US and their mutual funds sell fewer dollars forward. It also raises the hedged return on the assets of country i for US households, who invest more in its mutual fund. The fund buys more of both the

Figure 2: Wealth Heterogeneity



Notes: The figure illustrates the effect of higher household wealth in country i relative to the average, under Assumption 1. Shading identifies the market in which each effect takes place. The figure shows the case $k_2 < \bar{k}_2$ of Proposition 1, in which the corporate spread falls.

safe assets of country i , which it hedges by buying dollars forward, and the corporate dollar bonds of its firms. Firms, which are indifferent between dollar and local currency debt when they hedge, issue more of their debt in dollars and buy more dollars forward to hedge it.

The last term of (42) is the key mechanism. With a portfolio share $1 - h$ allocated to US dollar assets, higher wealth raises the holdings of dollar assets by country i , and hence the supply of forward dollars to hedge them. A higher CIP deviation is needed to clear the forward market. This is the middle column of Figure 2, running from the higher demand for US dollar bonds to the hedging of dollar assets. Wealth therefore raises the

CIP deviation through the forward market and lowers the safe interest rate through the safe asset market, the left column of the figure. Since the interest rate does not enter (41)–(42), the negative relationship between the two does not run from one to the other. Instead, cross-country differences in wealth move both, generating the negative relationship between CIP deviations and interest rates in Figure 1.

The middle term of (42) links the forward market to the corporate spread. The term in brackets is positive, as shown in the Online Appendix. A lower spread therefore raises the CIP deviation. It reduces US demand for the corporate dollar bonds of country i , and hence the dollars its firms buy forward to hedge them.

Higher wealth affects the corporate spread through both demand and supply of corporate capital. On the demand side, higher wealth raises the demand for corporate bonds, which lowers the spread. On the supply side, the lower safe interest rate lowers the corporate yield for a given spread. This raises the supply of capital, which raises the spread. The demand effect dominates when $k_2 < \bar{k}_2$. This is the case shown in the right column of Figure 2. The fall in the spread then reinforces the rise in the CIP deviation. When $k_2 > \bar{k}_2$, the spread rises and works in the opposite direction. The CIP deviation still rises unless k_2 exceeds a second, higher cutoff, which may be infinite and is derived in the Online Appendix.⁹

Finally, the capital stock is higher regardless of the behavior of the spread. If the spread falls, the corporate yield falls along with the safe interest rate, raising the supply of capital. If the spread rises, households demand more corporate bonds both because they are wealthier and because the spread is higher. The quantity of capital again rises.

5.2 Productivity Asymmetry

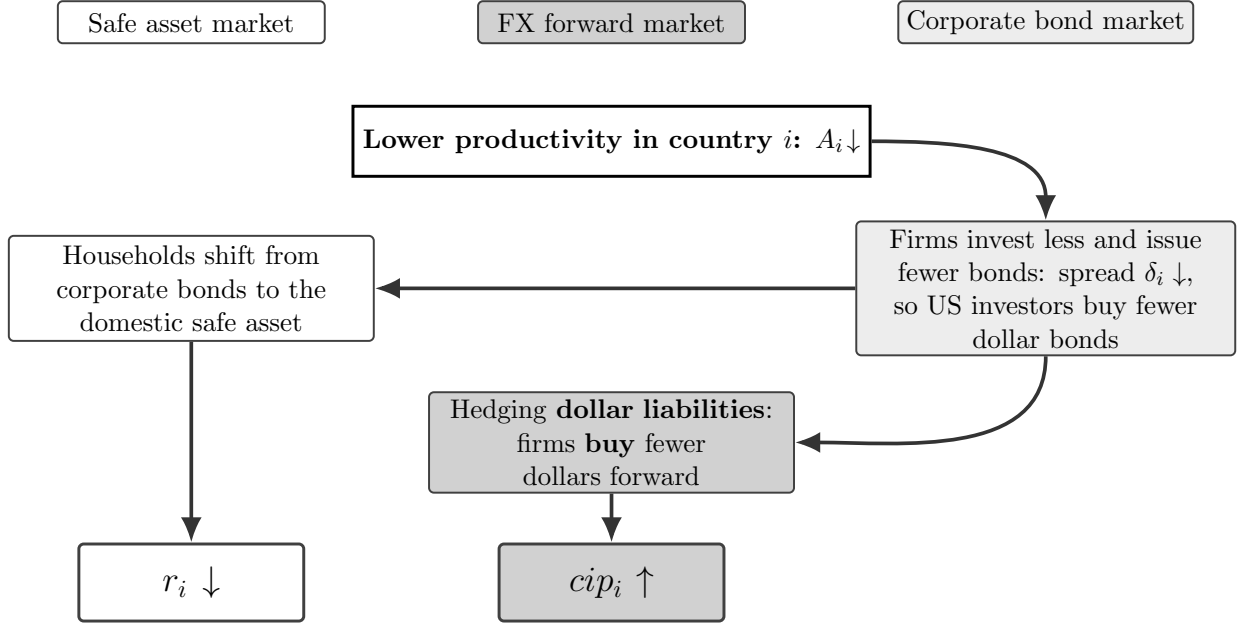
Lower productivity reduces the return on capital and investment demand.

Proposition 2 *Under Assumption 1, a country with lower productivity than average has a lower capital stock, a lower corporate spread, a lower safe interest rate and a higher CIP deviation.*

⁹With a fixed capital stock the supply effect is absent. A country with higher household wealth than average then has a lower corporate spread and a higher CIP deviation for all parameter values. This is shown in the Online Appendix, as part of the analysis of partial hedging.

Figure 3 illustrates the mechanisms behind Proposition 2. They all run through the corporate bond market, in the right column of the figure. Lower productivity reduces the supply of corporate capital. The corporate spread must then fall to clear the market.

Figure 3: Productivity Heterogeneity



Notes: The figure illustrates the effect of lower productivity in country i relative to the average, under Assumption 1. Shading identifies the market in which each effect takes place.

The lower spread affects the other two markets. It raises the demand for the safe asset, which lowers the safe interest rate. From the forward market equilibrium (41)-(42), it also raises the CIP deviation. A lower spread reduces US demand for the corporate dollar bonds of country i , so its firms buy fewer dollars forward to hedge them.

A country with low productivity therefore has a low interest rate and a high CIP deviation, as in the data. Productivity plays the role that wealth plays in Section 5.1, affecting the interest rate and the CIP deviation separately, but through the corporate spread rather than through holdings of dollar assets.

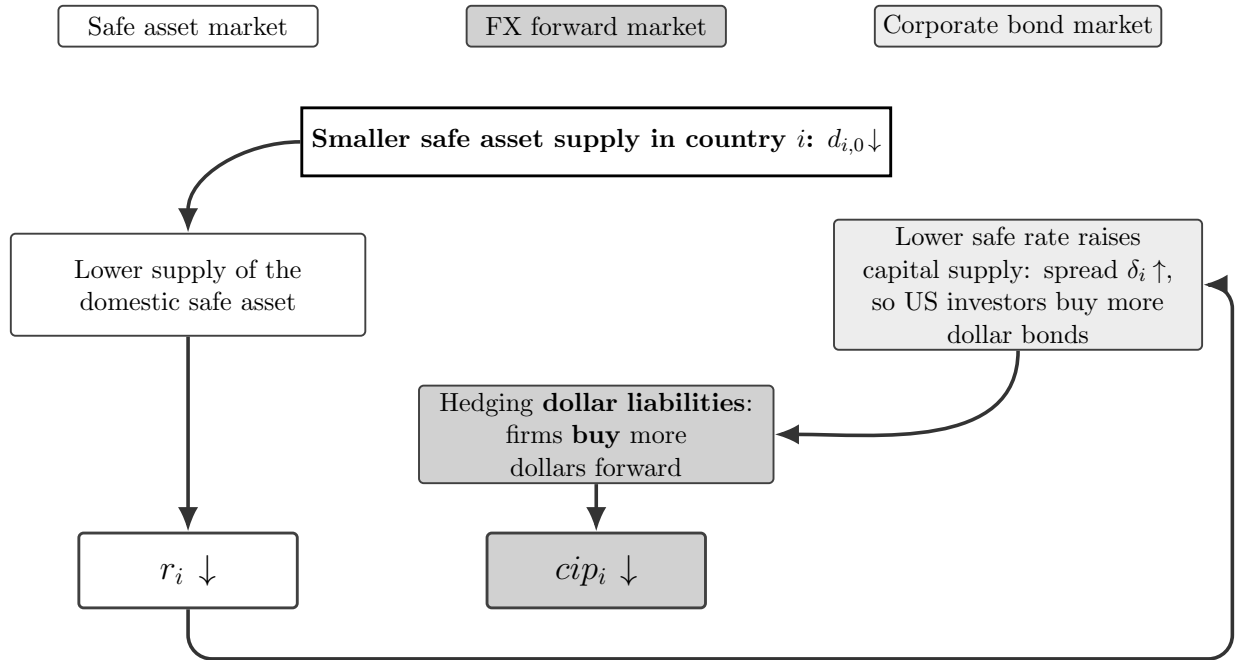
5.3 Safe Asset Supply Asymmetry

The net supply of safe assets can differ across countries, for example because of differences in public debt or in central bank asset purchases.

Proposition 3 *Under Assumption 1, a country with a smaller safe asset supply than average has a lower safe interest rate, a lower CIP deviation, a higher corporate spread and a higher capital stock.*

Figure 4 illustrates the mechanisms behind Proposition 3. They start in the safe asset market, in the left column of the figure, where a smaller supply lowers the safe interest rate.

Figure 4: Safe Asset Supply Heterogeneity



Notes: The figure illustrates the effect of a smaller safe asset supply in country i relative to the average, under Assumption 1. Shading identifies the market in which each effect takes place.

The lower safe interest rate lowers the corporate yield for a given spread, which raises the supply of capital. The corporate spread must rise to clear the market, as shown in the right

column of the figure. The higher spread raises US demand for the corporate dollar bonds of country i , so its firms buy more dollars forward to hedge them. From (41)–(42), the CIP deviation then falls.

A country with a smaller safe asset supply therefore has both a lower interest rate and a lower CIP deviation, which is inconsistent with the cross-country evidence in Figure 1. One might expect a low interest rate to raise the demand for dollar assets by country i , and therefore the supply of forward dollars. Under full hedging, however, portfolio choice depends on the difference in hedged returns, which is the CIP deviation itself, and not on the interest rate differential. We return to this point in Section 5.6.

Table A1 in Appendix A shows that public debt is negatively related to the safe interest rate. This is also inconsistent with safe asset supply heterogeneity, which implies that countries with less public debt have lower interest rates. It is consistent, however, with wealth or productivity heterogeneity. Countries with a relatively low interest rate, because of either high wealth or low productivity, have a relatively high supply of public debt.

5.4 Hedging of Dollar Assets

Du and Huber (2026) find that countries whose investors hedge a larger volume of dollar assets, relative to GDP, have higher CIP deviations.¹⁰ In the model, the hedged dollar assets of country i are $\alpha_{i,m}W_i$ under full hedging. This is gross hedging of dollar assets. It differs from net hedging, $X_i^{hedge} = \alpha_{i,m}W_i - \omega_{i,m}W_d$, the net supply of forward dollars associated with hedging. Net hedging subtracts the dollars bought forward by US mutual funds investing in country i and by firms of country i . By the forward market equilibrium (41), $X_i^{hedge} = \Gamma cip_i$, so that net hedging is always positively related to the CIP deviation across countries.

The Online Appendix shows that for gross hedging

$$\widehat{\alpha_{i,m}W_i} = (1 - h)\epsilon_{i,w} - \frac{NW}{\gamma c^2 \tilde{v}} \widehat{cip_i} \quad (43)$$

Higher wealth raises holdings of dollar assets directly, while a higher CIP deviation reduces

¹⁰They report a negative relationship with the cross-currency basis, which is opposite in sign to our CIP deviation.

them by making hedged dollar assets less attractive. Under productivity and safe asset supply heterogeneity, only the second effect is present, so that hedging of dollar assets moves opposite to the CIP deviation. Under wealth heterogeneity, the Online Appendix shows that the direct effect dominates unless the corporate spread falls sharply. The evidence in [Du and Huber \(2026\)](#) is therefore consistent with wealth heterogeneity, but not with productivity or safe asset supply heterogeneity alone.

5.5 Speculative Forward Demand

We now relax the assumption that hedge funds take no speculative positions, while maintaining full hedging. Hedge funds buy $H_i = \Gamma_h f_i$ dollars forward, as in [26](#), so that the forward market equilibrium [41](#) becomes

$$\Gamma \widehat{cip}_i + \Gamma_h \hat{f}_i = \hat{X}_i^{hedge} \quad (44)$$

where $\hat{f}_i = \widehat{cip}_i - \hat{r}_i$.

Define

$$\bar{c} = \frac{\frac{N}{\bar{v}} - \frac{1-h}{h} \frac{1}{v}}{\frac{N}{\bar{v}} + \frac{1}{v}} \quad (45)$$

which satisfies $0 < \bar{c} < 1$.

Proposition 4 *Assume full hedging and $\Gamma_h > 0$.*

- (i) *A country with higher household wealth than average has a lower safe interest rate for all Γ_h . Its CIP deviation is lower when Γ_h is sufficiently large.*
- (ii) *For a country with lower productivity than average, the safe interest rate and the CIP deviation move in the same direction when Γ_h is sufficiently large. Both are lower if $c > \bar{c}$ and both are higher if $c < \bar{c}$.*
- (iii) *A country with a smaller safe asset supply than average has a lower safe interest rate, a lower CIP deviation and a higher corporate spread for all Γ_h .*

The proof is in the Online Appendix, where the responses of the safe interest rate, the CIP deviation and the corporate spread are derived for any $\Gamma_h \geq 0$. The Online Appendix also gives the cutoffs on Γ_h beyond which the signs change.

Speculation can overturn the negative relationship between the interest rate and the CIP deviation. Consider a country with high wealth. Its larger supply of forward dollars raises the forward rate f_i , which raises the expected profit from buying dollars forward. Hedge funds then take part of the other side of the market, reducing the increase in the CIP deviation needed to clear it. When Γ_h is large enough, the CIP deviation falls. This is most transparent in the limit $\Gamma_h \rightarrow \infty$. Hedge fund positions then remain finite only if $\hat{f}_i = 0$, so that $\widehat{cip}_i = \hat{r}_i$. The CIP deviation then moves together with the interest rate, whatever the source of heterogeneity. Under wealth heterogeneity, a country with high wealth then has both a low interest rate and a low CIP deviation. Under productivity heterogeneity, the interest rate and the CIP deviation also move together. In a country with low productivity they are both lower when $c > \bar{c}$ and both higher when $c < \bar{c}$. Both explanations of the evidence in Figure 1 therefore require speculative demand in the forward market to be limited. Safe asset supply heterogeneity, on the other hand, implies a positive relationship between the interest rate and the CIP deviation for any Γ_h .

Limited speculation is consistent with the evidence in [Hacıoğlu-Hoke et al. \(2026\)](#). Using data from the London FX derivatives market, they find that dealer banks take the opposite position of hedgers, while hedge funds have positions that are close to zero on average. Hedge fund positions are positive or negative for short periods of time to exploit short-term profit opportunities. Since our focus is on persistent cross-country differences, which are related to persistent positions in the forward market, the case $\Gamma_h = 0$ is the relevant one. Speculative positions may matter more for the time-series response of CIP deviations to shocks.

5.6 Partial Hedging

While full hedging is a useful benchmark, the evidence points to partial hedging. We now assume that mutual funds and firms hedge a fraction $\theta < 1$ of their foreign currency exposure, while maintaining $\Gamma_h = 0$. Such a hedge ratio can be motivated by a quadratic cost of using the forward market, as discussed in the Online Appendix. We take the hedge ratio as given, and assume it is the same for mutual funds and firms. The portfolios of mutual funds and households, and the financing decision of firms, are derived in Appendix D. The forward

market equilibrium becomes

$$B_i^{CIP} + \theta \omega_{i,m} W_d - \theta \alpha_{i,m} W_i = 0 \quad (46)$$

Partial hedging changes the analysis in two ways. First, a smaller part of external assets and liabilities is hedged, which weakens the effect of changes in external positions on the forward market. Second, portfolio choice now depends on the interest rate differential as well as the CIP deviation. Appendix D shows that the share that households in country i invest in the US depends on $-\theta cip_i - (1 - \theta)(r_i - r_*)$. The same holds, with the opposite sign, for US households investing in country i . If the interest rate in country i is low, its households invest more in dollar assets and US households invest less in its assets. Since part of these positions is hedged, this creates a direct link from the interest rate to the forward market. This is the carry trade channel emphasized by Du et al. (2018), Du and Schreger (2022) and Dao et al. (2025).

However, with partial hedging the model is no longer analytically tractable. We therefore consider a special case, with the derivations in the Online Appendix. We assume that the capital stock is fixed and consider only the effect of a marginal drop of the hedge ratio θ below 1. We consider the impact of both wealth heterogeneity and safe asset supply heterogeneity. Productivity heterogeneity plays no role in this case since it affects the equilibrium only through the supply of corporate capital.

Define

$$S = \frac{W}{\gamma} \left(\frac{1}{v} + \frac{N}{\tilde{v}} \right), \quad Q = \frac{NW}{\gamma c^2 \tilde{v}}, \quad U = \frac{W}{\gamma} \left(\frac{N}{\tilde{v}} + \frac{1+h}{hv} \right)$$

Proposition 5 *Assume $\Gamma_h = 0$ and a fixed capital stock. Starting from full hedging, consider a marginal reduction in the hedge ratio θ .*

- (i) *In a country with higher household wealth than average, it reduces the fall in the safe interest rate. It increases the rise in the CIP deviation if $U \geq \rho c^2$, or if $U < \rho c^2$ and $\Gamma < QU(U + \rho c^2) / [S(\rho c^2 - U)]$.*
- (ii) *In a country with a smaller safe asset supply than average, it raises the CIP deviation, which is unaffected by safe asset supply under full hedging. The fall in the safe interest rate is unchanged.*

Consider first a country with high wealth. Its households buy more safe assets, which lowers the interest rate. They also buy more dollar assets. Hedging those assets raises the CIP deviation.

Partial hedging leads to a smaller drop in the interest rate. For given household portfolios, only part of the extra dollar assets is hedged. CIP arbitrageurs, who take the other side of the hedge, therefore hold less of the domestic safe asset than under full hedging. This raises the interest rate relative to full hedging.

Partial hedging has two opposite effects on the CIP deviation. First, since only part of the extra dollar assets is hedged, the rise in the CIP deviation is smaller. Second, under partial hedging the lower interest rate leads its households to buy more dollar assets. Since these are partly hedged, the CIP deviation rises. This carry trade effect is strong when the interest rate falls substantially, which happens when ρ is small. The first effect dominates only when ρ is large and CIP arbitrage capacity Γ is large.¹¹

These results also clarify the role of carry trade. The presence of carry trade only modifies the basic result that wealth heterogeneity leads to a negative relationship between the interest rate and the CIP deviation. Key to the result is that high wealth raises the CIP deviation directly, since households buy and hedge more dollar assets. Carry trade at most changes the extent of the rise in the CIP deviation. Its effect vanishes under both full hedging and no hedging, since investors respond to the interest rate only on the unhedged part of their positions, while only the hedged part affects the forward market. Moreover, as discussed above, the partial hedging that gives rise to the carry trade also has a direct effect on the CIP deviation in the opposite direction.

Finally consider safe asset supply heterogeneity. With a fixed capital stock, the outcome under full hedging differs from Proposition 3. A country with a smaller safe asset supply still has a lower interest rate, but its CIP deviation is unaffected since the lower interest rate no longer raises the supply of capital and hence the corporate spread. With partial hedging, the lower interest rate leads its households to buy more dollar assets. Since this is partially hedged, it raises the CIP deviation. In this special case, safe asset supply heterogeneity can therefore account for the negative relationship between interest rates and CIP deviations. However, it remains inconsistent with the negative relationship between public debt and

¹¹A large Γ keeps the CIP deviation low, so households hedge more dollar assets. Hedging a smaller fraction of these (the first effect) then matters more.

interest rates in Table [A1](#).

6 Conclusion

We have developed a model to account for the cross-country relationship between CIP deviations and interest rates. In the model, saving, investment, portfolios, interest rates and hedging are determined jointly. Accounting for the negative relationship between CIP deviations and interest rates requires a hedging motive.

Differences across countries in saving and in investment demand both generate the observed relationships. A country with high saving or weak investment demand has a low interest rate and a high CIP deviation. The relationship does not arise because the interest rate affects the CIP deviation. It arises because saving and investment affect both the safe asset market and the forward market. The two mechanisms work through different hedgers. High saving raises the hedging of dollar assets by households, while weak investment demand reduces the hedging of dollar debt by firms. Differences in the supply of safe assets, by contrast, imply that countries with low interest rates have low CIP deviations. They are also inconsistent with the negative relationship between public debt and interest rates.

These results also clarify the role of the carry trade mechanism, the standard explanation for the relationship between interest rates and CIP deviations. Under full hedging there is no carry trade, but the relationship still arises. Under partial hedging, the carry trade effect raises the CIP deviation in countries with low interest rates. At the same time, a smaller part of foreign positions is hedged, which works in the opposite direction. The carry trade effect therefore modifies the relationship, but does not cause it.

A more systematic empirical assessment of the mechanisms developed in this paper is constrained by the small number of advanced-economy currencies. Expanding the sample to emerging markets raises difficulties in measuring comparable interest rates and CIP deviations, as emphasized by [Dao and Gourinchas \(2026\)](#). It also introduces differences in financial market structure, including market segmentation and the role of speculative demand in forward markets, highlighted by [De Leo et al. \(2025\)](#). A larger sample would therefore require addressing both measurement and differences in the mechanisms determining CIP deviations.

Future work can consider several directions. We have taken hedge ratios as given and

made currency exposures endogenous, while the literature on hedging has done the opposite. A natural next step is to determine both jointly, which would also allow hedge ratios to differ across countries. Another direction is a dynamic model that accounts for both the cross-sectional and time-series features of the data. CIP deviations reflect both persistent differences in hedging pressures, which we have studied here, and more temporary dollar funding shocks.

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Appendix

A Cross-country Evidence and Data Definitions

A.1 Additional Cross-country Evidence

Table A1 reproduces the relationships in Table 1 and Figure 1 and presents evidence on other variables related to sectoral balances, debt, and growth measures.

The first line of Table A1 corresponds to Figure 1. The following five lines correspond to Table 1. The next line shows strong correlations with private net lending, estimated by the OECD, which is similar to the private saving minus investment gap but also includes net capital transfers and non-produced non-financial assets. The CA/GDP has weaker correlations (0.74 and -0.79) than private positions. The implied government balance has weak correlations with both financial variables. The implied government S-I gap is the difference between the CA and the private saving-investment gap. Government net saving, provided by the OECD, is measured before investment and therefore differs from government net lending. Both show a negative but insignificant correlation with the CIP deviation.

We also consider public debt outside the domestic central bank. Even though it is positively correlated with CIP deviations (0.64), it is negatively correlated with interest rates (-0.56), as discussed in Section 5.3.

Finally, we consider variables that can measure investment opportunities or productivity. Real GDP growth is strongly negatively correlated with CIP deviations (-0.81) and positively correlated with interest rates (0.73). GDP per capita, labor productivity, and TFP growth have the same signs but weaker correlations.

A.2 Variable Definitions and Data Sources

The sample comprises Australia, Canada, Japan, New Zealand, Sweden, Switzerland, the United Kingdom, and an eleven-country euro-area aggregate: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. Observations are averages over 2007–2020, except New Zealand private wealth (2007–2017). Financial vari-

Table A1: Cross-country Correlations

	CIP deviation	Libor interest rate
Libor interest rate	−0.95 ^{**}	—
NFA/GDP	0.73 ^{**}	−0.88 ^{**}
Private net saving/GDP	0.69 [*]	−0.61
Private net investment/GDP	−0.81 ^{**}	0.76 ^{**}
Private saving-investment gap/GDP	0.92 ^{**}	−0.84 ^{**}
Private wealth/GDP	0.81 ^{**}	−0.77 ^{**}
Private net lending/GDP	0.89 ^{**}	−0.79 ^{**}
Current account/GDP	0.74 ^{**}	−0.79 ^{**}
Implied government S-I gap/GDP	−0.25	0.05
Government net saving/GDP	−0.35	0.19
Public debt/GDP	0.64 [*]	−0.56
Real GDP growth	−0.81 ^{**}	0.73 ^{**}
Real GDP per capita growth	−0.61	0.57
Labor productivity growth	−0.53	0.37
TFP growth	−0.41	0.28

Notes: Pearson correlations across eight currency areas, using 2007-2020 averages, except New Zealand private wealth (2007-2017). Stock and flow variables are divided by nominal GDP; growth rates are defined below. ** (*) denotes significance at the 5% (10%) level in a two-sided test with six degrees of freedom.

ables are averaged monthly and macroeconomic variables annually. Stock and flow variables are divided by nominal GDP before averaging. Euro-area ratios use contemporaneous GDP weights; growth rates use previous-year GDP weights.

“Private” covers households and non-profit institutions serving households, financial corporations, and non-financial corporations, including public corporations outside general government. “Net” saving and investment deduct consumption of fixed capital.

Libor rates: Three-month Libor or comparable interbank rates, Haver Analytics.

Spot and forward rates: Tullett Prebon.

CIP deviation: Synthetic dollar rate minus the dollar cash rate, calculated from monthly interest rates and monthly averages of the annualized three-month forward premium. Rates and CIP deviations are expressed in annualized percent.

GDP: Nominal GDP, OECD annual national accounts.

NFA: Total-economy net financial worth, OECD annual financial balance sheets. Non-consolidated series, except for Australia, where the consolidated series is used.

Private net saving: Household and corporate gross saving less consumption of fixed capital, OECD annual sector accounts. Australia uses total-economy net saving minus government net saving; Switzerland uses the same calculation from Swiss Federal Statistical Office (SFSO) sector accounts.

Private net investment: Private gross capital formation less consumption of fixed capital, OECD annual sector accounts. Includes fixed investment, inventory changes, and valuables. Australia uses total economy minus government; Switzerland uses SFSO capital accounts.

Private saving–investment gap: Private net saving minus private net investment.

Private net lending: Corporate and household net lending/borrowing, OECD National Accounts at a Glance. Unlike the saving–investment gap, it also includes net capital transfers and subtracts net acquisitions of non-produced non-financial assets.

Private wealth: $W_{priv} = K_{priv} + NFW_{priv}$, with both components measured at current prices.

Private non-financial capital stock, K_{priv} : Net produced fixed assets of the total economy minus government, OECD annual non-financial balance sheets; Switzerland’s total is from the SFSO. Excludes land and inventories. Missing government capital shares are imputed using the sample-average shares of the United Kingdom for Ireland, Australia for New Zealand, and Germany for Switzerland. Missing years for Spain (2007–2011) and Greece

(2007–2009) use each country’s average government share over its observed years. New Zealand capital data end in 2017.

Private net financial worth, NFW_{priv} : Sum of net financial worth of households/NPISH and financial and non-financial corporations, OECD annual financial balance sheets. Non-consolidated series, except for Australia.

Current account: Current-account balance, OECD balance-of-payments statistics.

Implied government saving–investment gap: Current account minus the private saving–investment gap. This residual may include discrepancies between balance-of-payments and national-accounts sources.

Government net saving: General-government gross saving less consumption of fixed capital, OECD annual sector accounts; Switzerland uses OECD Economic Outlook 119 (SAVG). Measured before investment, and therefore distinct from government net lending.

Public debt: General-government debt less domestic central-bank holdings, following [Fang, Hardy, and Lewis \(2025\)](#). Total debt is from the IMF Global Debt Database and Historical Public Debt Database. New Zealand’s 2016–2020 values extend the 2015 level using the IMF Sovereign Debt Investor Base.¹² Central-bank holdings are from IMF Monetary and Financial Statistics, except Switzerland and the United Kingdom, which use fourth-quarter IMF Sovereign Debt Investor Base holdings.

GDP and GDP per capita growth: Average annual percentage growth in real GDP and real GDP per person, OECD.

Labor productivity growth: Average annual percentage growth in real GDP per hour worked, OECD.

TFP growth: Average annual log growth of $rtfpna$, Penn World Table 11.0, using 2006–2020 levels to calculate growth over 2007–2020. This differs from the relative TFP level measure $ctfp$. Euro-area growth measures are GDP-weighted averages of member-country growth rates.

¹²The retained New Zealand extension uses growth in the dollar-converted series, so exchange-rate changes enter the extrapolation.

B Expectation and variance of log-linearized portfolio returns

We derive the expectation and variance of log-linearized portfolio returns that give rise to the optimal portfolios of mutual funds and households in Section 3.2 and 3.3. Starting with the mutual fund used by country i households to invest in the US, the return in terms of the country i currency is

$$R_{m,i} = (1 - \mu_{i,m})R_{\$}\frac{1}{S_{i,2}} + \mu_{i,m}\tilde{R}_{\$,c}\frac{1}{S_{i,2}} + \left(\frac{1}{F_i} - \frac{1}{S_{i,2}}\right) \quad (\text{B.1})$$

Here $\mu_{i,m}$ is the fraction invested in US corporate bonds, with the remainder invested in the safe dollar asset. The return on the corporate bond is $\tilde{R}_{\$,c}$, which is the yield $R_{\$,c}$ with probability $1 - \pi$ and 0 with probability π (from the perspective of the mutual fund). To hedge the exchange rate risk, the fund sells dollars forward, captured by the last term.

Log-linearizing around $R_{\$} = \tilde{R}_{\$,c} = S_{i,2} = F_i = 1$, we have

$$R_{m,i} = 1 + (1 - \mu_{i,m})r_{\$} + \mu_{i,m}(\tilde{R}_{\$,c} - 1) - f_i \quad (\text{B.2})$$

where $\tilde{R}_{\$,c} - 1 = R_{\$,c} - 1$ with probability $1 - \pi$, which is log-linearized as $r_{\$}$. $\tilde{R}_{\$,c} - 1$ is -1 with probability π . The expectation of $\tilde{R}_{\$,c} - 1$ is then $(1 - \pi)r_{\$} - \pi$. Since $\pi r_{\$}$ is a second-order term, we approximate this as $r_{\$} - \pi$. The variance of $\tilde{R}_{\$,c} - 1$ is $(1 - \pi)r_{\$}^2 + \pi - (r_{\$} - \pi)^2$. Again, omitting second-order terms in the form of quadratic returns and the product of returns and π , this is equal to $v = \pi(1 - \pi)$. The expressions for $E(R_{i,m})$ and $var(R_{i,m})$ in the text follow immediately.

Next consider the mutual fund that the US uses to invest in country i . The return in dollars is

$$R_{m,d,i} = (1 - \phi_{i,m})R_i S_{i,2} + \phi_{i,m}\tilde{R}_{\$,i,c} + (1 - \phi_{i,m})\left(1 - \frac{S_{i,2}}{F_i}\right) \quad (\text{B.3})$$

Here $\phi_{i,m}$ is the fraction invested in the country i corporate dollar bond, with the remainder invested in the country i safe asset. The return on the corporate bond is $\tilde{R}_{\$,i,c}$, which is $R_{\$,i,c}$ with probability $1 - \pi$ and 0 with probability π . To hedge the exchange rate risk associated with investment in the safe country i asset, the fund buys $1 - \phi_{i,m}$ dollars forward, reflected

in the last term.

Log-linearizing around $R_i = \tilde{R}_{\$,i,c} = S_{i,2} = F_i = 1$, we have

$$R_{m,d,i} = 1 + (1 - \phi_{i,m})(r_i + f_i) + \phi_{i,m}(\tilde{R}_{\$,i,c} - 1) \quad (\text{B.4})$$

where $\tilde{R}_{\$,i,c} - 1 = R_{\$,i,c} - 1$ with probability $1 - \pi$, which is log-linearized as $r_{\$,i,c}$. $\tilde{R}_{\$,i,c} - 1$ is -1 with probability π . The expectation of $\tilde{R}_{\$,i,c} - 1$ is then $(1 - \pi)r_{\$,i,c} - \pi$. Since $\pi r_{\$,i,c}$ is a second-order term, we approximate this as $r_{\$,i,c} - \pi$. The variance of $\tilde{R}_{\$,i,c} - 1$ is $(1 - \pi)r_{\$,i,c}^2 + \pi - (r_{\$,i,c} - \pi)^2$. Again omitting second-order terms as before, this is equal to $v = \pi(1 - \pi)$. The expressions for $E(R_{i,m,d})$ and $var(R_{i,m,d})$ in the text follow immediately.

Next consider country i households. Their portfolio return is

$$R_{p,i} = \alpha_{i,c}\tilde{R}_{i,c} + \alpha_{i,m}R_{m,i} + (1 - \alpha_{i,c} - \alpha_{i,m})R_i \quad (\text{B.5})$$

where $\alpha_{i,c}$ is the fraction invested in the domestic corporate bond and $\tilde{R}_{i,c}$ is the return of the country i corporate bond in the country i currency. It is equal to $R_{i,c}$ with probability $1 - \pi$ and 0 with probability π . Log-linearizing around $R_i = 1$, we have

$$R_{p,i} = 1 + \alpha_{i,c}(\tilde{R}_{i,c} - 1) + \alpha_{i,m}(R_{m,i} - 1) + (1 - \alpha_{i,c} - \alpha_{i,m})r_i \quad (\text{B.6})$$

Since we assume that returns on corporate bonds are uncorrelated across countries, we have

$$ER_{p,i} = 1 + \alpha_{i,c}E(\tilde{R}_{i,c} - 1) + \alpha_{i,m}E(R_{m,i} - 1) + (1 - \alpha_{i,c} - \alpha_{i,m})r_i \quad (\text{B.7})$$

$$var(R_{p,i}) = \alpha_{i,c}^2 var(\tilde{R}_{i,c} - 1) + \alpha_{i,m}^2 var(R_{m,i} - 1) \quad (\text{B.8})$$

Following the same approach as above, we have $E(\tilde{R}_{i,c} - 1) = r_{i,c} - \pi$ and $var(\tilde{R}_{i,c} - 1) = v$. In the expressions for $E(R_{m,i} - 1)$ and $var(R_{m,i} - 1)$ in the text we need to replace π and v with $\tilde{\pi}$ and $\tilde{v}/N$. This gives the expressions for $ER_{p,i}$ and $var(R_{p,i})$ in the text. Note that from the perspective of country i we could write $\tilde{R}_{\$,c}$ as the average of the return in N regions of the US that have the same probability of default, but uncorrelated default outcomes. This gives rise to a variance of $\tilde{R}_{\$,c}$ of $\tilde{v}/N$.

Finally, the portfolio return of US households is

$$R_{p,US} = \omega_{d,c} \tilde{R}_{\$,c} + \sum_{i=1}^N \omega_{i,m} R_{m,d,i} + \left(1 - \omega_{d,c} - \sum_{i=1}^N \omega_{i,m}\right) R_{\$} \quad (\text{B.9})$$

where $\omega_{d,c}$ is the fraction invested in the domestic corporate dollar bond and $\tilde{R}_{\$,c}$ is the return on the domestic corporate dollar bond. Linearizing around $R_{\$} = 1$, we can write this as

$$R_{p,US} = 1 + \omega_{d,c} (\tilde{R}_{\$,c} - 1) + \sum_{i=1}^N \omega_{i,m} (R_{m,d,i} - 1) + \left(1 - \omega_{d,c} - \sum_{i=1}^N \omega_{i,m}\right) r_{\$} \quad (\text{B.10})$$

Again using that corporate bond returns are uncorrelated across countries, we have

$$ER_{p,US} = 1 + \omega_{d,c} E(\tilde{R}_{\$,c} - 1) + \sum_{i=1}^N \omega_{i,m} E(R_{m,d,i} - 1) + \left(1 - \omega_{d,c} - \sum_{i=1}^N \omega_{i,m}\right) r_{\$} \quad (\text{B.11})$$

$$\text{var}(R_{p,US}) = \omega_{d,c}^2 \text{var}(\tilde{R}_{\$,c} - 1) + \sum_{i=1}^N \omega_{i,m}^2 \text{var}(R_{m,d,i} - 1) \quad (\text{B.12})$$

We have $E(\tilde{R}_{\$,c} - 1) = r_{\$,c} - \pi$ and $\text{var}(\tilde{R}_{\$,c} - 1) = v$. Substituting the expressions for $E(R_{m,d,i} - 1)$ and $\text{var}(R_{m,d,i} - 1)$ in the text, replacing π and v with $\tilde{\pi}$ and $\tilde{v}$, we obtain the expressions for $ER_{p,US}$ and $\text{var}(R_{p,US})$ in the text.

C Symmetric Equilibrium

To obtain a symmetric equilibrium, we assume that the N countries have the same household wealth, productivity and safe asset supply: $W_i = W$, $A_i = A$ and $d_{i,0} = d_0$. Household wealth is the same when the discount factors β_i are the same, leading to identical saving. We also assume that the US has the same size as the sum of the N small countries, so that $d_{\$,0} = Nd_0$, $W_d = NW$ and in equilibrium output and the capital stock are N times that in each small country. The latter is accomplished by setting $A_d = AN^{1-\nu}$.

The previous assumptions imply that a share $1 - c$ of assets are safe, so that $D_i = (1 - c)W$

and $D_d = (1 - c)W_d$. It follows from the safe asset supply expressions that

$$r_i = r_{\$} = (d_0 - (1 - c)W) / d_1 \quad (\text{C.13})$$

We set productivity A_i and A_d so that the marginal product of capital is equal to $1 + r_{i,c} = 1 + r_{\$,c}$ when $K_i = cW$ and $K_d = cW_d$.

The assumptions regarding the foreign share $1 - h$ and corporate share c imply that $\mu_{i,m} = \phi_{i,m} = c$, $\alpha_{i,c} = \omega_{d,c} = hc$, $\alpha_{i,m} = N\omega_{i,m} = 1 - h$. Using these portfolio shares, it is easy to check that the market equilibrium conditions (29)-(33) are satisfied. Next we need to make sure that the 6 portfolio shares take on these values. It follows from (5) and (6), setting $\mu_{i,m} = \phi_{i,m} = c$, that

$$r_{i,c} = r_{\$,c} = r_i + \pi + \gamma_m v c \quad (\text{C.14})$$

We set $\gamma_m = h\gamma$, so that we also have $\alpha_{i,c} = \omega_{d,c} = hc$. Finally, to make sure that the foreign portfolio shares $\alpha_{i,m} = N\omega_{i,m}$ are $1 - h$, we set $\tilde{\pi}$ such that $\tilde{\pi} - \pi + (1/N)(1 - h)c\gamma\tilde{v} = \gamma v h c$.

D Partial Hedging

Here we derive the portfolios of mutual funds and households, as well as first-order conditions for firms, under an assumed hedge ratio of θ .

D.1 Mutual Funds

With a hedge ratio of θ , (B.1) becomes

$$R_{m,i} = (1 - \mu_{i,m})R_{\$} \frac{1}{S_{i,2}} + \mu_{i,m}\tilde{R}_{\$,c} \frac{1}{S_{i,2}} + \theta \left(\frac{1}{F_i} - \frac{1}{S_{i,2}} \right) \quad (\text{D.15})$$

Following the procedure in Appendix B, we have

$$ER_{m,i} = 1 + (1 - \mu_{i,m})r_{\$} + \mu_{i,m}(r_{\$,c} - \pi) - \theta f_i \quad (\text{D.16})$$

$$\text{var}(R_{m,i}) = (1 - \theta)^2 \sigma^2 + \mu_{i,m}^2 v \quad (\text{D.17})$$

With the same mean-variance objective $E(R_{m,i}) - 0.5\gamma_m \text{var}(R_{m,i})$ as before, the optimal portfolio share $\mu_{i,m}$ remains as in (5).

The mutual fund used by US households to invest in country i allocates a share $1 - \phi_{i,m}$ to the safe country i asset and a share $\phi_{i,m}$ to the country i corporate dollar bond. Assume again a hedge ratio of θ . This implies a demand for forward dollars of $\theta(1 - \phi_{i,m})$ for each dollar invested in the mutual fund. The period 2 dollar return of the mutual fund is then

$$R_{m,d,i} = (1 - \phi_{i,m})R_i S_{i,2} + \phi_{i,m} \tilde{R}_{\$,i,c} + \theta(1 - \phi_{i,m}) \left(1 - \frac{S_{i,2}}{F_i}\right) \quad (\text{D.18})$$

Following Appendix B, we can write the expectation and variance of the return as

$$\begin{aligned} ER_{m,d,i} &= 1 + (1 - \phi_{i,m})r_i + \phi_{i,m}(r_{\$,i,c} - \pi) + \theta(1 - \phi_{i,m})f_i \\ \text{var}(R_{m,d,i}) &= \phi_{i,m}^2 v + (1 - \phi_{i,m})^2 (1 - \theta)^2 \sigma^2 \end{aligned}$$

The fund maximizes the mean variance objective $ER_{m,d,i} - 0.5\gamma_m \text{var}(R_{m,d,i})$. The first-order condition with respect to $\phi_{i,m}$ implies

$$\phi_{i,m} = \frac{(1 - \theta)^2 \sigma^2}{(1 - \theta)^2 \sigma^2 + v} + \frac{r_{\$,i,c} - \pi - r_i - \theta f_i}{\gamma_m((1 - \theta)^2 \sigma^2 + v)} \quad (\text{D.19})$$

D.2 Households

Substituting the expressions above for $ER_{m,i}$ and $\text{var}(R_{m,i})$ into (B.7)-(B.8), with π and v replaced by $\tilde{\pi}$ and $\tilde{v}/N$, we have

$$\begin{aligned} ER_{p,i} &= 1 + r_i + \alpha_{i,c}(r_{i,c} - \pi - r_i) + \alpha_{i,m}((1 - \mu_{i,m})r_{\$} + \mu_{i,m}(r_{\$,c} - \tilde{\pi}) - r_i - \theta f_i) \\ \text{var}(R_{p,i}) &= \alpha_{i,c}^2 v + (\alpha_{i,m} \mu_{i,m})^2 \frac{\tilde{v}}{N} + \alpha_{i,m}^2 (1 - \theta)^2 \sigma^2 \end{aligned}$$

The first-order conditions of maximizing $E(R_{p,i}) - 0.5\gamma \text{var}(R_{p,i})$ with respect to $\alpha_{i,c}$ and

$\alpha_{i,m}$ imply

$$\alpha_{i,c} = \frac{r_{i,c} - \pi - r_i}{\gamma v} \quad (\text{D.20})$$

$$\alpha_{i,m} = \frac{r_{\$} - r_i + \mu_{i,m}(r_{\$,c} - \tilde{\pi} - r_{\$}) - \theta f_i}{\gamma \mu_{i,m}^2 \frac{\tilde{v}}{N} + (1 - \theta)^2 \gamma \sigma^2} \quad (\text{D.21})$$

For US households, substitute the expressions above for $ER_{m,d,i}$ and $var(R_{m,d,i})$ into (B.11)-(B.12), with π and v replaced by $\tilde{\pi}$ and $\tilde{v}$. This gives

$$ER_{p,US} = 1 + r_{\$} + \omega_{d,c}(r_{\$,c} - \pi - r_{\$}) + \sum_{i=1}^N \omega_{i,m}((1 - \phi_{i,m})(r_i - r_{\$}) + \phi_{i,m}(r_{\$,i,c} - \tilde{\pi} - r_{\$}) + \theta(1 - \phi_{i,m})f_i)$$

$$var(R_{p,US}) = \sigma^2 \sum_{i=1}^N \omega_{i,m}^2 (1 - \phi_{i,m})^2 (1 - \theta)^2 + \tilde{v} \sum_{i=1}^N (\omega_{i,m} \phi_{i,m})^2 + \omega_{d,c}^2 v$$

Maximizing $E(R_{p,US}) - 0.5\gamma var(R_{p,US})$, the optimal portfolios are then

$$\omega_{d,c} = \frac{r_{\$,c} - \pi - r_{\$}}{\gamma v} \quad (\text{D.22})$$

$$\omega_{i,m} = \frac{r_i - r_{\$} + \phi_{i,m}(r_{\$,i,c} - \tilde{\pi} - r_i) + (1 - \phi_{i,m})\theta f_i}{\gamma \tilde{v} \phi_{i,m}^2 + \gamma \sigma^2 (1 - \phi_{i,m})^2 (1 - \theta)^2} \quad (\text{D.23})$$

D.3 Firms

For country i firms capital is financed by selling dollar and country i currency bonds. A fraction η_i is financed through dollar bonds. Assume that a fraction θ of dollar bonds are hedged. Then the profit of the firm in period 2 is

$$\Pi_i = A_i K_i^\nu - K_i \left(\eta_i R_{\$,i,c} \frac{1}{S_{i,2}} + (1 - \eta_i) R_{i,c} \right) + \theta \eta_i K_i \left(\frac{1}{S_{i,2}} - \frac{1}{F_i} \right)$$

The last term is dollars bought forward. After log-linearizing returns, this is

$$\Pi_i = A_i K_i^\nu - K_i [1 + \eta_i (r_{\$,i,c} - s_{i,2}) + (1 - \eta_i) r_{i,c} - \theta \eta_i (f_i - s_{i,2})] \quad (\text{D.24})$$

Assume that the firm maximizes

$$K_i \left(E \frac{\Pi_i}{K_i} - 0.5\gamma var \left(\frac{\Pi_i}{K_i} \right) \right) \quad (\text{D.25})$$

This is equal to the capital stock times the risk-adjusted profit per unit of capital. It corresponds to

$$A_i K_i^\nu - K_i [1 + \eta_i r_{\$,i,c} + (1 - \eta_i) r_{i,c} - \theta \eta_i f_i + 0.5\gamma \sigma^2 \eta_i^2 (1 - \theta)^2] \quad (\text{D.26})$$

The first-order conditions with respect to η_i and K_i imply

$$r_{\$,i,c} - r_{i,c} - \theta f_i + \gamma \sigma^2 (1 - \theta)^2 \eta_i = 0 \quad (\text{D.27})$$

$$A_i \nu K_i^{\nu-1} = 1 + r_{i,c} \quad (\text{D.28})$$

Here we have abstracted from a second-order term on the right hand side of (D.28) equal to $-0.5\gamma \sigma^2 \eta_i^2 (1 - \theta)^2$.