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Currency Risk Premia and Unhedged, Foreign-Currency Borrowing in Emerging Markets

by

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Abstract

This paper develops an analytical framework to jointly rationalize two important unresolved puzzles in international economics: the generation of currency risk premia in the interest rates of many emerging markets, and the desire of firms in these environments to expose themselves to currency risk by denomining their debt, unhedged, in foreign-currency. In contrast to the extant theoretical literature, we focus on the asymmetry of national monies to demonstrate how foreign-currency assets can often serve as consumption hedges to households in emerging markets, who then demand a risk-premium to hold domestic-currency-denominated assets. The portfolio diversification decisions of firms, in turn, reveals that risk-averse firms in emerging economies are inclined to undertake foreign-currency liabilities for variance-minimizing purposes and, in the presence of a risk premium, for speculative purposes. Differentiating between these opposing motives is crucial from the standpoint of assessing firm vulnerability to unanticipated currency movements. We are thus able to show that, contrary to conventional wisdom, unhedged, foreign-currency debt can arise even in the absence of any bailout guarantees and the associated moral hazard. Finally, combining the different portfolio demands, we can solve for the equilibrium premium in terms of the economy’s parameters, including the current account deficit, relative net-worth of the nontradable and tradable sectors, volatility of the exchange rate and the extent to which nominal depreciations translate into real depreciations. Our analysis reveals that -- contrary to conventional wisdom -- increased exchange rate uncertainty may not necessarily reduce the desire of firms to take on risky, foreign-currency debt.

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1. Introduction

This paper develops an analytical framework to jointly rationalize two important unresolved puzzles in international economics: the generation of currency risk premia in the interest rates of many emerging markets, and the desire of firms in these environments to expose themselves to currency risk by denomingating their debt, unhedged, in foreign-currency.

There is widespread consensus among observers that unhedged, foreign-currency borrowing by banks and firms in emerging markets has been at the core of many of the recent financial and currency crises in these countries. Not only do these unhedged, foreign-currency liabilities render economies vulnerable to a self-fulfilling currency crisis (see, Krugman (1999), Radelet and Sachs (1998)) but, upon the advent of such a crisis, exacerbate an economic downturn through defaults and bankruptcies that arise out of the mismatched balance sheets of banks and firms (see, inter alia, IMF (1998)). In the wake of sharp currency depreciations in East Asia, for instance, these unhedged foreign-currency liabilities wreaked havoc on the balance sheets of banks and firms, and the resulting defaults and bankruptcies contributed sharply to the economic downturns in these countries.

Yet, while much work has documented the contribution of these dollar-denominated liabilities to the economic downturns in East Asia, there has been little systematic general-equilibrium analysis of why firms choose to contract unhedged, dollar-denominated debt (as opposed to domestic-currency debt) in the first place? Why, for instance, did a firm in Indonesia’s non-tradable sector find it optimal to expose itself to currency risk by expecting to use a future stream of Rupiah revenues to repay a stream of future dollar liabilities? Why did it choose not to hedge this currency risk in the forward market, or equivalently, denominate its debt in domestic currency?

These are open questions in the literature to date. The literature on unhedged, foreign-currency borrowing (pioneered by McKinnon and Pill (1999) and Burnside, Eichenbaum and Rebelo (1999)) has thus far focused primarily on the desire of banks and other financial institutions to take on unhedged, offshore foreign-currency liabilities. Specifically, the risk-taking behavior of
these entities is rationalized by the moral hazard that arises from deposit insurance and other explicit or implicit bailout guarantees that these entities are the recipient of. It is undeniable that moral hazard is often an important factor explaining the risk-taking behavior of financial institutions – whose failure may have systemic implications – and large conglomerates (for example, the Korean Chaebol) who may be considered “too big to fail.” But observers are skeptical about whether this logic can, more generally, explain the motivations of firms in taking on currency risk. As Eichengreen and Hausmann (1999) note, “While bank-to-bank lending was massive in East Asia, so was foreign lending to corporations, which is harder to explain in terms of moral hazard. Korean Chaebol may be bailed out, but not Indonesian corporations.” Radelet and Sachs (1998) characterize the lending in a similar vein: “That investors knew that their investments were to weak borrowers, but felt protected by explicit and implicit guarantees – also seems to be only a partial explanation. One obvious reason is that much of the lending was directed to private firms that did not enjoy these guarantees. Approximately half of the loans by international banks and almost all the portfolio and direct equity investments went to non-bank enterprises for which state guarantees were far from assured.”

In light of this, an analysis of why firms find it optimal to take on offshore foreign-currency liabilities and not hedge the associated currency risk is conspicuous by its absence in the literature. This analytical gap seems significant in light of our documentation in Section 2.3 on the extent to which firms directly took on offshore foreign-currency liabilities in the run-up to the East Asian crisis. As we document, in the case of three of the five East Asian countries that we have data for, the offshore borrowing of private, non-financial firms exceeded the sum of public sector and bank borrowing.

Our goal is therefore to develop an analytical framework to rationalize the decisions of firms to take on currency risk by denominating their debt, unhedged, in foreign currency – without relying on any assumptions of bailout guarantees or moral hazard. Instead, we focus on how currency risk is priced into the interest rates of emerging markets, and show how the equilibrium

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Schneider and Tornell (2000) do address the question of foreign-currency borrowing by firms – in the Mexican case – but they, too, justify their debt denomination decisions as arising from the moral hazard of implicit bailout guarantees to firms.
pricing of this currency risk creates incentives for even risk-averse firms to take on risky, unhedged, foreign-currency liabilities.

Our focus on the pricing of currency risk is crucial because it allows us to rationalize another important unresolved puzzle in international finance: the presence of currency risk premia (excess returns) in the interest rates of many emerging markets. In a world of risk-neutral agents and liberalized capital accounts, the returns on domestic currency assets should be equal to expected returns on foreign-currency assets -- of equivalent default risk and maturity -- when converted back to the domestic currency\(^3\). In other words there should be no \textit{ex ante} expected excess returns on any of the assets, when measured in a common currency. This relationship is dubbed the principle of uncovered interest parity (UIP), and constitutes an important building block in many classes of open-economy models of international finance. In contrast to its theoretical prominence, however, the assumption of uncovered interest parity has been decisively rejected in the empirical literature. Starting from Cumby and Obstfeld (1981, 1984) and Fama (1984) and extending to Bansal and Dahlquist (2000) researchers have documented significant deviations from uncovered interest parity across a large number of interest and exchange rates (including all the major currencies -- dollar, yen, deutsche mark, pound) and over long time periods. As we document in Section 2.2, deviations from uncovered interest parity pervade emerging markets as well and, as we show case of a sample of East Asian countries, these deviations can be very significant in magnitude.

So what accounts for these deviations from uncovered interest parity? Although deviations can arise on account of transactions costs or a failure of the rational expectations assumption that characterizes most empirical tests on this subject, there is an increasing consensus that these deviations arise due to the risk-aversion of market participants. Specifically, these deviations are thought to represent the country and currency risk premium that investors demand to hold financial assets in currencies and political domains that are deemed relatively risky. Yet, despite acknowledgment of the existence of these premia in the interest rates of most emerging markets -- where risk perceptions are perceived to be relatively higher -- there is no systematic theoretical, general-equilibrium, analysis of why exactly these premia arise, and their implications on the

\(^3\) This assumes that transaction costs are zero, and arbitrage is costless.
debt-denomination decisions of market participants. What specifically are the currency risks facing emerging markets? How does the natural asymmetry among national monies, between the “center” and the “periphery,” contribute to the currency risks faced by market participants in emerging markets? How do these currency risks interact with the structural characteristics that characterize most emerging market environments, and how does the resulting risk get priced into the domestic interest rate in the form of a currency premium? What are the resulting implications of this premium? These important questions, particularly as they relate to emerging markets, have not been adequately covered in the extant literature. As we discuss in Section 3, the current general-equilibrium workhorse models of open-economy macroeconomics ((Obstfeld and Rogoff (1998), Engel and Devereux (1998)) are built on assumptions that are at odds with the situation facing most emerging markets. Not surprisingly, the implications of these models on the generation of currency risk premia are not borne out in most emerging markets. This paper therefore aims to fill this gap by developing a theoretical framework that mirrors the stylized facts of many emerging markets, and helps understand the conditions that lead to the generation of currency risk premia in these environments.

In sum, our goal is to understand how currency risk-premia arise endogenously in the interest rates of emerging markets, and to show how these premia induce firms (particularly in the nontradable sector) to take on currency risk, by denominating their debt, unhedged, in foreign currency -- thus rendering these economies vulnerable to a currency and financial crisis.4

To model this phenomenon, we focus on the portfolio diversification motives of firms and households in an economy subject to exchange-rate uncertainty. An important building block of our analysis is the passthrough from exchange rates to domestic prices that characterize most emerging markets (see Calvo and Reinhart (2000a,b)). As we demonstrate formally, a positive, but imperfect, passthrough from exchange rates to domestic prices renders foreign-currency denominated assets imperfect substitutes to their domestic-currency counterparts. From the

4 Despite overwhelming evidence documenting the failure of uncovered interest parity, and the presence of risk premia, much of the extant literature on debt-denomination in emerging markets ignores all issues of risk aversion and risk premia and assumes that UIP holds (see, for instance, Schneider and Tornell (2000), Burnside et al (1999). Only McKinnon and Pill (1999) explicitly acknowledge the presence of risk premia in emerging markets, and demonstrate how a premium increases the margin of temptation for banks governed by moral hazard to undertake unhedged, foreign-currency liabilities.
perspective of households, a positive passthrough renders foreign-currency assets a natural hedge against exchange-rate induced price inflation. Thus, risk-averse households desire to save a (possibly large) fraction of their portfolio in foreign-currency assets, and need to be induced with a risk-premium to hold domestic-currency assets at the margin. This household proclivity towards foreign-currency assets has important implications for the size of the equilibrium currency premium.

From the perspective of firms, we demonstrate that the substitutability of liabilities in domestic and foreign-currency depends in large measure on the extent to which nominal exchange rate changes translate into real exchange rate changes. If the interest rate on domestic-currency debt is not completely indexed to inflation, and there is a positive passthrough from exchange rates to firm output prices, we show that the real payouts on domestic-currency and foreign-currency debt are negatively correlated. Thus, we demonstrate that a risk-averse firm finds it optimal to denominate a fraction of its debt in foreign-currency simply to hedge against the real risk posed by domestic-currency debt, as well as other parts of its portfolio. This is the firm’s “variance minimizing” demand for foreign-currency debt, and depends upon, among other variables, the fraction of a firm’s investment financed by debt vis-à-vis internal capital. In addition to this variance-minimizing demand, firms also develop a penchant for foreign-currency liabilities if there exists a risk-premium in the domestic interest rate. This is dubbed the firm’s “speculative” demand for foreign-currency liabilities, because in its bid to take advantage of the excess return in the domestic interest rate, the firm consciously deviates from its minimum variance portfolio and leaves itself exposed to unanticipated currency movements. Distinguishing between these motives is crucial from the standpoint of assessing firm vulnerability to unanticipated exchange rate movements because the former serves to exacerbate a firm’s exposure to currency risk, while the latter serves to mitigate it.

The desire of households to hold a (possibly large) fraction of their saving in foreign-currency-denominated assets, and the corresponding desire of firms to take on foreign-currency liabilities – which we endogenously develop in our framework – is symptomatic of a natural asymmetry among national monies, between a “center” and a “periphery,” and is analyzed further by McKinnon (2000b).
Combining the portfolio demands for firms and household, we can solve for the equilibrium risk premium in the domestic-currency interest rate as a function of the economy’s parameters. Specifically, in our framework, the equilibrium premium depends jointly upon the size of the currency account deficit, the volatility of the exchange rate, the net-worth of the nontradable sector relative to the tradable sector, the fraction of expenditure devoted to tradables, the extent to which nominal exchange rates translate into real exchange rates, and the coefficient of risk aversion of agents in the economy.

Our analysis has two important policy implications. First, we are able to show how unhedged, foreign-currency liabilities arise even in the absence of any bailout guarantees or moral-hazard considerations. The implication is that -- to the extent that accumulation of risky foreign-currency debt is being driven by risk-premium considerations -- even if government guarantees to firms were to be removed, we should still expect to see some of this behavior. Secondly, it is not immediately clear whether increasing currency volatility would necessarily reduce the desire to denominate debt in foreign currency on the part of firms -- as has been alluded to in this literature. As we will see, on the one hand, currency volatility increases the risk of holding foreign-currency debt and thus acts as a deterrent. On the other hand, increased currency volatility also increases the equilibrium risk premium thus inducing firms to take on more foreign-currency debt. In our set-up, increased currency volatility has no impact on firm’s accumulation of foreign-currency debt because the above-mentioned effects exactly offset each other. More generally, which of these effects dominates depends upon the parameters of the economy.

The rest of this chapter is organized as follows: Section 2 provides an empirical motivation for our analysis by documenting the existence of positive (and often significant) currency risk premia in several emerging markets for which data is available, and also the extent to which offshore foreign-currency borrowing in pre-crisis East Asia was undertaken by private

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5 Technically, it depends only on the excess of investment in the nontradable sector over household saving. Thus, if the current account deficit changes because of a change in total saving in the economy, or total investment in the nontradable sector, the equilibrium risk premium is affected. The only case in which changes in the current account
nonfinancial firms and corporations, relative to banks and the public sector. Section 3, in turn, provides a theoretical motivation for our framework by reviewing the extant literature on currency risk premia, and discussing the inapplicability of existing frameworks to the situation in many emerging markets. Section 4 then details the analytical underpinnings of our approach, while Section 5 builds a formal two-period, stochastic general equilibrium model to demonstrate the main results of this chapter. Section 6 concludes.

2. Empirical Motivation

This section provides an empirical motivation for our analysis by documenting the existence of, often-significant, currency risk-premia in the pre-crisis interest rates of several East Asian economies, and also the extent to which foreign-currency borrowing in these countries was undertaken by non-financial firms and corporations vis-à-vis banks and the public sector.

To understand why deviations from uncovered interest rate parity can be construed as evidence of risk aversion and the possible existence of a currency risk premia, Section 2.1 starts by reviewing the basic parity conditions that should govern asset returns across different currencies and political domains. The discussion emphasizes the importance of controlling for issues of country and default risk premia and also the rational expectations assumption that characterizes most of the tests on this subject, when attributing deviations from uncovered interest parity to currency risk premia. Using this methodology, Section 2.2 then documents the existence of currency risk premia in the domestic interest rates of several East Asian countries in the pre-crisis period. Finally, Section 2.3 presents data on the quantum of unhedged, foreign-currency liabilities undertaken by different classes of agents in these economies in the pre-crisis period.

2.1 Uncovered Interest Parity, Covered Interest Parity and Deviations Thereof

balance do not impact the equilibrium premium, is when these changes are brought out solely by changes to investment in the tradable sector.
The starting point for our discussion on the existence on currency premia is the principle of uncovered interest parity (UIP). According to this, in a world of risk-neutral agents and liberalized capital accounts, the returns on domestic currency assets should be equal to expected returns on foreign-currency assets -- of equivalent default risk and maturity -- when converted back to the domestic currency\(^6\). In other words risk neutrality implies that there should be no \textit{ex ante} expected excess returns on any of the assets, when measured in a common currency. This condition is represented in equation (2.1):

\[
(1 + i) = (1 + r^*) \frac{E(S_{t+1})}{S_t}
\]

Taking logs, this can be rewritten as:

\[
\ln(1 + i) = \ln(1 + r^*) + \ln(E(S_{t+1})) - \ln(S_t)
\]

Here \((1+i)\) represents the one-period gross rate of return on the domestic currency asset at time \(t\), while \((1 + r^*)\) represents the one-period gross rate of return at time \(t\) -- in foreign currency -- from the foreign currency asset\(^7\). \(S_x\) represents the nominal exchange rate (domestic currency units per unit of foreign currency) for time period \(x\). Investing in the foreign-currency asset is risky because of the uncertain value of the exchange rate in the next period \((S_{t+1})\). However, given our assumption of risk-neutrality, agents equate the gross rate of return derived from the home-currency asset with the expected rate of return -- measured in domestic currency -- of the foreign currency asset. (2.1) is referred to as the uncovered interest parity condition.

Deviations from uncovered interest parity are therefore interpreted as evidence for risk averse behavior, and the existence of a currency risk-premium in the returns of one of the assets. It is important to note, however, that this conclusion presumes that both assets in (2.1) and (2.2) have equivalent default risk If not, deviations from uncovered interest parity can arise even in the

\(^6\) This assumes that transaction costs are zero, and arbitrage is costless.
\(^7\) For ease of exposition, we assume that assets are invested for one-period. The principle extends to all terms of maturity, however.
presence of risk neutrality. To see this, assume that the foreign asset (which pay \( r^* \) in foreign-currency) has no default risk, but that the domestic-currency asset has some positive probability of default \((\delta)\). This default could arise either due to systemic factors, dubbed country risk, (i.e. the threat that the country in which the asset is issued will impose capital controls preventing the (foreign) lender from repatriating the asset returns) or idiosyncratic factors (the agent that issues the asset goes bankrupt). In light of the positive probability of default of one of the assets, the indifference condition for risk-neutral investor now becomes:

\[
(1 - \delta)(1 + i) = (1 + r^*) \frac{E(S_{t+1})}{S_t}
\]  

(2.3)

Taking logs on both sides:

\[
\ln(1 + i) + \ln(1 - \delta) = \ln(1 + r^*) + \ln(E(S_{t+1})) - \ln(S_t)
\]

(2.4)

Rearranging terms

\[
\ln(1 + i) = \ln(1 + r^*) + \ln(E(S_{t+1})) - \ln(S_t) - \ln(1 - \delta)
\]

(2.5)

Thus, (2.5) differs from (2.2) even in the absence of risk aversion. Thus, when testing for risk-aversion (and the existence for currency risk-premia) it is important to net out measures of default risk premia from the returns of both assets.

In turn, a measure of these default premia can be obtained by examining deviations in the covered interest parity condition. The covered interest parity condition governing returns on assets with equivalent default risk is as follows:

\[
(1 + i) = \frac{1}{S_t} \left(1 + i^*\right) F_{t+1}
\]

(2.6)

Taking logs and rearranging terms, this conditional is typically represented as:

\[
\ln \left(1 + i\right) - \ln \left(1 + i^*\right) = \ln F_{t+1} - \ln S_t
\]

(2.7)
where \((1+i)\) represents the one-period gross rate of return on the domestic currency asset at time \(t\), while \((1+ r^*)\) represents the one-period gross rate of return at time \(t\) -- in foreign currency -- from the foreign currency asset. \(S_t\) represents the nominal exchange rate (domestic currency per units of foreign currency) at time period \(t\), while \(F_{t+1}\) represents the price today of buying one unit of the foreign-currency at time \((t+1)\). The right hand side of (2.7) is known as the “forward premium” which, by this condition, must be equal to \((\text{the log of } )\) the interest rate differential.

Abstracting from transaction costs, (2.6) is expected to hold almost perfectly, because deviations from this condition would present riskless arbitrage profit opportunities for investors -- since there is no uncertainty and all prices are known at time \(t\). Observed deviations from (2.6) are therefore construed to be the compensation for the increased probability of default for one of the assets under consideration. This default risk is a combination of both country-risk (the threat of capital controls) and idiosyncratic risk of default of the particular asset used in the comparison.

Obstfeld (1995) and Frankel (1993) show that for developed economies (2.6) holds almost perfectly, while Kumhof (2000) shows that there exists a (small) deviation from (2.6) on inter-bank rates for Mexico, Thailand, & Indonesian in the mid 1990s -- confirming the casual presumption of relatively lower creditworthiness of governments and agents in many emerging markets. Deviations obtained in these studies can therefore be used to measure default risk and can be used as a control in (2.5)

While the covered interest parity condition is found to hold almost perfectly -- especially when tested on developed countries -- the principle of uncovered interest parity has been decisively rejected in the empirical literature. Starting from Cumby and Obstfeld (1981, 1984) and Fama (1984) and extending to Bansal and Dahlquist (2000) researchers have documented significant deviations from uncovered interest parity across a large number of interest and exchange rates (including all the major currencies -- dollar, yen, deutsche mark, pound) and over long time periods. Even though most of these tests have been conducted on the exchange rates and interest rates of the G-7 countries, where issues of default and country risk are less of a concern, deviations of uncovered interest parity still cannot be construed as currency premia because of
the data limitations that have governed most empirical tests of UIP thus far. Specifically, these
tests typically use \textit{ex post} changes in the exchange rate to proxy for the \textit{ex ante} expectations of
agents that is required to test (2.2) – thus implicitly assuming “rational expectations” on the part
of agents. The null hypothesis of these tests is therefore a joint one of no risk premium and
rational expectations. Thus, even though most tests reject the null hypothesis, this does not
necessarily imply the presence of a risk premium. Instead, it could merely be a rejection of the
“rational expectations” assumption, thereby symbolizing systematic forecast errors on the part of
agents, or alternatively that that agents’ expectations do not materialize in the time-horizon used
by the econometrician (the “peso problem”)\textsuperscript{8}.

Indeed, when agents’ ex-ante expectations of future currency movements have been captured
using survey data, Froot and Frankel (1989) find that deviations of uncovered interest parity in
the 1980s for several industrialized countries were driven largely by systematic forecast errors
and not risk premia. Their result emphasizes the importance of avoiding the rational expectations
assumption, when testing for the presence of risk premia.

In sum, before ascribing deviations of uncovered interest parity to currency premia, it is
important to net out the country and default premia implicit in the returns of each asset, and also,
where possible, use a proxy for the \textit{ex ante} expectations of market participants of future currency
movements. This is precisely what we do in the next section when measuring the currency
premia across a sample of East Asian economies in the pre-crisis period.

\section*{2.2 Documenting Currency Risk Premia in Emerging Markets}

\textsuperscript{8} As Lewis (1994) describes, a “peso problem” arises when market participants expect a discrete shift in the
exchange rate (or more generally in the exchange rate regime) that does not materialize within the sample period
examined by the econometrician. This phenomenon is more likely in emerging markets, where exchange rates are
closely managed, but there exists the (typically) small probability that authorities will not be able to sustain the
existing policy, due to possibly changed risk-perceptions in the future. Apparently, this phrase was first coined by
Milton Freidman to explain why Mexican peso deposit rates during the early 1970s remained substantially higher
than the U.S. dollar interest rates despite the fact that the exchange rate had been fixed for a decade. This
presumption was justified when the peso was devalued later that decade.
In this section, we present evidence on deviations from uncovered interest parity, and the associated currency risk premia, for a sample of 6 emerging markets in East Asia: Indonesia, Malaysia, Philippines, South Korea, Thailand and Taiwan. Our motivation is twofold: (i) much of the empirical wisdom concerning deviations from uncovered interest parity come from tests conducted on the interest and exchange rates of G-7 countries (see, inter alia, Hansen and Hodrick (1980), Hodrick (1987), Backus et al (1996) and Bansal (1997)) as opposed to emerging markets. We therefore endeavor to add to the empirical evidence of this phenomenon in emerging markets; (ii) of the studies that do focus on emerging markets, most use ex post movements in the exchange rates to proxy for ex ante expectations under the rational expectations assumption (with the exception of Frankel and Okungwu (1994). Given the dangers of this approach, as discussed in the previous section, we avoid this assumption and instead use survey data on exchange rate forecasts to proxy for the expected deprecation of market participants⁹.

It is important to point out, however, that the expectations data gleaned from surveys may also be a biased predictor of the true expectation of currency movements in certain cases. This is because most of the East Asian economies had closely managed exchange rates and there perhaps existed the small probability, of a deep, discrete devaluation for some of these countries. In the case of Indonesia, this was acknowledged explicitly by the World Bank (1996). Thus, these countries were afflicted by a “peso problem” (as described in footnote 8). In light of this, it is possible that market participants when surveyed about their “best forecast” for the spot exchange rate at three and twelve month intervals, did not include this small probability of deep devaluation, and may have offered the “mode” instead of the “mean” of the distribution. If this is the case, our data for exchange rate expectations are biased downward, and our measure of currency risk premia captures both the true risk premia (compensation demanded for exchange rate uncertainty) and the expectation of a deep devaluation. McKinnon and Pill (1999) have already described and analyzed this phenomenon, and dubbed the resulting residual as the “super risk premium”. As they point out, however, in creating the margin of temptation to borrow, unhedged, in foreign-

⁹ Our source for exchange rate expectations is Consensus Economics. This is one of the world's largest international economic survey organizations and polls more than 400 economists each month to obtain their forecasts and views. The exchange rate forecasts issued for Indonesia are a simple arithmetic average of all of the individual predictions collected by Consensus Economics at a three and twelve month horizon.
currency, the super-risk premium is probably an even better measure for regulators to monitor, than is the true risk premium.

Notwithstanding this caveat, Figures 1-6 plots the 3-month domestic-currency interest rate of each country along with the 3-month US dollar LIBOR rate and the expected movement of the exchange rate over three months for the time period January 1995 to June 1997\textsuperscript{10}. Figures 7 and 8 plot the currency risk premium (i.e. deviations from (2.1)) for each country over the entire time period covered. In the case of Indonesia and Thailand we also net out country risk, by subtracting covered interest rate differentials for these countries from the domestic interest rate.

In the case of Indonesia, the Rupiah interest rate has consistently exceeded the sum of the corresponding LIBOR rate and expected depreciation. Since default risk has already been netted out from the Rupiah rate, we construe these large residuals to be currency risk premia. The average currency premium in the 3-month interest rate in Indonesia is 1.7 percent and is found to be statistically significantly different from zero. The domestic-currency interest rates of Korea and Thailand too consistently exceed the sum of the LIBOR rate and expected exchange rate movements. The average premium for these countries is 1.4 percent and 1.2 percent over three months respectively, and in both cases, statistically significantly different from zero. The cases of Taiwan, Malaysia and the Philippines are less clear-cut. Though these countries exhibit sharp deviations from uncovered interest parity, these deviations are both positive and negative. The average premium for all three countries is positive but relatively small (less than 0.5 percent over three months) and is statistically significantly different from zero only in Malaysia and Taiwan.

\begin{figure}
\caption{Figure 1}
\end{figure}

\begin{figure}
\caption{Figure 2}
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\caption{Figure 3}
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\caption{Figure 4}
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\textsuperscript{10} This is the only time period for which we have exchange rate expectations for most of these countries.
Thus 5 of the 6 countries have statistically significant average risk premia, and in the case of Indonesia, Thailand and Korea the magnitudes are strikingly large. In the case of Indonesia and Korea, for instance, these premia approach almost 8 and 6 percent, respectively, in annualized terms.

Our decision to test for risk premia in this sample of countries is governed only by data considerations: these are the only countries and time-periods for which we have data on exchange rate expectations. Currency risk premia are likely to be present, however, across a range of emerging markets. For instance, Frankel and Okungwu (1994) and Garcia and Didier (2000) document the presence of, often significant, country and currency risk premia in Mexico and Brazil respectively.

2.3 Documenting Foreign-Currency Corporate Borrowing

This section serves as an empirical motivation for the second key component of our thesis: the desire of nonfinancial forms to take on unhedged, foreign-currency liabilities. Although, there is widespread consensus among observers about the crucial role played by unhedged, foreign-currency liabilities in generating and exacerbating the East Asian crisis, there is perhaps an inadequate acknowledgment and appreciation of the extent to which this off-shore foreign-currency liabilities were issued by private, non-financial firms – as opposed to banks and other financial intermediaries. Although some studies have alluded to the relative significance of private corporate debt, there does not seem to exist a systematic quantitative documentation of
this phenomenon. Using some new data sources, this section attempts to make a start in this direction, by quantifying the relative importance of foreign-currency liabilities among private firms and corporations in East Asia.

It should be stated at the outset that limitations of existing data preclude a precise estimation of banks’ and firms’ net exchange rate exposure in most emerging markets. Existing evidence in East Asia, though, clearly points to the substantial contribution of private firms to the net foreign-currency liabilities of these economies. An important source in this regard is data from the Bank of International Settlements (BIS), which allow for a sectoral decomposition of the net foreign-currency liabilities of a country owed to major OECD banks. Table 1 presents the BIS data for several East Asian countries prior to the onset of the East Asian financial crises. What is striking is the fraction of “non-bank private” liabilities in some of the East Asian countries. In Indonesia, for instance, as much as two-thirds of the stock of off-shore borrowing from OECD banks in 1996 was undertaken by private firms and corporations. In Thailand, the fraction was close to 60 percent in 1996. In Malaysia, the fraction was even higher, and private firm borrowing exceeded the combined borrowing of banks and the public sector. These ratios significantly exceeded that of Mexico’s in 1994-5 for instance.

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11 An important advantage of using data from foreign creditor banks instead of from the borrowing agents in non-OECD countries – is to get around the subtle ambiguities of how transactions are reported. For instance, as Burnside et al. (1999) point out, suppose that Bank A in country X borrows dollars from abroad and uses the proceeds to make dollar-denominated loans to local firms. Bank A may take the position that this transaction does not cause a decline in its net foreign assets and would not report it as such. However, to the extent that devaluations are associated with higher default rates on bank loans, this transaction still exposes the bank to exchange risk – albeit indirectly. Since the BIS data are based on reports from the foreign creditors of Bank A (assuming that they are banks in OECD countries) the transaction would indeed show up as a decrease in the net foreign assets of banks in Country X.

12 Reports from the major OECD banks suggest that about 30 percent of this lending was denominated in yen, while most of the remainder in dollars. BIS (1998), p. 123 – as reported in Hausmann and Eichengreen (1999)
Table 1 International Claims Held By Foreign Banks vis-à-vis East Asia as of 1996-97: Sectoral Breakdown

(Billions of dollars)

<table>
<thead>
<tr>
<th></th>
<th>Total Outstanding</th>
<th>Banks</th>
<th>Public Sector</th>
<th>Non-bank Private</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>End-1996</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>55.5</td>
<td>11.7</td>
<td>6.9</td>
<td>36.8</td>
</tr>
<tr>
<td>Malaysia</td>
<td>22.2</td>
<td>6.5</td>
<td>2.0</td>
<td>13.7</td>
</tr>
<tr>
<td>Philippines</td>
<td>13.3</td>
<td>5.2</td>
<td>2.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Thailand</td>
<td>70.2</td>
<td>25.9</td>
<td>2.3</td>
<td>41.9</td>
</tr>
<tr>
<td>Korea</td>
<td>100.0</td>
<td>65.9</td>
<td>5.7</td>
<td>28.3</td>
</tr>
<tr>
<td><strong>Mid-1997</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>58.7</td>
<td>12.4</td>
<td>6.5</td>
<td>39.7</td>
</tr>
<tr>
<td>Malaysia</td>
<td>28.8</td>
<td>10.5</td>
<td>1.9</td>
<td>16.5</td>
</tr>
<tr>
<td>Philippines</td>
<td>14.1</td>
<td>5.5</td>
<td>1.9</td>
<td>6.8</td>
</tr>
<tr>
<td>Thailand</td>
<td>69.4</td>
<td>26.1</td>
<td>2.0</td>
<td>41.3</td>
</tr>
<tr>
<td>Korea</td>
<td>103.4</td>
<td>67.3</td>
<td>4.4</td>
<td>31.7</td>
</tr>
<tr>
<td>Memo:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico (1994)</td>
<td>64.6</td>
<td>16.7</td>
<td>24.9</td>
<td>22.8</td>
</tr>
</tbody>
</table>

Source: Bank for International Settlements

As alluded to above, a limitation of the BIS data is that it only reflects lending by major OECD banks. Lending by other banks or foreign corporations is not captured in these statistics. Sectoral breakdowns of a more comprehensive nature for foreign-currency liabilities are even harder to procure. Table 2, however, presents an estimate for East Asia -- prior to the crisis -- from a new data source – a survey undertaken by the SBC Warburg Dillon Read (SBC-WDR).\textsuperscript{13}

\textsuperscript{13} One should be cognizant of the “quality” versus “quantity” tradeoff between the BIS and SBC-WDR data sets. It seems reasonable to attach greater credence to the BIS data given the greater standardization and higher accounting
Table 2 Breakdown of Stock of Foreign-Currency Debt: 1996-97

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Foreign Currency Debt</th>
<th>of which Private Sector</th>
<th>of which Banks</th>
<th>of which Major Listed Industrials</th>
<th>of which Smaller Listed + Non-listed Industrials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>136</td>
<td>68</td>
<td>10</td>
<td>15</td>
<td>43</td>
</tr>
<tr>
<td>Korea</td>
<td>154</td>
<td>102</td>
<td>40</td>
<td>43</td>
<td>19</td>
</tr>
<tr>
<td>Thailand</td>
<td>95</td>
<td>72</td>
<td>39</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Philippines</td>
<td>45</td>
<td>18</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Malaysia</td>
<td>41</td>
<td>17</td>
<td>1</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: SBC Warburg Dillon Read

These numbers, though less dramatic than the BIS data, also point to the significance of non-bank private sector debt -- particularly in the cases of Indonesia, Malaysia and Korea. Interestingly, in the case of Indonesia, major listed industrials contributed only about a quarter of all foreign-currency corporate debt – the bulk being issued by smaller listed and non-listed industrials.

At an aggregate level, both the BIS and the SBC-WDR data sets point to the significance of foreign-currency corporate debt in several East Asian countries. It is important to note that this debt does not necessarily translate into an equivalent degree of exchange-rate exposure, because in principle it could have been hedged. Many qualitative analyses suggest, however, that much of this debt was unhedged. For example, IMF (1999, p.17) concludes that Indonesia, Korea and Thailand had “large unhedged private short-term foreign-currency debt in a setting where corporations were highly geared.” Folkerts-Landau et al. (1997, p. 46) write, with reference to standards of banks in the OECD countries. In contrast, the SBC-WDR data set – though possibly less reliable and subject to some double-counting -- is more comprehensive.
Thailand, “While banks are believed to have hedged most of their net foreign liabilities, the opposite is believed to be true for the corporate sector.”

A more precise estimate of the degree of unhedged borrowing for East Asia's largest exchange-listed firms is, however, available from the SBC-WDR data. Specifically, in its *Reality Check* series on East Asia, SBC Warburg Dillon Read surveyed approximately 40 of the largest non-financial, exchange-listed, corporations in East Asia in 1997 to identify the direct currency exposure of these corporations. Summary statistics of that survey are presented in Table 3.

Table 3  Currency Exposure of the Largest, Non-Financial, Exchange-Listed Firms:

<table>
<thead>
<tr>
<th>Country(Obs)</th>
<th>Foreign-Currency Debt (% of total debt)</th>
<th>Fraction Hedged (% of foreign-currency debt)</th>
<th>Exposed Foreign Currency Debt (% of total debt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia(40)</td>
<td>67</td>
<td>23</td>
<td>52</td>
</tr>
<tr>
<td>Thailand(29)</td>
<td>62</td>
<td>26</td>
<td>46</td>
</tr>
<tr>
<td>Korea(31)</td>
<td>33</td>
<td>n.a.</td>
<td>33</td>
</tr>
<tr>
<td>Philippines(39)</td>
<td>34</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td>Malaysia(38)</td>
<td>15</td>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: SBC Warburg Dillon Read

These numbers clearly demonstrate a strong preference for foreign-currency debt vis-à-vis domestic currency debt in Indonesia and Thailand. More damagingly, only a small fraction of this debt was hedged, leaving a large fraction of foreign-currency debt exposed to currency risk.

The riskiness of this unhedged, foreign-currency debt would depend in large measure upon the extent to which the firms issuing this debt were in the tradable sector and were thus “naturally hedged”. In general the sectoral decomposition of this unhedged, debt is hard to obtain. Where it is available, though, the results are striking. For instance Ghosh and Pangestu (1999) document
that in the case of Indonesia between 1995 and 1997, about 79.5 percent of total foreign corporate borrowing was undertaken by firms in the nontradable sector, and only about 20.5 percent of the borrowing by export-oriented companies. The five most active cross-border borrowers, for instance, were the banking and finance companies, infrastructure, property, pulp and papers producers -- all but the last one in the nontradable sector.

3. Theoretical Motivation: The Extant Literature

The previous section documented the existence of often significant (statistical and quantitative) currency risk premia in a sample of emerging markets in East Asia. Yet despite widespread empirical acknowledgement of this phenomenon across various emerging markets in the world, the extant theoretical literature has not been able to adequately model how and why these premia develop in the interest rates of most emerging markets. Indeed, as we point out in this section, the workhorse general-economy models often give rise to perverse implications – when applied to emerging markets. This theoretical gap is a key motivation for the development of the analytical framework in this paper.

Towards that end, this section briefly surveys the extant literature on the modeling of currency risk premia in open economy general equilibrium models. The objective is to demonstrate that many of the assumptions -- particularly those relating to risk-sharing across countries, the symmetry of national monies, and the link between prices and exchange rates – implicit in the current workhorse models are inapplicable to many emerging markets. Consequently, the implications for risk-premia of many of the existing models are at odds with the situation in many emerging markets. A discussion of these issues in this section helps to motivate the modeling technique that we pursue in subsequent sections.

The Lucas (1982) fruit-tree model is the classical starting point to understanding asset pricing and the generation of foreign-currency risk premia in two-country general-equilibrium models. Both countries are modeled as endowment-economies, where the representative agents in each of
the two countries are endowed with a different fruit-tree. Agents get utility from both kinds of fruit, thus setting the stage for trade in goods, money and assets. Real-income streams (the fruit trees) in both countries follow a stochastic Markov process. Money is introduced through a cash-in-advance constraint and agents must pay for each good using the money of the country that the fruit was produced in. Agents also receive a stochastic transfer of their respective currencies at the beginning of each period. All prices are flexible.

Apart from the two monies, there are four other assets that are traded in the model -- shares in the two types of fruit trees, and bonds. The specification of assets and states in this model is such that asset markets are complete, which in conjunction with the assumption that all agents have identical utility functions and initial wealth, allows for the perfect pooling of risk across the two countries. So all individuals make identical consumption choices and asset holding choices.

As alluded to in the previous section, currency risk-premia in general-equilibrium models arise from the covariance of the exchange rate with the marginal utility of consumption. As Engel (1992) demonstrates, since the exchange rate in this model is a function only of domestic and foreign money and consumption, in equilibrium, is a function only of output, the foreign-exchange risk premium arises from the (exogenous) correlation of monetary and output shocks. Specifically, as per Engel (1992), the risk premium is equal to:

\[-\rho \text{Cov}[m^H - m^F, nY^H + (1-n)Y^F] \]

where m and Y refers to the exogenous streams of money and output in each period, the subscripts H and F refer to “home country” and “foreign country”, \(\rho\) is the coefficient of relative risk aversion and n and (1-n) refer to the share of income spent on domestic and foreign goods respectively.

Expanding the covariance terms reveals the risk-premium to be:

\[-\rho n\text{Cov}(m^H, Y^H) - \rho(1-n)\text{Cov}(m^H, Y^F) + \rho n\text{Cov}(m^F, Y^H) + \rho(1-n)\text{Cov}(m^F, Y^F) \]
The sign of the risk premium in this model boils down to the strength of the (exogenous) covariance between the output of each country vis-à-vis the money growth of each of the two countries. Specifically, foreign assets are relatively risky -- generating a negative risk premium in the domestic interest rate -- when the covariance between home money growth and home output growth for each country is high relative to the covariance between foreign money growth and home output growth for each country.

While this is undoubtedly a pioneering effort in the study of asset-pricing across countries, the Lucas model ignores important stylized facts that afflict emerging markets and potentially affect how currency risk is priced in these environments. Specifically, the model’s assumption of complete asset markets and perfect risk sharing across countries is not a realistic characterization of the situation facing most emerging markets. Unlike the model’s hypothesis of seamless risk sharing, Calvo and Reinhart (2000a, 2000b) have documented that the ability of emerging markets to smooth fluctuations by borrowing from international sources is precarious -- relative to the developed economies -- even in normal times. In the event of a negative shock (for instance, a currency-crisis) this effect is greatly amplified, and emerging markets seems to be completely rationed out of international capital markets -- leading to an large adjustments in the current account -- dubbed the “sudden stop” problem by Calvo. For instance, these authors review a large sample of currency crises in both emerging markets and industrialized countries, and note that the current account adjustment in emerging markets, in the three year period surrounding the crisis, was almost five times as large as that for the developed economies -- pointing to the involuntary loss of access of international capital markets that emerging markets face in the wake of an adverse shock. Thus, emerging markets are not easily able to smooth consumption and output in the face of adverse shocks through accessing international markets. If anything, their lost access further exacerbates the problem. Additionally, Hausmann and Eichengreen (1999) point to the fact that foreigners rarely take on the currency risk of emerging markets (dubbed as “original sin” by the authors). As the authors note, essentially all non-OECD countries have virtually no external debt denominated in their own currency.

All this points to the incompleteness of financial markets, and the inability of most emerging markets to diversify against aggregate shocks both ex-ante (“original sin”) and ex-post (“sudden
In turn, this financial incompleteness has important implications for how a country’s output, consumption, and current-account balance evolve in the wake of an adverse currency shock -- thus influencing the sign and magnitude of the covariance of consumption and output with the exchange rate, and thus the equilibrium risk premium. Yet none of this is captured in Lucas-type models that assume complete asset markets and prefect risk-sharing across countries of the world.

A more general shortcoming of this model is that the sign of the premium is driven entirely by exogenously specified correlations of money and output shocks. Thus the sign of the premium is easily switched by simply assuming a stronger covariance between home output shocks and foreign-money shocks.

This phenomenon is avoided by the sticky-price, dynamic, stochastic, general equilibrium models (a la Obstfeld and Rogoff (1998), Engel and Devereux (1998)) that characterize the new-open economy macroeconomics literature. Just like Lucas (1982), these models are two-country models, but model the production side explicitly. A key assumption in these models is temporary price rigidities, in which case, the correlation between monetary shocks and real variables arises endogenously. Furthermore, Obstfeld and Rogoff (1998) assume a unit elasticity of substitution between home and foreign goods, and that nominal price rigidities exist only in the currency of producer so that the law of one price holds internationally. These assumptions guarantee complete consumption risk-sharing between countries -- just as in Lucas (1982).

The endogenous correlation between monetary impulses and real variables and the perfect-risk-sharing assumption however result in some perverse predictions for asset pricing, when applied to emerging markets. For instance, a positive monetary shock in the home country leads to an exchange rate depreciation and increased global consumption. This makes domestic money a consumption hedge, in real terms, against monetary-induced consumption shocks. The opposite is true if global consumption rose because of a depreciation in the foreign country. In that case foreign-currency assets serve as a consumption hedge. The net result of this is that greater monetary uncertainty at home relative to a partner country results in a negative risk premium -- a
risk discount -- on domestic currency assets! Greater relative monetary uncertainties yield higher
discounts.

In light of the documented risk premia in emerging markets and the inherent monetary and
exchange rate uncertainty that beset these economies, predictions of the new-open economy
macroeconomic literature that increased uncertainty should result in higher risk discounts seems
at odds with the experience of most emerging markets. An important underlying reason for this
dichotomy is that, as in the standard textbook case, Obstfeld and Rogoff (1998) model
depreciations to always be expansionary, thus making domestic money the better hedge against
consumption. However, as Calvo and Reinhart (2000b) document, sharp currency depreciations
in emerging markets over the last three decades -- far from being expansionary -- have resulted
in significant growth slowdowns, and in the 1990s, actual contractions in output. In light of this,
it is not surprising that foreign-currency assets become consumption hedges for agents in these
economies, resulting in risk-premia on domestic-currency assets -- exactly the opposite to what
the Obstfeld and Rogoff model generates.

Engel and Devereux (1998) extend the analysis of Obstfeld and Rogoff (1998) to allow pricing
to market. This assumption results in an even starker prediction for asset pricing. Since all goods
prices are rigid in the short run, the law of one price is violated, and any monetary volatility
results in a risk discount in their model. Calvo and Reinhart (2000a,b) find that the average pass-
through from exchange-rate movements to inflation is about 4 times as large for emerging
markets, on average, as for developed economies. They find that lagged exchange rates have
statistically significant effects on inflation in 43 percent of cases within their emerging market
sample compared to only 13 percent of cases within the developed country sample. Thus, the
Engel and Devereux (1998) assumption of no passthrough at all seems particularly inapplicable
to the emerging market case. More generally, higher passthrough from exchange rates to
domestic prices in emerging markets relative to the developed countries is symptomatic of a
natural asymmetry that exists between the national monies of countries of the center vis-à-vis the
periphery. This asymmetry is also evident in the “original sin” phenomenon pointed out by
Hausmann and Eichengreen (1999), wherein foreigners are averse to taking on any of the
currency risk posed by holding liabilities denominated in emerging-market currencies. This
asymmetry – which seems to have completely escaped formal open-economy modeling to date – constitutes an important building block of our model.

Given the inapplicability of the extant literature to the situation facing emerging markets, our focus in the remainder of this paper is to develop a stochastic, general equilibrium model that better captures the stylized facts of emerging markets, and so as to better understand the driving forces behind the generation of currency risk premia in their interest rates.

4. The Analytical Underpinnings

In this section we present the analytical underpinnings of our modeling approach to provide some intuition for the formal model developed in the next section.

As alluded to in the previous section, an important building block of our analysis is the observation that, unlike in industrialized countries, exchange rate movements in emerging markets often have a significant passthrough onto domestic prices. Exchange rate pass-through in emerging markets is not surprising in light of McKinnon’s (1979, 2000a) documentation of the trade invoicing patterns in many emerging markets. McKinnon discusses how exports of most homogeneous primary products are invoiced in dollars with worldwide price determination in certain centralized exchanges. This has important ramifications for most emerging markets whose exports typically have a high primary commodity content. The implications for price-pass through in this context seem clear. As McKinnon notes, “if any other country allows its exchange rate to fluctuate against the dollar, its domestic currency prices of primary commodities will vary in proportion”

Furthermore, almost all trade involving the United States is dollar invoiced (90 percent of US imports and 98 percent of US exports), and much intra-regional trade within Latin America and East Asia is invoiced in dollars – the latter being dubbed the East Asian dollar standard by McKinnon(2000b). The implication of all this is that domestic currency prices of tradable goods
in many emerging markets are much more sensitive to exchange rate movements (particularly against the US dollar) than in developed countries – exactly the finding obtained by Calvo and Reinhart.

The passthrough from exchange rate movements to prices, in turn, has important implications for the pricing of financial assets in emerging markets. This is because, from the perspective of risk-averse agents in economies subject to currency uncertainty, foreign-currency assets and liabilities appear as imperfect substitutes to their domestic-currency counterparts -- as long as the interest rates on the latter are not completely indexed to exchange rate movements. The nature of this imperfect substitutability, in turn, depends in large measure on the degree of passthrough from exchange rate movements to domestic prices.

For instance, from the perspective of risk-averse households, the passthrough of exchange rate movements onto domestic prices (and the resulting positive correlation between exchange rate depreciations and domestic inflation), implies that foreign-currency-denominated financial assets can serve as a better hedge against unexpected domestic inflation than can their domestic-currency counterparts. For instance, in the event of an unexpected devaluation-inflation episode, the foreign-currency assets pays out more relative to its mean (in domestic currency), than does a nominally-non-stochastic domestic-currency asset. Thus, unlike a fixed-interest rate domestic-currency asset, a foreign-currency asset pays out more precisely when the households needs it most. Similarly, in the event of an unexpected currency appreciation (and price deflation) episode, the foreign-currency assets pays out less than its mean -- precisely when the household needs it least. Thus, relative to domestic-currency-denominated assets, foreign-currency denominated assets serve as natural hedges against unexpected exchange-rate-induced price movements.

As a result, households, when facing exchange-rate uncertainty, find it optimal to save a (possibly large) fraction of their total saving in foreign-currency to help smooth their income and consumption across different states of nature. The stronger the correlation between exchange rate and price movements, the larger the fraction of total saving that households find optimal to hold in foreign-currency -- given the superior inflation-hedging properties of these assets. The upshot
of this household inclination towards foreign-currency assets, is that to be induced into holding a
greater fraction of their saving in domestic currency, households require a risk-premium (an
excess return) on domestic currency assets.

Thus, the imperfect substitutability of assets -- from the perspective of risk-averse households --
has important ramifications for the equilibrium risk premium that arises on domestic-currency
assets. For a given quantity of aggregate saving (and, more generally, for a given current account
deficit or surplus), the stronger the household inclination towards saving in foreign-currency
assets, the higher the risk-premium (or the lower the risk-discount) that arises on domestic-
currency assets in equilibrium. The sign and magnitude of the risk premium, in turn, is
significant because it helps determine -- as we shall see-- the extent to which firms take on risky,
unhedged, foreign-currency liabilities14. This will become evident when we analyze the portfolio
decisions that firms need to make -- to which we turn next.

Risk averse firms choose the currency composition of their debt to jointly minimize the expected
cost of borrowing and the variance of their portfolios. To help understand firms’ debt-
denomination decisions, it is therefore crucial to examine how the cost of borrowing in domestic-
currency compares to the expected cost of borrowing in foreign-currency -- and whether there is
an excess return (risk premium) implicit in the cost of borrowing in domestic or foreign-
currency. As we shall see, when the interest rate on domestic-currency debt implicitly contains a
currency risk-premium, firms find it optimal to denominate (a fraction of) their debt, unhedged,
in foreign currency. This is done so as to avoid paying the excess return implicit in the cost of
domestic-currency borrowing, but is “risky” in that it leaves the firm’s balance sheet and net
worth vulnerable to unanticipated currency movements.

Apart from considerations of expected cost, the currency composition of a firm’s debt is also
affected by the desire of a risk averse firm to smooth its income and net-worth across different
states of nature. To see this, note that, just as with households, domestic-currency and foreign-
currency liabilities are imperfect substitutes to firms, in that their real payouts are not perfectly

14 More generally, as McKinnon and Pill (1999) point out, the existence of a large risk premia increases the margin
of temptation for banks, that are governed by moral hazard, to undertake unhedged, foreign-currency liabilities --
exacerbating the regulatory problem in these economies.
correlated -- and may in fact be negatively correlated -- across different states of nature. The firm
is thus able to take advantage of this imperfect substitutability and denominate its debt between
foreign-currency and domestic-currency liabilities so as to minimize the variance of its portfolio.
Apart from the risk-premium induced foreign-currency borrowing, this variance-minimizing
motive constitutes another reason for firms (including those in the nontradable sector) to
undertake unhedged, foreign currency debt.

The imperfect substitutability of liabilities in different currencies depends not only on the
cumulative passthrough of exchange rate movements to domestic prices (as was the case with
households), but more crucially, on the differential extent to which tradable and nontradable
prices change (if at all) in the wake of exchange rate movements (i.e. how the real exchange rate
changes). Thus, the extent to which nominal currency depreciations (appreciations) translate into
real depreciations (appreciations) has important implications for the manner in which firms
denominate their liabilities in domestic and foreign currency.

As we demonstrate formally in a model below, in the event of a real depreciation, the evolution
of the net-worth of a nontradable firm depends upon the extent to which investment in the
previous period was financed by the entrepreneur’s own capital vis-à-vis external debt, and the
fraction of debt denominated in domestic-currency vis-à-vis foreign-currency. The intuition for
this is as follows. The real return on the entrepreneur’s own invested capital decreases in the
event of a real depreciation. This is because this capital is used to produce nontradable goods --
whose relative price falls in the wake of a real depreciation. Since entrepreneurs consume a
composite of tradable and nontradable goods, this translates to a negative real income shock in
the wake of an unexpected currency depreciation. On the other hand, to the extent that the
entrepreneur has issued any fixed-interest rate domestic currency debt, net-worth may rise. To
see this, note that if the price of the nontradable good rises in the wake of a currency depreciation
(because of some degree of monetary accommodation of nominal exchange rate changes by the
central bank), the real value of any outstanding fixed-interest-rate domestic-currency debt issued
by the entrepreneur falls. This increases the real value of entrepreneurial net worth. In contrast,
the real value of foreign-currency denominated debt increases in the wake of a real depreciation -
- tending to lower net worth.
The risks posed by domestic-currency and foreign-currency debt are negatively correlated and risk averse entrepreneurs are able to use each kind of debt to offset the risk posed by the other and also offset other non-hedggable risks on its portfolio. All this is part of a risk-averse entrepreneur’s desire to use its debt-denomination decisions to minimize the variance of its net-worth. The fraction of foreign-currency debt undertaken for these purposes is therefore dubbed the “variance minimizing” demand, as distinct from the risk-premium-induced speculative demand described above. As we demonstrate formally below, this variance-minimizing demand for foreign-currency is determined by the (i) degree to which nominal devaluations translate into real devaluations; (ii) the fraction of total investment that is financed by the entrepreneur’s own capital vis-à-vis by issuing debt; and (iii) the share of tradable goods in total consumption.

The logic for firms in the tradable sector is similar -- but the implications are reversed. Tradable sector entrepreneurs benefit from a real depreciation (and lose in the event of a real appreciation). To smooth their net-worth across different realization of the exchange rate, tradable sector entrepreneurs therefore find it optimal to be net-suppliers of domestic-currency assets, as we will see in the model below.

Our analysis therefore demonstrates that, even in the absence of bailout guarantees, tradable and nontradable firms desire to undertake foreign-currency debt. Furthermore, this foreign-currency debt can be decomposed into a speculative component and a variance-minimizing component. It is important to differentiate between these motives because they have very different implications for assessing firm-vulnerability to unanticipated currency movements. To the extent that foreign-currency debt is undertaken for variance-minimizing purposes, it helps mitigates the currency risk that a firm is exposed to. In contrast, the risk-premium-induced foreign-currency borrowing exacerbates the currency risk that a firm is exposed to. This is because, in its bid to take advantage of the expected cost differential, the firm departs from its minimum-variance portfolio, and consciously exposes its net-worth to currency risk.

---

15 The variance-minimizing motive of risk-averse firms seems to have been largely missed in the extant literature. The analysis of foreign-currency debt thus far has focussed exclusively (see Schneider and Tornell (2000), Eichenbaum et al. (1999) on the speculative nature of foreign-currency debt. As we show, however, firms may well
To solve for the equilibrium risk premium, we combine the portfolio demands of households and firms to solve for the equilibrium in the domestic-currency capital market, and thus generate the equilibrium risk premium. As we show formally in the next section, the equilibrium risk premium depends upon the current account deficit of the economy, the relative net-worth of the nontradable and tradable sectors, the volatility of the exchange rate, the extent to which nominal depreciations translate into real depreciations, and the share of consumption devoted to tradables.

5 A Model

In this section, we build a two-period, stochastic, general-equilibrium model of an open-economy model to formalize the phenomena discussed above. The only source of aggregate uncertainty facing agents in the model economy is exchange-rate uncertainty in the second period.

5.1 Description of the Economy

The economy consists of three classes of agents: households, tradable-sector-entrepreneurs (firms), and non-tradable-sector-entrepreneurs (firms).

5.1.1 Consumption and Prices

All agents consume an aggregate consumption good at time $t$, $C_t$, where

$$C_t = \left( C_t^T \right)^\alpha \left( C_t^N \right)^{1-\alpha}$$

(4.1)
is a Cobb-Douglas aggregate of a tradable \( C_t^T \) and non-tradable \( C_t^N \) good at time \( t \)

The consumption-based price index \( P_t \) at time \( t \) can therefore be represented as:

\[
P_t = \omega \left( P_t^T \right)^{\alpha} \left( P_t^N \right)^{1-\alpha}
\]  

\[ (4.2) \]

where \( P_t^T \) is the domestic-currency price of the tradable good, \( P_t^N \) is the domestic currency price of the non-tradable good, and \( \omega \) is an irrelevant constant for our purposes.

We impose the no-arbitrage condition in the market for tradable goods to pin down its domestic currency price. Therefore the equilibrium domestic-currency price of the tradable good reflects its purchasing power parity price\(^\text{16}\):

\[
P_t^T = (P_t^*)^T S_t
\]  

\[ (4.3) \]

where \( (P_t^*)^T \) is the foreign-currency world price of the tradable good at time \( t \), and \( S_t \) is the nominal exchange rate (defined as pesos/$) at time \( t \). We normalize \( P^* \) to 1, without loss of generality. Therefore:

\[
P_t^T = S_t
\]  

\[ (4.4) \]

The equilibrium price of non-tradable goods \( P_t^N \) is determined endogenously in the model so as to clear the market for nontradables.

Let the one-period, consumption-based, rate of inflation between period \( t-1 \) and \( t \) be depicted by \( p \). Thus,
\[
1 + p = \frac{P_t}{P_{t-1}} = \left( \frac{P_t^R}{P_{t-1}^R} \right)^\alpha \left( \frac{P_t^N}{P_{t-1}^N} \right)^{1-\alpha}
\]  
(4.5)

\[
1 + p = \left( 1 + p^R \right)^\alpha \left( 1 + p^N \right)^{1-\alpha}
\]  
(4.6)

where \( p^R, p^N \) represent the one-period rate of tradable and non-tradable price inflation respectively. By (4.4) \( p^R = s \), where \( s \) represents the rate of nominal currency depreciation between time period \( t-1 \) and \( t \).

Taking logs (4.6) can be re-written as

\[
\ln(1 + p) = \alpha \ln(1 + s) + (1 - \alpha) \ln(1 + p^N)
\]  
(4.7)

Since, \( \ln(1 + x) \approx x \) for small \( x \), we can represent the consumption-based, one-period rate of inflation \( (p) \) as:

\[
p = \alpha s + (1 - \alpha) p^N
\]  
(4.8)

### 5.1.2 Time Horizon and Classes of Economic Agents

The lifespan of the economy is only two periods: 0 and 1. The source of uncertainty in the model is the exchange-rate/monetary policy of period 1.

---

\[\text{16 This assumption is made to capture the stylized facts presented in the last section about the impact of exchange rate changes on domestic prices. Here we mark the stark PPP assumption in the case of tradable goods primarily for notational convenience. The qualitative results of the model do not change if we assume incomplete passthrough.}\]
All agents receive an endowment in period 0, but consumption only takes place in period 1. Households therefore have to save their endowment for one period. However, they need to make a portfolio decision in period 0 – before the resolution of uncertainty – about what fraction of their saving to undertake in domestic-currency assets vis-à-vis foreign-currency assets.

In contrast, entrepreneurs in both the tradable and nontradable sector are endowed with production technologies to produce tradable and nontradable goods, respectively. Production takes 1 period to mature. To exploit these production technologies, entrepreneurs therefore need to hire factors of production in period 0 – before the resolution of uncertainty – to produce and sell output in period 1.

The factors of production are capital and labor. We assume that labor is sector-specific and provided by the representative entrepreneur herself. Furthermore, this labor endowment is normalized to 1, without any loss of generality. Abstracting from issues of labor provision allows us to focus exclusively on the entrepreneurs’ financial investment -- and the associated portfolio decision -- which is at the heart of our inquiry.

Specifically, in addition to investing their own endowments, entrepreneurs need to borrow financial capital to undertake their desired physical capital investment. Their decision set, therefore, involves choosing both the quantum of financial investment, and more interestingly, the currency composition of their debt, i.e. deciding whether to denominate their debt in domestic currency or, unhedged, in foreign currency.

Households are therefore net savers in period 0 while firms are net borrowers. At the heart of the model, therefore, is the portfolio decision that both households and firms need to make in period 0 – before the resolution of exchange rate uncertainty – about the currency in which to denominate their saving and borrowing, respectively.

---

17 The principle of covered interest parity illustrates that borrowing in foreign-currency and then hedging this risk in the forward market is exactly equivalent in its risk and return characteristics to borrowing in domestic currency. Thus, the entrepreneur really only has two different choices from a risk-return standpoint: borrow (1) unhedged in foreign currency; (2) borrow in domestic currency.
5.1.3 Asset-Choice

Agents have the choice of saving and borrowing in two assets: a foreign-currency-denominated (say, dollar) asset and a domestic-currency-denominated (say, peso) asset. The payout of both assets is nonstochastic in nominal terms in their respective currencies. Thus the gross, one-period, rate of return (in dollars) from investing/borrowing in the dollar asset is \((1 + r^*)\) where \(r^*\) is the world rate of interest. Given the small-economy assumption, \(r^*\) is taken as a given by agents in this economy. The nominal rate of return in domestic currency from investing/borrowing in the dollar asset is, however, stochastic and contingent upon the realization of the exchange rate in period 1. Specifically, it can be represented as:

\[
\frac{(1 + r^*)S_1}{S_0}
\]

where \(S_0\) and \(S_1\) represent the value of the nominal exchange rate in time periods 0 and 1 respectively.

The nominal rate of return on the domestic-currency asset is \((1+i)\), where \(i\) is the one-period domestic-currency interest rate. The equilibrium value of \(i\) is determined in the domestic capital market, and is the key endogenous variable of the model, since its equilibrium value reflects the existence and magnitude, if any, of a currency risk premium.

5.1.4 Exchange Rate Management

The nominal exchange rate is modeled as a policy variable: one that the authorities control and manage. Calvo and Reinhart (2000a,b) provide overwhelming evidence of the fact that exchange rates in emerging markets are closely managed by authorities, thus giving credence to a “fear of floating.” The randomness associated with the exchange rate in our model can therefore be thought as arising both from the uncertainty associated with the exchange rate policy pursued by authorities; and by the fact that there are limits beyond which the exchange rate cannot be controlled by the authorities (for example, when international reserves run out).
5.1.5 Timeline

An explicit time-line of events in the model-economy can be represented as follows:

Period 0:

- All agents receive endowments.
- Households save this endowment for one-period, and make a portfolio decision of saving in domestic-currency vis-à-vis foreign currency assets.
- Firms make an investment and portfolio decision. They decide on the quantum of total financial borrowing, and also on the currency in which to denominate this debt.
- The domestic interest-rate adjusts to clear the domestic-currency capital market.

Period 1:

- The exchange-rate uncertainty is resolved at the start of this period.
- Output is produced. Tradable prices are pinned down by the PPP assumption.
  - The price of non-tradable adjusts so as to clear the market for non-tradable goods.

Having described the economy in general, we now turn to the optimization problem faced by households and firms and then combine these to solve for the equilibrium conditions.

5.2 The Household Optimization

Households receive a monetary endowment \( A_0^S \) in period 0. Since they only consume in period 1, they save this endowment for one period. In period 0, they therefore have to make a portfolio decision of saving between domestic-currency-denominated and foreign-currency-denominated assets. Their decision variable therefore is the fraction of their endowment to be saved in foreign-currency assets vis-à-vis domestic-currency denominated assets.
Their optimization can formally be represented as follows:

\[
\max_{f^s} \quad -e^{-\gamma C_1}
\]

subject to

\[
C_1^s = \frac{A_1^s}{P_1}
\]

where:

- the utility function, defined over period 1 consumption, \( U(C_1) = -e^{-\gamma C_1} \) is of the constant-absolute-risk-aversion form.

- the choice variable, \( f^s \), represents the fraction of the monetary endowment in period 0 that is invested in foreign-currency-denominated assets.

- period-1 household consumption, \( C_1^s \), (and income) is equal to real asset income \( \left( \frac{A_1^s}{P_1} \right) \) in period 1, wherein \( A_1^s \) is the nominal asset income in period 1--denominated in domestic currency, and \( P_1 \) is the consumption-based price index in period 1.

Nominal asset income in period 1, in turn, can be decomposed as follows:

\[
A_1^s = f^s A_0^s (1 + f^*) \frac{S^*}{S_0} + (1 - f^s) A_0^s (1 + i)
\]

where, as described above, \( A_0^s \) is the monetary endowment of the household in period 0.

(4.11) can be rearranged as:

\[
\frac{A_1^s}{P_1} = f^s A_0^s (1 + f^*) \frac{S^*}{S_0} + (1 - f^s) A_0^s (1 + i)
\]
\( A_i^s = A_0^s \left( f^s \left( 1 + r^* \right) \frac{\tilde{S}_1}{S_0} + (1 - f^s)(1 + i) \right) \)  

Using (4.12) we can solve for the growth rate of nominal income \( \left( a^N \right) \) between periods 0 and 1 as follows:

\[
a^N = \frac{A_1^s}{A_0^s} - 1 = f^s \left( r^* \right) \frac{\tilde{S}_1}{S_0} + (1 - f^s)(i)
\]

(4.13)

(4.8) and (4.13) allows us to represent real asset income in period 1 in terms of its growth-rate over its nonstochastic counterpart in period 0.

Specifically,

\[
\frac{A_1^s}{P_1} = \frac{A_0^s}{P_0} (1 + a)
\]

(4.14)

where 'a' is defined to be the one period real growth rate of asset income.

(4.14) can be rewritten as:

\[
(1 + a) = \frac{A_1^s}{P_1} \frac{P_1}{A_0^s} \frac{A_0^s}{P_0}
\]

(4.15)

In turn, this can be rewritten as

\[
(1 + a) = \frac{1 + a^N}{(1 + p)}
\]

(4.16)
where $a^N$ is defined as in (4.13), and $p$ is defined as in (4.8)

Taking logs:

$$\ln(1 + a) = \ln(1 + a^N) - \ln(1 + p) \quad (4.17)$$

Combining (4.8), (4.13), (4.14) and using the approximation $\ln(1 + x) \approx x$ for small $x$, we can rewrite period 1 real asset income as:

$$\frac{A^S_1}{P_1} \approx \frac{A^S_0}{P_0} \left( 1 + f^S (r^* + \tilde{s}) + (1 - f^S)i - \alpha \tilde{s} - (1 - \alpha) \tilde{P}^N \right) \quad (4.18)$$

Substituting (4.8) into (4.10) we can rewrite period-1 household consumption as:

$$C^S_1 \approx \frac{A^S_0}{P_0} \left( 1 + f^S (r^* + \tilde{s}) + (1 - f^S)i - \alpha \tilde{s} - (1 - \alpha) \tilde{P}^N \right) \quad (4.19)$$

Non-tradable prices are endogenously determined so as to clear the market for nontradables in period 1. Since the output of nontradables in period 1 is predetermined, nontradable prices depend on the total expenditure devoted to nontradables in each state of nature in period 1. In our economy all agents demand money for transaction purposes. Thus, in equilibrium, total expenditure is equal to the total money supply in the economy (assuming a constant velocity, which is set equal to 1 without loss of generality). Since all agents consume a Cobb-Douglas aggregate of tradable and nontradable goods, they spend a constant fraction $(1 - \alpha)$ of their total expenditure on nontradable goods. Thus, the equilibrium price of non-tradables depends on the money-supply in each state of nature. Since states of nature are defined by realizations of the nominal exchange rate, what matters for the real-exchange rate, is the extent to which nominal exchange rate changes are accommodated by changes in the money supply by monetary authorities. This degree of monetary accommodation of nominal exchange rate changes is an important parameter of the model. Assume that a one percent change in the nominal exchange is
accommodated by $\lambda$ percent change in the nominal money supply. The rate of growth of non-tradable prices $\left(\tilde{p}^N\right)$ can therefore be represented as $\lambda \tilde{s}$.

Substituting this into (4.19), we can rewrite period-1 household consumption as:

$$C_1^S \approx \frac{A_0^S}{P_0} \left(1 + f^S (r^* + \tilde{s}) + (1 - f^S)i - \alpha \tilde{s} - (1 - \alpha)\lambda \tilde{s}\right)$$

which can be re-organized as:

$$C_1^S \approx \frac{A_0^S}{P_0} \left(1 + f^S (r^* + \tilde{s}) + (1 - f^S)i - (\alpha + (1 - \alpha)\lambda) \tilde{s}\right) \quad (4.20)$$

As is typically the case, we assume that the exchange rate in period 1, $\tilde{S}_1$, is log-normally distributed. If we normalize $S_0$ to be 1, then we can rewrite $\tilde{S}_1 = (1 + \tilde{s})$. Since, $\tilde{S}_1$ is log-normally distributed, $\ln(\tilde{S}_1) \equiv s$ is normally distributed. Since $C_1^S$ is linear in $s$, and given our assumption of CARA utility, we can rewrite the household objective as follows:

$$\frac{\text{Max}}{f^S} \frac{E(C_1) - \frac{\gamma}{2}Var(C_1)}{}$$

where:

$$E(C_1) = \frac{A_0^S}{P_0} \left(1 + f^S (r^* + E(\tilde{s})) + (1 - f^S)i - (\alpha + (1 - \alpha)\lambda)E(\tilde{s})\right) \quad (4.22)$$

and

$$Var(C_1) = \left(\frac{A_0^S}{P_0} \left(f^S - (\alpha + (1 - \alpha)\lambda)\right)\right)^2 Var(\tilde{s}) \quad (4.23)$$
The first-order condition with respect to the share of foreign-currency assets in the household’s financial portfolio is:

\[ FOC: \ f^s \]

\[ f^s = (\alpha + (1 - \alpha)\lambda) + \frac{(r^* + E(\tilde{s}) - i)}{\gamma A_0^s / P_0 Var(\tilde{s})} \] (4.24)

The first term in the equation represents a risk-averse household’s demand for foreign-currency assets to help minimize the variability of asset income (and thus consumption) in period 1. Specifically, it represents the fraction of the household’s consumption basket that is subject to inflation (deflation) in the event of a currency depreciation (appreciation). Recall that the fraction of expenditure spent on tradable goods -- whose price changes 1-for-1 with exchange-rate movements -- is \( \alpha \). The remaining fraction is spent on non-tradable goods whose price changes by \( \lambda \) percent for a one percent change in the nominal exchange rate. In sum, the fraction of the household expenditure that changes 1-for-1 with nominal exchange rate movements is \( (\alpha + (1 - \alpha)\lambda) \). The household is therefore able to completely hedge away all exchange-rate induced price risk by saving \( (\alpha + (1 - \alpha)\lambda) \) fraction of its financial portfolio in foreign-currency-denominated assets. This represents the variance-minimizing demand for foreign-currency assets by the household.

In contrast to this variance-minimizing demand, the second term represents the household’s speculative demand for foreign-currency assets. If the second term is positive (i.e. the expected return from holding foreign-currency assets \( r^* + E(s) \) exceeds that of holding domestic-currency assets \( i \)) there exists an “excess return” in holding foreign-currency denominated assets. To take advantage of this, the household skews its portfolio to hold a greater fraction of foreign-currency assets in its portfolio than is dictated by the variance-minimizing demand. This exposes the household to currency risk -- as reflected by the variance of the exchange rate and the coefficient of risk aversion in the denominator of the second-term.
The fraction of the household’s portfolio not held in foreign-currency assets is held in domestic-currency assets. Since households are net-savers, their domestic-currency saving constitutes the supply curve of funds in the domestic-currency capital market, and this has important implications for the equilibrium domestic-currency interest rate. Specifically, the household’s supply of domestic currency funds is:

\[(1 - f^S)A^S = (1 - (\alpha + (1 - \alpha)\lambda))A^S + \frac{P_0(i - r^* - E(\tilde{s}))}{\gamma Var(\tilde{s})} \]  

(4.25)

The demand for domestic-currency assets by households (i.e. the supply of funds in the domestic-currency capital market) is just the flip side of the demand for foreign-currency assets. As the first term indicates, the greater the passthrough of exchange rate movements onto domestic prices, the lower is the fraction of total household saving held in domestic currency. As a means to minimize risk, households are therefore willing to hold only a (possibly small) fraction of their total financial saving in domestic currency in the absence of a risk-premium. To hold a larger fraction involves price and consumption risk, and to be compensated for this risk, households need to be induced by a risk premium (an excess return) in the domestic interest rate -- as reflected by the second term. Importantly, the greater is the uncertainty of the exchange rate -- as proxied by the variance term in the denominator of the second term -- the larger is the excess return that households must be induced with to hold a given fraction of their portfolio in domestic currency.

In assuming that household saving constitutes the only sources of domestic-currency funds, we have implicitly assumed that foreigners do not take on any currency risk by lending or supplying funds in domestic-currency. Though this is an extreme assumption in the model, it is meant to reflect the incompleteness in financial markets that seems to characterize international lending, and which Hausmann and Eichengreen (1999) refer to as the “original sin”. Specifically, the authors note that essentially all non-OECD countries have virtually no external debt denominated in their own currency. As the authors note, the reluctance of foreigners to take on the currency risk implicit in supplying funds in the borrower’s currency arises ostensibly because of the fear
harbored by foreign lenders about the borrower’s ability to erode the real value of her external
debt by manipulating her currency. More generally, it reflects the risks perceived by foreigners
of being exposed to volatile emerging market currencies, and the asymmetrical demand for
international monies that comes about as a result (McKinnon, 2001). To capture this stylized
fact, we assume that foreigners do not lend at all in the domestic currency in our model. Thus
households constitute the only source of domestic-currency funds. We can modify this extreme
assumption to reflect limited lending in domestic currency by foreigners -- but it does not change
the qualitative results of the model.

Next, we turn to the optimization problem faced by entrepreneurs in the non-tradable and
tradable sector.

5.3 Firm Optimization

Entrepreneurs (interchangeably referred to as firms) in both the tradable and nontradable sectors
are endowed with production technologies to produce tradable and nontradable goods,
respectively. Production takes 1 period to mature. To exploit these production technologies,
entrepreneurs therefore need to hire factors of production in period 0 – before the resolution of
uncertainty – to produce output for period 1.

The factors of production are capital and labor. We assume that labor is sector-specific and
provided by the representative entrepreneur herself. Furthermore, this labor endowment is
normalized to 1, without any loss of generality. Abstracting from issues of labor provision allows
us to focus exclusively on the entrepreneurs’ financial investment -- and the associated portfolio
decision -- which is at the heart of our inquiry.

In addition to investing their own endowments, entrepreneurs need to borrow financial capital to
undertake their desired physical capital investment. Their decision set, therefore, involves
choosing both the quantum of financial investment, and more interestingly, the currency
composition of their debt, i.e. deciding whether to denominate their debt in domestic currency or,
unhedged, in foreign currency.
In period 1, firms sell output, repay their loans, and firm owners consume their profits. They consume the same aggregate consumption good that households do. Just like households, they are risk-averse, and have a utility function over the aggregate good that is of the constant absolute risk aversion form.

5.3.1 Non-Tradable Sector Entrepreneurs

Entrepreneurs in the non-tradable sector receive a monetary endowment equivalent to $C_0^N$ units of the consumption good in period 0. Given prices in period 0, we can decompose the endowment into:

$$C_0^N = \frac{(P_0^N N_0)}{P_0}$$  \hspace{1cm} (4.26)

where $N_0$ is the endowment expressed in units of the non-tradable good

$P_0^N$ is price of nontradables in period 0

$P_0$ is the consumption-based price level

Real profits in period 1 -- denominated in units of the consumption good -- can be represented as:

$$C_1^N = \frac{\Pi_1^N}{P_1} = \left[ P_1^N f\left(\left( N_0 + \frac{B_0^N}{P_0^N} \right), L^N \right) - f^N B^N (1 + r^*) (\tilde{S}_1 / S_0) - (1 - f^N) B^N (1 + \delta) \right] \left( \tilde{S}_1 \right) ^\alpha (\tilde{P}_1^N) ^{1-\alpha}$$  \hspace{1cm} (4.27)

where $\Pi_1^N$ represents the firm’s nominal profits in period 1 and $P_1$ is the consumption based-price level. We explain each of the terms of this expression, in turn.
The first term in the numerator is the gross nominal revenue of the nontradable firm measured in domestic currency: the price of the non-tradable good in period 1, \( P_t^N \), multiplied the output of non-tradables\(^{18}\): 

\[
f((N_0 + \frac{B^N}{P^N_0}),1) = (N_0 + \frac{B^N}{P^N_0})^{\alpha^N} \cdot (1)^{\beta^N}; \quad \alpha^N + \beta^N < 1
\]

We assume -- without any loss of generality -- that the capital that needs to be invested is denominated in terms of the non-tradable good. Total investment (= total capital) is equal to the sum of the firm’s endowment and total borrowing. The total financial capital that the firm borrows is \( B^N \). Total real investment -- denominated in non-tradables -- can therefore be expressed as:

\[
I^N = N_0 + \frac{B^N}{P^N_0}
\]

The last two terms in (4.27) correspond to gross repayment (measured in domestic currency) of foreign-currency denominated \( f^N B^N \) and domestic-currency denominated \( (1 - f^N)B^N \) debt.

Just as we did in the case of the household optimization, we can express real income for the representative nontradable firm in period 1 \( (C_1^N) \) as a growth rate over its real endowment in period 0 \( (C_0^N) \). Specifically,

\[
C_1^N = C_0^N (1 + \epsilon^N)
\]

\(^{18}\) Recall, labor is sector-specific, provided by the entrepreneur herself and normalized to 1.

\(^{19}\) This can be easily rationalized by assuming the presence of a fixed input -- say land -- in the production process.
where $c^N$ is defined to be the one-period growth rate of real income.

Combing (4.26) and (4.28), we can solve for $c^N$ as follows:

\[
(1 + c^N) = \frac{C_1^N}{C_0^N} = \frac{\left(\frac{P_1^N N_1}{P_0^N N_0}\right)}{P_0}
\]

\[
(1 + c^N) = \frac{(1 + p^N)(1 + n)}{(1 + p)}
\]

where $(1 + n)$ is defines to be the real one-period growth rate of income denominated in non-tradables; $(1 + p^N)$ is the non-tradable price inflation, and $(1 + p)$ is the consumption-based price inflation.

Take logs, and approximating $\ln(1 + x) \cong x$ for small $x$, we can represent $c^N$ as:

\[
c^N = p^N + n - p
\]

Substituting this into 4.28 we have,

\[
C_1^N \equiv C_0^N (1 + \tilde{n} + \tilde{p}^N - \tilde{p})\quad (4.29)
\]

The growth of real income denominated in non-tradables $(1 + \tilde{n})$ can be represented as follows:
Substituting for \( p^N \) this can be expanded to:

\[
1 + \tilde{n} = \frac{f((N_0 + \frac{B^N}{P_0^N}),1) - \frac{f^N}{P_0^N} B^N (1 + r^* + \bar{s} - \bar{p}^N) - \frac{(1 - f^N)}{P_0^N} B^N (1 + i - \bar{p}^N)}{N_0}
\]  

Substituting (4.30) into (4.29), we can represent the entrepreneur’s net-worth (and thus consumption) in period 2 as:

\[
C_1^N \equiv \frac{P_0^N}{P_0} \left( f((N_0 + \frac{B^N}{P_0^N}),L^N) - \frac{f^N}{P_0^N} B^N (1 + r^* + (1 - \lambda)(\bar{s})) - \frac{(1 - f^N)}{P_0^N} B^N (1 + i - \lambda \bar{s}) \right) - \left( \frac{N_0 P_0^N}{P_0} \right) (\alpha(1 - \lambda)(\bar{s}))
\]  

(4.31)

It seems instructive to analyze how the entrepreneur’s net-worth (and consumption) varies with respect to movements in the exchange rate because this enables a better understanding of their debt-denomination decisions. As we shall see, in the event of nominal exchange rate changes, an entrepreneur’s net-worth depends upon the extent to which nominal changes translate into real changes, the extent to which total investment is financed by the entrepreneur’s own capital vis-à-vis external debt, and the fraction of debt denominated in domestic-currency vis-à-vis foreign currency.

For instance, in the event of a real depreciation (the logic is exactly reversed in the case of a real appreciation) the real return on the entrepreneur’s own invested capital decreases. This is because this capital is used to produce nontradable goods -- whose relative price falls in the wake of a real depreciation. Since entrepreneurs consume a composite of tradable and nontradable goods, this translates to a negative real income shock in the wake of an unexpected currency depreciation. This effect is reflected in the last term of (4.31). The larger the share of
entrepreneur capital in investment, the larger the fraction of tradables in consumption, and the larger the real depreciation for a given nominal depreciation (i.e. the lower is $\lambda$), the larger is the adverse shock to consumption in the wake of a nominal depreciation. Notice that if nominal depreciations did not translate into real depreciations ($\lambda = 1$), this effect disappears.

On the other hand, to the extent that the entrepreneur has issued any fixed-interest rate domestic currency debt, net-worth rises. To see this, note that if the price of the nontradable good rises ($\lambda > 0$) in the wake of a currency depreciation (because of some degree of monetary accommodation of nominal exchange rate changes by the central bank), the real value of any outstanding fixed-interest-rate domestic-currency debt issued by the entrepreneur falls. This increases the real value of entrepreneurial net worth (as reflected by the last term in the parenthesis of 4.31). In contrast, the real value of foreign-currency denominated debt increases in the wake of a real depreciation -- since non-tradable prices do not rise as fast as loan obligations -- tending to lower net worth. This is reflected in the middle term of the parenthesis of (4.31).

Thus, the risks posed by domestic-currency and foreign-currency debt are negatively correlated, and so risk averse entrepreneurs are able to use each kind of debt to offset the risk posed by the other and also offset other non-hedgable risks on their portfolio. All this is formalized in the optimization problem of the nontradable entrepreneur.

Given our assumptions about the normality of $\tilde{s}$, and CARA utility, we can rewrite the entrepreneur’s objective as:

$$\max_{f^N} \frac{E(C_1^N) - \frac{\gamma}{2} \text{Var}(C_1^N)}{f^N}$$

where

$$E(C_1^N) = \frac{P_0}{P_0^N} \left( f((N_0 + \frac{B^N}{P_0^N}), L^N) - \frac{f^N B^N (1 + r^* + (1 - \lambda)E(\tilde{s}))}{P_0^N} - \frac{(1 - f^N) \bar{B}^N (1 + i - \lambda E(\tilde{s}))}{P_0^N} \right)$$

$$- \left( \frac{N_0 P_0^N}{P_0} \right) (\alpha (1 - \lambda) E(\tilde{s}))$$
In the baseline model, we assume that the representative nontradable firm is credit-constrained in that the total borrowing that the firm can undertake \( (B^N) \) is fixed by lenders as some fraction of the firm’s initial net worth. We make this assumption for two reasons: (i) there is increasing evidence in both industrial countries (see Hubbard (1998)) and emerging markets that, in the wake of various agency and contract-enforceability problems, firms are constrained to borrow only a fraction of their contemporaneous cash-flow or net worth\(^{20}\); (ii) without changing the qualitative results of the model, this assumption allows us to generate closed form analytical solutions for the main variables of interest in the model;

Denote this constrained level of borrowing to be \( B^N \). Therefore the only choice variable for the firm is the fraction of total debt to denominate in foreign currency \( (f^N) \).

The first order condition for \( f^N \) (demand for foreign-currency debt) is:

\[
Var(C^N_t) = \left( \frac{1}{F_0} \left( \lambda (1 - f) B^N - (1 - \lambda) f B^N - (N_0 P_0^N) \alpha (1 - \lambda) \right) \right)^2 Var(\tilde{s})
\]

\[
0 = \frac{(i - r^* - E(\tilde{s})) P_0}{\gamma Var(\tilde{s}) B^N} + \left\{ \lambda - \frac{P_0^N N_0}{B^N} \alpha (1 - \lambda) \right\}
\]

(4.32)

Just as in the case of households, we can conceptually distinguish a firm’s demand for foreign-currency borrowing into a “variance-minimizing” component and a “speculative” component. The variance-minimizing motive is captured by the second component of (4.32). This is the fraction of debt denominated in foreign-currency so as completely insulate the firm’s net-worth from unanticipated currency movements. As we described in the previous section, in the event of a real depreciation \( (\lambda < 1) \), a firm suffers an adverse shock to its net-worth to the extent that its investment is financed by its own capital. This is because this capital is used to produce non-

\(^{20}\) As a result this is gaining increasing credence in the theoretical literature: see, inter alia, Schneider and Tornell (2000), Aghion et al. (1999)
tradable goods -- whose relative price falls in the event of a real depreciation. Since the firm-owner consumes an aggregate of a tradable and nontradable good, this is akin to a negative “terms of trade” shock.

Conversely, to the extent that a firm has issued domestic currency debt (which we assume to be fixed-interest rate), it benefits in the event of a devaluation-induced increase in its output price \((\lambda > 0)\). When the latter effects swamp the former \(\lambda > \frac{P_0^N}{B^N} N_\alpha \alpha(1 - \lambda)\), the firm’s net-worth increases in the event of a depreciation (and falls in the event of an appreciation). To hedge this uncertainty, the firm finds it optimal to undertake some foreign-currency debt (whose cost increases in the event of a real depreciation and falls in the event of an appreciation). This ensures that the firm’s portfolio is completely hedged against currency movements. It is important to note that if \(\lambda < \frac{P_0^N}{B^N} N_\alpha \alpha(1 - \lambda)\) the firm has a negative demand for foreign-currency liabilities, i.e. it finds it optimal to borrow in foreign-currency liabilities and on lend in the domestic-currency market. The logic is similar: in this scenario a real devaluation always reduces the net-worth of firms (even in the absence of any foreign-currency debt). To counteract this, the firm finds it optimal to go long in foreign-currency assets, so that it gains on this part of its portfolio in the event of a real depreciation. In sum, the larger the price-increase of non-tradables in the event of a devaluation, the larger is the ratio of debt to internal-capital, the larger the fraction of expenditure on tradable goods, the larger is the variance-minimizing demand for foreign-currency liabilities.

Apart from this variance-minimizing demand, the firm also has a speculative demand for foreign-currency liabilities to take advantage of expected-cost differentials. As the first term (4.32) illustrates, if there exists an excess return (a risk-premium) in the domestic-currency interest rate (i.e. if the first term in 4.32 is positive) the firm finds it optimal to skew its debt-denomination away from domestic-currency debt, and towards foreign-currency debt -- to avoid paying the excess return on the former.
It is important to emphasize the different implications that arise from the variance-minimizing demand vis-à-vis the speculative demand for foreign-currency debt. As we pointed out the variance-minimizing demand completely insulates the firm from currency risk. In contrast, the existence of a risk-premium induces the firm to skew its debt-denomination away from its minimum-variance portfolio, and towards more foreign-currency debt. In turn, this exposes the entrepreneur’s net-worth to unanticipated currency movements. From the standpoint of assessing firm vulnerability, it is therefore crucial to distinguish between these motives.

The demand for domestic-currency liabilities (represented in (4.33) is just the flip-side of (4.32) and similarly depends on the risk-premium and the parameters that affect the variance-minimizing demand. It is important to observe that the variance-minimizing demand does not depend only on the total-borrowing needs of the firm (and in fact could exceed the total borrowing requirement of the firm). As we shall see in the next section, the total-demand for domestic-currency liabilities has an important bearing on the equilibrium risk-premium. To the extent that this demand depends on factors in addition to the total investment in this sector, we are able to show how, for any given investment (or more generally, current account balance), the equilibrium premium depends on other parameters of the economy.

\[
(1 - f^N)B^N \equiv D^N = \frac{(r^* + E(\delta) - i)P_0}{\gamma \text{Var}(\delta)} + \{p^N_0 N_0 \alpha (1 - \lambda) + (1 - \lambda)B^N \} \tag{4.33}
\]

5.3.2 The Tradable Sector

The portfolio optimization of tradable sector entrepreneurs is very similar to that of non-tradable entrepreneurs. We thus trace through just the main steps of the derivation:

Period-1 net-worth (and thus consumption) for an entrepreneur in the tradable sector, \( C^T_i \), is
\[
C_1^T = \frac{S_1 \left[ f((T_0 + \frac{B^T}{S_0}), L^T) - f^T B^T (1 + r^*)(\tilde{S}_1 / S_0) - (1 - f^T) B^T (1 + i) \right]}{(\tilde{S}_1)^{\alpha} (\tilde{P}_1^N)^{1-\alpha}} 
\]

(4.34)

where \( (T_0) \) is the period-0 endowment of the tradable sector endowment denominated in tradables; \( (B_0^T) \) is the quantity of nominal borrowing, and all other variables are as defined above. Total real investment (denominated in tradables) by the tradable entrepreneur is therefore:

\[
(T_0 + \frac{B^T}{S_0})
\]

As in the case of the nontradable sector, firms have access to a technology with decreasing returns to scale. Specifically\(^ {21} \):

\[
f((T_0 + \frac{B^T}{S_0}), L^T) = (T_0 + \frac{B^T}{S_0})^{\alpha^T}(1)^{\beta^T};\quad \alpha^T + \beta^T < 1
\]

Just as with the nontradable sector, the objective function of entrepreneurs can be represented as:

\[
\text{Max} \quad E(C_1^T) - \frac{\gamma}{2} \text{Var}(C_1^T)
\]

where

\[
E(C_1^T) \cong C_0^T \left( \frac{f((T_0 + \frac{B^T}{S_0}), L^T) - f^T B^T (1 + r^*)}{S_0^T - S_0} \right)
\]

\[+ \frac{(1 - f^T) B^T (1 + i - E(\tilde{s}))}{S_0} + C_0^T ((1 - \alpha)(1 - \lambda)E(\tilde{s})) \]

\[21 \text{ Recall, labor is sector-specific, provided by the entrepreneur herself and normalized to 1.} \]
\[ Var(C^T_0) = \left( \frac{1}{P_0} (1 - f) B^T + W_0^T (1 - \alpha)(1 - \lambda)) \right)^2 Var(\tilde{s}) \]

Here \((C^T_0)\) is the tradable sector endowment denominated in units of the aggregate consumption good.

The FOCs governing the demand for the fraction of liabilities denominated in foreign-currency is:

\[ f^T = \frac{(i - \arrow{r} - E(\tilde{s})) P_0}{\gamma Var(\tilde{s}) B^T} + \{1 + \frac{S_0 T_0 (1 - \alpha)(1 - \lambda)}{B^T}\} \]  \hspace{1cm} (4.35)

Just as in the case of non-tradable entrepreneurs, the demand for foreign-currency liabilities by entrepreneurs in the tradable sector can be decomposed into a speculative and variance-minimizing component. An important result captured in the second-term of (4.35) is that the variance-minimizing demand for foreign-currency liabilities exceeds the total borrowing requirement of firms in the tradable sector. Thus, not only is all debt denominated, unhedged, in foreign-currency, but also the firm finds it optimal to borrow additionally in foreign-currency and on-lend in the domestic-currency. The intuition for this is as follows. When nominal exchange rate movements translate into real changes \((\lambda < 1)\), an entrepreneur gains in the event of a nominal devaluation and loses in the event of an appreciation. To see this, note that since the entrepreneur produces tradable good but consumes a composite of tradable and nontradable goods in the event of a real depreciation (relative price of tradable good increase) the net-worth of an entrepreneur increases. The opposite is the case of an exchange rate appreciation.

To hedge this uncertainty of its net-worth, the entrepreneur borrows an appropriate amount in foreign-currency and on lends this in domestic-currency. On this part of its portfolio, it loses in the event of an unanticipated depreciation and gains in the event of an unanticipated appreciation -- thus hedging against movements in the opposite direction in the other components of its portfolio. Notice that borrowing in excess of total investment needs only occurs to hedge against
real-exchange rate shocks. If nominal exchange rate movements do not translate into real exchange rate movements \( \lambda = 1 \) observe that the second term of (4.35) is equal to 1 -- signifying that the total foreign-currency borrowing is equal to total investment, and there is no on-lending in the domestic-currency market.

In addition to this variance-minimizing demand, the entrepreneur also has a speculative demand -- motivated by possible excess returns in the domestic currency interest rate. The higher the premium the greater the borrowing in foreign-currency and on-lending in domestic-currency.

The total demand for domestic-currency liabilities is represented in (4.36)

\[
(1 - f^T)B^T \equiv D^T = \left( \frac{r^* + E(\tilde{s}) - i}{\gamma Var(\tilde{s})} \right) P_0 - S_0 T_0 (1 - \alpha)(1 - \lambda) \tag{4.36}
\]

The second term of (4.36) -- which captures the variance-minimizing demand -- is negative, indicating that tradable firms are net-suppliers of domestic-currency assets. Also, the higher the risk-premium on the domestic-currency asset, i.e. the more negative is the first term of (4.36), the higher the supply of domestic-currency assets by tradable firms.

5.4 Equilibrium

Having generated the supply and demand functions for domestic-currency assets and liabilities from the portfolio decisions of households, non-tradable and tradable sector firms, we are now ready to solve for the equilibrium domestic-currency interest rate, implicit within which is the key endogenous variable of the model: the currency risk premium.

The equilibrium domestic interest rate is that which equilibrates the domestic-currency capital market. Equilibrium in the domestic-currency capital market, in turn, is characterized by a zero net supply of domestic-currency funds. The equilibrium risk premium can be computed as the
deviation of the equilibrium interest rate from the sum of the foreign-currency interest rate and the expected change in the currency.

As the portfolio-choice optimizations of the different classes of agents revealed, households and tradable sector firms are net suppliers of domestic-currency assets, while nontradable firms are net demanders of domestic-currency liabilities. Both households and tradable sector firms supply domestic-currency funds for variance-minimizing purposes. In addition, they also have a speculative motive to supply domestic-currency funds, if there exists a risk premium in the domestic-currency assets. Higher the risk-premium leads to greater supply. Non-tradable firms make up the other side of the market. They have a positive net-demand for domestic-currency liabilities. However, this demand is reduced in the presence of a risk-premium; the higher the premium the lower the demand for domestic-currency liabilities, and the greater the proclivity towards borrowing in foreign-currency.

Equilibrium in the domestic-currency market can be formally characterized by equating the supply of domestic currency assets by households and tradable sector firms (4.25, 4.36) with the demand for domestic-currency liabilities (4.33) by nontradable firms:

\[
(1 - (\alpha + (1 - \alpha)\lambda))A_s^g + \frac{2(i - r^* - E(\bar{s}))P_0}{\gamma Var(\bar{s})} + S_0 T_0(1 - \alpha)(1 - \lambda)
\]

\[
\frac{(r^* + E(\bar{s}) - i)P_0}{\gamma Var(\bar{s})} + \{P_0^\gamma N_0 \alpha(1 - \lambda) + (1 - \lambda)B^\gamma\} 
\]

(4.37)

(4.37) can be solved directly for the currency risk-premium \((i - r^* - E(\bar{s}))\). Specifically:

\[
\rho \equiv i - r^* - E(\bar{s}) = \frac{\gamma Var(\bar{s})}{3P_0^\gamma} \left( (1 - \lambda)B^\gamma + P_0^\gamma N_0 \alpha(1 - \lambda) - S_0 T_0(1 - \alpha)(1 - \lambda) - (1 - (\alpha + (1 - \alpha)\lambda))A_s^g \right)
\]

(4.38)
The risk-premium is therefore a function of several parameters of the economy: the current account-deficit\textsuperscript{22}, the volatility of the exchange rate, the net-worth of the non-tradable sector relative to the tradable sector, the extent to which nominal depreciations translate into real depreciations, and the fraction of expenditure devoted to tradable goods.

Specifically, a positive risk-premium arises when there is an excess demand for domestic currency funds at the uncovered-interest parity rate. Formally, a necessary and sufficient condition for a positive risk-premium is:

\[
(1 - \lambda)B^N + P_0^N N_0\alpha(1 - \lambda) > S_0T_0(1 - \alpha)(1 - \lambda) + (1 - (\alpha + (1 - \alpha)\lambda))A_0^S
\]  

(4.39)

Thus, the greater the borrowing requirement of the nontradable sector relative to household savings (proxying the current account deficit of the economy (see footnote 16)), the greater the net-worth of the non-tradable sector relative to that of the tradable sector, and the greater the fraction of expenditure devoted to tradable goods, the greater the likelihood of a positive risk premium in equilibrium.

Formally, we can derive comparative statics as follows:

\[
\frac{\partial \rho}{\partial B^N} = \frac{\gamma \text{Var}(\bar{s})}{3P_0}(1 - \lambda) 
\]  

(4.40)

\[
\frac{\partial \rho}{\partial A_0^S} = -\frac{\gamma \text{Var}(\bar{s})}{3P_0}(1 - (\alpha + (1 - \alpha)\lambda)) 
\]  

(4.41)

(4.40) and (4.41) demonstrate that a marginal increase in the borrowing requirements of the nontradable sector increases the equilibrium risk premium, while a marginal increase in

\textsuperscript{22} Technically, it depends only on the excess of investment in the nontradable sector over household saving. Thus, if the current account deficit changes because of a change in total saving in the economy, or total investment in the nontradable sector, the equilibrium risk premium is affected. The only case in which changes in the current account balance do not impact the equilibrium premium, is when these changes are brought out solely by changes to investment in the tradable sector.
household saving reduces it. Both of these effects are larger, the greater is the volatility of the exchange rate. Since \((1 - \lambda) > (1 - (\alpha + (1 - \alpha)\lambda))\) \(\forall \lambda < 1\), we can combine (4.40) and (4.41) to conclude that an increase in non-tradable relative to household saving (proxying for an increase in the economy’s current account deficit) increases the equilibrium risk premium.

\[
\frac{\partial \rho}{\partial \left( P_0^N N_0 \right)} = \frac{\gamma \text{Var}(\tilde{s})}{3P_0} (\alpha(1 - \lambda)) \tag{4.42}
\]

\[
\frac{\partial \rho}{\partial \left( S_0 T_0 \right)} = -\frac{\gamma \text{Var}(\tilde{s})}{3P_0} ((1 - \alpha)(1 - \lambda)) \tag{4.43}
\]

(4.42) and (4.43) illustrate that an increase in the net-worth of the nontradable sector increases the premium, while an increase in the net-worth of the tradable sector reduces the premium. Again, the magnitude of this effect increases, the greater is the volatility of the exchange rate. If \((\alpha) > \frac{1}{2}\) an increase in the non-tradable sector relative to the tradable sector always increases the premium, while if \((\alpha) < \frac{1}{2}\) the relative increase in the nontradable sector needs to large enough to increase the premium.

\[
\frac{\partial \rho}{\partial \alpha} = \frac{\gamma \text{Var}(s)}{3P_0} (1 - \lambda) \left( P_0^N N_0 + S_0 T_0 + A_0^S \right) \tag{4.44}
\]

(4.44) demonstrates that an increase in the share of expenditure devoted to tradables increases the premium.

\[
\frac{\partial \rho}{\partial \text{Var}(s)} = \frac{\gamma}{3P_0} \left( (1 - \lambda)B^N + P_0^N N_0 \alpha(1 - \lambda) - S_0 T_0 (1 - \alpha)(1 - \lambda) - (1 - (\alpha + (1 - \alpha)\lambda)) A_0^S \right) \tag{4.45}
\]

\(23\) We assume from here on that 4.39 holds, thus each of these results an increase in the premium, whereas technically it could just reduces the discount.
Finally (4.45) demonstrates that if the conditions for a positive premium are met (i.e. (4.39) holds) an increase in the volatility of the exchange rate increases the equilibrium premium.

Notice, that the model we have developed is purely a flow-model, with no debt-overhang. However, if firms in the economy already had a stock of existing foreign-currency debt, this would increase the equilibrium risk premium. This is because the variance-minimizing demand of firms for domestic-currency liabilities would increase (since firms would desire to use these liabilities to hedge against the currency risk inherent in the existing stock of foreign-currency debt). Ceteris paribus, this would increase the demand for domestic-currency liabilities by the nontradable sector, and reduce the net-supply of domestic-currency assets by the tradable sector. Both these effects would result in a greater excess demand of domestic-currency assets at the uncovered interest parity rate, resulting in a higher currency risk premium in equilibrium.

Finally, we substitute the equilibrium (4.38) into the demand for foreign-currency debt by the non-tradable sector (4.32) so as to represent the latter as a function of the parameters of the model:

\[
F = \left( B^N \left( \lambda + \frac{(1 - \lambda)}{3} \right) - \frac{2}{3} P_0^N N_0 \alpha (1 - \lambda) - \frac{1}{3} S_0 T_0 (1 - \alpha)(1 - \lambda) - \frac{1}{3} (1 - (\alpha + (1 - \alpha) \lambda)) A_0^s \right)
\]

Notice that the quantity of foreign-currency liabilities is not a function of the volatility of the exchange rate -- which contradicts the casual presumption that increasing exchange rate uncertainty reduces the incentive for firms to take on foreign-currency debt by making foreign-currency debt appear to be more risky\(^{24}\). To understand why currency uncertainty does not affect the equilibrium demand for foreign-currency debt, note that there are two channels through which currency uncertainty affects this demand. The direct effect is captured in the denominator of the first term of (4.32). It is undoubtedly the case that for a given risk premium increased currency uncertainty reduces the desire of firms to take on foreign-currency debt. However, the risk premium is not a given! As (4.38) demonstrates increased currency uncertainty also

\(^{24}\) In a similar vein, McKinnon and Pill (1999) point out how floating exchange rates may well increase the super risk premium and with it the margin of temptation for banks to borrow unhedged, in foreign currency relative to a “good fix” exchange rate regime.
increases the equilibrium risk premium, which in turn, increases the incentive to take on foreign-currency debt -- as demonstrated by the numerator of the first term of (4.32). In our setup, these opposing effects exactly offset each other, so that currency uncertainty plays no role in determining the incentive to take on foreign-currency debt. Our analysis therefore demonstrates that the conventional wisdom on the impact of increase exchange rate volatility on foreign-currency debt is partial-equilibrium in nature, and ignores the general equilibrium effect of currency uncertainty on the equilibrium risk premium.

6 Conclusion

This paper develops an analytical framework to jointly rationalize two important unresolved puzzles in international economics: the generation of currency risk premia in the interest rates of many emerging markets, and the desire of firms in these environments to expose themselves to currency risk by denominating their debt, unhedged, in foreign-currency. In contrast to the extant theoretical literature, we focus on the asymmetry of national monies to demonstrate how foreign-currency assets can often serve as consumption hedges to households in emerging markets, who then demand a risk-premium to hold domestic-currency-denominated assets. The portfolio diversification decisions of firms, in turn, reveals that risk-averse firms in emerging economies are also inclined to undertake foreign-currency liabilities for variance-minimizing purposes and, in the presence of a risk premium, for speculative purposes. Differentiating between these opposing motives is crucial from the standpoint of assessing firm vulnerability to unanticipated currency movements. We are thus able to show that, contrary to conventional wisdom, unhedged, foreign-currency debt can arise even in the absence of any bailout guarantees and the associated moral hazard. Finally, combining the different portfolio demands, we can solve for the equilibrium premium in terms of the economy’s parameters, including the current account deficit, relative net-worth of the nontradable and tradable sectors, volatility of the exchange rate and the extent to which nominal depreciations translate into real depreciations. Our analysis reveals that -- contrary to conventional wisdom -- increased exchange rate uncertainty may not necessarily reduce the desire of firms to take on risky, foreign-currency debt.
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