Discretionary Monetary Policy and Financial-Sector Fragility in Normal and Crisis Periods

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Abstract: How does the fragility of the banking system affect average macroeconomic performance? This paper studies optimal discretionary policy in a small, open economy with dollarized liabilities where financial-sector fragility is socially costly and foreign investors are risk-averse. Expected future depreciation matters because it affects the *ex ante* real interest rate. The analytical framework builds upon recent empirical work on conditional risk premia for resolving the forward discount puzzle in currency markets (Flood and Rose (1996,2001), Bansal (1997), Bansal and Dahlquist (2000)). It is shown that lack of precommitment is neither a necessary nor a sufficient condition for depreciation bias to arise. Average depreciation depends on the size of the forward risk premium, which is state-dependent on asset market volatility. For plausible parameter values, financial-sector fragility may induce deflationary bias in normal periods but not during crises. The results reinforce the balance-sheet view that financial considerations are an important determinant of developing countries’ macroeconomic performance.

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1 Introduction

How does financial-sector fragility affect discretionary macroeconomic policy outcomes? Partly in response to recent financial crises in many developing economies, "third-generation" models have focused on illiquidity in the banking system and adverse spillovers from the financial sector to currency markets and vice versa. International illiquidity may be traced to financial liberalisation, shorter foreign debt structure and the currency mismatch of assets and liabilities.\(^1\) Liquidity problems are amplified by strong systemic bias towards bank-intermediated debt finance leading to massive short-term reversals of capital flows—Calvo’s (1998, 2000) sudden stops—and eventual exchange rate collapse, thus creating "twin crises" (Kaminsky and Reinhart (1999), Fischer (2001)). The fact that banking crises are contractionary and the resulting recessions are more protracted than for currency crises has long been recognized as a motive for central banks to smooth interest rates (Cukierman (1992), Mankiw, Miron and Weil (1987)). However, as recently argued by Calvo and Reinhart (2002), open economies across income groups and exchange rate regimes are characterized by fear of floating: interest rate variability is high relative to exchange rate variability. This is particularly so for emerging markets whose short-term liabilities are dollarized.

Against this background, Svensson (2002) argues that financial stability is a distinct central bank objective which, although not placing a restriction on monetary policy in normal times, becomes binding during financial crises. Eichengreen (2002) suggests that "the longer a currency peg or fixed exchange rate is maintained, the more vulnerabilities build up in the financial system".

However, a consensus has yet to emerge on what leading indicators best explain countries’ post-crisis macroeconomic performance. On the one hand, forward-looking indicators of financial-sector fragility have attracted attention alongside traditional current and capital account measures. A prominent such indicator is the \textit{ex ante real interest rate} on deposits (Krugman (2000)). Kaminsky and Reinhart (1998) classify recent banking and currency crises and find that real rates were significantly higher in the 18 months leading to

the crisis compared to their average in normal, or tranquil, periods. Adverse impact on the corporate balance sheet is transmitted via the real interest rate. Real effects of balance sheet fluctuations are due to information asymmetries, as in Bernanke and Gertler (1989) and Bernanke et al. (1998).

On the other hand, following Eichengreen and Rose (2001), the pre-crisis state of the economy determines the response of policymakers and the economy to extreme events. In "second generation" crisis models, state-dependence involves fragile macroeconomic fundamentals (Jeanne (1997)), while third generation models stress the role of financial-sector fragility. However, the behavior of macroeconomic and financial variables appears to be no different prior to successful speculative attacks and prior to successful defences. The authors argue that failure to successfully defend a currency peg is a shock to confidence. This raises post-crisis currency risk premia and depresses consumption and investment. Indeed, Calvo and Reinhart (2002) stress that both emerging and developed financial markets are buffeted by large swings in risk premia.

This paper has three aims along these lines. The first is to integrate financial-sector fragility into discretionary monetary policy by incorporating the ex ante real interest rate into the policy maker's objectives. Two related aspects of interest are the implications for average macroeconomic performance and expected welfare compared to the "benchmark" quadratic and symmetric objective function.

Unlike second-generation models, there is no fixed cost attached to exchange rate realignment. Rather, with perfect capital mobility the present cost/benefit of expected future depreciation varies continuously with the magnitude of the currency risk premium. I assume purchasing power parity holds in the short-term, reflecting the inflation targeting regimes in place in many developing economies, and obtain the impact of actual on expected future depreciation from the intersection of short-run aggregate demand and supply.

In closed-economy models, incorporating future inflation expectations

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2 Other overlending indicators include the ratio of domestic credit to nominal GDP, deposits at commercial banks, the ratios of lending to deposit rates and M2 to foreign exchange reserves and the M2 multiplier.
into forward-looking policy rules is widely accepted in the context of model uncertainty and lags in the monetary transmission mechanism.\textsuperscript{3} In an open-economy setup, welfare may also depend on 1-period-ahead depreciation expectations formed in the previous and current period. I link this period’s expectations of future outcomes and observed interest differentials by the Fisher equation and uncovered interest parity (UIP). Expectations of future devaluation affect current social welfare to the extent that they can influence the \textit{ex ante} real rate. The latter’s sensitivity to expected future depreciation is zero only if foreign investors are risk-neutral. This is arguably unrealistic in the context of rapid capital outflows leading to financial crises and sovereign insolvency and/or default. Indeed, the impact of interest rate differentials on expected future exchange rates is frequently in the opposite direction from what UIP would predict, the \textit{forward discount puzzle} (Fama (1984)).

The second aim of the paper is, then, to assess the implications of the currency risk premium’s state-dependence for average macroeconomic performance and social welfare. The perceived benefits of expected future depreciation reflect the competitive advantage notion that, \textit{in normal times}, devaluations are frequently viewed as expansionary. However, when financial-sector fragility matters and liabilities are dollarized, a devaluation may spark a banking crisis. I argue that under these conditions the net impact on welfare depends on the currency risk premium.

The empirical motivation for the analytical framework lies in recent work showing that the forward risk premium—defined as one minus the estimated slope coefficient in UIP regressions, $1 - \hat{\delta}$—is greater in normal periods than in crisis periods. Flood and Rose (1996) find that UIP deviations are much bigger for floating than for fixed exchange rates. The fact that emerging markets are more prone to financial crises is reflected in the higher volatility of their asset markets and risk premia. Floating regimes may correspond to \textit{normal periods}, when exchange rate and interest rate variability are low, ceteris paribus, and the local currency is not under speculative pressure. In contrast, during \textit{crisis periods} there is higher risk premium variability, driven by heightened future uncertainty and lack of credibility. Moreover,

\textsuperscript{3}See Levin et al. (2003), Meyer et al. (2001), Svensson (1999, 2000) and Svensson and Woodford (2003).
the UIP violation increases when exchange rate realignments are excluded from the sample; for the case of the ERM (1979-1994), the difference in UIP slope estimates when the exchange rate realignments are excluded from the sample is about $-0.5$.

Assuming $\delta_t$ is lower in normal times also follows recent empirical work by Flood and Rose (2001), who argue that UIP violation is a necessary condition for a successful interest rate defense of a fixed exchange rate or currency peg. For, if the predictable excess return from holding the local currency is zero then risk-averse foreign investors will be unwilling to hold it. They find that in crisis periods UIP works better than in normal times, when the currencies of countries with higher interest rates tend to appreciate on average. This is consistent with the findings of Bansal (1997) and Bansal and Dahlquist (2000), who show that UIP violation is more relevant for developed and middle income countries—particularly those having negative interest rate differentials with the U.S.—than for emerging markets and low income countries. Such conditioning of the forward premium puzzle seems in line with the distinction between low and high asset market volatility.

The third objective of the paper is to show that time-inconsistency ($k < 1$) is not a necessary condition for inflation/depreciation bias when financial-sector fragility matters. In the benchmark discretionary model of Barro and Gordon (1983), expected future outcomes are irrelevant because actual depreciation is implemented after the supply shock realization while expected depreciation is fixed beforehand. This induces equilibrium depreciation bias if the policymaker has a short-term expansionary motive. Clearly, the benchmark model describing discretionary monetary policy as trying to exploit a Phillips curve is irrelevant for most developing economies with high and variable inflation rates. Nevertheless, policy makers in these countries are not indifferent to inflation surprises due to the resulting seigniorage revenue (Calvo and Reinhart (2002)). Moreover, central bankers in emerging markets are extremely mindful of the exchange rate, not the least because of the financial-fragility factors described above, as well as the recent popularity of inflation targeting following crises episodes. In the light of these considerations, I argue that explicitly allowing expected future outcomes into period-$t$ welfare may render the discretionary model more suitable for policy analysis.
Expectations can also be costly if they affect current nominal wages, as in Obstfeld (1996) or the *ex post* real interest rate, as in Eichengreen and Jeanne (1998). A related expectational framework was studied by Krugman (1996), who argued that self-fulfilling crises may be an artifact of the unrealistic treatment of expectations. If fundamentals deteriorate deterministically, and expected future devaluation is costly because it raises *ex ante* real interest rates then multiple equilibria cannot exist. However, Krugman’s result relies on the loss function being sensitive to future expectations only (Kehoe (1996)). I follow Jeanne and Masson (2000), who argue that the policy maker’s decision is sensitive to the agents’ depreciation expectations formed during, as well as before the crisis. They show that if expectations are formed in the last and current periods, then devaluation expectations can become chaotic and a complete information model can admit arbitrarily many equilibria and chaotic dynamics.\(^4\) Morris and Shin (1998) show that an alternative sufficient condition for uniqueness is lack of common knowledge about the fundamentals.

The main findings can be summarized as follows. First, the trade-off between, on the one hand, raising interest rates to defend the currency and, on the other hand, expanding monetary policy to limit financial fragility, is such that in normal times expected future depreciation is welfare-improving through the traditional channel. In contrast, in crisis times expected future appreciation is welfare-improving, as the financial-fragility channel dominates. Second, if aggregate demand depends on the *ex post* real interest rate, then average depreciation can be zero if (i) aggregate demand is more sensitive to the *ex post* real rate than aggregate supply is to unanticipated depreciation and (ii) policy has a short-term expansionary motive. In the absence of such an incentive, it is also possible that financial-sector fragility induces *deflationary bias* under discretion in normal times. In expected welfare terms, the extended objective function may dominate the benchmark one provided the policy maker’s seigniorage motive exceeds a certain threshold. In terms of policy outcomes, average depreciation is *increasing* in the risk premium provided financial-sector fragility matters in equilibrium, i.e. if aggregate supply and demand are not equally sensitive.

\(^4\) Along these lines see Tambakis (2003).
I also derive second moment conditions to satisfy the two forward premiun puzzle 'stylized facts' (Fama (1984)), namely that the risk premium and expected future depreciation have negative covariance but that the risk premium is more volatile. Subject to these two restrictions, I find that a more persistent and less noisy risk premium yields less depreciation variability, as does a smaller weight on financial-sector stability in the objective function. Moreover, $k > 0$ may violate one of the two conditions, whereas the absence of a short-term expansionary motive is sufficient for the risk premium to be more volatile that expected future depreciation. I tentatively conclude that expected social welfare is lower than the benchmark when financial fragility matters. Dollarization then seems a desirable option for removing both the currency liability mismatch and policy makers’ time inconsistency.

In the remainder of the paper, Section 2 presents the model, Section 3 obtains its equilibrium properties and Section 4 discusses the implications for expected social welfare and the forward premium puzzle. Section 5 concludes.

2 The model

2.1 Benchmark discretionary policy

In the discretionary monetary policy model applied to a small open economy, $s_t$, $p_t$ and $p^*_t$ are the (log) nominal spot exchange rate and the home and foreign price levels in period $t$. Assuming absolute PPP holds ($s_t = p_t - p^*_t$), normalising $p^*_t = 1$ and differencing implies $\Delta_s = \pi$, so actual depreciation and inflation are equivalent. Welfare losses are given by

$$L_t = (y_t - y^*)^2 + \chi \pi_t^2$$

(1)

$y_t$ and $\pi_t$ are the (log) period-$t$ output level and depreciation rate. The depreciation target is set to zero, without loss of generality, and relative depreciation aversion normalised to $\chi > 0$. The output target $y^* \geq 0$ exceeds the home potential growth rate $\gamma$ by $k = y^* - \gamma \geq 0$, capturing the policy maker’s "surprise" inflation tax (seigniorage) incentive. Home output is determined from short-run aggregate supply function
\[ y_t = \gamma + \alpha (\pi_t - E_{t-1}\pi_t) + z_t \quad (2) \]

The slope \( \alpha \geq 0 \) captures the short-run output-depreciation trade-off, i.e. the open economy’s sacrifice ratio. Supply shocks are assumed iid with conditional mean zero, standard error \( \sigma_z \) and uncorrelated with \( \pi_t \). Depreciation expectations \( E_{t-1}\pi_t \) are set in \( t-1 \) before observing \( z_t \), but policy sets \( \pi_t \) after the shock. Minimizing (1) subject to (2) yields
\[
\pi_t = \frac{k\alpha}{\chi} - \frac{\alpha}{\alpha^2 + \chi} z_t \quad y_t = \gamma + \frac{\chi}{\alpha^2 + \chi} z_t \quad (3)
\]

The first two equilibrium moments of policy outcomes are
\[
E_{t-1}\pi_t = \frac{k\alpha}{\chi} \quad E_{t-1}y_t = \gamma \quad \sigma^2_{\pi} = \frac{\alpha^2}{(\alpha^2 + \chi)^2} \sigma^2_z \quad \sigma^2_{y} = \frac{\chi^2}{(\alpha^2 + \chi)^2} \sigma^2_z \quad (4)
\]

Expected depreciation bias increases in \( k \). Thus, for finite \( \chi \) and non-vertical short-run aggregate supply \( (\alpha \neq 0) \), average depreciation is zero only if the policy maker can credibly precommit to \( k = 0 \). Depreciation and output variability increase in \( \alpha \) and \( \chi \), respectively. The resulting benchmark expected social welfare is falling in the policy maker’s short-term expansionary motive and in the variability of the supply shock:
\[
E_{t-1}L_t = \frac{\alpha^2 + \chi}{\chi} k^2 + \frac{\chi}{\alpha^2 + \chi} \sigma^2_z \quad (5)
\]

### 2.2 Financial-sector stability in the objective function

In "second-generation" crisis models, the short-term macroeconomic junction’s impact on the state of fundamentals is such that by introducing an extra fixed cost of actual depreciation there can be self-fulfilling speculative attacks and perhaps contagion from other countries suffering crises. Provided

\(^5\) Dollarization can also serve as a commitment device in an open economy. See also Gale and Vives (2002) for lender-of-last-resort issues.
$k > 0$, these models generate multiple equilibria for expected depreciation which are self-fulfilling: a short-term expansionary motive is a necessary condition for multiplicity. In turn, the fixed cost of exchange rate realignment is justified by the policy maker’s desire to overcome this motive. Multiplicity is also dependent on the shape of the shock distribution.\footnote{On the self-fulfilling view see Cole and Kehoe (1995), Jeanne (1997), Masson (1999), Obstfeld (1996) and Radelet and Sachs (1998).}

Welfare losses are

\[ \mathcal{L}_t = (y_t - y^*)^2 + \chi \pi_t^2 + c_t(\pi_t) \]

Any depreciation (appreciation) in period $t$ results in $c_t(\cdot) = \bar{c}(\underline{c})$, where $\bar{c}$ and $\underline{c}$ are positive constants and the actual marginal loss is zero.

Importantly, second-generation crisis models are effectively one-period because agents form their expectations in period $t - 1$ before the crisis. If this feature is relaxed, then multiplicity arises without the need for the policy maker to have a surprise motive. I follow Jeanne and Masson (2000) and assume that period-$t$ welfare depends on current expectational errors $(\pi_t - E_{t-1}\pi_t)$ and expectations for period $t + 1$ ($E_t\pi_{t+1}$). $E_{t-1}\pi_t$ is built into period-$t$ nominal wage contracts but $E_t\pi_{t+1}$ is determined contemporaneously with $\pi_t$. The period-$t$ loss function is extended by the additional term $c_t = c r^A_t$, where $r^A_t$ is the ex ante short-term real interest rate given by the Fisher equation $r^A_t = \bar{i}_t - E_t\bar{\pi}_{t+1}$ and $c$ is the marginal social welfare cost of higher ex ante real rates. In principle $c$ may be time-varying—for example, rising sharply following traumatic devaluation/hyperinflation episodes. For analytical simplicity I assume it is constant:

\[ \mathcal{L}_t = (y_t - y^*)^2 + \chi \pi_t^2 + c r^A_t, \quad c > 0 \]  \hspace{1cm} (6)

Incorporating the ex ante real interest rate means that expected future outcomes matter for period-$t$ welfare. This can be justified through the balance-sheet transmission mechanism, long recognized in a closed economy (Bernanke and Gertler (1989)) and recently acknowledged as one of the principal causes of "twin" banking and currency crises in open developing economies where balance sheets matter (Chang and Velasco (2001), Kaminsky and Reinhart (1999)).
In the domestic capital market, the current welfare impact of higher \textit{ex ante} real rates is unambiguously negative. On the one hand, higher nominal interest rates mean the corporate sector’s debt servicing burden increases, damaging corporate balance sheets and raising the prospect of insolvency. On the other hand, expected future inflation/depreciation means the expected real value of debt obligations is eroded, improving balance sheets and promoting financial stability. Conversely, lower \textit{ex ante} real interest rates benefit the domestic financial sector.

In international capital markets, the net impact of higher $r^d_t$ is ambiguous and depends on the degree of \textit{effective dollarization} in the small open economy. Ceteris paribus, higher nominal rates—for example, while the central bank is defending a currency peg against speculative attack—raise the value of foreign debt payments and induce financial fragility. However, to the extent that the banking sector debt is mostly in foreign currency (dollars \textit{wlog}), if higher nominal rates are accompanied by expected future \textit{appreciation} then the expected home-currency value of foreign debt repayments is smaller, hence financial stability improves. Indeed, such expectations of appreciation are at the source of financial-sector overlending. In contrast, if the speculative attack against a highly-dollarized economy succeeds and higher nominal rates generate expected future \textit{depreciation}, that may subsequently trigger abrupt reversals in short-term international capital flows ("sudden stops") which can push a developing country to insolvency and default. The prospect of servicing a mounting stock of foreign-denominated liabilities then becomes more expensive, aggravating the existing international illiquidity and leading to intensified speculation against the home currency. In turn, the negative balance-sheet effects of the currency plunge may lead to a collapse in home investment and consumption (Calvo (1998)).

The above arguments suggest that the net impact of expected future depreciation on the \textit{ex ante} real rate—thus also period-$t$ outcomes and welfare—depends on foreign investors’ risk aversion and the forward risk premium. Modeling this dependence is the subject of the next Section.
2.3 Time-varying currency risk premia and welfare

Expected future depreciation is related to the home-foreign nominal interest differential by uncovered interest rate parity (UIP). If foreign investors are risk-neutral, domestic and foreign assets are perfect substitutes, forward exchange rates are unbiased predictors of future spot rates and capital is perfectly mobile then expected returns in the two currencies are equalised. Denoting the domestic interest rate for period-\( t \) deposits maturing at \( t+1 \) by \( i_t \) and the (constant) foreign rate by \( i^* \), positive interest differentials imply the home currency is expected to depreciate by the same amount:

\[
E_t \Delta s_{t+1} = E_t \pi_{t+1} \approx i_t - i^*
\]

The ensemble of UIP requirements is very difficult to satisfy empirically. There is extensive evidence of forward risk premia and peso problems reviewed, for example, in Lewis (1995). Risk neutrality fails to capture investor behavior and explain the highly volatile short-term capital flows to developing countries during crisis periods. I therefore proceed with the general case where foreign investors are not risk-neutral, following also McCallum (1994), and write the UIP relationship as

\[
E_t \pi_{t+1} = i_t - i^* - p_t ,
\]  

where \( p_t = f_t - E_t s_{t+1} \) is the local currency’s forward risk premium, that is the forward prediction bias in currency market expectations. I assume strictly positive interest differentials, reflecting the underlying country risk, and use the analytical equivalent

\[
E_t \pi_{t+1} = \delta_t (i_t - i^*) ,
\]  

where \( \delta_t \) and \( p_t \) are inversely related and UIP is violated if \( \delta_t \neq 1 \) (\( p_t \neq 0 \)). Ceteris paribus, the forward risk premium increases in \( p_t \) and decreases in \( \delta_t \). Substitute (8) into \( i_t = r_t^A + \pi_t^A \) and take rational expectations \( \pi_t^A = E_t \pi_{t+1} \) to obtain \( r_t^A \) as a linear combination of \( i^* \) and \( i_t \) with time-varying weights \( \delta_t \) and \( 1 - \delta_t \):
\[
\begin{align*}
    r_t^L &= \delta_t i^* + (1 - \delta_t) i_t \\
    &= i^* + \frac{1 - \delta_t}{\delta_t} E_t \widetilde{\pi}_{t+1} \\
    \Rightarrow \quad \frac{\partial r_t^L}{\partial E_t \widetilde{\pi}_{t+1}} &= \frac{1 - \delta_t}{\delta_t} (9)
\end{align*}
\]

If \( \delta_t = 1 \) then UIP holds and \( r_t^L = i^* \). The value \( \delta_t = 0 \) is ruled out as it implies zero average depreciation independently of the interest differential; \( r_t^L \) is then not well-defined. Otherwise, there are 3 cases to analyze as a function of the direction of UIP violation and the value of the risk premium. *Ex ante* real interest rates are: (i) falling in expected future depreciation if \( \delta_t < 0 \), that is the *forward premium puzzle*, (ii) rising in \( E_t \widetilde{\pi}_{t+1} \) if \( 0 < \delta_t < 1 \), and (iii) falling if \( \delta_t > 1 \).

In what follows, the last case is excluded as it implies that foreign investors would never invest in the home currency, an unrealistic case of negative risk premium—i.e. a negative weight on \( i_t \) in (9). Thus, provided \( i_t > i^* \) cases (i)-(ii) reflect positive risk premia \( (p_t > 0) \). Substituting (9) into (6) yields

\[
L_t = (y_t - y^*)^2 + \chi \pi_t^2 + ci^* + c \frac{1 - \delta_t}{\delta_t} E_t \widetilde{\pi}_{t+1} (11)
\]

Writing the loss function in this way emphasizes that the welfare impact of expected future depreciation is conditional on the sign and magnitude of \( \delta_t \). I will now argue these are, in turn, conditional on the state of asset market volatility.

### 2.3.1 Financial fragility in normal periods and floating exchange rate regimes: \( \delta_t < 0 \)

When \( \delta_t < 0 \), (11) implies expected future depreciation is welfare-improving. This is because positive interest differentials combined with \( E_t \widetilde{\pi}_{t+1} > 0 \) imply lower *ex ante* real interest rates, and hence less financial-sector fragility and higher social welfare. Conversely, expected future appreciation induces higher \( r_t^L \), thus more financial-sector fragility and lower welfare.
Based on the previous discussion, I suggest a conditional interpretation of this result, capturing a typical emerging market case where: (i) much of the home financial sector’s liabilities are dollarized, (ii) there is significant country risk—including political uncertainty, credibility and lack of lender of last resort problems underlying $i_t > i^*$—and (iii) there are strong balance sheet effects at work such that a real devaluation may be contractionary.

In particular, define normal times as periods in which interest rate and exchange rate volatility is low and $\delta_t < 0$, so the financial-sector is less fragile, and crisis times as periods when $\delta_t > 0$ and asset markets are volatile. Normal times include both fixed and flexible exchange rate regimes (Calvo and Reinhart (2002)). The former involve ”peso problem” periods over which a currency peg is successfully maintained, albeit in the presence of a persistent forward risk premium. Then, in normal times banks are encouraged by the expected home currency appreciation to take on more foreign-currency denominated debt. However, this makes it more fragile in the event of a devaluation, which in turn increases the risk premium demanded by foreign investors and maintains expectations of further strengthening of the home currency. Indeed, Flood and Rose (2001) point out that observed persistent negative $\delta_t$ estimates are a necessary condition for a successful interest rate defense of a currency peg.

This interpretation is based upon recent work on the forward discount puzzle that higher interest currencies tend to appreciate on average ($\delta_t < 0$) in floating periods, even though a forthcoming devaluation is anticipated by the markets. Slope estimates of $\hat{\delta}$ in UIP regressions tend to be significantly smaller than one and often negative. Such findings are commonly interpreted as evidence of time-varying risk premia.

Recent empirical research has found that the behavior of the risk premium is state-dependent.\textsuperscript{7} In particular, Flood and Rose (1996) show that the magnitude of UIP violation is sensitive to the exchange rate regime: it is bigger during floating than during fixed exchange rate periods. Adding exchange rate realignments to a fixed exchange rate sample also results in higher $\delta_t$ estimates. In related work, Flood and Rose (2001) find that, after controlling for countries’ different income levels and inflation rates, UIP slope

\textsuperscript{7}For a theoretical account see Cespedes, Chang and Velasco (2000).
estimates become significantly less negative (more positive) in crisis periods than in normal times during which depreciation and interest rate variability is low. That is, UIP works systematically better during crisis episodes than it does for fixed and flexible exchange rate countries in normal times.

2.3.2 Financial fragility in crises and fixed exchange rate regimes: 

\[ 0 < \delta_t < 1 \]

Following this conditional interpretation, in fixed exchange rate periods including realignments and in crisis times—that is, when asset market volatility is high—positive interest differentials induce less average / more depreciation of the home currency, that is the forward discount puzzle range \( 0 < \delta_t < 1 \). Equation (11) then implies expected future depreciation raises the \textit{ex ante} real rate. This induces financial-sector fragility, domestic currency substitution and foreign capital flight, all of which lower period-\( t \) welfare. Conversely, expected future appreciation strengthens dollarized bank balance sheets and encourages capital inflows; it thus improves current welfare. Note also that the marginal welfare impact of changing \( \delta_t \) through the financial fragility channel is \(-1/\delta_t^2 < 0\) in both normal and crisis times. This confirms the intuition that, given expected future currency fluctuation, lower risk premium volatility—equivalently, more credibility—is always welfare-improving.

Therefore, it can be argued that the state of the home financial sector should be expected to differ systematically as a function of \( \delta_t \). This interpretation stresses the dependence of financial-sector fragility, in particular the home-currency value of the banking sector’s dollarized short-term liabilities, on the forward risk premium. Flood and Rose (2001) emphasize that state-dependence is essential in understanding persistent deviations from UIP. To summarize, in a small, open dollarized economy, the trade-off between a pro-cyclical (higher nominal interest rates) and a counter-cyclical (lower nominal rates) monetary policy response to exogenous adverse supply shocks is between financial-sector fragility, on the one hand, and the improved terms-of-trade from real devaluation on the other. In normal times the real effect dominates, while in crisis times it is the financial sector which drives the net welfare impact. The two are distinguished by the opposite sign of the forward risk premium.
3 Optimal discretionary policy

This Section analyzes the implications of the above trade-off for average macroeconomic performance. The FOC for minimizing loss function (11) is

\[
(y_t - y^*) \frac{\partial y_t}{\partial \pi_t} + \chi \pi_t + c \frac{\partial r_t^A}{\partial \pi_t} = 0
\]

\[
\alpha (y_t - y^*) + \chi \pi_t + c \frac{\partial r_t^A}{\partial E_t \pi_t+1} \frac{dE_t \pi_t+1}{d\pi_t} = 0
\] (12)

Substituting \( \frac{\partial r_t^A}{\partial E_t \pi_t+1} \) from (10) implies

\[
\alpha (y_t - y^*) + \chi \pi_t + c \frac{1 - \delta_t}{\delta_t} \frac{dE_t \pi_t+1}{d\pi_t} = 0
\] (13)

In order to compute \( dE_t \pi_t+1/d\pi_t \) and avoid infinite forward-induction and multiple equilibria, I now close the model by specifying home aggregate demand as a function of the ex post short-term real interest rate:

\[
y_t = \beta - \gamma r_t + u_t \ , \ \gamma > 0
\] (14)

where \( r_t = i_t - \pi_t \) and \( u_t \sim (0, \sigma_u) \) is an iid shock. This is aggregate demand function \( y_t = \beta + \lambda (s_t + p_t^* - p_t) - \gamma r_t + u_t \) with short-run PPP imposed. Assuming market clearing in each period yields

\[
\beta - \gamma (i_t - \pi_t) + u_t = \gamma + \alpha (\pi_t - E_{t-1} \pi_t) + z_t
\] (15)

Apply UIP relation (8) to (15) to replace \( i_t \) and solve for the equilibrium impact of actual on expected future depreciation:

\[
\frac{dE_t \pi_t+1}{d\pi_t} = \frac{\gamma - \alpha}{\gamma} \delta_t
\] (16)

Higher absolute \( \delta_t \) generates more inflation/depreciation persistence, all else equal. This is consistent with the findings of Flood and Rose (2001) provided \( \gamma > \alpha \): actual depreciation rates are less mean-reverting and more variable during crises than in normal times, and crisis periods tend to be characterized by higher \( \delta_t \). Substituting (16) to FOC (13) yields
\[
\alpha^2(\pi_t - E_{t-1}\pi_t) = \alpha k + \alpha z_t + \chi \pi_t + \frac{c(1 - \delta_t)(\gamma - \alpha)}{\gamma} = 0 
\]  

(17)

Taking expectations at \( t - 1 \) yields average depreciation under discretion:

\[
E_{t-1}\pi_t = \frac{k\alpha}{\chi} - \frac{c}{\chi} \frac{\partial r_t^A}{\partial \pi_t} = \frac{k\alpha}{\chi} - \frac{c(1 - \delta_t)(\gamma - \alpha)}{\chi\gamma} 
\]  

(18)

If \( \gamma = \alpha \) the effects of aggregate demand and supply cancel out and the financial fragility channel does not operate. Average depreciation then equals its benchmark level \( k\alpha/\chi \) from equation (4). For \( \gamma \neq \alpha \), excess depreciation depends on \( \partial r_t^A/\partial \pi_t \), hence on the perceived state of the domestic economy as reflected in the value of the risk premium. Average depreciation is higher than the benchmark if actual depreciation lowers the \textit{ex ante} real rate, and vice versa if it raises \( r_t^A \).

Therefore, \( \partial r_t^A/\partial \pi_t \) is positive if \( \gamma > \alpha \) and negative if \( \gamma < \alpha \). In the first case, the average depreciation rate is lower in the presence of financial-sector fragility, while in the second case average depreciation is greater. The rationale when aggregate supply is relatively less sensitive to unexpected depreciation than aggregate demand is to the real interest rate (\( \gamma > \alpha \)) is that surprise depreciation \textit{raises} the \textit{ex ante} real rate and worsens financial-sector fragility. Average depreciation is then smaller than otherwise. Conversely, when \( \gamma < \alpha \), actual depreciation raises home aggregate demand in the \textit{current} period by lowering \textit{ex post} real interest rates. Higher aggregate demand creates expectations of future depreciation and lowers the \textit{ex ante} real interest rate. This has a favorable macroeconomic effect by strengthening the home banking sector; greater average depreciation thus improves period-\( t \) welfare for all \( \delta_t < 1 \).

There are two further implications. First, because \( 1 - \delta_t > 0 \) is greater in normal times (\( \delta_t < 0 \)) than in crises periods (\( 0 < \delta_t < 1 \)), the absolute magnitude of \( E_{t-1}\pi_t \) increases in the risk premium. Thus average depreciation is \textit{bigger} in normal times when UIP regressions have negative slopes.
That is, given its sign, the contribution of financial fragility to equilibrium depreciation bias is increasing in the UIP violation. In the light of the recent empirical findings (Flood and Rose (2001)), this result suggests that the macroeconomic impact of financial-sector fragility is greater in normal times (↓ \( \delta_t \)) than in crises times (↑ \( \delta_t \)). The intuition is that in normal times—when financial markets are calm—fundamental considerations (inflation and output growth) matter relatively less, while financial fragility matters relatively more. In contrast, in crisis times when asset market variability is high, dealing with macroeconomic dislocation in the form of hyperinflation and/or deep recession becomes the central bank’s top priority. Put differently, assuming \( k = 0 \) and \( \gamma > \alpha \) implies there is a greater likelihood of deflation in normal times than in crisis periods.

Second, conditional on \( \gamma > \alpha \)—i.e., a steep short-run Phillips curve—average depreciation can be zero even if the policy maker has an expansionary motive \( (k > 0) \) provided period-t welfare is sufficiently sensitive to \( r_t^A \). Setting \( E_{t-1} \pi_t = 0 \) in (18) yields:

\[
e^* = \frac{k\alpha\gamma}{(1 - \delta_t)(\gamma - \alpha)}
\]

(19)

Note that if \( k = 0 \) then \( e^* = 0 \), and the threshold level of aversion to financial-sector fragility increases in the policy maker’s expansionary motive. In order to deliver zero expected depreciation the financial-fragility channel acts to counterweight the time-inconsistency constraint. If the latter is absent, financial fragility is the only contributor to average exchange rate fluctuation, opening up the possibility of a deflationary spiral in normal times.

For \( k > 0 \), \( e^* \) is positive for \( \gamma > \alpha \) and \( \delta_t < 1 \), which covers the two relevant risk premium ranges. It is independent of relative depreciation aversion \( \chi \) and decreasing in the expansionary motive \( 1 - k \) and the risk premium. Its sensitivity to the latter is \( \partial e^*/\partial \delta_t = k\alpha\gamma/[\delta_t(\gamma - \alpha)] > 0 \) for all \( \gamma > \alpha \). It follows that \( e^* \) is lower in normal times than during financial crises. The intuition relates to the previous result. Because in absolute terms financial-sector fragility contributes more to average depreciation during normal times, a smaller weight on the ex ante real rate in the loss function is sufficient to eliminate depreciation bias under discretion.
In contrast, the absolute contribution of the term in \( r_t^A \) is smaller during financial crises, hence it requires a bigger weight in the loss function to attain zero average depreciation. In the limiting case where UIP holds, so foreign investors are risk-neutral (\( \delta_t \rightarrow 1 \)), the \( c^* \) threshold becomes infinite. Intuitively, as the extra average depreciation term in (18) tends to zero, the macroeconomic ”leverage” of the financial fragility channel also becomes negligible. Conversely, the further currency markets are from UIP and risk neutrality, the smaller the threshold \( c^* \) required to eliminate depreciation bias under discretion.

Therefore, \( c \) measures policy’s aversion to financial-sector fragility. This is in line with empirical work by Bansal and Dahlquist (1997, 2000) showing that the forward discount puzzle is more relevant for developed, or stable, economies than for low and middle income developing countries. The last two groups are characterized by more volatile asset markets and are more prone to financial crises. Therefore, from a normative viewpoint, the present framework suggests that policy makers in emerging market economies can lower average depreciation by raising their aversion to financial-sector fragility, all else equal.

4 Discussion

4.1 Expected social welfare: comparative statics

I now compare expected welfare losses under the benchmark to those when financial-sector fragility matters. The latter are given by

\[
E_{t-1} L_t = E_{t-1} \left[ (y_t - y^*)^2 + \chi \pi_t^2 + cr_t^A \right]
\]

Note that FOC (17) suggests the \( E_{t-1} r_t^A \) term contributes a constant to the optimisation, implying that the variances of output growth and depreciation are the same as under benchmark loss function (4). Therefore, any change in expected social welfare is due to: (i) the different average depreciation under the two loss functions, and (ii) the contribution of the expected \textit{ex ante} real rate \( E_{t-1} r_t^A \). Average depreciation is different if one considers that aggregate demand is determined by the \textit{ex ante} or \textit{ex post} real interest
rate. However, the welfare contribution of \( cE_{t-1}r_t \) is the same under both. This may be seen by expressing (15) as a function of \( r_t \):

\[
\begin{align*}
\gamma r_t &= \beta - \overline{\gamma} - \alpha(\pi_t - E_{t-1}\pi_t) - z_t + u_t \\
E_{t-1}r_t &= \frac{\beta - \overline{\gamma}}{\gamma}
\end{align*}
\]

(20)

Positive average real interest rates impose the weak parameter restriction \( \beta > \overline{\gamma} \): the fixed component of aggregate demand must exceed fixed aggregate supply, determined by the economy’s long-run potential growth rate \( \overline{\gamma} \). Applying (20) to expected welfare yields\(^8\)

\[
E_{t-1}\mathcal{L}_t = \frac{\alpha^2 + \chi}{\chi} k^2 + \frac{\chi}{\alpha^2 + \chi} \sigma^2 + \frac{c}{\gamma}\left[ \beta - \overline{\gamma} + \frac{c(1 - \delta_k)^2(\gamma - \alpha)^2}{\gamma\chi} - 2k \frac{\alpha(1 - \delta_k)(\gamma - \alpha)}{\chi} \right]
\]

(21)

The first two terms coincide with expected welfare under the benchmark, given in (5). The sign of the last term is ambiguous unless \( k = 0 \); it is then strictly positive, so expected welfare losses under the extended loss function always exceed the benchmark level. Therefore, a necessary condition for expected welfare losses under \( \mathcal{L} \) to be lower than under the benchmark is that \( k > 0 \), that is a certain of short-term expansionary motive is required. A sufficient condition is that the whole expression in square brackets is negative, implying the following range of \( c \):

\[
E_{t-1}\mathcal{L}_t < E_{t-1}L_t \quad \iff \quad c < \overline{\mathcal{C}} = \frac{\gamma\chi}{(1 - \delta_k)^2(\gamma - \alpha)^2} \left[ \frac{2k\alpha}{\chi}(1 - \delta_k)(\gamma - \alpha) + \overline{\gamma} - \beta \right]
\]

(22)

This yields a corresponding inequality on the range of \( k \):

\[
k > \overline{k} = \frac{(\beta - \overline{\gamma})\chi}{2\alpha(1 - \delta_k)(\gamma - \alpha)}
\]

(23)

\(^8\)The algebraic manipulation is straightforward.
From equation (19), requiring that the threshold level $c^*$ for $E_t \pi_t = 0$ is less than $\tau$ yields the following inequality constraint for $k$:

$$c^* < \tau \iff k > k^* = \frac{(\beta - \gamma)\chi}{\alpha(1 - \delta_t)(\gamma - \alpha)}$$

(24)

Note that $k^* = 2\bar{k}$. Therefore, satisfying inequality (24) also satisfies (23) and implies both $E_t \pi_t = 0$ and $E_t \mathcal{L}_t < E_t \hat{L}_t$. Conductive structural parameter values for expected social welfare to be higher under financial-sector fragility include $\gamma > \alpha$, small $\alpha$ and large $\chi$, that is a steep short-run Phillips curve and high depreciation aversion. Based on the earlier intuition, if aggregate demand is more sensitive to the *ex post* real rate than aggregate supply is to unanticipated depreciation, average depreciation is lower and expected welfare improves. However, note that (21) also implies that any welfare gain due to large $\gamma$ is bounded above, as the expected loss increment is multiplied by $c/\gamma$.

Appropriate international parameters involve small $\delta_t$, that is a large forward risk premium $p_t$. These *ceteris paribus* parameter restrictions involve large foreign investor risk aversion, corresponding to normal times when asset market volatility is low. Conversely, in crisis times when $\delta_t$ is close to 1 inequality (23) is unlikely to be met, unless $k$ is very large. One interpretation of this result is that in turbulent times the domestic policy maker is more likely to be short-termist. More generally, the tentative conclusion is that financial-sector fragility considerations are likely to weigh down social welfare in countercyclical fashion. *Prima facie*, this framework lends support to arguments in favor of an international lender of last resort and/or opting for official dollarization for countries in distress.

4.2 Volatility: implications from the forward discount puzzle

Finally, I ask whether the forward discount puzzle’s two main predictions can be captured within this stylized representation for capturing the macroeconomic impact of financial fragility. These are
\[
\frac{\partial E_t \pi_{t+1}}{\partial \delta_t} > 0 \quad , \quad \text{var}(\delta_t) > \text{var}(E_t \pi_{t+1}) \quad (25)
\]

The first property amounts to \(\text{cov}(p_t, E_t \pi_{t+1}) < 0\), illustrating the peso problem. The second states that the risk premium is more volatile than the expected depreciation; it is reflected in the observation that interest rate variability is high relative to exchange rate variability in many countries and across exchange rate regimes (Calvo and Reinhart (2002)). To shed light on these issues, assume for simplicity that the forward risk premium follows the stationary AR(1) process

\[
\delta_t = \theta \delta_{t-1} + \eta_t \quad (26)
\]

Assuming risk premium shocks are independent, \(\eta\) is iid \(\sim (0, \sigma_\eta)\) and \(|\theta| < 1\), the variance of \(\delta_t\) is just:

\[
\text{var}(\delta_t) = \frac{\sigma_\eta^2}{1 - \theta^2} \quad (27)
\]

To compare this with the variability of expected future depreciation, lead equation (18) by one period:

\[
E_t \pi_{t+1} = \frac{k\alpha}{\chi} - \frac{c(1 - \delta_{t+1})(\gamma - \alpha)}{\chi^\gamma}
\]

Substitute \(\delta_{t+1}\) from (26) and differentiate with respect to \(\delta_t\) to obtain

\[
\frac{\partial E_t \pi_{t+1}}{\partial \delta_t} = \frac{\theta c(\gamma - \alpha)}{\gamma \chi} \quad (28)
\]

This is positive—thus the risk premium and expected depreciation are negatively related—if \(\theta > 0 (< 0)\) and \(\gamma - \alpha > (<) 0\). For the second property, computing \(\text{var}(E_t \pi_{t+1})\) from the above expression yields

\[
\text{var}(E_t \pi_{t+1}) = \frac{\theta^2 c^2 (\gamma - \alpha)^2}{\gamma^2 \chi^2} \left( \frac{\phi^2}{1 - \theta^2} + 1 \right) \quad (29)
\]
Comparing this to (27) and requiring $\text{var}(\delta_t) > \text{var}(E_{t-1}\pi_t)$ yields

$$c < \frac{\gamma \chi}{\gamma - \alpha} \quad (30)$$

Therefore, the range of positive $c$ consistent with the risk premium being more volatile than expected future depreciation is independent of the risk premium persistence ($\theta$). The range is wider for greater $\chi$. The critical level of $c$ in (30) can be compared with $c^*$ from (19). Requiring $c < c^*$ in order for $E_{t-1}\pi_t = 0$ to be consistent with the second property of the forward risk premium implies

$$1 - \delta_t > \frac{k \alpha}{\chi} \quad (31)$$

For $\delta_t < 1$ this is always true if $k = 0$. The absence of a short-term seigniorage motive is a sufficient condition for $E_{t-1}\pi_t = 0$. Therefore, although expected welfare under financial fragility can be higher when $k > 0$, the outcomes violate the second part of (25), and as such are not feasible, especially during crises when $1 - \delta_t$ is likely to be small. This result offers *prima facie* support to dollarization as a policy option for overcoming both financial-sector fragility due to currency mismatch and time-inconsistency. Substituting the AR(1) process for $\delta_t$ into FOC (17), equilibrium depreciation variability becomes

$$\text{var}(\pi_t) = \frac{\alpha^2}{(\alpha^2 + \chi)^2} \sigma_z^2 + \frac{c^2(\gamma - \alpha)^2}{\gamma^2(\alpha^2 + \chi)^2} \sigma_\eta^2 \quad (32)$$

Ceteris paribus, a more persistent (higher $|\theta|$) and less noisy (smaller $\sigma_\eta$) risk premium results in less volatile depreciation rates, as does smaller $c$.

5 Concluding remarks

This paper studied the optimal discretionary policy problem in a small open economy with dollarized liabilities where financial-sector fragility is socially costly and foreign investors are risk-averse. Expected future depreciation then influences period-$t$ welfare through the *ex ante* real interest rate. It was
shown that average depreciation can be zero if expected future depreciation is sufficiently costly, and the level of this cost was shown to be higher during financial crises than in normal times. "Normality" was defined as low conditional market volatility, against crisis episodes when markets are turbulent and policy credibility is low. This conditional interpretation was motivated by research empirical research on the forward discount puzzle.

It was also shown that average depreciation is likely to be higher in crises than in normal times, during which there may also be average deflation (exchange rate appreciation) under policy precommitment. In that respect, a certain short-term expansionary motive by domestic policy makers — e.g. driven by fiscal seignorage considerations as in Calvo and Reinhart (2002) — may yield higher expected social welfare than the benchmark. Taken together with second-generation models’ requirement that $k > 0$ for multiple equilibria to exist, this suggests that understanding policy makers’ short-term incentives is important for assessing the consequences of banking and currency crises. However, $k > 0$ may violate one of the two requirements in Fama (1984), whereas no time-inconsistency is sufficient for the risk premium to be more variable than expected future policy outcomes. The tentative implication is that expected welfare is lower when financial-sector fragility matters. Therefore, dollarization seems a desirable option for removing both the currency mismatch of assets and liabilities and time inconsistency (Gale and Vives (2002)). Overall, the paper emphasizes the equilibrium interaction of state-dependent forward risk premia and interest rate policy. The results reinforce the "third generation" balance-sheet view that financial-sector fragility and foreign investors’ changing attitude to country risk is a key determinant of average macroeconomic performance in developing countries. Modeling the forward risk premium’s conditional volatility endogenously is one way to extend the analytical framework.
References


