An interest rate defense of a fixed exchange rate?

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Abstract

Defending a government’s exchange-rate commitment with active interest rate policy is not an option in first-generation models of speculative attacks. In those models, the interest rate is the passive reflection of currency-depreciation expectations. In this paper, we show how to adapt the first-generation framework to allow for an interest rate defense. It is shown that increasing domestic currency interest rate before the attack makes domestic assets more attractive according to an asset substitution effect, but weakens the domestic currency by increasing the government’s fiscal liabilities. As a result, an interest rate defense can be successful only conditional on sound fiscal policy.

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1. Introduction and literature survey

This paper is about the possibility of an active interest rate defense in first-generation models of speculative attacks a la Krugman–Flood–Garber (KFG). It is straightforward to...
see that this requires a departure from uncovered interest parity (UIP), which was a basic KFG building block. UIP implies that the domestic currency interest rate is the *passive* reflection of devaluation expectations. There is, therefore, no room for *active* interest rate policy.

A policy-responsive wedge must be driven into the interest parity condition. Readers are used to risk aversion implying such a wedge and this is one *entrée* to the problem. A good bit of progress on interest rate policy is possible, however, in an environment of certainty so we will forgo uncertainty for now.\(^3\) We bring in our wedge by assuming a transaction cost that allows the domestic monetary authorities room to maneuver in setting the interest rate. This defines the program of the paper: solving a generalized version of the KFG model in which domestic and foreign bonds are imperfect substitutes and the domestic currency interest rate is one of the variables controlled by domestic monetary policy.

Our goal is to find the scope for policy tradeoffs involving a number of potential policy tools—interest rates, nominal-liability growth (money and bonds), the real government deficit and international reserve management all as they arise in the first-generation framework. We evaluate policies—on an equal footing—in terms of how long the policies preserve a given fixed exchange rate. This analysis is supported by numerical simulations parameterized with data from emerging market countries in the 1990s.

Recent policy debates over the efficacy of defending exchange rates using the interest rate have spurred a literature related closely to the present paper.\(^4\) At the empirical level, Furman and Stiglitz (1998) find, in a small set of episodes of crises in nine emerging markets, that interest rate hikes are associated with exchange rate depreciations. Kraay (2003), considering a larger sample of speculative attacks in developed and developing economies, concludes to a lack of systematic correlation between interest rates and the outcome of speculative attacks. Goldfajn and Baig (1998) do not find any robust correlation between interest rates and exchange rates in the recent crises in Southeast Asia. Overall, the evidence presented in these papers is difficult to interpret as a systematic lack of efficacy of interest rate defenses, given the obvious reverse causality and endogeneity problems, but at least suggests that the link between the level of interest rates and the credibility of the currency is not systematic and depends on the circumstances. Thus theoretical work may be useful in identifying the circumstances in which an interest rate defense can work and those in which it does not.

Recent theoretical papers studying the efficacy of interest rate defenses of fixed currency pegs include Bensaid and Jeanne (1997), Drazen (2003) and Lahiri and Végh (2003a,b). The first two papers belong to the “second-generation” or “escape clause” approach to currency crises.\(^5\) Bensaid and Jeanne’s (1997) paper was motivated by the 1992–1993 crisis of the European Monetary System; it formalizes the point that raising the interest rate may be a self-defeating strategy because of the harm it inflicts on the economy, and can make speculation against the currency self-fulfilling. Drazen (2003) presents a framework in which the government chooses between two defense strategies.

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\(^3\) Krugman (1979) was conducted in certainty as was the first section of Flood and Garber (1984).


raising the interest rate or borrowing reserves. One important aspect of this decision—in Drazen’s setup—is that it signals to the market some unobservable characteristics of the government, such as the availability of reserves or the government’s resolve to defend the currency. Drazen shows that depending on the precise information structure, raising the interest rate might send a good signal and enhance the credibility of the fixed peg.

The present paper is related more closely to Lahiri and Végh (2003a,b), who, like us, adopt a first-generation framework and stress the fiscal implications of an interest rate defense.6 Like Lahiri and Végh, we consider a model in which the speculative attack is caused by unsustainable debt dynamics.7 Lahiri and Végh (2003a) find that the link between the level of interest rates and the timing of the attack is non-monotonic: an interest rate rise might delay the attack if it is small, but hasten it if it is large. This stems in part from the menu of assets available to households in their model: they introduce a new asset, “liquid bonds”, which on the one hand is assumed to be part of broad money together with cash holdings, but on the other hand pays interest—though not the same as regular bonds. Thus an interest rate defense (defined as a rise in the interest rate on liquid bonds) increases money demand, which contributes to delay the attacks. Like in our model, this also increases fiscal liabilities, with an opposite effect. Because money demand has been kept standard in our model only the second effect is present.

2. The model

We study a small open economy in continuous time. There is one homogeneous global good, and the Law of One Price applies at all times. The foreign price level is constant and normalized to 1. The domestic price level, therefore, is equal to exchange rate $S_t$ (defined as the domestic currency price of the foreign currency).

The economy is inhabited by a mass 1 of identical infinitely lived consumers who receive a constant flow $y$ of a perishable good. The representative consumer’s lifetime utility is given by

$$U = \int_0^{+\infty} [u(c_t) + v(m_t) - w(b_t)]e^{-rt}dt$$

where $c_t$ is the individual’s flow of consumption, $m_t$ his real money balances and $b_t$ his holding of domestic currency bonds. The disutility $w(b_t)$ reflects the assumption that domestic currency bonds are more costly to hold than international bonds because of their lower liquidity or higher transaction costs. $u(\cdot)$, $v(\cdot)$ and $w(\cdot)$ are increasing. $u(\cdot)$, $v(\cdot)$ and $w(\cdot)$ are concave, $u', v', w'>0$, $u'', v'', -w''<0$.

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6 Most of the results in Lahiri and Végh (2003a) relate to a “contemporaneous” interest rate defense in which the monetary authorities raise the interest rate after the speculative attack. Like Lahiri and Végh (2003b), we focus here on a “preemptive” interest rate defense in which the interest rate is raised before the crisis.

Domestic currency bonds are held only by domestic residents. In addition, residents can hold two other assets: money, and international bonds denominated in foreign currency. International bonds bear a real interest rate \( i^* = r \). Denoting by \( a_0 \) the real financial wealth of the representative resident at time 0, his intertemporal budget constraint is given by

\[
a_0 + \frac{y}{r} = \int_0^{+\infty} \left[ c_t + \tau_t + (i^* + \delta_t) m_t + (i^* + \delta_t - i_t) b_t \right] e^{-r t} dt,
\]

where \( \delta_t = \dot{S}_t / S_t \) is the rate of depreciation (inflation) of the domestic currency, \( \tau_t \) a lump sum tax levied by the government, and \( i_t \) is the nominal interest rate on domestic currency bonds. Maximizing lifetime utility (Eq. (1)) subject to (Eq. (2)) gives the following first-order conditions

\[
c_t = c^*, \tag{3}
\]

\[
v'(m_t) = i^* + \delta_t, \tag{4}
\]

and

\[
w'(b_t) = i_t - i^* - \delta_t. \tag{5}
\]

Consumption is constant since the consumers’ rate of time preference coincides with the world real interest rate. Eqs. (4) and (5) implicitly define the demand for money and for domestic currency bonds

\[
m_t = \tilde{m}(\delta_t), \quad \tilde{m}' < 0 \tag{6}
\]

\[
b_t = \tilde{b}(i_t - \delta_t), \quad \tilde{b}' > 0. \tag{7}
\]

The demand for money is decreasing with the rate of depreciation The demand for domestic currency bonds is increasing with the real return on bonds, \( i_t - \delta_t \).

The domestic government is composed of two institutions, the central bank and the treasury. The domestic central bank sets the level of nominal money supply \( M_t \), which has two counterparts on the asset side of its balance sheet, domestic credit and foreign exchange reserves.

\[
M_t = D_t + R_t, \tag{8}
\]

where \( R_t = \int_{-\infty}^{t} S_t \tilde{R}_0^* d \theta \) is the quantity of pesos that have been issued to purchase foreign currency debt. Domestic credit is composed of domestic currency government bonds. The central bank always holds a nonnegative level of foreign exchange reserves,

\[
R^*_t \geq 0. \tag{9}
\]
The cash-flow budget constraint for the treasury is:

\[ \dot{N}_t = i_t N_t - \tau S_t - Z_t. \] (10)

The treasury’s budget constraint determines the evolution of the total nominal stock of outstanding domestic currency bonds, \( N \). According to Eq. (10), \( N \) grows in pace with the government’s net deficit, which is equal to the interest payment on the public debt, \( iN \), minus the fiscal receipts, \( \tau S \), and the dividend received from the central bank, \( Z \). Throughout the paper, we take the real level of taxation, \( \tau \), as exogenous and constant.\(^\text{11}\)

The central bank’s budget constraint is:

\[ \dot{M}_t + i_t D_t + s_t i^* R_t^* = \dot{D}_t + s_t \dot{R}_t^* + Z_t. \] (11)

The central bank’s resources stem from money creation and the returns on its domestic and foreign bonds holdings; they are used to accumulate domestic and foreign bonds and to pay the dividend to the treasury. Differentiating the balance sheet constraint (Eq. (8)) and using the resulting expression to substitute \( M \) out of Eq. (11) gives an expression for the central bank’s dividend (or seigniorage revenues):

\[ Z_t = i_t D_t + s_t i^* R_t^*. \] (12)

The central bank’s dividend is equal to the total return on its holdings of domestic and foreign bonds. The government consolidated budget constraint, then, can be derived by plugging this expression into Eq. (10):

\[ \dot{N}_t = i_t (N_t - D_t) - i^* R_t^* - \tau S_t. \] (13)

The flow increase in government debt is equal to the net interest payments of the consolidated government minus the return on foreign exchange reserves and the government’s fiscal revenues.

Finally we close the expanded model with an accounting identity:

\[ N_t = B_t + D_t. \] (14)

All domestic government bonds must be held either by domestic residents or by the domestic monetary authority.

In all of our work, the monetary authority fixes the exchange rate at \( \bar{S} \) as long as international reserves are above an exogenous lower bound, set at zero. When reserves are exhausted the exchange rate floats. The survival of the fixed rate regime depends on the behavior of the post-collapse floating exchange rate. Let \( \tilde{S} \) be the shadow exchange rate, which is defined to be the flexible exchange rate that would prevail if the fixed rate regime were attacked successfully. As usual, the fixed rate regime survives until the attack is

\(^{11}\) Holding \( \tau \) constant is a simplification that allows us to divorce asset market effects of interest rate policy from associated fiscal reform.
worthwhile to speculators, i.e., $\tilde{S} \geq \bar{S}$. In the current perfect foresight setting, an anticipated attack takes place when $\tilde{S} = \bar{S}$.

This set of assumptions makes our model very close to the fiscal versions of the KFG framework of Buiter (1987), Drazen and Helpman (1987) and Van Wijnbergen (1991). The only difference is the wedge in the interest parity condition,

$$i_t = i^* + \frac{\dot{\tilde{S}}_t}{\tilde{S}_t} + w'\left(\frac{B_t}{\tilde{S}_t}\right), \quad B_t \geq 0. \quad (15)$$

The last term reflects the imperfect substitutability between domestic and foreign bonds. It is positive and increasing with the quantity of domestic currency bonds in domestic portfolios.

The interesting properties of the model result from the wedge that we have introduced in UIP. They do not hinge on the particular way this wedge is justified. The wedge may reflect a utility-based bias toward or against own-currency assets that could be derived from those assets having a liquidity advantage or disadvantage over foreign currency assets (see Lahiri and Végh, 2003a,b). The wedge could equally well result from increasing marginal domestic currency borrowing cost (see Drazen, 2003). An expression similar to Eq. (15) can also be derived from investors’ risk aversion (Jeanne and Rose, 2002).\(^{12}\)

An active interest rate defense policy is impossible in the standard model (with $w=0$) since UIP implies that the domestic interest rate must remain equal to its foreign counterpart before the collapse of the currency peg. The wedge in the interest parity condition that we have introduced in the model, on the other hand, gives the authorities an additional degree of freedom in setting the interest rate. Can it be used to postpone—or forestall—the crisis? This is the question we address in the following section.

### 3. An interest rate defense

We focus on the interest rate as an instrument to defend the currency before the speculative attack. We assume that after a speculative attack the rate of depreciation is set to some constant level $\delta$. A successful interest rate defense is defined as a pre-attack interest rate path $(i_t)_{t \geq 0}$ such that a speculative attack never happens. We proceed backwards, characterizing the post-collapse regime first, and the pre-collapse regime second. The government primary surplus, $\tau$, is constant throughout the analysis.

\(^{12}\) In Jeanne and Rose (2002), the exchange rate is stochastic and normally distributed, and investors maximize a CARA utility function. It follows that the risk premium is a linear function of private holdings of domestic bonds expressed in terms of foreign currency. In the first version of this paper, we used a formulation, derived from Flood and Marion (2000), where the wedge was proportional to the ratio of domestic bonds to foreign bonds in investors’ portfolio—and we obtained similar results.
3.1. The post-collapse regime

After the collapse the authorities adopt a regime in which the exchange rate depreciates at the constant rate \( d \). The exchange rate is given by

\[
S_t = \tilde{S}_T \exp(d(t-T)),
\]

where \( \tilde{S}_T \) is the shadow exchange rate at \( T \), the time of the collapse.

The authorities supply the resulting money demand \( M_t = \tilde{m}(d)S_t \) by purchasing domestic currency bonds and, if necessary, foreign exchange reserves. Foreign exchange reserves can be set to zero if the stock of nominal debt is large enough to back money demand, that is, if

\[
N_t \geq \tilde{m}(d)S_t.
\]

As will be shown below, this condition is satisfied in equilibrium after a successful speculative attack, so that reserves can be set to zero in the post-collapse regime.\(^{13}\)

The government’s consolidated budget constraint (Eq. (13)) then becomes:

\[
\dot{N}_t = i_t(N_t - M_t) - \tau S_t.
\]

Using Eq. (15), this implies a first-order differential equation for real debt \( n = N/S \):

\[
\dot{n}_t = [i^* + \delta + w'(n - m)](n - m) - \delta n - \tau,
\]

with \( m = \tilde{m}(d) \).

Eq. (19) says that the flow increase in the real level of debt is equal to the real interest payments on debt minus seigniorage revenues and the real primary surplus. This is a first-order non-linear differential equation for the real level of debt. Fig. 1 shows how \( \dot{n} \) varies with \( n \). The root \( v \) can be characterized graphically as the point where the curve corresponding to the right-hand side of Eq. (19) intersects the x-axis. The curve is upward sloping, implying that real debt dynamics are stable if and only if \( n = v \). This curve is linear for \( n \) lower than \( \tilde{m}(d) \) and non-linear for \( n \) larger than \( \tilde{m}(d) \) because of the term \( w'(n - m) \).

We rule out unstable debt dynamics because they violate the transversality condition for the government. Consequently, the level of real debt must be equal to \( v \) at the time of the collapse. Following a collapse, the economy settles immediately into a real steady state with constant rates of depreciation, nominal expansion and a constant real level of government debt.

Note that the stock of government debt must be higher than the stock of money after the speculative attack, \( v > \tilde{m}(d) \). If not, then the interest rate wedge \( w'(v - m) \) would be equal to zero (all the debt being held by the central bank) and \( v \) would be equal to \( m + (\tau + \delta m)/i^* > m \), a contradiction. If the stock of debt is lower than the stock of money, the debt dynamics are sustainable and a speculative attack cannot occur.

\(^{13}\) It is not obvious that the post-attack level of reserves can be set to zero in fiscal versions of the KFG framework. In these models, the post-collapse nominal money supply must be such that seigniorage revenues cover the shortfall in fiscal revenues. If the required money supply is higher than the government’s nominal debt, the central bank must hold a positive level of foreign exchange reserves even after the collapse.
With the help of Fig. 1, one can study the comparative statics relationship between the exogenous and endogenous variables of the model. Increasing the level of taxation shifts the curve downwards and so shifts its intersection with the x-axis to the right—i.e., this increases \( m \). In other words, an increase in the level of taxation allows the government to support a higher steady state level of debt.

\[
\frac{\partial v}{\partial \tau} > 0. \tag{20}
\]

The comparative statics effects of a change in the rate of depreciation, \( \delta \), are a bit more complicated to analyze. Raising \( \delta \) may shift the curve upwards or downwards. One has

\[
\frac{\partial \dot{n}}{\partial \delta} = -\frac{d((i^* + \delta)\tilde{m}(d))}{d\delta} + \frac{d}{d\delta} ((n - \tilde{m}(d))w'(n - \tilde{m}(d))). \tag{21}
\]

This first term reflects the seigniorage effect. It is negative if seigniorage increases with the inflation rate, i.e., if the seigniorage Laffer curve is upward sloping. The second term reflects the interest rate wedge on government debt held by the public. It is positive, because increasing \( \delta \) reduces money demand and shifts bonds from the central bank to private portfolios. This increases the stock of debt held by the public (term \( n - \tilde{m}(\delta) \)) as well as the real interest rate \( i - \delta \) paid on this debt (term \( w'(n - \tilde{m}(\delta)) \)).

Thus, the sign of the impact of an increase in \( \delta \) on the sustainable level of debt \( v \) is a priori ambiguous and depends on the relative strength of two opposite effects. Raising \( \delta \) tends to increase \( v \) by increasing the seigniorage (assuming that the seigniorage Laffer
curve is upward sloping), but tends to lower \( v \) by increasing the service of debt. The net impact is positive if the first effect dominates, that is, if the slope of the seigniorage Laffer curve is large enough.

3.2. The pre-collapse regime

Foreign exchange reserves have been purchased at rate \( \bar{S} \) and Eq. (8) becomes

\[
M_t = D_t + \bar{S} R_t^* .
\]  

(22)

The domestic monetary authority sets the domestic interest rate by intervening in the domestic bond market and in the foreign exchange market. For given prices (exchange rate and interest rate), quantities adjust to achieve equilibrium. Asset market equilibrium is characterized by:

\[
i_t - i^* = w' \left( \frac{N_t - M_t + \bar{S} R_t^*}{S} \right).
\]  

(23)

Foreign exchange reserves, \( R^* \), move to clear the market. An increase in the domestic interest rate, \( i_t \), raises reserves by increasing the private sector’s demand for domestic currency bonds. Conversely, an increase in the foreign interest rate \( i^* \) increases the demand for foreign currency assets, which requires a fully sterilized balancing reserve outflow.

In the fixed rate epoch, the dynamics of \( R^* \) are determined by the dynamics of \( N \). While the exchange rate is fixed the government consolidated budget constraint is obtained by setting \( S_t \) equal to \( \bar{S} \) in Eq. (13). Then using Eqs. (14) and (22) to substitute out \( D_t \) and \( R_t^* \) gives:

\[
\dot{N}_t = i^* N_t - \tau \bar{S} + (i_t - i^*)B_t - i^* M_t .
\]  

(24)

This equation is intuitive. If it were not for nominal bonds or money, the flow increase in government debt would be equal to the interest payments on existing debt minus the primary surplus. Debt accumulates faster than that to the extent that the government issues nominal debt whose interest rate exceeds \( i^* \), but accumulates slower than that to the extent that it issues paper money whose interest rate is zero.

Using Eqs. (6) and (7) to substitute out \( M_t \) and \( B_t \) from Eq. (24), the rate of debt accumulation can be written as a function of \( i_t \) only

\[
\dot{N}_t = i^* N_t + (i_t - i^*) \bar{S} b (i_t - i^*) - i^* \bar{S} \hat{n}(0) - \tau \bar{S} .
\]  

(25)

Eq. (25) makes clear that raising the interest rate leads to a faster accumulation of debt. Raising \( i_t \) increases private holdings of domestic bonds \( B_t \), as well as the premium that the government has to pay on these bonds, \( i_t - i^* \). These effects both work toward raising \( \dot{N}_t \) given \( N_t \).

**\[ \frac{\partial \dot{N}_t}{\partial i_t} > 0. \]**
The pre-collapse dynamics of debt can be derived from Eq. (25) for a given path \((i_t)\). For example, if the interest rate is set at the constant level \(i^\ast\), the solution is an exponential debt path:

\[
N_t = (N_0 + \lambda)e^{(i^\ast t)} - \lambda,
\]

where \(\lambda\) is given by:

\[
\lambda = \left(\frac{(i^\ast - i^\ast)\hat{b}(i^\ast - i^\ast) - \hat{m}(0)}{i^\ast}\right)\tilde{S}.
\]

The variable \(\lambda\) is strictly increasing with \(i^\ast\) and strictly decreasing with \(\tau\). Hence, given \(N_0\), the level of nominal debt at any given time \(t > 0\) before the speculative attack is strictly increasing with the interest rate and strictly decreasing with the primary surplus.

\[
\forall t \in (0, T), \frac{\partial N_t}{\partial i^\ast} > 0, \quad \frac{\partial N_t}{\partial \tau} < 0.
\]

3.3. The defense

At the attack time, money supply will jump to preserve asset market equilibrium and avoid a foreseen exchange rate jump. Asset rates of return jump from pre- to post-attack levels but not the exchange rate. A foreseen exchange rate jump would present a risk-free profit opportunity. In certainty, the attack time is determined to ensure no foreseen profits. The shadow exchange rate at time \(t\), \(\tilde{S}_t\), is the value of the exchange rate such that

\[
\frac{N_t}{\tilde{S}_t} = v(\delta, \tau).
\]

For given post-collapse policies, \(\tilde{S}\) is proportional to the state variable \(N_t\). If \(N\) starts small but grows without bound, then the fixed rate is doomed. The currency peg collapses if and when the shadow exchange rate crosses the fixed peg, i.e., if there is a time \(T\) such that:

\[
N_T > \tilde{S} v(\delta, \tau).
\]

In the special case where the interest rate is constant, this condition becomes

\[
\frac{(N_0 + \lambda)e^{i^\ast T} - \lambda}{\tilde{S}} = v(\delta, \tau).
\]

The collapse is inevitable if nominal debt explodes, i.e., if \(N_0 + \lambda > 0\). In that case, the time of collapse is given by Eq. (30). Several observations are in order.

First, the collapse is essentially the reflection of fiscal imbalance. It is always possible, other things equal, to raise taxes such that \(N_0 + \lambda < 0\), which prevents public debt from exploding. The most natural way to defend the currency peg is to fix the underlying fiscal problem.

Second, the model is set up to see if the same result can be achieved using the interest rate. It is easy to see from Eq. (28) that the time of the collapse is decreasing with the pre-collapse interest rate:

\[
\frac{\partial T}{\partial i^\ast} < 0.
\]
Raising the interest rate before the attack only hastens the collapse of the currency peg. This result is intuitive from the underlying fiscal nature of the crisis. Raising the interest rate before the collapse worsens the government’s fiscal problem, since it amounts to financing a stock of low-interest-rate-bearing foreign assets by borrowing at a high interest rate.

A constant interest rate is not the policy that maximizes the length of the fixed rate epoch. The policy that maximizes the lifetime of the fixed exchange rate peg minimizes pre-attack debt accumulation subject to $R^* \geq 0$. Using Eq. (23), the constraint $R_t^* \geq 0$ implies

$$i_t \geq I_t = i^* + \nu' \left( \frac{N_t}{S} - \tilde{m}(0) \right).$$

(31)

The authorities may be forced to maintain high interest rates by a high level of public debt. This is what an interest rate defense means in this model.

The interest rate path $\bar{i}_t$ is the best interest rate defense in this model, since it minimizes the rate of accumulation of debt under the constraint that reserves are non-negative. This defense is implemented by pegging the domestic interest rate to the foreign level if this is consistent with non-negative reserves, and maintaining zero reserves otherwise. If the fixed peg collapses when the government follows this policy, then no other interest rate defense can succeed.

Let us assume that the initial stock of debt is high enough to constrain the authorities to raise the interest rate above the foreign level, i.e., $N_0 > \tilde{S} \tilde{m}(0)$. For the defense to be successful, the stock of debt must never exceed the critical threshold $\tilde{S} \tilde{v}(\delta, \tau)$. As long as the stock of debt is larger than the stock of money ($N_t \geq M_t$), the dynamics of debt under the defense ($\bar{i}_t$) are governed by the same equation as in the post-collapse regime (since in both cases, the depreciation rate is constant and the reserves are set to zero). These dynamics, therefore, are described by Eq. (19), with the rate of depreciation $\delta$ set to zero:

$$\dot{N}_t = (i^* + \nu' (n_t - \tilde{m}(0))(n_t - \tilde{m}(0)) - \tau. \quad \text{(32)}$$

If the stock of debt is smaller than the stock of money ($N_t < M_t$), then the central bank holds all the debt plus a positive level of reserves. Setting $B_t = 0$ in Eq. (24) gives

$$\dot{N}_t = i^* (N_t - M_t) - \tau \tilde{S},$$

which, in real terms, is the same as Eq. (32) since the interest rate wedge is equal to zero if the central bank holds all the domestic currency debt. Hence the debt dynamics are given by Eq. (32) whether the stock of debt is larger or smaller than the stock of money.

Let us assume that the sustainable debt level is higher in the post-collapse regime than in the pre-collapse regime ($\nu(0, \tau) < \nu(\delta, \tau)$). Then there are two cases. If the initial nominal debt level is larger than $\nu(0, \tau) \tilde{S}$, it increases over time. A speculative attack occurs when the level of nominal debt level reaches the critical threshold $\nu(\delta, \tau) \tilde{S}$. By contrast, if the initial nominal debt level is smaller than $\nu(0, \tau) \tilde{S}$, it decreases over time and the speculative attack never occurs. If the central bank implemented the minimum interest

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14 This assumption simplifies the exposition; it can easily be relaxed.
rate policy \((\hat{\mu})\) until the end of times, the debt would implode to minus infinity, and the transversality condition of the government would be violated. To avoid this, the authorities must raise the interest rate above the minimum level at some point.

Our main results are recapitulated in the following proposition.

**Proposition 1.** The interest rate defense that maximizes the lifetime of the fixed peg minimizes the amount of foreign exchange reserves held by the central bank. An interest rate defense can be successful if and only if the initial level of debt is not too large

\[ N_0 \leq v(0, \tau) \bar{S}. \]

If this condition is violated the stock of nominal debt increases during the fixed exchange rate period. A speculative attack occurs when \(N_T = v(\hat{\delta}, \tau) \bar{S}.\)

Increasing the interest rate is a way to build up the stock of reserves at the central bank. However, a policy of maintaining high reserves before an attack is self-defeating. While such a policy makes reserves *look good* before the collapse, those reserves are not reliably positive indicators of the health of the fixed rate regime. The only reliable indicator of the health of the fixed rate is the level of government debt, assuming a constant fiscal surplus. Reserves are expensive window dressing here; by accumulating them the government behaves as an insolvent household that would try to impress creditors by financing large cash balances with credit card debt.

Furthermore, an interest rate defense is successful if it does not fall in the vicious circle of high interest rates and a ballooning debt. For that, the initial level of debt should be low enough.

4. Concluding comments

We have studied an extension of the KFG model and found that an interest rate defense can work, but only if the underlying fiscal situation is sustainable. The purpose of a successful interest rate defense is to prevent foreign exchange reserves from falling into negative territory while the stock of debt decreases. If the fiscal situation is unsustainable, this strategy is bound to fail: increases in debt and in the interest rate feed each other until the fixed peg collapses.

Our model points to a possible contradiction between the high interest rates required by the short-run defense of a fixed peg and the low interest rates required by its long-run viability. This contradiction is certainly suggestive of the policy dilemma that some emerging market countries faced in recent crises. This problem could be mitigated—in our model—by issuing debt denominated in foreign currency. Foreign currency debt makes the task of defending the fixed peg easier to the extent that the government pays a lower interest rate on that debt than on domestic currency debt. On the other hand, there might be reasons (outside of the model) why governments do not want to denominate their debts entirely in foreign currency—for example, the risks posed a currency mismatch if there is a large devaluation. It would be interesting to extend our analysis to a framework in which the currency composition of debt is endogenous.
Our model predicts that the interest rate decreases over time in a successful defense and increases over time in a failed defense. This property stems from the assumption of perfect foresight and would not hold in general in a model with uncertainty. The interest rate and debt could remain high or even increase over time if there are continuing doubts on the sustainability of the fixed peg—although the defense might turn out to be successful ex post, if the doubts are dispelled by good news or a fiscal adjustment.

Another property of our model is that the best interest rate defense pegs the foreign exchange reserves to zero. Maintaining a positive level is self-defeating—it always shortens the fixed rate epoch. Raising the interest rate draws in international reserves, but international reserves are a bad investment here—a fiscal drag that weakens the currency. We recognize that this cannot be the whole story. Sensible policymakers and policy advisors worldwide are comforted uniformly by high reserve balances that have poor portfolio performance. There must, therefore, be some return to reserves that we are missing. We suspect the missing return might involve liquidity constraints or short-term capital stickiness that simply do not enter perfect capital mobility models like ours.

References

Bensaid, Bernard, Jeanne, Olivier, 1997. The instability of fixed exchange rate systems when raising the interest rate is costly. European Economic Review 41, 1461–1478.