Abstract

Fiscal deficits have been put forward as the main factor in the occurrence of currency crises by the first-generation currency crisis models. In these models, financing ongoing or future deficits by seigniorage revenues or by reducing the real value of outstanding debt leads to the collapse of the fixed exchange rate regime. While most of the papers within the first-generation framework consider a fiscal deficit that occurs with certainty, in reality an increase in the fiscal burden of the government may be an uncertain outcome. This paper introduces a model where there is uncertainty about the occurrence of a fiscal deficit for a finite number of periods, and studies the effects of such uncertainty on the evolution of currency crises. If the fiscal deficit materializes, the government has to abandon the fixed exchange rate regime, as in the standard case. However, the paper shows that the fixed exchange rate regime will become unsustainable even if the fiscal deficit never materializes. Therefore, a speculative attack occurs and the fixed exchange rate regime collapses with the mere possibility of a deficit, independently of whether this outcome actually occurs or not. The paper also predicts that the depreciation of the exchange rate gets bigger as the uncertainty lasts longer, and the nominal interest rate increases before the currency crisis as long as the uncertainty continues.

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1 Introduction

Emerging market economies quite often experience significant depreciation of their currencies. Fiscal imbalances and unsustainable fiscal policies have been put forward as the main factor in the occurrence of currency crises by the “first-generation” currency crisis models, based on classic papers by Krugman (1979) and Flood and Garber (1984). In these models, the government runs a persistent fiscal deficit, which leads to sustained reserve losses under a fixed exchange rate regime. In the absence of fiscal reforms, the government must eventually leave the peg since it has to finance the deficit by printing money to raise seigniorage revenue. While these models postulate a government that runs a persistent fiscal deficit, it is clear that currency crises are not necessarily preceded by fiscal deficits. The Asian crisis of 1997 is a typical example of this, where the governments of these countries have been running fiscal surpluses or moderate fiscal deficits before the crisis. In more recent variants of these models, future deficits that will be financed by seigniorage revenues lead to the collapse of the fixed exchange rate regime before these deficits materialize and before the government starts to print money (Corsetti, Pesenti and Roubini, 1999a; Burnside, Eichenbaum and Rebelo, 2001).

Most of the papers within the first-generation framework consider a fiscal deficit as a certain outcome, whether it is a current deficit or a future one. However, in reality, the occurrence of a fiscal imbalance is oftentimes an uncertain event. The possibility of a future change in fiscal policy can generate a reaction in financial markets, even if there may be no change in fiscal policy eventually. This paper studies the effects of uncertainty about a fiscal deficit on the evolution of currency crises, and shows that a currency crisis of a fiscal origin can occur without any change in the fiscal stance of the government, only through expectations of a fiscal expansion.

In order to explore the effects of fiscal uncertainty on the evolution of currency crises, this paper considers uncertainty about future fiscal policy that lasts for a finite time period,
which is meant to capture a period of financial turmoil. In such episodes, governments may have to incur fiscal costs of a magnitude that is not manageable to cover through an increase in taxes or a reduction in expenditures. The increase in the fiscal burden may be due to a bailout of the troubled banking system as in the Asian crisis. Depending on how economic conditions evolve, the government may have to incur such an additional fiscal burden or it may continue with its planned spending if the anticipated problems in the financial system can be solved through other means without a bailout by the government. However, if agents perceive some risk of a fiscal imbalance, which will have to be financed by depreciation-related revenues, they will respond to this risk even if eventually it never materializes. Therefore, the possibility of a fiscal imbalance generates a reaction in the economy, and depreciation expectations associated with this possibility may reduce the demand for domestic currency and lead to a capital outflow.

Such a fragile economic condition may arise due to global economic conditions as well. If there is a possibility that a country will engage in expansionary fiscal policy to fend off the contractionary effects of a global slowdown, as in the global financial crisis of 2008, financing the costs of such policies may become problematic. Since the borrowing options of emerging market economies become limited due to decreasing global liquidity, the risk of not being able to finance the costs of a fiscal expansion raises the possibility of monetization of the deficit. Therefore, even before governments engage in a fiscal expansion, and even if they eventually do not resort to such policies, the possibility of a fiscal expansion that will be monetized may create a run on the currency.

This paper analyzes the effects of fiscal uncertainty on the occurrence of currency crises by using a model that features uncertainty about future fiscal policy that lasts for a finite number of periods. The model considered in the paper is similar to the model used by Burnside, Eichenbaum and Rebelo (2001). The economy is initially operating under a sustainable fixed exchange rate regime, which requires that the real value of initial government debt equals the present discounted value of current and future real primary surpluses. At
time zero, agents receive information that the government transfers may increase with some probability in every period, and this uncertainty continues for some time into the future. If the increase in the fiscal burden materializes, the government will have to finance this increase by using seigniorage revenues or by reducing the real value of public debt through inflation. Both of these options imply that the fixed exchange rate regime will have to be abandoned and the currency will depreciate as a result of a monetary expansion, as also predicted by other papers in the literature. The current paper shows that the fixed exchange rate regime will become unsustainable even if the expected increase in fiscal burden does not materialize. The reason why the model generates a currency crisis even when there is no change in the fundamentals of the economy is that an endogenous fiscal imbalance arises because of expectations of a depreciation. The possibility of a depreciation reduces the money demand and leads to reserve losses. The reduction in money demand continues as long as the uncertainty continues, as a result of which the government has to generate extra revenue to offset the fiscal imbalance that occurs endogenously. In order to generate revenue, the government again has to use seigniorage or reduce the real value of nominal debt through a depreciation. Therefore, regardless of whether the uncertainty ends with an increase in government transfers or not, the government has to abandon the fixed exchange rate regime and the country experiences a currency crisis. That is, even if the exchange rate regime is fundamentally viable, uncertainty renders it unsustainable.

The model predicts that the exchange rate depreciation that occurs when the peg is abandoned gets bigger as the uncertainty lasts longer. The model also predicts that the domestic nominal interest rate increases before a currency crisis occurs, and this increase continues as long as the uncertainty continues. This is a feature that is observed before many currency crisis episodes: interest rates start to rise while the exchange rate is still fixed, due to the fact that agents start expecting a depreciation. The paper also shows that the borrowing structure of the government affects the depreciation rate. If the government has nominal liabilities indexed to the interest rate, then the debt burden of the government
increases as interest rates increase while the exchange rate is still fixed. This implies that the revenue requirement of the government rises, and it expands the money supply more when the peg is abandoned, resulting in a higher depreciation of the exchange rate.

Currency crisis models based on unsustainable fiscal policy have been studied extensively in the literature. Among the more recent variants of the “first-generation” models of currency crises, the current paper is closest to Burnside, Eichenbaum and Rebelo (2001) in terms of its modeling. In that paper, the occurrence of the 1997 Asian currency crisis is explained by prospective fiscal deficits that are due to implicit bailout guarantees to the failing banking system.\(^1\) Therefore, even though the Asian countries did not have fiscal deficits before the crisis, it was known that their governments would incur additional liabilities in the future, and in the model, a currency crisis occurs before the government actually starts to print money. Therefore, the crisis is not preceded by large fiscal deficits or high growth rates of money. This paper is based on the same motivation and uses a similar model. However, in this paper, the occurrence of a fiscal deficit is an uncertain event, and the effects of this uncertainty on the economy and on the evolution of a currency crisis are analyzed.

There are earlier papers in the literature which have introduced uncertainty into the Krugman-Flood-Garber framework. The way uncertainty is introduced falls broadly into two categories: uncertainty regarding the reserve limit that triggers the crisis and uncertainty regarding the domestic credit growth.\(^2\) Uncertainty about domestic credit growth, which is closer to the idea in this paper, has first been analyzed by Flood and Garber (1984) by assuming that domestic credit depends on a random component. In this setting, the collapse time of the peg becomes a random variable and the probability of an attack next period rises as the value of the domestic credit increases.\(^3\) The focus of the current paper

\(^1\)The idea that future fiscal deficits can lead to currency crises have also been analyzed by Daniel (2001) and Corsetti and Mackowiak (2006).

\(^2\)Uncertainty about the reserve limit has been analyzed by (Willman, 1989), Cumby and van Wijnbergen (1989), and Otani (1989).

\(^3\)Uncertainty about domestic credit growth has also been analyzed by Blanco and Garber (1986), Dorn-
is different in the sense that the economy is allowed to have no increase in fiscal deficit in certain states, and the fixed exchange rate becomes unsustainable even in these cases. In Flood and Garber (1984), domestic credit growth has a random component but there is always positive growth, and the focus is on making the timing of the speculative attack random.

The paper proceeds as follows. Section 2 introduces the model. Section 3 explains the model calibration. Section 4 presents the results and Section 5 concludes.

2 The Model

Consider a small open economy with a government and a representative household. The household receives an endowment of the single, tradable, and perishable consumption good every period. With no barriers to trade, the law of one price holds: \( P_t = E_t P^*_t \), where \( P_t \) and \( P^*_t \) denote the domestic and foreign price levels, respectively. The exchange rate, denoted by \( E_t \), is defined as units of domestic currency per unit of foreign currency. It is assumed that \( P^*_t \) is constant and normalized to unity. Both the government and the household can borrow and lend in international financial markets at a constant real interest rate \( r \).

The economy is operating under a fixed exchange rate regime with the exchange rate being fixed at \( E_t = \bar{E} \). Before time zero, the fixed exchange rate regime is sustainable, meaning that the government can satisfy its intertemporal budget constraint without resorting to seigniorage. At time zero, new information is revealed about a possible one-time increase in government transfers. If government transfers increase, the government can raise taxes or reduce spending in order to pay for its increased expenditures. However, it is assumed that the revenue that the government can raise through such a fiscal reform will not be enough to cover all of its additional liabilities. Therefore, the options that the government has are printing money in order to generate seigniorage revenues, or deflating the real value of nominal debt issued prior to time zero.

busch (1987) and Grilli (1986).
2.1 The Government

In each period the government levies real lump sum taxes of $\tau_t$ units and transfers $\nu_t$ units of output to the household. It also carries out expenditures of $g_t$ units, which are assumed to yield no utility to the household. In addition, the government prints money, and borrows and lends in international and domestic financial markets. The government issues one-period foreign currency bonds $b^*_t$ in every period, that pay the world real interest rate $r$. The initial stock of foreign currency debt is $b^*_{t-1}$.

I use the same setup as in Burnside, Eichenbaum and Rebelo (2001), and assume that the government issued non-indexed government consols with a face value of $B^m > 0$ units of domestic currency and coupon rate $r$, before time zero. I also assume that the government issued $B^i > 0$ units of government consols in domestic currency with a coupon rate indexed to the domestic currency nominal interest rate, $i_t$. This implies that, in every period, the government has to repay $i_t B^i$ units of domestic currency for these indexed government liabilities. Before time zero, the nominal interest rate is equal to $r$ since the exchange rate is fixed and the coupon rate on the two kinds of debt are the same. Both kinds of government consols are issued in the domestic market and held by the household.\(^4\)

The flow budget constraint of the government in real terms is given by:

$$b^*_t + \frac{M_t}{E_t} + \tau_t = (1 + r) b^*_{t-1} + \frac{i_t B^i}{E_t} + \frac{r B^m}{E_t} + \frac{M_{t-1}}{E_t} + g_t + \nu_t$$ \hspace{1cm} (1)

where $M_t$ denotes nominal money holdings.

The flow budget constraint of the government, together with the condition\(^5\) $\lim_{t \to \infty} \frac{b^*_t}{(1+r)^t} = 0$ implies that the government is raising revenue which it never plans to spend, this kind of behavior can be ruled out as well, which would give $\lim_{t \to \infty} \frac{b^*_t}{(1+r)^t} = 0$.

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\(^4\)This assumption prevents a wealth transfer between the domestic economy and the rest of the world that would result from exchange rate uncertainty and the policies pursued by the government.

\(^5\)A no Ponzi game condition would imply that $\lim_{t \to \infty} \frac{b^*_t}{(1+r)^t} \leq 0$. Since a negative limit would imply that the government is raising revenue which it never plans to spend, this kind of behavior can be ruled out as well, which would give $\lim_{t \to \infty} \frac{b^*_t}{(1+r)^t} = 0$. 

6
0, gives the following intertemporal budget constraint:

$$\sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \left( \frac{M_t - M_{t-1}}{E_t} + \tau_t \right) = (1+r) b^* + \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \left( \frac{i_t B^i + r B^n}{E_t} + g_t + \nu_t \right)$$

(2)

This budget constraint implies that the present value of the government’s revenues, through printing money and lump-sum taxes, must be equal to the present value of the government expenditures, the transfers and debt repayment.

2.2 The Household

There is no uncertainty at time zero prior to the new information being revealed. The household maximizes lifetime utility, defined as:

$$\sum_{t=0}^{\infty} \beta^t U \left( c_t, \frac{M_t}{E_t} \right) = \sum_{t=0}^{\infty} \beta^t \ln \left[ c_t \left( \frac{M_t}{E_t} \right)^{1-\gamma} \right]$$

where $c_t$ denotes consumption, $0 < \beta < 1$ is the discount factor and $0 < \gamma < 1$.

The household receives an exogenous flow of output, $y_t$, pays lump-sum taxes, $\tau_t$, and receives government transfers, $\nu_t$, in every period. The household holds the consols issued by the government prior to time zero and also can borrow and lend in international financial markets using one-period foreign bonds, $f_t$, that yield a constant real rate of return $r$. The flow budget constraint of the household is:

$$f_t + \frac{i_t B^i}{E_t} + \frac{r B^n}{E_t} + \frac{M_{t-1}}{E_t} + y_t + \nu_t = c_t + (1+r) f_{t-1} + \frac{M_t}{E_t} + \tau_t$$

(4)

and the no-Ponzi game condition is:

$$\lim_{t \to \infty} \frac{f_t}{(1+r)^t} \leq 0$$

(5)

Assuming that $(1+r)\beta = 1$, the first order conditions of the household’s problem imply that consumption is constant over time. Using the first order conditions and the uncovered interest parity condition gives the money demand equation as:

$$\frac{M_t}{E_t} = \left( \frac{1-\gamma}{\gamma} \right) \left( 1 + \frac{1}{i_{t+1}} \right) c_t$$

(6)
where the uncovered interest parity condition is:

\[
1 + i_t = (1 + r)E \left( \frac{E_t}{E_{t-1}} \right)
\]  

(7)

Under the fixed exchange rate regime and without any uncertainty, the interest parity condition implies that the domestic currency nominal interest rate is equal to the world real interest rate, \( r \).

### 2.3 Equilibrium with No Uncertainty

A competitive perfect foresight equilibrium for this economy can be defined as follows:

**Definition 1** A competitive equilibrium for this economy is a specification for the vector \( \{c_t, M_t, f_t, y_t, g_t, \tau_t, \nu_t, b^*_t, E_t, P_t, i_t\}_{t=0}^{\infty} \) given the values for \( M_{-1}, f_{-1}, b^*_{-1}, B^i, B^n \) such that (i) \( \{c_t, M_t, f_t\}_{t=0}^{\infty} \) solves the household’s problem given \( \{y_t, \tau_t, \nu_t, E_t, P_t, i_t\}_{t=0}^{\infty} \) (ii) the government’s intertemporal budget constraint (2) holds (iii) the interest parity condition (7), and purchasing power parity, \( E_t = P_t \), hold for all \( t \).

Using the budget constraints of the household and the government implies that the resource constraint of the economy is:

\[
f_t + b^*_t + y_t = c_t + (1 + r) \left( f_{t-1} + b^*_{t-1} \right) + g_t
\]

(8)

The intertemporal resource constraint of the economy is given by:

\[
\sum_{t=0}^{\infty} \left( \frac{1}{1 + r} \right)^t (y_t - c_t - g_t) = (1 + r) \left( f_{-1} + b^*_{-1} \right)
\]

(9)

At time zero, before the new information is revealed, there is no uncertainty and the country has a fixed exchange rate regime. Therefore, the nominal interest rate equals the world real interest rate by the interest parity condition. It is assumed that \( y_t, g_t, \tau_t, \) and \( \nu_t \) have constant paths. The first order conditions of the household’s problem imply that
consumption is constant over time under the assumption \((1 + r)\beta = 1\). Then, equations (9) and (6) imply that consumption and real money balances are given by:

\[
\tilde{c} = y - g - r(f_{-1} + b_{-1}^*)
\]

\[
\frac{\bar{M}}{E} = \left( \frac{1 - \gamma}{\gamma} \right) \left( 1 + \frac{1}{r} \right) \tilde{c}
\]

The fixed exchange rate regime being sustainable implies that the intertemporal budget constraint of the government holds for a fixed exchange rate. By equation (11) demand for money is constant and the seigniorage revenue is equal to zero. Therefore, the intertemporal budget constraint of the government reduces to:

\[
\frac{\tau - g - \nu}{r} = \frac{B^i + B^m}{E} + b_{-1}^*
\]

Equation (12) states that the present value of current and future real surpluses must equal the initial real net liabilities of the government for the fixed exchange rate regime to be sustainable.

### 2.4 Fiscal Imbalance

At time zero, new information is revealed about a possible one-time increase in government transfers: in every period until time \(T\), if this increase has not yet happened, government transfers will stay constant with probability \(p\), where \(0 < p < 1\), and with probability \(1 - p\) they will increase permanently to a new, higher level. The present value of the increase in transfers is denoted by \(\phi\). If transfers do not increase by date \(T\), then the uncertainty ends without any change in the initial level of transfers. This formulation of uncertainty is meant to capture, in a simple way, a time period during which the economy is going through financial turbulence. The government may go through this period without an increase in its fiscal burden, or it may have to incur additional liabilities and end this time period with an higher fiscal burden.

With the introduction of uncertainty, I will denote the state of the economy at period \(t\) by \(s^t = (\nu_0, \nu_1, \nu_2, ..., \nu_t)\), which is the history of government transfers up through and
including period \( t \). The probability, as of period zero, of any particular state \( s^t \) is \( \pi(s^t) \). The initial realization \( \nu_0 \) is given, i.e. the increase in government transfers can occur starting at period one.

### 2.4.1 The Household’s Problem under Uncertainty

With the arrival of the new information the household reoptimizes by maximizing its expected lifetime utility, defined as:

\[
E \left\{ \sum_{t=0}^{\infty} \beta^t U \left( c_t, \frac{M_t}{S_t} \right) \right\} = \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \ln \left[ c_t(s^t)^{\gamma} \left( \frac{M_t(s^t)}{E_t(s^t)} \right)^{1-\gamma} \right] \pi(s^t) \tag{13}
\]

The state dependent flow budget constraint of the household is:

\[
f_t(s^t) + \frac{i_t(s^t)B^t}{E_t(s^t)} + \frac{rB^n}{E_t(s^t)} + \frac{M_{t-1}(s^{t-1})}{E_t(s^t)} + y + \nu_t(s^t) = c_t(s^t) + (1+r)f_{t-1}(s^{t-1}) + \frac{M_t(s^t)}{E_t(s^t)} + \tau \tag{14}
\]

The first order conditions of the household’s problem simplify as:

\[
\frac{\pi(s^t)}{c_t(s^t)} = \sum_{s^{t+1}|s^t} \frac{\pi(s^{t+1})}{c_{t+1}(s^{t+1})} \tag{15}
\]

\[
\frac{M_t(s^t)}{E_t(s^t)} = \left( \frac{1-\gamma}{\gamma} \right) \frac{1}{c_t(s^t)} \sum_{s^{t+1}|s^t} \frac{1}{c_{t+1}(s^{t+1})} \frac{E_t(s^t)}{E_{t+1}(s^{t+1})} \left( \frac{\pi(s^{t+1})}{\pi(s^t)} \right) \tag{16}
\]

Equation (16) states the money demand of the household at time \( t \), state \( s^t \), as a function of the next period’s exchange rate at different states. If next period’s exchange rate at some state is higher than this period’s exchange rate, demand for money decreases in the current period. Therefore, if the equilibrium path of the exchange rate entails a depreciation in one or more of the states next period while the exchange rate is fixed in the other states, then the money demand will fall in the current period.

### 2.4.2 Equilibrium under Uncertainty

The increase in the fiscal burden of the government is a transfer to the households. Therefore, the resources available in the economy do not change and the resource constraint at
date $t$, state $s^t$ is given by:

$$f_t(s^t) + b^*_t(s^t) + y = c_t(s^t) + (1 + r) \left[ f_{t-1}(s^{t-1}) + b^*_{t-1}(s^{t-1}) \right] + g \quad (17)$$

The budget constraint of the government at date $t$, state $s^t$ is given by:

$$b^*_t(s^t) + \frac{M_t(s^t)}{E_t(s^t)} + \tau = (1 + r)b^*_{t-1}(s^{t-1}) + \frac{i_t(s^t)B^i}{E_t(s^t)} + \frac{rB^n}{E_t(s^t)} + \frac{M_{t-1}(s^{t-1})}{E_t(s^t)} + g + \nu_t(s^t) \quad (18)$$

After the arrival of the new information, a competitive equilibrium for this economy can be defined as follows:

**Definition 2** A competitive equilibrium for this economy is a sequence of functions \(\{c_t(s^t), M_t(s^t), f_t(s^t), y_t(s^t), g_t(s^t), \tau_t(s^t), \nu_t(s^t), b^*_t(s^t), E_t(s^t), P_t(s^t), i_t(s^t)\}_{t=0}^{\infty}\) given the values for \(M_{-1}, f_{-1}, b^*_{-1}, B^i, B^n\) such that (i) \(\{c_t(s^t), M_t(s^t), f_t(s^t)\}_{t=0}^{\infty}\) solves the household’s problem given \(\{y_t(s^t), \tau_t(s^t), \nu_t(s^t), E_t(s^t), P_t(s^t), i_t(s^t)\}_{t=0}^{\infty}\) (ii) the government’s budget constraint \((18)\) holds (iii) the interest parity condition \((7)\), and purchasing power parity, \(E_t(s^t) = P_t(s^t)\), hold for all $t$ and $s^t$.

Using equation (15) from the household’s problem together with the resource constraint implies that consumption is constant across time and states in the new equilibrium.

**Proposition 1** In the competitive equilibrium under uncertainty, consumption, \(c_t(s^t)\), is constant for all $t$ and $s^t$.

**Proof.** See Appendix A. ■

The constant level of consumption is given by:

$$c_t(s^t) = \bar{c} = y - g - r(f_{-1} + b^*_{-1}) \quad (19)$$

Then the money demand equation (16) becomes:

$$\frac{M_t(s^t)}{E_t(s^t)} = \left( \frac{1 - \gamma}{\gamma} \right) \frac{\bar{c}}{1 - \sum_{s^{t+1}|s^t} \frac{E_t(s^t)}{E_{t+1}(s^{t+1})} \left( \frac{\pi(s^{t+1})}{\pi(s^t)} \right)} \quad (20)$$
Using the flow budget constraint of the government, its intertemporal budget constraint can be written for any realization of the government transfers. If we denote a specific realization of the transfers by \( s^t_j \), then the intertemporal budget constraint of the government for any \( j \) is:

\[
\sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \left( \frac{M_t(s^t_j) - M_{t-1}(s^{t-1}_j)}{E_t(s^t_j)} \right) + (1 + r) \left( \frac{B^i + B^n}{E} \right) 
\]

\[
- \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \left( \frac{i_t(s^t_j)B^i + rB^n}{E_t(s^t_j)} \right) = \begin{cases} 
\phi & \text{if transfers increase} \\
0 & \text{otherwise}
\end{cases} 
\]

The intertemporal budget constraint of the government shows the two sources of revenue for the government: the seigniorage revenues through printing money, and a reduction in the real value of nominal debt through a depreciation of the exchange rate, i.e. an increase in \( E_t \). For generating revenue through either one of these sources, the government has to abandon the fixed exchange rate regime.

While a depreciation reduces the real value of both indexed and non-indexed nominal debt, the existence of indexed debt, \( B^i \), introduces an additional effect. When the government has indexed debt, its debt repayment burden increases with an increase in the nominal interest rate as long as the exchange rate stays constant. When agents start expecting a depreciation, the nominal interest rate rises above the real interest rate. If depreciation does not occur, then the real value of indexed nominal debt increases, unlike the real value of non-indexed debt which stays constant as long as the exchange rate does not change. Therefore, uncertainty about an exchange rate depreciation increases the debt burden of the government if it continues to keep the exchange rate fixed.

Sustainability of the fixed exchange rate regime can be analyzed using the intertemporal budget constraint of the government. If the government continues holding the exchange rate fixed in every state, then the intertemporal budget constraint of the government in
the case that the transfers increase will be as follows:

$$
\sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t \left( \frac{M_t - M_{t-1}}{E} \right) + (1 + r) \left[ \left( \frac{\tau - g - \nu}{r} \right) - b^*_{t-1} - \left( \frac{B^i + B^n}{E} \right) \right] = \phi \quad (22)
$$

For a fixed exchange rate, the first term will be zero since the money demand is constant and the government cannot raise any seigniorage revenue. By equation (12) the second term is also zero. Therefore, the intertemporal budget constraint of the government cannot hold for a fixed exchange rate and the government has to abandon the fixed exchange rate regime if the increase in government transfers materializes. This is the standard result in the literature about an increase in the fiscal burden of the government rendering the fixed exchange rate regime unsustainable.

For a calibrated version of the model, it is shown in Section (4) that the fixed exchange rate regime becomes unsustainable and the exchange rate depreciates, whether the transfers increase or not. The following proposition proves this result for a special case in which the uncertainty lasts one period and the government finances the budget deficit with a one-time increase in the money supply when the fixed exchange rate regime is abandoned.

**Proposition 2** When the agents in the economy receive information about the new time-path of government transfers, the fixed exchange rate regime becomes unsustainable and the exchange rate depreciates regardless of whether the increase in government transfers materializes or not. The exchange rate that occurs in the case of an increase in transfers is higher than the exchange rate that would occur in the same period for a constant level of transfers.

**Proof.** See Appendix A. □

This result is due to the fact that the possibility of a depreciation leads to a reduction in money demand and causes a speculative attack. The resulting revenue loss of the government causes a fiscal imbalance to arise endogenously, through the reaction of the household to the new information. When the uncertainty ends at time $T$, if there has not been an
increase in government transfers, the government will still have to raise additional revenue 
to cover the losses it has incurred. Therefore, the exchange rate depreciates in equilibrium, 
whether the transfers increase or not, even though the depreciation of the exchange rate is 
bigger when transfers increase.

2.4.3 The Government Policy

Following the literature, I assume that the government finances its increased liabilities by 
a combination of a one-time increase in the money supply at the date that it abandons the 
fixed exchange rate regime, and growth in the money supply at a constant rate thereafter. 
Therefore, the policy followed by the government if it leaves the peg at time $s$ is:

$$M_t = M_s(1 + \mu_s)^{t-s} \quad \text{for } t \geq s$$ (23)

where $\mu_s$ is the growth rate of the money supply.

The benchmark results of the model are derived under the assumption that $\mu_s = 0$ for 
all $s$, which means the fiscal imbalance is financed by a one-time increase in the money 
supply in the period that the peg is abandoned. The government sets the money supply at 
a level that covers the fiscal deficit and satisfies its intertemporal budget constraint, taking 
as given the path of the exchange rate. The level of the exchange rate in every period will 
adjust so that the money market is in equilibrium every period, for the level of the money 
supply set by the government. The implications of changing the value of $\mu_s$ are analyzed 
in Section (4.2).

If the fiscal burden of the government increases, the fixed exchange rate regime becomes 
unsustainable. The government can postpone the abandonment of the peg for some time 
if it can pay for the increased expenditures by borrowing. However, if it has a borrowing 
constraint that prevents a level of debt that would be enough to pay for the increased 
fiscal burden, then the peg has to be abandoned immediately. It is assumed here that 
the government faces a borrowing constraint in the period that the transfers increase and 
it cannot borrow enough to pay for the increased burden. Therefore, it has to leave the
peg as soon as the fiscal burden increases. This assumption is plausible if the increase in government transfers is thought of as occurring due to a banking crisis or a bailout of the financial sector, which would considerably limit the borrowing options of an emerging market economy due to lack of confidence in the economy. Financial outflow from emerging market economies during crisis episodes can be interpreted as evidence of borrowing limits faced by these countries in times of turmoil.

Uncertainty about the possible increase in government transfers ends at some date $T$. If government transfers do not change until date $T$ and uncertainty ends, the government has to still leave the peg as illustrated in Section (2.4.2). In such a case, it is assumed that the government will leave the peg when its debt level reaches a threshold, $\kappa$. This assumption also follows from the first-generation models of currency crisis. A more restrictive version of this rule, which has also been used in this literature, is to assume that the only component of the government’s portfolio that changes over time is the central bank’s foreign reserves. In that case, the government leaves the fixed exchange rate regime when its foreign reserves hit a lower limit.

3 Model Calibration

The properties of the model are analyzed quantitatively in the next section. For this purpose the model is calibrated to Korean data and the parameter values of the benchmark model are given in Table 1. Throughout the analysis, output and the level of the fixed exchange rate, $\bar{E}$, are normalized to one, and a period represents one month. It is assumed that the uncertainty lasts for 6 periods. Since it is hard to get an estimate for the probability attached to an increase in transfers, a small probability of 0.02 has been chosen to highlight the differences between this case and the case of certainty.

Some of the parameter values are taken from Burnside, Eichenbaum and Rebelo (2006), which uses a similar model. They identify period zero, which is the time at which agents learn that the government intends to bailout the failing banking system, as the end of June
1997. This is the time at which banking sector problems turned into a currency crisis in Thailand, which may have provided information to the Koreans that the problems in the banking sector could lead to a bailout in Korea as well. Therefore, end of June 1997 will be used as period zero in this paper too. The other parameter values taken from this paper are the value of domestic debt, the real interest rate and the increase in government transfers. Using the dollar rate of return on a variety of domestic instruments in Korea in the period 1991 to 2002, they set the value of $r$ as 0.055, which implies a monthly real interest rate of 0.0045. They have estimated the cost of the banking sector bailout that needs to be financed through depreciation related revenues as 13.5% of output, which is the value of $\phi$. Since domestic debt ($B^n$) is modeled as a perpetuity, it has a duration different from that of Korea’s domestic debt. Therefore, they do not use the data on domestic debt of Korea but instead estimate this value as 7.5% of GDP. In the benchmark model I assume that all of the domestic debt is non-indexed so that $B^n = 0.075$ and $B^i = 0$. In Section (4.3) I analyze the implications of changing the shares of indexed and non-indexed debt while keeping the value of total domestic debt constant.

Table 1. Parameter Values in the Benchmark Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>1</td>
<td>Real output</td>
</tr>
<tr>
<td>$\hat{E}$</td>
<td>1</td>
<td>Time 0 exchange rate</td>
</tr>
<tr>
<td>$\tau - \nu$</td>
<td>0.4739</td>
<td>Lump-sum taxes net of transfers</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.9936</td>
<td>Weight of consumption in the utility function</td>
</tr>
<tr>
<td>$r$</td>
<td>0.0045</td>
<td>Monthly real interest rate</td>
</tr>
<tr>
<td>$b^*_{-1}$</td>
<td>-0.042</td>
<td>Time 0 government net foreign debt</td>
</tr>
<tr>
<td>$B^n$</td>
<td>0.075</td>
<td>Time 0 government non-indexed domestic debt</td>
</tr>
<tr>
<td>$B^i$</td>
<td>0</td>
<td>Time 0 government indexed domestic debt</td>
</tr>
<tr>
<td>$f_{-1}$</td>
<td>0.149</td>
<td>Time 0 private net foreign debt</td>
</tr>
<tr>
<td>$\phi$</td>
<td>0.135</td>
<td>Present value of increase in deficit</td>
</tr>
<tr>
<td>$p$</td>
<td>0.98</td>
<td>Probability that transfers stay constant</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>0.71</td>
<td>Upper limit on foreign debt of the government</td>
</tr>
<tr>
<td>$\mu_s$</td>
<td>0</td>
<td>Monthly growth rate of money</td>
</tr>
</tbody>
</table>
To calibrate the values of initial private net foreign debt, $f_{-1}$, and initial net foreign debt of the government, $b^{*}_{-1}$, I use data on net external assets from the Bank of Korea. The figures as of the end of June 1997 show that the net foreign debt of the private sector was 14.9% of GDP and the public sector had net foreign assets of 4.2% of GDP. I set the value of lump-sum taxes net of transfers, $\tau - \nu$, in order to have a ratio of consumption to output in the steady state equal to the sample average of 52.6% in the period 1993Q1-1997Q2. The weight of consumption in the utility function, $\gamma$, is set to match the quarterly average of the ratio of money supply to output in the same period, which is of 25.2%. The data on consumption, money supply, output and exchange rate are obtained from the IMF International Financial Statistics database.

The monthly growth rate of money supply after the abandonment of the peg, $\mu_s$, is taken as zero in the benchmark calibration for all $s$, and the implications of changing the value of $\mu_s$ are analyzed in Section (4.2).

The value of $\kappa$, which is the threshold percentage of debt at which the government abandons the peg, determines whether the peg ends before or after the uncertainty resolves. The value of $\kappa$ used in the benchmark model is chosen so that the government leaves the peg in the period right after the uncertainty ends. As another possibility, the results for a case where the government leaves the peg some time after the uncertainty ends is presented in Appendix B.\(^6\)

\(^6\)The reason for analyzing these two cases instead of a case where the peg is abandoned before the uncertainty ends is to avoid making an arbitrary assumption about the monetary policy in the period between the period the peg is abandoned and the new steady state after the uncertainty ends. As long as the uncertainty continues, the government will not be able to implement its new steady state policy, and it will have to adjust its policy depending on the state of the economy.
4 Results

4.1 Benchmark Results

The main results of the paper are illustrated in Figure 1 and the numerical values are given in Table 2. The first panel of Figure 1 depicts the money supply, $M_s$ (as a ratio of the initial money supply, $\bar{M}$), set by the government at different dates for the cases in which the increase in government transfers occurs in the corresponding period. If transfers increase at a certain period, say period one, then the government abandons the fixed exchange rate regime and sets the money supply in that period, $M_1$, and the money growth rate for the following periods, $\mu_1$, at levels that will satisfy the government’s intertemporal budget constraint. Solving the model, I keep $\mu_s$ constant at zero for all $s$, in order to compare the initial expansion in money supply that would be required at different dates. Therefore, the first panel shows the money supply that would be set by the government at different dates and the resulting exchange rate values. Each value of the money supply is calculated under the assumption that the fiscal burden has increased and the government left the fixed exchange rate in the corresponding period, while the peg was still in place in the periods before that. Hence, the horizontal axis here shows the time at which transfers increase, except for time zero as the increase in government transfers can occur starting at period one.

At time zero, the fixed exchange rate regime is still in place and the exchange rate is fixed at its initial level. There is a drop in money supply reflecting a speculative attack on the currency as the money demand falls due to the depreciation possibility in period one. Households exchange money balances for foreign assets accounting for next period’s depreciation possibility. The falling money demand also results in an increase in the foreign debt stock of the government in period one, as illustrated in the last panel. The money supply levels in the following periods, illustrated in panel 1 and given in the first column of Table 1, are set by the government as the fixed exchange rate regime is abandoned. These
values show the expansion in money supply required to keep the government’s intertemporal budget constraint satisfied. The results show that the monetary expansion required by the government increases with time, reflecting the fact that the government’s need for seigniorage revenue increases as the uncertainty continues. If the expected increase in transfers and the associated depreciation of the currency do not occur in a certain period, the money demand keeps falling since agents continue expecting a depreciation, as illustrated by the fall in the money supply in the second panel of the same figure. The continuing loss of revenue leads to a rise in the government’s foreign debt level as seen in the last panel. Therefore, if the increase in government transfers occurs in later periods, the revenue loss and the debt level of the government continue increasing, as a result of which the expansion in money supply required to satisfy its intertemporal budget constraint increases as well.

Figure 1. Results from the benchmark model
The behavior of the exchange rate follows that of the money supply. At time zero the exchange rate is fixed at its initial level. If the government transfers increase in period one, a currency crisis occurs as the government leaves the peg, and the exchange rate depreciates substantially. The depreciation of the exchange rate gets larger, reflecting the higher values of the money supply, as the onset of the fiscal imbalance is delayed. The depreciation of the exchange rate is 64.7% if the uncertainty is resolved in period one, while it increases to 89.4% in period six.

The second panel of Figure 1 shows the values of the money supply and the exchange rate for the case in which the uncertainty ends in period six without an increase in government transfers, and the fixed exchange rate regime is abandoned in the following period. Here the exchange rate is fixed at its initial value and money demand is falling until period seven. As the uncertainty continues, there is a certain probability in every period that the exchange rate will depreciate as a result of an increase in the fiscal burden. As illustrated in the first panel, the size of the depreciation increases over time. As agents correctly account for the depreciation possibility, with the depreciation size getting larger, their money demand falls over time. Therefore, the speculative attack on the currency that starts at the initial period continues until the foreign debt level reaches a threshold and the government decides to leave the peg. This steady fall in money demand is reflected in the growing foreign debt level of the government. Therefore, even though there is no exogenous increase in the fiscal burden, the government incurs a budget deficit endogenously by the continuous attack on the currency and the resulting negative seigniorage. As a result of this, the government has to abandon the fixed exchange rate regime in order to raise revenue and balance its intertemporal budget, even if the expected increase in government transfers never materializes. The resulting depreciation is illustrated by the jump in the exchange rate at period seven and the exchange rate depreciates by 22.1%. This is a

\footnote{The exchange rate, money supply and interest rate values for a case where the government leaves the peg after the uncertainty ends are illustrated in Appendix B.}

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sizable depreciation given that the depreciation that would occur in the case of an increase in transfers in period one is 64.7%. In anticipation of this depreciation, the money demand falls further in the period just before the depreciation occurs.

Panel three shows the nominal interest rate on domestic currency debt for the case in which the exchange rate regime is abandoned in period seven, as in the second panel. The interest rate jumps up at time one, reflecting the news about a possible increase in transfers and the depreciation that would occur as a result of this. The rise in the interest rate continues as the uncertainty continues and it peaks at period seven, reflecting the depreciation that would occur with certainty at this date. After this time period, the interest rate drops down to its new steady state level of \((1 + r)(1 + \mu) - 1\). The behavior of interest rates illustrated in this figure is consistent with the behavior observed before many currency crises: interest rates start to rise while the exchange rate is still fixed and increases sharply when the exchange rate depreciates.

<table>
<thead>
<tr>
<th>Time of increase in transfers</th>
<th>Transfers increase</th>
<th>Transfers stay constant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M/\bar{M})</td>
<td>(E)</td>
</tr>
<tr>
<td>0</td>
<td>0.3641</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1.6473</td>
<td>1.6473</td>
</tr>
<tr>
<td>2</td>
<td>1.6927</td>
<td>1.6927</td>
</tr>
<tr>
<td>3</td>
<td>1.7429</td>
<td>1.7429</td>
</tr>
<tr>
<td>4</td>
<td>1.7987</td>
<td>1.7987</td>
</tr>
<tr>
<td>5</td>
<td>1.8609</td>
<td>1.8609</td>
</tr>
<tr>
<td>6</td>
<td>1.8937</td>
<td>1.8937</td>
</tr>
<tr>
<td>7</td>
<td>1.2212</td>
<td>1.2212</td>
</tr>
</tbody>
</table>

If the government has indexed debt, i.e. \(B^i \neq 0\), then the illustrated increase in the interest rate will raise the debt repayment burden of the government as long as the exchange rate is kept fixed. This will impose an additional revenue need on the government other than that due to the loss of revenue through falling money demand. The effects of changing
the share of indexed debt on equilibrium exchange rate and money supply are discussed in Section (4.3) and illustrated in Figure 3.

The last panel illustrates how the foreign debt issued by the government in each period changes through time. As mentioned earlier, the government incurs additional debt to compensate for the loss of revenue due to the reduction in money demand. This rise in the debt stock continues until the fixed exchange rate regime is abandoned and foreign debt reaches its new steady state level after that.

4.2 Changes in the Growth Rate of Money

In the benchmark solution of the model, the growth rate of the money supply, $\mu_s$, is kept constant at zero for all $s$. In Figure 2 the money supply (as a ratio of the initial money supply, $\bar{M}$) and the exchange rate levels for different values of $\mu_s$ are plotted. The first panel is for the case in which the fiscal deficit increases in period one and the second panel is for the case in which there is no increase in transfers and the peg is abandoned in period seven.

Figure 2. Money supply and exchange rate for different values of $\mu_s$. 
The figure shows that as the money growth rate increases, the initial increase in the money supply decreases. Higher values of $\mu_s$ imply that after the fixed exchange rate regime is abandoned, more seigniorage revenue is generated over time with a higher growth rate of money. Therefore, the initial expansion in money supply that is required to balance the government’s intertemporal budget decreases as $\mu_s$ increases. The depreciation of the exchange rate that occurs as a result of the new government policy decreases with higher values of $\mu_s$ as well. The exchange rate depreciation decreases at a rate lower than the decrease in the money supply since the exchange rate is also affected by $\mu_s$: higher $\mu_s$ implies an higher interest rate, $i_t$, and therefore reduces money demand, which implies an increase in $E_t$ for a given level of $M_t$. The exchange rate value decreases from 1.65 to 1.45 in the first panel whereas it decreases from 1.22 to 1.11 in the second panel. The value of $\mu_s$ at which the initial expansion in the money supply falls down to zero and the exchange rate reaches its minimum level is lower in the second panel. When transfers increase in period one, at $\mu_1 = 0.002$ the exchange rate reaches its minimum level of 1.45, whereas when transfers stay constant $\mu_7 = 0.00048$ is sufficient for the government to balance its budget.

4.3 Changes in the Share of Indexed Debt

In the benchmark calibration the value of indexed debt is taken as zero. In this section, I analyze how equilibrium exchange rates in different periods change with the share of indexed debt in total domestic debt, while keeping the value of total domestic debt constant at 0.075. I also analyze how the share of indexed debt affects the per-period repayment on domestic debt.

The first panel of Figure 3 shows the exchange rate levels that would occur in period one and period six (the last period of uncertainty), conditional on the fiscal burden increasing in the corresponding period. The amount repaid on indexed debt increases with an increase in the nominal interest rate. The possibility of a currency crisis leads to increasing nominal
interest rates as long as the uncertainty continues, and if the government does not let the exchange rate float, the real interest rate increases too. As a result, the real value of the government’s debt burden rises with the share of indexed debt. Therefore, the expansion in money supply needed by the government and the resulting depreciation of the exchange rate increase with a higher share of indexed debt, holding money growth rate constant.

Increasing the share of indexed debt affects the exchange rate in period one much less compared to the exchange rate in period six. If the uncertainty is resolved in the first period and the government leaves the peg, it has to pay a higher real value on indexed debt only for one period. However, if the uncertainty continues until period six, then the government has to pay a higher value on indexed debt for a much longer period of time. The loss incurred by the government due to indexed debt increases as the uncertainty continues longer and as a result, the depreciation of the exchange rate increases more with an increase in the share of indexed debt in later periods.

Figure 3. The effects of changing the share of indexed debt

The second panel of Figure 3 illustrates how the per-period repayment on domestic debt, \((i_tB^i + rB^n)/\bar{E}\), changes with the share of indexed debt in periods one and six, holding the
total value of domestic debt constant. The equilibrium value of the exchange rate, when the government leaves the peg, increases as the share of indexed debt rises. Therefore, the nominal interest rate and the repayment due on domestic debt increases as well. Since the rise in the exchange rate, and hence the interest rate, is higher in later periods, the rise in the repayment value increases more with an increase in the share of indexed debt in period six compared to period one.

It has been argued in many papers that the presence of domestic currency debt helps governments in coping with the fiscal burden in crisis episodes since depreciation of the exchange rate reduces the real value of this kind of debt. However, if the interest rate on domestic currency debt is indexed to the market interest rate, then the debt burden of the government increases on the way to a currency depreciation if this episode is characterized by rising interest rates as has been the case before many currency crises. A similar analysis would apply if the government does not have indexed debt but needs to roll over its domestic currency debt while the interest rates are rising so that it has to borrow at a higher nominal cost. This translates into a higher real cost as long as the government holds on to the fixed exchange rate. Therefore, during periods of uncertainty about the value of the exchange rate, the government has to incur an additional cost if it has to borrow in domestic currency or if it has domestic currency debt indexed to the nominal interest rate as illustrated in this model.

5 Conclusions

In the first-generation models of currency crises, a fiscal deficit financed by a flow of seigniorage from the monetary authority renders the fixed exchange rate regime unsustainable. The widely used assumption in this literature is that the government is either currently running a fiscal deficit, or will incur a deficit in the future. However, in reality the occurrence of a fiscal deficit may be an uncertain event, which might never materialize. This paper introduces uncertainty about a future fiscal deficit into a first-generation currency crisis model,
and explores the effects of such an uncertainty on the evolution of crisis episodes.

The paper shows that when agents learn about a possible increase in the fiscal burden of the government, which cannot be financed through a fiscal reform, the fixed exchange rate regime becomes unsustainable and a currency crisis occurs independently of whether the fiscal imbalance materializes or not. Therefore, the mere possibility of a deficit is sufficient to generate a speculative attack and abandonment of the fixed exchange rate regime. The reason for this outcome is that expected depreciation reduces money demand and the government incurs revenue losses as it keeps the exchange rate fixed. As a result, a fiscal imbalance occurs endogenously in the model through negative seigniorage, even if the exogenous fiscal deficit does not materialize. The model also predicts that the exchange rate depreciation that occurs with the abandonment of the peg gets bigger as the uncertainty lasts longer.

Another prediction of the model is that the interest rates will increase before a currency crisis occurs, which is a feature that is observed before many currency crisis episodes. The model’s predictions also indicate that the borrowing structure of the government is important in the depreciation rate of the currency. If the government has nominal liabilities indexed to the interest rate, the currency depreciates more when the fixed exchange rate regime is abandoned.
References


Appendix A

**Proof of Proposition 1.** The uncertainty lasts until period \( T \) and if transfers do not increase by this date, then they stay at their initial level. This implies that at date \( T \), the economy reaches a new steady state, either with high transfers or low transfers. Denoting the state in which transfers stay constant by superscript 1 and the state in which transfers increase by superscript 2, consumption at these two steady states can be named \( c^1_T \) and \( c^2_T \), for low transfers and high transfers respectively. Using equation (9), these two consumption levels will be equal and given by

\[
c^1_T = c^2_T = \bar{c}_T = y - g - r(f_{T-1}^1 + b_{T-1}^{s1}).
\]

Using equation (15)

\[
\frac{1}{c^1_{T-1}} = \frac{p}{c^1_T} + \frac{1-p}{c^2_T} \Rightarrow c^1_{T-1} = \bar{c}_T
\]

Since consumption is constant from period \( T - 1 \) onwards if state 1 materializes, again using the intertemporal resource constraint (9),

\[
c^1_{T-1} = y - g - r(f_{T-2}^1 + b_{T-2}^{s1})
\]

If state 2 materializes in period \( T - 1 \), then the economy again reaches a steady state and consumption is given by

\[
c^2_{T-1} = y - g - r(f_{T-2}^1 + b_{T-2}^{s1})
\]

Therefore, \( c^1_{T-1} = c^2_{T-1} = \bar{c}_{T-1} = \bar{c}_T \). Continuing backwards, it can be concluded that \( c_t(s^t) = \bar{c} = y - g - r(f_{-1} + b_{-1}^{*1}) \) for all \( t \) and \( s^t \).

**Proof of Proposition 2.** The proposition is proven for the case where the uncertainty lasts one period and the government finances the budget deficit with a one-time increase in the money supply when the fixed exchange rate is abandoned. The time period in which the information arrives is taken as time 0 and the government transfers increase at time 1.
Hence, at time 1 there are two possible states; in state 1 government transfers stay constant and in state 2 they increase to a new level. The probabilities of state 1 and state 2 as of time 0 are \( p \) and \( 1 - p \), respectively.

First, I will show that the exchange rate at time 1 in state 2, \( E_1(2) \), has to be greater than the exchange rate at the same time 1 in state 1, \( E_1(1) \). This is implied by the intertemporal budget constraint of the government. Assuming that the money growth rate is set to zero after the abandonment of the fixed exchange rate, the real money demand, implied by equation (20), is the same in both states at time 1. Therefore, \( \frac{M_1(1)}{E_1(1)} = \frac{M_1(2)}{E_1(2)} \).

The present value of the fiscal surplus of the government will be denoted by \( \Gamma_1 \) if government transfers do not increase and by \( \Gamma_2 \) if they increase as follows:

\[
\sum_{t=0}^{\infty} \left( \frac{1}{1 + r} \right)^t (\tau_t - g_t - \nu_t) = \begin{cases} 
\Gamma_1 & \text{if transfers stay constant} \\
\Gamma_2 & \text{if transfers increase}
\end{cases}
\]

where \( \Gamma_1 > \Gamma_2 \).

The difference of the intertemporal budget constraints of the government in the two states is given by:

\[
\frac{1}{1 + r} \left( \frac{M_1(2) - M_0}{E_1(2)} - \frac{M_1(1) - M_0}{E_1(1)} \right) + (\Gamma_2 - \Gamma_1) = \left( \frac{B^i(1 + i_1)}{1 + r} + B^n \right) \left( \frac{1}{E_1(2)} - \frac{1}{E_1(1)} \right)
\]

where

\[
1 + i_1 = (1 + r) \left( \frac{pE_1(1) + (1 - p)E_1(2)}{E} \right).
\]

Using \( \frac{M_1(1)}{E_1(1)} = \frac{M_1(2)}{E_1(2)} \), the above equation simplifies as

\[
\left( \frac{1}{E_1(2)} - \frac{1}{E_1(1)} \right) \left( \frac{M_0}{1 + r} + \frac{B^i(1 + i_1)}{1 + r} + B^n \right) = \Gamma_2 - \Gamma_1
\]

Since \( \Gamma_2 - \Gamma_1 < 0 \) and \( M_0 > 0 \), for \( B^i \geq 0 \) and \( B^n > 0 \)

\[
\frac{1}{E_1(2)} - \frac{1}{E_1(1)} = \frac{\Gamma_1 - \Gamma_2}{\left( \frac{M_0}{1 + r} + \frac{B^i(1 + i_1)}{1 + r} + B^n \right)} < 0
\]

which implies that

\[ E_1(2) > E_1(1) \] (24)
Therefore, the equilibrium exchange rate when government transfers increase is greater than the exchange rate in the case of no increase in transfers. This condition also shows that the fixed exchange rate cannot be kept at the initial level, \( \bar{E} \), in both of the states and has to be abandoned in at least one of the states.

I will next show that the only possible equilibrium is where \( E_1(2) > E_1(1) > \bar{E} \), that is, the fixed exchange rate regime will have to be abandoned in both states and the government will set the money supply such that the resulting exchange rates in both states are higher than the initial level.

The intertemporal budget constraint of the government in state 1 is:

\[
\frac{M_0 - \bar{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(1) - M_0}{E_1(1)} \right) + \Gamma_1 = (1 + r) b^*_{-1} + r \frac{B^n}{E_1(1)} + r \frac{B^i}{E} + \frac{B^i(1 + i_1)}{E_1(1)(1 + r)}
\]

which simplifies, using equation (12), as

\[
\frac{M_0 - \bar{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(1) - M_0}{E_1(1)} \right) = B^n \left( \frac{1}{E_1(1)} - \frac{1}{E} \right) + B^i \left( \frac{(1 + i_1)}{E_1(1)(1 + r)} - \frac{1}{E} \right)
\]

The left-hand side of equation (25), after substituting in the money demand functions, becomes

\[
\frac{M_0 - \bar{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(1) - M_0}{E_1(1)} \right) = (1 - p) \bar{E} \bar{c} \left( \frac{1}{1 + r} \right) \left( \frac{1 - \gamma}{\gamma} \right) \left( \frac{1}{E_1(2)} - \frac{1}{E_1(1)} \right)
\]

where

\[
A = 1 - \frac{1}{1 + r} \left( p \frac{\bar{E}}{E_1(1)} + (1 - p) \frac{\bar{E}}{E_1(2)} \right).
\]

Using the money demand function at time 0 given by

\[
\frac{M_0}{E} = \bar{c} \left( \frac{1 - \gamma}{\gamma} \right) \left[ \frac{1}{1 - \frac{1}{1 + r} \left( p \frac{E}{E_1(1)} + (1 - p) \frac{E}{E_1(2)} \right)} \right]
\]

we can conclude that \( A > 0 \), since \( \frac{M_0}{E} > 0 \).

By condition (24)

\[
\frac{1}{E_1(2)} - \frac{1}{E_1(1)} < 0.
\]
This condition, together with \(0 < p < 1\), \(0 < \gamma < 1\) and \(A > 0\), implies that

\[
\frac{M_0 - \tilde{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(1) - M_0}{E_1(1)} \right) < 0
\]

in equilibrium. Therefore, the right hand side of equation (25) has to be negative as well. We can determine the sign of the last term on this side as:

\[
\frac{(1 + i_1)}{E_1(1)(1 + r)} - \frac{1}{E} = \frac{(1 - p)}{E} \left( \frac{E_1(2)}{E_1(1)} - 1 \right) > 0
\]

which follows from condition (24).

Therefore, for \(B^i \geq 0\) and \(B^n > 0\), equation (25) holds only when

\[
\frac{1}{E_1(1)} - \frac{1}{E} < 0,
\]

which implies that

\[
E_1(1) > \bar{E}.
\]

Therefore, the exchange rates in equilibrium will have to satisfy

\[
E_1(2) > E_1(1) > \bar{E}
\]

for the intertemporal budget constraint of the government to hold in state 1.

Now we can check whether the given ordering of the exchange rates is consistent with the intertemporal budget constraint of the government in state 2, which is given by

\[
\frac{M_0 - \tilde{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(2) - M_0}{E_1(2)} \right) + (\Gamma_2 - \Gamma_1) = B^n \left( \frac{1}{E_1(2)} - \frac{1}{E} \right) + B^i \left( \frac{(1 + i_1)}{E_1(2)(1 + r)} - \frac{1}{E} \right)
\]

The left hand side of this equation, after substituting in the money demand functions, becomes

\[
\frac{M_0 - \tilde{M}}{E} + \frac{1}{1 + r} \left( \frac{M_1(2) - M_0}{E_1(2)} \right) + (\Gamma_2 - \Gamma_1) = \frac{p\bar{E}\bar{c}}{A} \left( \frac{1}{1 + r} \right) \left( \frac{1 - \gamma}{\gamma} \right) \left( \frac{1}{E_1(1)} - \frac{1}{E_1(2)} \right) + (\Gamma_2 - \Gamma_1)
\]
Using condition (24),
\[
\frac{1}{E_1(1)} - \frac{1}{E_1(2)} > 0.
\]

Since we know that \( A > 0 \) and \( \Gamma_2 - \Gamma_1 < 0 \), the left hand side of equation (27) can be positive or negative depending on the parameter values. The terms on the right hand side of (27) have the following signs:
\[
\frac{1}{E_1(2)} - \frac{1}{E} < 0
\]
\[
\frac{(1 + i_1)}{E_1(2)(1 + r)} - \frac{1}{E} = \frac{p}{E} \left( \frac{E_1(1)}{E_1(2) - 1} \right) < 0
\]

Therefore, for \( B^i \geq 0 \) and \( B^n > 0 \), the left hand side of equation (27) is negative. This implies that, depending on the parameters of the model, we can find exchange rate values such that \( E_1(2) > E_1(1) > \bar{E} \) and the budget constraint of the government holds in state 2 as well. ■
Appendix B

Figure 5. The case where uncertainty ends at $t = 6$ and the peg is abandoned at $t = 11$