UNIVERSITY OF NOTTINGHAM

Discussion Papers in Economics

Discussion Paper
No. 06/02

THE CURRENCY DENOMINATION OF SOVEREIGN DEBT

by Michael Bleaney

January 2006

DP 06/02

ISSN 1360-2438

UNIVERSITY OF NOTTINGHAM

Discussion Papers in Economics

Discussion Paper
No. 06/02

THE CURRENCY DENOMINATION OF SOVEREIGN DEBT

by Michael Bleaney

Michael Bleaney is Professor, School of Economics, University of Nottingham

January 2006

The Currency Denomination of Sovereign Debt

by

Michael Bleaney

School of Economics
University of Nottingham
Nottingham NG7 2RD, U.K.
e-mail: michael.bleaney@nottingham.ac.uk
Tel. (+44) 115 951 5464
Fax. (+44) 115 951 4159

Abstract
This paper considers the currency composition of sovereign debt in the context of risk-sharing through excusable defaults. It is shown that monetary credibility is not a sufficient condition for borrowing in domestic currency. With real exchange rate risk, debt denominated in a borrowing country's currency can be too state-contingent to support international lending on purely reputational considerations, even when debt denominated in the lending country's currency is viable. The model can explain the geographical pattern of bond issuance, the phenomenon of "original sin", and the concentration of defaults on foreign-currency debt.

Keywords: debt, default

JEL Nos: F34

INTRODUCTION

It is well known that emerging-market sovereign debt issued on the world's major exchanges is overwhelmingly denominated in foreign currency (Hausmann and Panizza, 2003). This paper examines this phenomenon in the context of a theoretical model of sovereign debt. Grossman and Van Huyck (1988) present a model of international lending in which partial default can be excused in identifiably bad states of the world, and is followed by a resumption of lending. In such a model payments to lenders are *de facto* state-contingent. Alfaro and Kanczuk (2005) provide a quantitative assessment of this model, and conclude that it fits the empirical data provided that there are output losses associated with default. In practice, even when partial default is eventually accepted by the lenders, output losses can arise while the precise extent of default is subject to negotiation, because of high interest rates and depressed capital flows (Flandreau and Zumer, 2004). These output losses are, of course, precisely what has motivated concern about the costs of "dependence" on foreign debt.

Theoretical analysis of sovereign debt has focused on a world of many legal jurisdictions but a single currency. These assumptions are a reflection of two important features of the real world – that defaults have been much more frequent on debt denominated in foreign currency, and that sovereign debt is overwhelmingly denominated in the currency of the market in which it is issued.[1] Emerging-market countries tend to have their debt issued in the world's major financial markets, and therefore in foreign currency – a phenomenon that has become known as "original sin" (Eichengreen and Hausmann, 1999).

[1] Manasse *et al*. (2003) provide a list of sovereign defaults over the period 1970-2001. Russia 1998 is an exception to the rule that defaults only afflict foreign-currency debt.

Opinions differ as to the explanation of the low default rate on domestic-currency debt. The cynical view is that the benefits of default can be obtained, without the costs, by simply printing money and exploiting the inflation tax. Another possibility is that governments are inhibited from default on debt that is owned to a significant extent by domestic residents whose welfare it values (Tirole, 2002). The latter interpretation implies that the low default rate on domestic-currency debt is in part a consequence of original sin, since domestic residents would be less likely to hold this debt if it were issued on foreign financial markets.

This paper develops a model of sovereign debt in which domestic bond markets are costly to establish. The borrowing government is interested in its purchasing power over foreign goods, but suffers real exchange rate uncertainty because of the fluctuating price of the country's exports. Debt may be indexed to either the import or the export price. In the latter case (which corresponds to debt denominated in domestic currency), payments are strongly state-contingent, which is desirable for the borrowers, but, as we shall see, this also implies that lending is more likely to be undermined by the threat of repudiation. In the former case (debt denominated in foreign currency), payments are in principle not state-contingent but may in practice be partially so (if there are excusable defaults). The costly development of domestic bond markets may be regarded as an investment in a commitment not to repudiate domestic-currency debt by ensuring that there is a significant constituency of domestic bondholders. It is shown that the phenomenon of original sin may arise if (a) servicing of domestic-currency debt is too state-contingent to support lending, (b) if the output costs of default are sufficiently low and (c) if the costs of developing domestic bond markets are too high relative to the benefits. The main

message of the paper is that monetary credibility is not a sufficient condition for being able to borrow in one's own currency.

THE MODEL

Assumptions

The model is based on that of Cole and Kehoe (1995). There are two countries, each using the same currency. One has a risk-neutral government which is a monopolist of an investment project but initially has no resources to exploit it. The other consists of risk-neutral bankers who compete to lend to this government. All agents have a discount factor of β, and competition amongst bankers forces the gross interest rate down to $r = 1/\beta$. The returns to the investment project are of the following pattern: in alternate periods they are zero, and in alternate periods an investment of one unit in the previous period produces output of a non-storable commodity of $A > r$. There is a maximum investment of one. The government has a linear per-period utility function in consumption:

$$U(c_t) = c_t \tag{1}$$

Thus, if t is odd, the government borrows and invests one unit and consumes nothing. If t is even, the government has output of A from the previous period's investment, repays debt of r, borrows and invests nothing, and consumes $A - r$. Alternatively, the government could repudiate the debt, after which there is no further lending. As Cole and Kehoe (1995) show, repudiation is always preferable if the government is able to save the

resources obtained and earn a gross return of r on them.[2] Therefore we assume that the government is unable to save, and that repudiation implies immediate consumption of the entire output, with zero output in all future periods.

This model is modified here in the following respects. First, the countries have separate currencies, and there is production in the lending country. Second, utility is derived only from consumption of the real output of the lending country. Third, bonds may be issued on financial markets in the lending or the borrowing country, and in either currency. At time zero, the financial markets in the borrowing country do not exist. There is a sunk cost C in establishing them, and the government makes a binding commitment that bonds issued in the borrowing country are never repudiated.[3]

Finally, the output of the borrowing country is exchanged for imports from the lending country at an uncertain real exchange rate (p). The real exchange rate, which is specified as the purchasing power of the borrower's currency over the lenders' currency, is assumed to be one in each odd period, and to be uniformly distributed over the range $(1 - x, 1 + x)$ in each even period. If x is large enough that $A(1 - x) < r$, the borrowing country does not have enough resources to repay the debt in full when the loan is denominated in the lenders' currency and p is low. This is assumed to be a situation of excusable partial default, in the sense of Grossmann and Van Huyck (1988). If excusable default occurs, the borrowers hand over all of the output to the lenders, who are able to verify that the consumption of the borrowers is zero, but lending resumes in the next period. Clearly, in this case loans incorporate a default risk premium.

[2] As Grossman and Han (1999) show, this is the consequence of the risk-neutrality of the borrower. With risk-averse borrowers and state-contingent debt repayments, repudiation is not necessarily optimal when the borrowers can save.

Solution

In addition to the option of never borrowing and having consumption of zero in all periods, the borrowing country has three choices, which we examine in turn.

(a) Borrow in domestic currency on foreign markets (DCFM);

(b) Borrow in foreign currency on foreign markets (FCFM);

(c) Invest in the development of domestic bond markets and use them to borrow in domestic currency (DCDM).

Borrowing in domestic currency on foreign markets (*DCFM*)

Debt of this form can be supported if, whatever the realisation of the real exchange rate, the benefits of future borrowing exceed the gains from repudiation. If the real exchange rate at time t is p_t, and t is an even number, then repudiation of the debt at time t yields discounted utility of

$$U(R) = Ap_t. \tag{2}$$

Here R denotes repudiation. The expected utility of repaying the debt [$U(N, DC)$] is:

$$U(N, DC) = (A - r)p_t + \frac{\beta^2}{1-\beta^2}(A - r). \tag{3}$$

The first term on the right-hand side represents utility in period t, and the second term represents the discounted expected utility of consumption in future even periods, when p is on average equal to one. Note that debt repayments are highly state-contingent,

[3] This assumption captures the idea that bonds issued in the borrowing country attract domestic investors, thus increasing the political cost of repudiation. For the costs involved in establishing domestic debt markets, see Litan *et al*. (2003).

because they are indexed to the real exchange rate. Debt will not be repudiated if $U(R) < U(N, DC)$, i.e. if

$$rp_t \leq \frac{\beta^2}{1-\beta^2}(A-r). \tag{4}$$

If there are any values of p for which this condition is not met, lenders know that with some probability the debt will be repudiated, and we assume that they therefore do not lend.[4] Allowing for the fact that $\beta = 1/r$ and that p_t has a maximum value of $1 + x$, the condition for debt never to be repudiated is that

$$A \geq r^3 + xr(r^2 - 1) = A^*. \tag{5}$$

This condition ensures that debt will be repaid even when the amount due is at its maximum value. Note that, as x increases, implying greater real exchange rate volatility, this condition is less likely to be met. Equation (5) has to hold for lenders to be willing to buy bonds issued in the borrower's currency in foreign markets.

Borrowing in foreign currency on foreign markets (*FCFM*)

In this case the debt is no longer indexed to the real exchange rate. There are two cases: where export revenues are always sufficient to repay the debt, and where they are not. The first case arises when $A(1 - x) \geq r$. Then repudiation yields the same utility as before, whilst repayment yields an expected utility of

$$U(N, FC) = Ap_t - r + \frac{\beta^2}{1-\beta^2}(A-r). \tag{6}$$

The condition that $U(R) \leq U(N, DC)$ is

[4] If the probability of repudiation is low, it is possible that the lenders could lend at an interest rate premium until repudiation occurs, and that this could be consistent with their zero-profit condition.. We assume that, if lenders have offered such a contract in the past, repudiation has occurred and lending has ceased.

$$r \leq \frac{\beta^2}{1-\beta^2}(A-r) \tag{7}$$

or, since $\beta = 1/r$,

$$A \geq r^3 \tag{8}$$

This is a less stringent condition for non-repudiation than for domestic-currency debt for any $x > 0$. The reason is that the resources which can be confiscated by the debtor in repudiating the debt are fixed in terms of the lenders' currency (but with the same mean as in the case of borrowing in domestic currency). Since the no-repudiation condition depends on the *maximum* resources measured in the lenders' currency which the debtor can confiscate, repudiation is less likely in this case.

Now consider the possibility that $A(1 - x) < r$. Assume that the lenders can recognise that this is the case, and are willing to accept payment of the entire output in this situation, reducing the borrower's consumption to zero. Further assume that default entails an output cost of z. To cover the risk of partial default, which has a probability of q, lenders charge a higher interest rate R. Lenders receive R with a probability of $1 - q$ and $Ap - z$ with a probability of q, and the borrower's consumption is respectively $Ap - R$ or zero. Mean consumption is $A - r - qz$. Since lenders must have an expected return of r, R must satisfy the following equations:

$$(1-q)R + q\left(\frac{R + A(1-x)}{2} - z\right) = r \tag{9}$$

$$q = \frac{R - A(1-x)}{2Ax}. \tag{10}$$

Equation (10) follows from the assumptions about the probability distribution of p. This yields a quadratic in R for which the valid solution is:

$$R = A(1+x) - z - \sqrt{\left(4Ax(A-r-z) + z^2\right)} \tag{11}$$

$$q = 1 - \frac{z}{2Ax} - \frac{1}{2Ax}\sqrt{\left(4Ax(A-r-z) + z^2\right)} \tag{12}$$

Note that $\partial R/\partial x > 0$ and $\partial q/\partial x > 0$.[5]

If period t is a non-default period, the expected utility of repayment is then:

$$U(N, FC) = Ap_t - R + \frac{\beta^2}{1-\beta^2}(A - r - qz)\,. \tag{13}$$

If period t is a default period, the utility of non-repudiation will be less than this, because consumption in period t will be zero. Consequently, to show that debt will not be repudiated, it is sufficient to demonstrate that it will not be repudiated in non-default periods.

Comparing equations (2) and (13), we can see that foreign-currency debt will not be repudiated if

$$R \le \frac{\beta^2}{1-\beta^2}(A - r - qz)\,. \tag{14}$$

Since a rise in x raises both R and q, this condition is less likely to be satisfied when real exchange rates are more volatile, and also when the output costs of default are greater. Substituting for q from (10), this condition may also be written:

$$R \le \frac{2x(A-r) - (1-x)z}{2Ax(1-\beta^2) - \beta^2 z}\beta^2 A = R^* \tag{15}$$

[5] This is true because $Ax > (A - r)$, otherwise $R = r$.

Borrowing in domestic currency on domestic markets (*DCDM*)

We assume that the sunk cost, C, of developing domestic bond markets is paid in an even period for borrowing in the following odd period. Although it is possible to issue foreign-currency debt once the cost C has been paid, this is inferior if it involves output costs associated with periodic default. Hence we assume that only domestic-currency debt is issued on domestic markets. The expected utility of investing in this development is:

$$U(DCDM) = \frac{\beta^2}{1-\beta^2}(A-r) - C\,. \tag{16}$$

This reflects the fact that investment of C in period t generates utility of $(A - r)$ in periods t+2, t+4 and so on.

If $A > A^*$, the utility level of $\frac{\beta^2}{1-\beta^2}(A-r)$ can be achieved without the expenditure of C by borrowing in domestic currency on foreign markets, and the cost C is not paid.

If $A < A^*$ and $R > R^*$, then the country is unable to borrow on foreign markets, and it will invest in the development of domestic bond markets provided that $U(DCDM) > 0$, or

$$C \prec \frac{\beta^2}{1-\beta^2}(A-r) = C_{\mathrm{H}}. \tag{17}$$

Finally, if $A < A^*$ and $R < R^*$, the country is borrowing in foreign currency on foreign markets, and it invests in the development of domestic bond markets only if $U(DCDM) > U(N, FC)$. Since $U(N, FC) > 0$ in this case, this is a more stringent condition than $C < C_{\mathrm{H}}$. The prospective value of $U(N, FC)$ is:

$$U(N, FC) = \frac{\beta^2}{1-\beta^2}(A - r - qz). \tag{18}$$

Comparing this with (16) gives the result that $U(DCDM) > U(N, FC)$ if

$$C \prec \frac{\beta^2}{1-\beta^2} qz = C_{\mathrm{L}} \tag{19}$$

or in other words that C is less than the present value of the future output costs of default. It is clear from inspection that $C_{\mathrm{L}} < C_{\mathrm{H}}$.

Table 1. Patterns of lending as a function of various parameters

	Cost of developing domestic bond markets (C)		
	$C > C_{\mathrm{H}}$	$C_{\mathrm{H}} > C > C_{\mathrm{L}}$	$C < C_{\mathrm{L}}$
	(high)	(medium)	(low)
$A \geq A^*$	DCFM	DCFM	DCFM
$A < A^*$ and $R \leq R^*$	FCFM	FCFM	DCDM
$A < A^*$ and $R > R^*$	No lending	DCDM	DCDM

Notes. *DCFM*: borrowing in domestic currency on foreign markets; *FCFM*: borrowing in foreign currency on foreign markets; *DCDM*: borrowing in domestic currency on domestic markets. See equations (5), (15), (17) and (19) respectively for the definitions of A^*, R^*, C_{H} and C_{L}.

Summary

The results derived above may be summarised as shown in Table 1. If conditions are very favourable ($A \geq A^*$), domestic-currency bonds can be issued on foreign markets. If they are rather less favourable ($A < A^*$), and defaults on foreign-currency bonds are sufficiently infrequent and costs of default not too high ($R \leq R^*$), only foreign-currency

bonds can be issued on foreign markets. Further, if the costs of developing domestic bond markets are above a critical level, this situation will give rise to the phenomenon of "original sin". If, on the other hand, the costs of developing domestic bond markets are low, borrowing countries will develop their own bond markets. Note that borrowing on foreign markets in foreign currency can discourage the development of domestic bond markets, i.e. "original sin" can be an optimal choice.

CONCLUSIONS

The model developed above shows that acquiring monetary credibility is not a sufficient condition for being able to borrow in domestic currency. With real exchange rate risk, loans denominated in the borrower's currency are more state-contingent than loans denominated in the lenders' currency. In particular, debt payments denominated in the borrower's currency fully reflect the real exchange rate when it is strong. This increases the incentive to repudiate the debt. Consequently, sovereign lending may be viable when it is denominated in the lenders' currency but not when it is denominated in the borrower's currency, even when the debt is indexed to the price level. For this situation to arise, defaults on foreign-currency debt must be not too frequent and the output costs of default not too large.

A country always has the option of investing in the development of its domestic bond markets, insuring investors against repudiation, but has less incentive to do so if it can borrow in foreign financial markets in foreign currency (and none if it can borrow in foreign markets in domestic currency). Hence we tend to observe the following pattern:

countries tend to borrow in domestic currency in domestic markets and in foreign currency in foreign markets, and defaults occur mostly in the latter case.

REFERENCES

Alfaro, L. and Kanczuk, F. (2005). Sovereign debt as a contingent claim: a quantitative approach, *Journal of International Economics* 65, 297-314.

Cole, H.L. and Kehoe, P.J. (1995). The role of institutions in reputation models of sovereign debt, *Journal of Monetary Economics* 35, 45-64.

Eichengreen, B., and Hausmann, R. (1999). Exchange rates and financial fragility, *NBER Working Paper* no. 7418.

Flandreau, M. and Zumer, F. (2004). *The Making of Global Finance 1880-1913*, Paris: OECD.

Grossman, H.I. and Han, T. (1999). Sovereign debt and consumption smoothing, *Journal of Monetary Economics* 44, 149-58.

Grossman, H.I. and Van Huyck, J.B. (1988). Sovereign dent as a contingent claim: excusable default, repudiation, and reputation, *American Economic Review* 78, 1088-97.

Hausmann, R. and Panizza, U. (2003). On the determinants of Original Sin: an empirical investigation, *Journal of International Money and Finance* 22, 957-90.

Litan, R.E., Pomerleano, M. and Sundararajan, V. (2003). *The Future of Domestic Capital Markets in Developing Countries*, Washington, DC: Brookings Institution.

Manasse, P., Roubini, N. and Schimmelpfennig, A. (2003). Predicting sovereign debt crises, *International Monetary Fund Working Paper* no. 03/221.

Tirole, J. (2002). *Financial Crises, Liquidity, and the International Monetary System*, Oxford: Princeton University Press.