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INTERNATIONAL RESERVE HOLDINGS WITH SOVEREIGN RISK AND COSTLY TAX COLLECTION*

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We derive a precautionary demand for international reserves in the presence of sovereign risk and show that political-economy considerations modify the optimal level of reserve holdings. A greater chance of opportunistic behaviour by future policy makers and political corruption reduce the demand for international reserves and increase external borrowing. We provide evidence to support these findings. Consequently, the debt-to-reserves ratio may be less useful as a vulnerability indicator. A version of the Lucas Critique suggests that if a high debt-to-reserves ratio is a symptom of opportunistic behaviour, a policy recommendation to increase international reserve holdings may be welfare-reducing.

Over the past fifteen years, developing countries have increased their participation in international financial markets and faced new challenges. In the aftermath of the 1997–8 Asian financial crises, some observers have called on emerging markets to reduce short-term external debt relative to international reserve holdings in order to lower their vulnerability to crisis. Countries such as Korea, Taiwan and Chile have managed to build up large stockpiles of foreign-currency reserves in recent years. Does it follow that all developing countries would benefit from increasing their cushion of international reserves to signal they are safe borrowers? As the Lucas Critique suggests, this question cannot be answered without understanding the underlying factors that determine a country's choice of international reserve holdings.

We illustrate this point using a model where both efficiency and political-economy considerations play roles in determining a country's optimal holdings of international reserves. In the absence of political-economy considerations, a country characterised by volatile output, inelastic demand for fiscal outlays, high tax collection costs and sovereign risk will want to accumulate both international reserves and external debt. External debt allows the country to smooth consumption when output is volatile. International reserves, if they are beyond the reach of creditors, allow the country to smooth consumption in the event of a default on the external debt that results in lost access to international capital markets.[1]

Domestic political uncertainty can modify the country's strategy. Suppose governments can alternate between a 'tough' administration that enforces the planned fiscal allocation and a 'soft' administration that behaves opportunistically,

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[1] International reserves thus provide insurance in case of default. For more on the insurance value of international reserves, see Van Wijnbergen (1990), Ben-Bassat and Gottlieb (1992*a*) and Detragiache (1996).

'looting' the combined assets of the treasury and central bank to channel additional resources towards narrow interest groups with high discount rates. If the present administration is 'soft', it has little incentive to accumulate international reserves and carry them over to the future. It prefers to reduce international reserve holdings and increase international borrowing in order to maximise the current consumption of special interest groups. If the present administration is 'tough', it may want to hold a lot of reserves, but it may be reluctant to accumulate them if there is a high probability that the future administration will be 'soft' and grab these reserves for favoured insiders. Political instability, by taxing the effective return on reserves, can thus reduce desired current reserve holdings below the level supported by efficiency considerations. In the same way, political corruption acts as a tax on the return to holding reserves and reduces optimal holdings.

If a high external debt-to-reserve ratio is a symptom of political instability or corruption, then a policy recommendation to increase international reserve holdings in order to reduce that ratio may be welfare reducing. Indeed, increasing international reserves may increase the chance of financial crisis rather than reduce it.

The rest of the paper is organised as follows. In Section 1 we illustrate the confusion surrounding the appropriate level of reserves to hold by describing the current debate in Korea. In Section 2 we examine the empirical literature for the consensus view about determinants of reserve demand. We also present some new evidence suggesting reserves are held to insure against external shocks but may be reduced by political economy considerations. In Section 3 we present a model that shows how optimal international reserve holdings are sensitive to both efficiency and political economy concerns. Section 4 concludes.

1. Korea's Debate About Optimal Reserve Holdings

At the end of 2002, South Korea held international reserves (minus gold) totalling \$121.3 billion, a remarkable turnaround from the \$6 billion available during its financial crisis at the end of 1997. Measured in absolute dollar terms, these reserve holdings were the fourth largest in the world. Only Japan, China and Taiwan held more. Reserves accounted for about 25% of Korea's GNP, compared with about 7% at the start of the 1990s and in 1996. Reserves covered 41.5 weeks of imports, up from 13 weeks at the start of the 1990s and 12 weeks in 1996. Reserves as a share of M2 almost doubled after 1990, to about 30% by the end of 2002.

A debate is now under way in Korea over how much foreign-exchange reserves it should accumulate. According to the *Korea Times*, 'one group contends that Korea's reserves are 'excessive' and has proposed that amounts beyond the optimal level be invested abroad [in less liquid high-return projects]. But the Bank of Korea – currently in charge of managing the reserves – and its sympathisers argue that a small, open economy like Korea's must accumulate sufficient reserves to cope with unexpected occurrences like the currency crisis in 1997.' (*Korea Times*, January 17, 2002).

Those who believe Korea's reserve holdings are excessive point to the fact that some reserves have been accumulated through government bond sales. Whereas reserves earn a current market rate of 2–3%, the government bonds carry an interest rate of 9%. They argue that Korea is paying unnecessarily high interest rates for reserves that are excessive to begin with. They favour the establishment of a government-appointed body that would manage Korea's external assets and debts and invest reserves into more profitable assets overseas.

Others dismiss the notion that Korea's reserves are excessive. They point out that it has been only four years since Korea was near bankruptcy, a number of Korean companies still face bankruptcy or low profitability, large amounts of foreign funds still move in and out of local stocks and other financial investments, and Korea cannot rule out the possibility of a future crisis. According to the *Korea Times*, the supporters of large reserve holdings believe 'the costs linked to overcoming a currency crisis are astronomical while the gains to be made from the productive investment of the reserves will be quite small.' (*Korea Times*, January 17, 2002.)

Foreign policy uncertainties also appear to be a factor in Korea's decision to hold sizeable reserves. Many Korean economists maintain that Korea needs more than $500–1,000 billion in reserves for use if and when the two Koreas unite. (*Korea Times*, January 17, 2002). Should there be an escalation in inter-Korean tensions instead, they believe South Korea would also need a lot of reserves to buffer it from difficulties such as a panic by foreign investors. Thus some argue that Korea needs a very large stockpile of international reserves regardless of the future foreign policy outcome.

From the ongoing debate in Korea, it seems that the desire to protect the Korean economy from external shocks is the driving force behind the rapid accumulation of international reserves. Domestic political uncertainties have not been sufficiently important to keep reserves at a more modest level.

2. Empirical Evidence

We wish to investigate whether political considerations play a significant role in determining international reserve holdings over and above the standard explanatory variables. Most previous empirical work on international reserve holdings relies on the buffer stock model to guide the specification.[2] The buffer stock model says that central banks should choose a level of reserves to balance the macroeconomic adjustment costs incurred in the absence of reserves with the opportunity cost of holding reserves. Reserve holdings turn out to be a stable function of just a few variables – the adjustment cost, the opportunity cost and reserve volatility. In practice, empirical work has generally excluded the opportunity cost measure because interest rate data on the alternative yield to reserves are unavailable for many developing countries and the measure is insignificant for developed ones. We return to the opportunity cost issue later.

[2] For example, see Frenkel and Jovanovic (1981), Frenkel (1983), Edwards (1983), Lizondo and Mathieson (1987) and Flood and Marion (2001). An alternative view relies on the monetary approach to the balance of payments and relates changes in international reserves to changes in money demand. See Edwards (1984) and Elbadawi (1990). For an empirical evaluation of the insurance value of international reserves, see Ben-Bassat and Gottlieb (1992*a*).

A common strategy is to assume actual reserve holdings are proportional to optimal reserves up to an error that is uncorrelated with right-hand side variables. The estimating equation then becomes:

$$\ln\left(\frac{R_t}{X_t}\right) = \alpha_0 + \alpha_1 \ln(S_t) + \alpha_2 \ln \sigma_t + \alpha_3 \ln(C_t) + \varepsilon_t. \quad (1)$$

The LHS of (1) is the log of actual reserve holdings, (R), valued in US dollars and expressed as a ratio of X, where X is usually the US GDP deflator. Since developing countries have minimal gold holdings, their international reserves are usually measured as 'reserves minus gold' and include convertible foreign exchange, the unconditional drawing right with the IMF, and special drawing rights. The RHS of (1) shows observed reserves depending on a scaling variable (S), the volatility of international transactions (σ) and adjustment costs (C).

The scaling variable measures the size of international transactions and is generally represented by real GDP, real GDP per capita, or population size. It should enter with a positive coefficient. The volatility of international receipts and payments is usually measured by the standard deviation of the trend-adjusted changes in reserves over some previous period. Since higher reserve volatility means that reserves hit their lower bound more frequently, the central bank should be willing to hold a larger stock of reserves in order to incur the cost of restocking less frequently. Volatility should enter with a positive coefficient.[3]

The marginal propensity to import was initially proposed as a proxy for adjustment costs. Early researchers noted that an external disequilibrium induced by a decline in export earnings could be corrected by a decline in output. The smaller the marginal propensity to import, the greater the output decline needed to bring about the correction. The cost of output adjustment could be saved if the central bank financed the external deficit with its international reserves. Thus the cost of adjustment in the absence of reserves would be inversely related to the marginal propensity to import (Heller, 1966). In empirical work, the average propensity to import was used instead of the marginal propensity and its coefficient frequently turned out to be positive. The propensity to import was then reinterpreted to measure the economy's openness and vulnerability to external shocks. The positive coefficient suggested that the demand for reserves increases as the economy faces greater external vulnerability.

While equation (1) is the benchmark specification of reserve holdings based on a buffer stock model, some researchers have considered additional variables. For example, Flood and Marion, (2001) and Disyatat and Mathieson (2001) found that the volatility of the effective exchange rate is an important determinant. The choice of exchange-rate regime should affect international reserve holdings. Greater

[3] Alternative volatility measures have also been used. Edwards (1985) used the volatility of export receipts. Flood and Marion (2001) showed that the reserve volatility measure is contaminated because it combines the volatility of a standard reserve increment that is possibly distributed conditionally normally with large upward and downward jumps in reserves associated with reserve restocking or speculative attacks on reserve stocks, respectively. When upward jumps in reserves dominate, this volatility measure imparts a positive bias to the coefficient on reserve volatility. They chose to use a measure of fundamentals volatility.

exchange-rate flexibility should reduce the demand for reserves since central banks no longer need a large reserve stockpile to maintain a peg or enhance the peg's credibility. The coefficient on exchange-rate volatility should therefore be negative.

Table 1 presents benchmark regressions, where the dependent variable is the log of reserves relative to either the US price deflator, the country's external debt, or the country's broad money supply (M2). [4] It also reports results for regressions enhanced by adding political variables. The original panel data set consisted of more than 100 developing countries over the 1980–99 period, but missing data on political variables reduced the sample to 64 countries over the 1980–96 period. A Data Appendix describes variable definitions and sources.

Regression (1) is the benchmark regression when reserves are deflated by the US deflator and it generally confirms findings from earlier studies. The scale variables, population size and real GDP per capita, are positive and highly significant. Volatility, represented here by the volatility of real export receipts, is not significant. Volatility of the effective exchange rate is significant, however, and reduces reserve holdings as expected. Vulnerability to external shocks, measured by the country's openness, is also positive and highly significant.[5] These five variables account for almost 70% of the variation in observed reserve holdings without country fixed effects. With country fixed effects, the version reported in Table 1, they account for 86% of the variation. The benchmark regression clearly illustrates that reserve holdings increase with the economy's growing vulnerability to external shocks and decrease with greater exchange-rate flexibility.

Regressions (3) and (5) present benchmark regressions when reserves are scaled by total external debt and broad money, respectively. Although the explanatory variables now account for less of the variation in reserve holdings, the results are qualitatively similar. More populous or higher per capita-income countries hold more reserves, greater vulnerability to exogenous shocks increases reserve holdings, and greater exchange-rate flexibility reduces reserve holdings, though not significantly in all cases.

Regressions (2), (4) and (6) add political variables to the benchmark regressions. We considered several political variables – the probability of a government leadership change by constitutional means, the probability of a government leadership change by unconstitutional means and an index of political corruption.[6] Since the probability of a leadership change by unconstitutional means was

[4] Benchmark regressions where reserves are expressed as a ratio of GDP or import months are not reported but available from the authors. The idea behind expressing the dependent variable as a ratio is that the authorities may choose to treat the ratio as the policy variable of interest.

[5] Terms-of-trade volatility may represent a more exogenous measure of uncertainty than the volatility of export receipts. By itself or interacted with openness, terms-of-trade volatility is not a significant determinant of reserve holdings when reserves are deflated by the US price deflator or scaled by a country's external debt. However, terms-of-trade volatility interacted with openness has a positive and highly significant effect when reserves are scaled by the country's broad money or GDP.

[6] The probabilities of constitutional and unconstitutional leadership change are estimates from a multinomial logit that uses as explanatory variables the length of time in power, leader age, a political regime dummy, an election time dummy, regional dummies, and the number of previous leadership exits. The logit was conducted by David Leblang (2000), who kindly agreed to share his results. The political corruption index is from the International Country Risk Guide and was kindly provided to us by Hamid Davoodi.

Table 1

Determinants of Reserve Holdings

	(1)	(2)	(3)	(4)	(5)	(6)
obs	913	913	899	899	912	912
countries	64	64	64	64	64	64
Dep var	ln(*R*/P)	ln(*R*/P)	ln (*R*/*Debt*)	ln(*R*/*Debt*)	ln(*R*/*M*2)	ln(*R*/*M*2)
lpop	1.5281** (0.6409)	1.4649** (0.6011)	0.3939 (0.7311)	0.3197 (0.6773)	1.2095* (0.6204)	1.1574** (0.5788)
lgpc	1.8199** (0.3683)	1.7433** (0.3737)	1.4476** (0.4556)	1.3664** (0.4671)	0.1950 (0.3789)	0.1308 (0.3801)
lexa	−0.0698 (0.1556)	−0.0956 (0.1498)	−0.0370 (0.1832)	−0.0605 (0.1754)	0.0323 (0.1693)	0.0107 (0.1594)
limy	0.5615** (0.2563)	0.5206** (0.2543)	0.5708* (0.2965)	0.5233* (0.2948)	1.1503** (0.2546)	1.1159** (0.2504)
lneer	−0.1227** (0.0585)	−0.1112* (0.0604)	−0.1413* (0.0631)	−0.1264** (0.0642)	−0.0516 (0.0616)	−0.0420 (0.0634)
corrupt	—	−0.1327** (0.0454)	—	−0.1501** (0.0545)	—	−0.1117** (0.0478)
pol	—	−0.2822* (0.1460)	—	−0.2899* (0.1517)	—	−0.2470 (0.1618)
$\bar{R}^2$	0.86	0.87	0.71	0.72	0.64	0.65

All regressions include country fixed effects. Constant terms not reported. Standard errors in parentheses are corrected for heteroskedasticity and serial correlation within countries. ** (*) indicates statistical significance at the 5% (10%) level. For variable definitions, see the Data Appendix.

never a significant explanatory variable in any regression, we report regressions without it.[7] The corruption index is based on a survey of foreign investors conducted by the International Country Risk Guide. We adjust this index so that a higher value indicates government officials are more likely to demand special payments and that illegal payments are expected to a greater degree throughout lower levels of government in connection with import and export licences, exchange controls, tax assessment, police protection or loans.

Political factors do influence reserve holdings. When reserves are deflated by the US price deflator (regression (2)) or expressed as a ratio of external debt (regression (4)), a greater probability of leadership change and greater political corruption both reduce international reserve holdings at standard confidence levels. When reserves are scaled by broad money (regression (6)), political corruption and political uncertainty are again negatively correlated with reserve holdings though only the corruption index is significant. We thus have some empirical support for the notion that political uncertainty and corruption effectively reduce the return to holding international reserves.

The opportunity cost of holding international reserves plays an important role in all theoretical models of the demand for reserves, yet most empirical studies have been unable to find a significant opportunity cost effect. Ben-Bassat and Gottlieb (1992*b*) show that when the opportunity cost is measured properly, it can be a significant determinant of reserve demand.[8] Ideally, the opportunity cost should be measured as the difference between the highest possible marginal productivity forgone from an alternative investment in fixed assets and the yield on international reserves. However, it is not possible to obtain such a measure for a large sample of developing countries. When we computed the opportunity cost in the less satisfactory but standard way, as the differential between the country's own-interest rate and the interest rate on US Treasuries, we found that it did not have a significant effect on the demand for reserves and so we excluded it from the regressions in Table 1. The poor explanatory power of the interest differential may be due to several factors: (1) own interest rates in most developing countries were not market determined until the early 1990s, (2) the yield on international reserves should reflect their currency composition and is not fully captured by the rate on US Treasuries, and (3) the standard interest differential probably does not properly capture the true opportunity cost of holding reserves.

Even though our opportunity cost variable is imprecisely measured by the interest differential, we investigated the possibility that political uncertainty influences optimal reserve holdings through its effect on this differential. The probability of constitutional leadership change and unconstitutional change are positively and significantly correlated with the interest differential and arguably

[7] The insignificance of this variable may be due, in part, to the fact that it was positively correlated with the corruption index and negatively correlated with real GDP per capita and openness.

[8] See Hipple (1979), Bahmani-Oskooee (1985), Edwards (1985) and Ben-Bassat and Gottlieb (1992*b*) for further discussion on measuring the opportunity cost variable empirically. Ben-Bassat and Gottlieb (1992*b*) computed a more appropriate measure of the opportunity cost of holding reserves for Israel during the 1968–88 period.

Table 2

Political Determinants of Reserve Holdings Accounting for Trends

	(1)	(2)	(3)
obs	913	899	912
countries	64	64	64
dep var	$\ln(R/P)$	$\ln(R/Debt)$	$\ln(R/M2)$
corrupt	−0.0836** (0.0388)	−0.0924** (0.0465)	−0.0758* (0.0415)
pol	−0.3357** (0.1409)	−0.3317** (0.1446)	−0.2980* (0.1637)

All regressions include country fixed effects plus a trend and quadratic trend term. Additional regressors are population, real GDP per capita, volatility of real export receipts, openness and volatility of the effective exchange rate, all expressed in logs.
Standard errors in parentheses are corrected for heteroscedasticity and serial correlation within countries. ** (*) indicates statistical significance at the 5% (10%) level.

exogenous to it, so we used them as instruments for the differential in a second set of regressions. The corruption measure was retained as a determinant of reserve demand in the second stage. We found that the instrumented interest differential was negatively signed but never significant at standard confidence levels. It could be that the political change variables are poor instruments or that the interest differential is a poor specification for the true opportunity cost. Thus we cannot totally dismiss the idea that political uncertainty and corruption are proxies for the true opportunity cost of holding reserves.

We also conducted one more experiment. Even though we scaled our reserve variable, it may still be the case that the dependent and independent variables are trending over time and we are picking up spurious correlations between reserves and our political variables. We therefore added a time trend and a quadratic time trend to our earlier regressions. The quadratic time trend was significant. Nevertheless, Table 2 shows that when political uncertainty and corruption are each included as determinants of reserve holdings, they have negative and significant effects on reserves even after accounting for trends.

We next turn to a model that tries to rationalise these findings. The model departs from the buffer-stock approach and instead emphasises the importance of international reserves and external debt in providing intertemporal consumption and distortion smoothing. The model incorporates features of developing economies and takes into account the possibility of opportunistic behaviour.

3. The Model

We consider a two-period model of an emerging-market economy. The economy experiences productivity shocks that create a volatile tax base. It faces inelastic fiscal outlays and finds it costly to collect taxes. The economy can borrow internationally in the first period, but because there is some chance it will default in the second period, it faces a credit ceiling.

The central bank actively targets the stock of reserves. Even so, a variety of exchange-rate arrangements are possible, such as a fixed exchange rate or a managed float, because the balance sheets of the central bank and treasury are consolidated and the net taxes paid by consumers are determined as a residual.[9]

3.1. *Output*

Suppose that productivity shocks occur only in the second period. Then GDP in period i ($i = 1, 2$) is

$$Y_1 = 1$$
$$Y_2 = 1 + \varepsilon$$

where ε is a productivity shock defined in the range $-\bar{\delta} \leq \varepsilon \leq \bar{\delta};\ 0 \leq \bar{\delta}$, with a corresponding density function $f(\varepsilon)$.

3.2. *International Borrowing*

The emerging market can borrow in international capital markets. Suppose it borrows B in period 1 at a contractual rate r, so it owes $(1 + r)B$ in period 2. If it faces a bad enough productivity shock in the second period, it defaults. Default is not without penalty, however. International creditors can confiscate some of the emerging market's export revenues or other resources equal to a share α of its output. We assume that the defaulting country's international reserve holdings are beyond the reach of creditors.[10]

In the second period, the country repays its international obligations if repayment is less costly than the default penalty. The country ends up transferring S_2 real resources to international creditors in the second period, where:

$$S_2 = \text{Min}[(1 + r)B;\ \alpha Y_2], \quad 0 < \alpha < 1. \tag{2}$$

Let ε^* be the value of the shock that causes the emerging market to switch from repayment to the default regime:[11]

$$(1 + r)B = \alpha(1 + \varepsilon^*). \tag{3}$$

Thus the future net resource transfer to international creditors will be:

$$S_2 = \begin{cases} (1 + r)B & \text{if } \varepsilon > \varepsilon^* \\ \alpha(1 + \varepsilon) & \text{if } \varepsilon \leq \varepsilon^*. \end{cases} \tag{4}$$

[9] This structure would also apply to the operation of export stabilisation funds, such as Chile's copper fund.

[10] This is a realistic assumption. For example, on January 5, 2002, *The Economist* reported '[President Duhalde] confirmed that Argentina will formally default on its debt, an overdue admission of an inescapable reality. The government has not had access to international credit (except from the IMF) since July. It had already repatriated nearly all of its liquid foreign assets to avoid their seizure by creditors.' (*The Economist*, p. 29). Our main results will hold even if creditors can confiscate a fraction of the reserves, as long as this fraction is below α.

[11] If the worst possible shock ($\varepsilon = -\bar{\delta}$) still makes repayment preferable to default, then ε^* is set equal to $-\bar{\delta}$.

Suppose the risk-free interest rate is r_f. The interest rate attached to the country's acquired debt, r, is determined by the condition that the expected return on the debt is equal to the risk-free return:

$$\mathrm{E}(S_2) = (1 + r_f)B. \tag{5}$$

From (4) we know that the expected return on the debt is the weighted average of the default penalty and full repayment, where the weights reflect the probability of each outcome:

$$\mathrm{E}(S_2) = \int_{-\bar{\delta}}^{\varepsilon^*} \alpha(1+\varepsilon)f(\varepsilon)\mathrm{d}\varepsilon + \int_{\varepsilon^*}^{\bar{\delta}} (1+r)Bf(\varepsilon)\mathrm{d}\varepsilon = (1+r_f)B. \tag{5'}$$

Differentiating (5′) with respect to B, we find that:

$$\frac{\mathrm{d}[(1+r)B]}{\mathrm{d}B} = (1+r_f)/Q, \tag{6}$$

where $Q = \int_{\varepsilon*}^{\bar{\delta}} f(\varepsilon)\mathrm{d}\varepsilon$ is the probability of full repayment. If there is no chance of default, $Q = 1$ and the country is charged the risk-free rate. But when there is some chance of default, the country is forced to pay a risk premium, since $0 < Q < 1$ implies $r > r_f$.

3.3. *The Fiscal Story*

The demand for public goods, such as health, pensions and defence, is assumed to be completely inelastic and set at $\bar{G}$. Public goods expenditures are financed, in part, by tax revenues. Collecting taxes is assumed to be costly. Costs include direct collection and enforcement costs as well as indirect deadweight losses associated with the distortions induced by taxes. Like Barro (1979), we model these costs as a non-linear share of output and let them depend positively on the tax rate. Thus a tax at rate t yields net tax revenue of

$$T(t) = Y[t - \Gamma(t)];\ \Gamma' \geq 0, \Gamma'' \geq 0. \tag{7}$$

The term $\Gamma(t)$ measures the fraction of output lost because of inefficiencies in the tax collection system. $\Gamma(t)$ is assumed to increase at an increasing rate as the tax rate rises.

It is convenient to specify the fiscal demand for net tax revenue as a share of GDP:

$$\xi_i = \frac{T_i}{Y_i};\ i = 1, 2. \tag{8}$$

Combining (7) and (8), we can express the tax rate as a function of the share of net tax revenue in GDP:

$$t_i(\xi_i);\ t' > 0. \tag{9}$$

For example, if the collection cost is quadratic in the tax rate, so that $\Gamma(t) = 0.5\lambda t^2$ where λ measures the relative inefficiency of the tax system, then

$$T(t) = Y(t - 0.5\lambda t^2) \tag{10}$$

and

$$t_i = \frac{1 - \sqrt{1 - 2\lambda\xi_i}}{\lambda}. \tag{11}$$

3.4. *Reserves*

The government can acquire international reserves in the first period, let them earn the risk-free rate, and spend them in the second period. One way of acquiring reserves is through sovereign borrowing. Even if reserves are acquired as the counterpart of private-sector borrowing, full sterilisation by the central bank implies an ultimate swap of sovereign debt for reserves. Another way of accumulating reserves is through taxation. Higher taxes depress domestic absorption and generate a bigger current-account surplus in the first period. In the second period, reserves may be spent to finance repayment of the international debt and government expenditures. In a two-period model, there is no need to hold reserves beyond the second period. Thus the terminal demand for reserves is zero.

The government faces the following budget constraints:

$$\begin{aligned} T_1 &= \bar{G} + R - B; \\ T_2 &= \bar{G} + S_2 - (1 + r_f)R. \end{aligned} \tag{12}$$

In the first period, spending on public goods and reserve accumulation must be financed by taxes and foreign borrowing. In the second period, spending on public goods and debt repayments must be financed by taxes and available reserves.

3.5. *Optimisation*

We now wish to evaluate the optimal foreign borrowing and demand for international reserves by a country with a costly tax collection system and some chance of defaulting. Subject to the government budget constraints in (12), the policy maker chooses the foreign debt and international reserves to acquire in the first period in order to maximise the intertemporal utility of consumers:

$$\underset{B,R}{\text{Max}}\ \text{V} = u(C_1) + \frac{1}{(1+\rho)} \int_{-\bar{\delta}}^{\bar{\delta}} u(C_2) f(\varepsilon) \mathrm{d}\varepsilon. \tag{13}$$

In (13), consumer preferences are characterised by a conventional time-separable utility, where ρ is the discount rate. Consumer spending in each period is merely output net of taxes, where taxes include collection costs:

$$C_i = Y_i\{1 - \xi_i - \Gamma[t(\xi_i)]\};\ i = 1, 2.^{12} \tag{14}$$

[12] Applying (7) and the definition of ξ, we know $\xi Y_i = T_i = (t_i - \Gamma) Y_i$. Thus $t_i = \xi_i + \Gamma_i$, and $C_i = Y_i(1 - t_i) = Y_i(1 - \xi_i - \Gamma_i)$.

Given the definition of output in (1), consumer spending in period 1 is $C_1 = \{1 - \xi_1 - \Gamma[t(\xi_1)]\}$ while consumer spending in period 2 is $C_2 = \{1 - \xi_2 - \Gamma[t(\xi_2)]\}(1+\varepsilon)$. For future reference, it is useful to note that the marginal cost of public funds, $-\partial C_i/\partial T_i$, can be inferred from (14) to be:

$$1 + \Gamma'(\xi) \quad \text{where} \quad \Gamma'(\xi) = \frac{\mathrm{d}\Gamma}{\mathrm{d}t}\frac{\mathrm{d}t}{\mathrm{d}\xi}, \tag{15}$$

[13]

while from (8) and (12) we know that:

$$\xi_1 = \frac{T_1}{Y_1} = \bar{G} + R - B; \xi_2 = \frac{T_2}{Y_2} = \frac{\bar{G} + S_2 - (1 + r_f)R}{1 + \varepsilon} \tag{16}$$

and S_2 is given by (5′).

The first-order condition that determines optimal borrowing is

$$u'(C_1)[1 + \Gamma'(\xi_1)] - \int_{\varepsilon^*}^{\bar{\delta}} \left\{\frac{1}{1 + \rho} u'(C_2)[1 + \Gamma'(\xi_2)]\right\} f(\varepsilon)\mathrm{d}\varepsilon \frac{1 + r_f}{Q} = 0, \tag{17}$$

which can be rewritten as

$$\int_{\varepsilon^*}^{\bar{\delta}} \left\{u'(C_1)[1 + \Gamma'(\xi_1)] - \left(\frac{1 + r_f}{1 + \rho}\right) u'(C_2)[1 + \Gamma'(\xi_2)]\right\} f(\varepsilon)\mathrm{d}\varepsilon = 0. \tag{17′}$$

The first-order condition that determines optimal first-period reserve holdings is:

$$\int_{-\bar{\delta}}^{\bar{\delta}} \left\{u'(c_1)[1 + \Gamma'(\xi_1)] - \left(\frac{1 + r_f}{1 + \rho}\right) u'(c_2)[1 + \Gamma'(\xi_2)]\right\} f(\varepsilon)\mathrm{d}\varepsilon = 0. \tag{18}$$

If the country fully repays its foreign debts ($Q = 1$), optimal borrowing equates the expected present value of the marginal cost of public funds in the two periods. It therefore provides expected smoothing of the tax burden over time. Put differently, the policy maker borrows in the first period up to the point where the gain in the consumer's first-period marginal utility is equal to the expected loss of second-period marginal utility that comes from raising future taxes to repay the debt.

If a bad enough shock reduces future output so much that the country defaults (i.e., if $Q < 1$), then the country pays the default penalty. In the absence of international reserve holdings to finance second-period public expenditures, the country also needs to raise taxes. Condition (17) implies that external borrowing alone is insufficient for achieving intertemporal smoothing of the tax burden in all states of nature.

Figure 1 illustrates the first-order condition that must be met in order to maximise the intertemporal utility of the consumer. It plots the present value of the expected

[13] This result follows from the observation that $\mathrm{d}C_i/\mathrm{d}T_i = -Y_i(1 + \Gamma')\mathrm{d}\xi_i/\mathrm{d}T_i$ and $\mathrm{d}\xi_i/\mathrm{d}T_i = 1/Y_i$. The marginal cost of public funds can also be written as $1 + \Gamma'(\xi) = 1/(1 - \mathrm{d}\Gamma/\mathrm{d}t)$. Since $t_i = \xi_i + \Gamma_i$, we know that $\mathrm{d}t_i/\mathrm{d}\xi_i = 1 + \Gamma'(\xi_i) = 1 + (\mathrm{d}\Gamma_i/\mathrm{d}t_i)(\mathrm{d}t_i/\mathrm{d}\xi_i)$. Rearranging terms, we find that $\mathrm{d}t_i/\mathrm{d}\xi_i = 1/(1 - \mathrm{d}\Gamma_i/\mathrm{d}t_i) = 1 + \Gamma'(\xi)$.

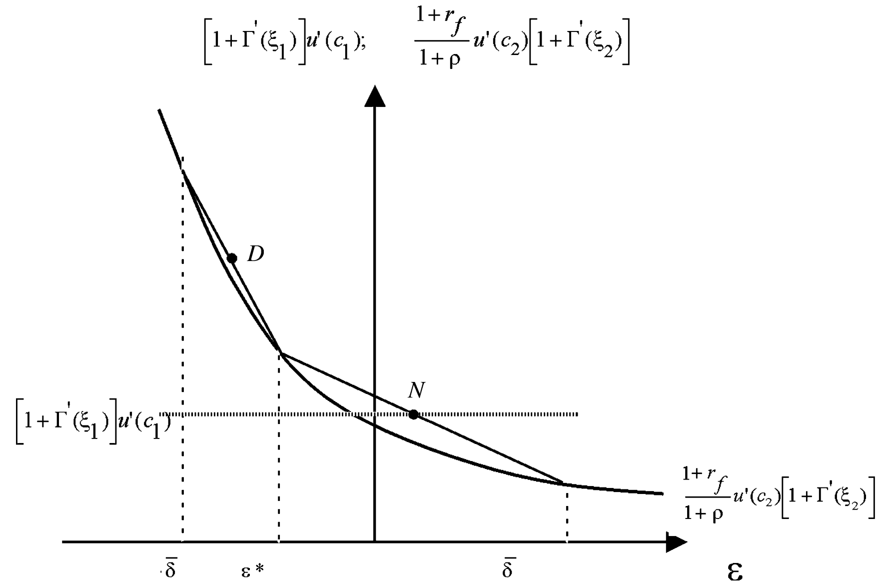

Fig. 1. *Marginal Cost of Public Funds and Optimal Borrowing (R = 0)*

second-period marginal cost of public funds, $[(1 + r_f)/(1 + \rho)]u'(C_2)[1 + \Gamma'(\xi_2)]$, as a function of the second-period productivity shock. The curve is downward sloping. The reason is two-fold. First, more positive output shocks generate higher output and lower the marginal cost of obtaining public funds. Second, higher levels of consumption lead to diminishing marginal utility, lowering the marginal cost of taxes. Observe that an increase in borrowing shifts up the curve. It raises the marginal cost of funds in the second period, expanding the range of shocks where default occurs, and it reduces the marginal cost of funds in the first period. Optimal borrowing equates the expected second-period marginal cost of public funds evaluated over the distribution of shocks that induce full repayment (point N in Figure 1) to the cost of public funds in the first period, illustrated by the horizontal broken line.

Figure 2 characterises optimal borrowing. Specifically, schedule MC_1 is the first-period marginal cost of raising public funds, $u'(C_1)\{1 + \Gamma'(\xi_1)\}$. Curve $\overline{MC_2}$ is the discounted second-period marginal cost of public funds, evaluated in the range of full repayment,

$$\int_{\varepsilon*}^{\bar{\delta}} \left\{\frac{1}{1 + \rho} u'(C_2)\{1 + \Gamma'(\xi_2)\}\right\} f(\varepsilon) d\varepsilon \frac{1 + r_f}{Q}.$$[14]

Optimal borrowing is characterised by the intersection of both curves. In the absence of sovereign risk, $Q = 1$ and the first-order condition for optimal borrowing simplifies to:

[14] While curve MC_1 is always sloping upward, curve $\overline{MC_2}$ may be downward sloping, as higher B reduces the range of full repayment. The second-order condition for maximisation, $\partial^2 V/\partial B^2 < 0$, implies that the slope of $\overline{MC_2}$ exceeds the slope of MC_1 (i.e., $(\partial(\overline{MC_2} - MC_1))/\partial B > 0$).

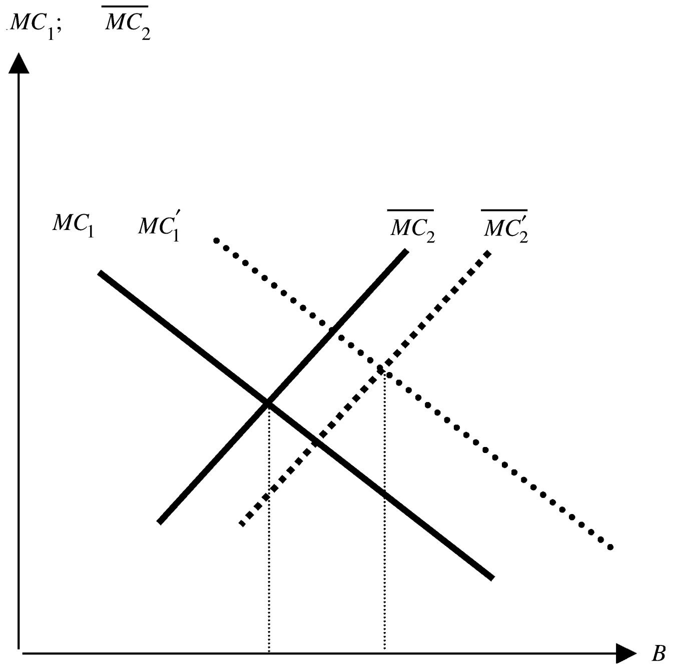

Fig. 2. *Marginal Cost of Public Funds, International Reserves and Optimal Borrowing*
Note: Higher R will shift both curves to the right, from the solid to the broken curves.

$$u'(C_1)[1+\Gamma'(\xi_1)] = \left(\frac{1+r_f}{1+\rho}\right)\mathrm{E}\{u'(C_2)[1+\Gamma'(\xi_2)]\}. \qquad (17'')$$

Optimal borrowing equates the expected cost of public funds across time. The left-hand side of (17″) captures the utility gain in the first period associated with funding one unit of fiscal expenditure by borrowing instead of taxes. The right-hand side measures the expected utility loss of raising future taxes in order to repay the first-period borrowing.[15] If the consumer is risk neutral and if $r_f = \rho$, optimal borrowing allows for intertemporal smoothing of the tax burden, as in Barro (1979). In these circumstances the marginal cost of raising one unit of net tax revenue in the current period equals the expected present value cost of raising one unit of net taxes in the future.

To understand the role of international reserves, we evaluate the impact of the first unit of reserves on consumer utility. Differentiating (13) with respect to reserves, we find that

$$\frac{\partial V}{\partial R} = -u'(c_1)[1+\Gamma'(\xi_1)] + \frac{1+r_f}{1+\rho}\int_{-\bar{\delta}}^{\bar{\delta}} u'(c_2)[1+\Gamma'(\xi_2)]f(\varepsilon)\mathrm{d}\varepsilon. \qquad (19)$$

[15] Note that raising one unit of net taxes increases the gross tax bill by $1 + \Gamma'(\xi_1)$. Borrowing one unit increases first-period utility by the product of the gross tax saving and the marginal utility.

Evaluating (19) around an initial equilibrium where $R = 0$ and borrowing is optimal, we find that:

$$\frac{\partial V}{\partial R}_{|R=0,optimalB} = \int_{-\bar{\delta}}^{\varepsilon^*} \left\{ \left(\frac{1+r_f}{1+\rho} \right) [1+\Gamma'(\xi_2)]u'(c_2) - [1+\Gamma'(\xi_1)]u'(c_1) \right\} f(\varepsilon)\mathrm{d}\varepsilon > 0. \tag{20}$$

Acquiring the first unit of reserves increases utility since it helps cushion the fall in second-period consumption should a bad shock trigger default. The larger the difference between first-period and second-period marginal utility when there is a default and no reserve cushion, the bigger the gain in utility from having international reserves to draw on when there is a default.

International reserves thus provide insurance. They help the economy smooth consumption intertemporally in the event of default. The combination of optimal external borrowing and optimal reserve accumulation permits expected consumption smoothing between period one and states of nature in period two when there is either full repayment of the foreign debt or default.

The result in (20) can be illustrated in Figure 1. Recall that point N represents the expected second-period marginal cost of public funds evaluated over the distribution of shocks that induce full repayment. Point D corresponds to the expected second-period marginal cost of public funds evaluated over the distribution of shocks that cause default. The gain in utility from acquiring the first unit of reserves is proportional to the vertical gap between points D and N.

A country with international reserves can transfer public funds from period one, where their marginal cost is low, to states of nature where bad shocks reduce output and trigger default. These are also the states of nature where the marginal cost of public funds is high. Hence, the benefit of holding international reserves is greatest when the country has an inefficient tax system and the probability of default is high.[16]

The first-order condition that determines optimal borrowing can also be used to show that:[17]

[16] Figure 1 corresponds only to the equilibrium where $R = 0$. Increasing R would impact both the location and the shape of the curve tracing the marginal cost of public funds. For example, when $\bar{G} < R(1 + r_f)$, the marginal cost curve is upward sloping over the range of shocks that lead to default.

[17] Applying the first order condition determining optimal borrowing it also follows that

$$\begin{aligned} \mathrm{sgn}\left(\frac{\partial B}{\partial R_{|optimal\ B}} \right) &= \mathrm{sgn}\left(\frac{\partial^2 V}{\partial R \partial B_{|optimal\ B}} \right) \\ &= \mathrm{sgn}\left\{ \int_{\varepsilon^*}^{\bar{\delta}} \left[-u''(c_1)[1+\Gamma'(\xi_1)]^2 + u'(c_1)\Gamma''(\xi_1). \right. \right. \\ &\quad \left. \left. + \left(\frac{(1+r_f)^2}{1+\rho} \left\{ -u''(c_2)[1+\Gamma'(\xi_2)]^2 + u'(c_2)\Gamma''(\xi_2) \right\} \right) \right] f(\varepsilon)\mathrm{d}\varepsilon \right\} > 0. \end{aligned}$$

$$\left.\frac{\partial B}{\partial R}\right|_{optimalB} > 0. \tag{21}$$

At the margin, acquiring international reserves increases the optimal amount of foreign borrowing. Obtaining reserves in period one not only makes more resources available in period two but these resources are insulated from second period's productivity shock. The net effect of acquiring reserves is to reduce the need for additional tax revenue in the future when there is a default. Having reserves thus reduces the expected cost of obtaining public funds in the future and increases the cost of acquiring public funds in the present. The change in the cost profile encourages more borrowing in the first period.

In terms of Figure 2, the effect of reserve accumulation is to shift curve MC_1 upwards, and to shift curve $\overline{MC}_2$ downward, to the dotted curves. Both effects increase optimal borrowing.[18] This process will continue until the optimal level of reserves is reached or until B reaches the credit constraint, whichever occurs first.

We can illustrate the optimal external borrowing and reserve accumulation determined by our model with the help of a simple example. Suppose there are two states of nature and second period output can be high or low with equal probability:

$$Y_1 = 1;\; Y_2 = \begin{cases} Y_{2,h} = 1 + \bar{\delta} & \text{with probability } 0.5 \\ Y_{2,l} = 1 - \bar{\delta} & \text{with probability } 0.5. \end{cases} \tag{22}$$

Then optimal taxes corresponding to the first-order conditions (17) and (18) can be reduced to:

$$\xi_{2,h} = \xi_{2,l};\; \left(\frac{1+\rho}{1+r_f}\right)^2 - 1 = \frac{2\lambda}{1 - 2\lambda\xi_{2,h}}\left(\xi_{2,h} - \xi_1\right). \tag{23}$$

The combination of optimal borrowing and optimal reserve holdings equalises the cost of public funds across the future two states of nature.[19] The gap between the subjective time preference and the risk free interest rate determines the intertemporal profile of the costs of public funds. The greater the bias towards present consumption, the greater the bias towards lower present tax rates. This bias, in turn, increases borrowing (B) and reduces saving (R).

A useful benchmark case is one where the intertemporal bias is zero ($r_f = \rho$). In this case, the tax rate is equalised across time and across the two future states of nature, and $B = R$. The net borrowing position, $B - R$, increases with the bias

[18] Figure 2 is plotted for the case where $\overline{MC}_2$ is upward sloping. Higher R will increase B even if $\overline{MC}_2$ is downward sloping, as its slope exceeds that of MC_1.

[19] The result that choosing reserve holdings and external borrowing optimally accomplishes tax smoothing between various states is the outcome of having only three states of nature – one realisation of first-period output and two possible realisations of the second-period output. If there were more than three state of nature but no additional financial instruments, complete tax smoothing could not occur. Yet even in that environment, holding international reserves as well as external debt would allow better tax smoothing because it would smooth the expected tax burden across periods.

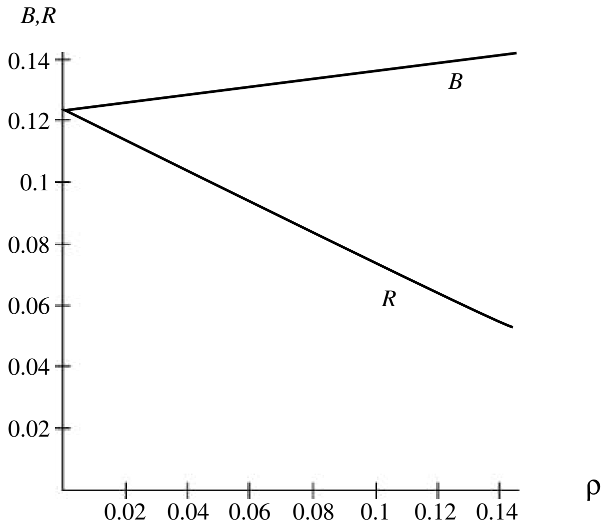

Fig. 3. *Optimal Borrowing (B) and International Reserves (R) as a Function of the Subjective Rate of Time Preference*
The Figure reports the values of B and R corresponding to $r_f = 0$; $\bar{G} = 0.06$; $\alpha = 0.14$; $\bar{\delta} = 0.2$; $\lambda = 0.7$.

towards present consumption, $\rho - r_f$.[20] This result is illustrated in Figure 3, where a simulation traces the dependence of optimal borrowing and international reserves on the subjective discount rate. A greater bias towards early consumption tilts the tax rate towards the future. To satisfy the budget constraints, international reserve holdings must fall and external borrowing must rise, increasing the country's net borrowing position.

The above discussion suggests that there are strong efficiency reasons for holding international reserves. Apart from any need to hold reserves for exchange-rate management, reserves help a country smooth consumption when there is a positive probability of default and a binding international credit ceiling. We now consider how political economy factors may undermine efficiency reasons for holding reserves and result in reduced reserve holdings.

3.6. *A Political Economy Story*

We now consider an economy where interest groups compete for additional fiscal resources to support their specific agenda. Realised fiscal expenditure is the outcome of this competition. Interest groups may be represented by cabinet ministers or, in a federal system, by the governors of various states or provinces. We retain our earlier assumption that consumer utility can be characterised by (13). Such

[20] For the case where the risk-free interest rate is zero, the condition for having an internal solution with a partial default is that the government expenditure not be 'too large' – $\alpha > \bar{G}$. A large enough fiscal demand would induce a corner solution where borrowing is at the credit ceiling.

will be the case if interest groups pursue narrow agenda and their marginal spending does not directly impact the representative consumer's welfare. The tax consequences of successful lobbying efforts will have the usual adverse effect on the consumer's utility, however.

The Treasury Minister (TM) is assumed to determine the ultimate fiscal allocation. We assume two types of Treasury Ministers – soft and tough. A soft one accommodates all the fiscal demands of the various interest groups up to the limit imposed by the contemporaneous budget constraint. A tough one forces the interest groups to adhere to the planned allocation, $\bar{G}$. There is uncertainty in period one about the type of Treasury Minister that will serve in period two. With probability ϕ the future Treasury Minister will be tough.

The sequence of events is as follows. In period one, the interest groups determine their desired second-period demand for fiscal resources. At the beginning of the second period, the productivity shock and the Treasury Minister's type are revealed. A soft TM in the second period will divide the maximum available fiscal resources, net of foreign debt repayments, among all the interest groups. In that case, aggregate fiscal expenditure and consumption in the second period will be:

$$\begin{aligned} G_{|\,\text{Soft2ndperiod}} &= (1+\varepsilon)[t_m - \Gamma(t_m)] + R(1+r_f) - S_2; \\ C_{|\,\text{Soft2ndperiod}} &= (1+\varepsilon)(1-t_m) \end{aligned} \tag{24}$$

where t_m is the tax rate that maximises net tax revenue and is obtained by solving $\max[t - \Gamma(t)]$. For example, with quadratic collection costs,

$$\begin{cases} t_m = 1/\lambda; \;\; T_m = Y/2\lambda & \textit{if } \lambda > 1 \\ 1; \;\; T_m = Y(1-0.5\lambda) & \textit{if } \lambda \le 1 \end{cases} \tag{25}$$

where T_m is the maximum net tax revenue attainable, i.e. $T_m = Y[t_m - \Gamma(t_m)]$.

If the TM is also soft in the first period, fiscal expenditure in period one will equal the maximum contemporaneous resources available. This outcome is the result of assuming interest groups have high discount rates and prefer maximising first-period fiscal expenditure. A soft TM will therefore have no incentive to acquire international reserves and carry them over to the future period. Moreover, a soft TM will borrow in the first period up to the external credit ceiling, $\alpha/(1+r_f)$. Consequently, first-period fiscal expenditure and consumption observed with a soft TM are:

$$\begin{aligned} G_{|\,\text{Soft 1st period}} &= 1[t_m - \Gamma(t_m)] + \frac{\alpha}{1+r_f}; \\ C_{|\,\text{Soft 1st period}} &= 1(1-t_m). \end{aligned} \tag{26}$$

The public finance problem solved by the soft TM has a trivial solution: maximise the fiscal outlay in period one. To do so, the first-period TM sets the tax rate at the peak of the tax Laffer Curve, borrows up to the external credit ceiling, and accumulates no international reserves.

We turn now to the more complex case, where a tough TM in the first period must determine the amount of international reserves and foreign debt to acquire in order to maximise the expected utility of the representative agent. The tough TM does not know the second-period productivity shock or TM-type, only the distribution of the productivity shock and the probability of having a particular TM-type. The tough TM's objective is to maximise:

$$\begin{aligned} V|_{\text{Tough 1st period}} = u\{1 - \xi_1 - \Gamma[t(\xi_1)]\} + \frac{\phi}{1+\rho} \\ \times \int_{-\bar{\delta}}^{\bar{\delta}} u[(1+\varepsilon)\Bigg(1 - \frac{S_2 + \bar{G} - R(1+r_f)}{1+\varepsilon} \\ -\Gamma\{t[\frac{S_2 + \bar{G} - R(1+r_f)}{1+\varepsilon}]\}\Bigg)]f(\varepsilon)\mathrm{d}\varepsilon \\ + \frac{1-\phi}{1+\rho}\int_{-\bar{\delta}}^{\bar{\delta}} u[(1+\varepsilon)(1-t_m)]f(\varepsilon)\mathrm{d}\varepsilon. \end{aligned} \tag{27}$$

Inspection of (27) reveals that whatever choice the tough TM makes about first-period external debt and reserve holdings, it will not affect expected future utility should the soft TM be in office next period (the last term in (27)). Hence, maximising (27) delivers first-order conditions identical to those derived in the previous section, except that now second-period utility is discounted at rate $\phi/(1 + \rho)$ instead of $1/(1 + \rho)$. The tough TM in the initial period must satisfy the first-order conditions:

$$\int_{\varepsilon^*}^{\bar{\delta}} \left\{u'(c_1)[1 + \Gamma'(\xi_1)] - \phi\frac{1+r_f}{1+\rho}u'(c_2)[1+\Gamma'(\xi_2)]\right\}f(\varepsilon)\mathrm{d}\varepsilon = 0. \tag{28}$$

$$-\int_{-\bar{\delta}}^{\bar{\delta}} \left\{u'(c_1)[1 + \Gamma'(\xi_1)] - \phi\,(\frac{1+r_f}{1+\rho})u'(c_2)[1+\Gamma'(\xi_2)]\right\}f(\varepsilon)\mathrm{d}\varepsilon = 0. \tag{29}$$

Inspection of (28) and (29) reveals that political uncertainty about whether the future Treasury Minister will be soft or tough induces today's tough TM to reduce the shadow real interest rate on borrowing and international reserves from $1 + r_f$ to $\phi(1 + r_f)$. If the country operates in the range where saving increases with the real interest rate and borrowing depends negatively on its expected cost, the higher probability of a soft future governor will lead to higher borrowing and lower international reserves accumulation in period 1. In the Appendix available on the JOURNAL's website www.res.org.uk, we provide the precise conditions needed to obtain this outcome.

The rationale for holding reserves is to increase tomorrow's buying power. The greater the probability of having a soft TM in the future (a small ϕ), the smaller the weight attached to the benefit of having high reserves in the future to increase purchasing power. With probability $(1 - \phi)$ the reserves will be appropriated – or looted – by a soft TM who will distribute them to various interest groups via higher fiscal expenditure.

Similarly, the greater the probability of having a soft TM in the future, the more borrowing a tough TM will undertake today. Greater borrowing today increases future debt service and reduces the resources left for the soft TM to distribute.

It is interesting to note that the greater the chance of having a soft TM in the future, the more likely today's tough TM will mimic the behaviour of a soft TM in the first period, reducing optimal reserve holdings and increasing optimal borrowing. Of course, the motivation is different. A tough TM in the first period chooses fewer reserves and more borrowing in the first period to reduce expected future looting. The absence of reserve holdings and high borrowing adopted by the soft TM is the outcome of present looting. Nevertheless, we can conclude that a greater chance of opportunistic behaviour by future policy makers reduces the demand for international reserves and increases external borrowing. By the same analysis, a greater degree of political corruption directly increases the likelihood of looting and leads to reduced reserve holdings.

The political economy model described above should be viewed as a minimal framework for analysing the impact of political uncertainty on the demand for reserves. It could be extended in several ways. For example, we could relax the exogeneity of second-period output and let it be affected by political uncertainty. In addition, we could allow uncertainty regarding the identity of the future regime to be influenced by the behaviour of the policy maker in the first period rather than be determined exogenously. It is not self evident that these modifications would reverse the main results, however.

To illustrate, we present in Appendix B the case where second-period output is the outcome of first-period investment. We illustrate there that a higher probability of a future soft regime generally has ambiguous effects on the pattern of investment and reserve accumulation. Specifically, if the coefficient of relative risk aversion is less than unity, a higher probability of future opportunistic behaviour reduces first-period investment because it implies a higher expected future tax rate. A by-product of the drop in first-period investment is that the supply of credit available to the country decreases, reducing equilibrium borrowing. If the present regime is corrupt (or 'soft'), it will borrow less. This result is reversed if the coefficient of relative risk aversion exceeds unity. Hence the impact of allowing for endogenous investment and future output is ambiguous. As a result, even were period-one behaviour to influence period-two output, it does not necessarily follow that a first-period 'soft' regime is penalised by foreign creditors or that a first-period 'tough' regime has more incentive to accumulate reserves.[21]

4. Conclusion

One general point is worth emphasising. Political instability and political corruption reduce the optimal size of buffer stocks. This point is illustrated in the

[21] We thank one of our referees for suggesting this extension.

context of the demand for international reserves but it is applicable to other stabilisation fund schemes as well. Our model described an economy where a higher chance of future looting by an opportunistic policy maker reduces the current demand for international reserves. A similar point has been made in the context of a polarised political system, where political parties differ in their spending priorities. A higher probability of losing power to the opposing party reduces the saving of the present administration (Alesina and Tabellini, 1990; Cukierman *et al.*, 1992).

Our empirical work suggests that greater attention should be given to the role of political-economy factors in explaining the demand for reserves and the functioning of buffer stocks. We found that the probability of leadership change and political corruption influenced the demand for reserves even after controlling for standard determinants and country fixed effects. Due to data limitations, we were unable to investigate the effects of external threats and internal political polarisation on the demand for international reserves.[22] Theoretical considerations suggest that external threats should increase reserve holdings whereas internal political polarisation should decrease them.

Another issue deserving further attention is the impact of access to international borrowing on the demand for reserves. Indeed, our modelling suggests that international borrowing and international reserve accumulation are the simultaneous outcome of optimising decisions. Accounting for international borrowing may require information not only about the sovereign risk premium but also about the supply-elasticity of credit facing the economy. Both factors will affect the cost of relying on foreign borrowing to smooth adjustment in the face of future adverse shocks. Addressing these issues is left for future work.

Data Appendix

R/P = reserves minus gold, deflated by the US GDP deflator (1995 = 100). Source: *International Financial Statistics* (IMF) for the reserves data and *World Economic Outlook* (IMF) for the deflator.

R/*Debt* = reserves minus gold scaled by total external debt. Source: *International Financial Statistics* (IMF) for the reserves data and *Global Development Finance* (World Bank) for the debt figures.

R/*M*2 = reserves minus gold scaled by broad money. Source: *International Financial Statistics*. Broad money is lines 34 + 35 of IFS converted into millions of US dollars using the bilateral exchange rate.

lpop = total population, logged. Source: *World Development Indicators*.

lgpc = real GDP per capita, logged. Source: *World Development Indicators*.

lexa = volatility of real export receipts, logged. Volatility is calculated using annual data and is the standard error of a regression of trend real exports. Source: IMF, *International Financial Statistics*.

[22] Important data sets of political variables, such as Taylor and Jodice (1983) and Banks (1994) have not been extended through the 1990s. Political measures of external foreign policy threats are available only by decade.

limy = the percentage share of imports in GDP, logged. Source: *World Development Indicators.*

lneer = volatility of the nominal effective exchange rate, logged. Annual volatility is calculated using the previous 24 months of data and is the standard deviation of the innovation of the percentage change in the nominal effective exchange rate. Source: Information System Network, IMF.

corrupt = corruption index based on the perception of foreign investors that high government officials will demand special payments or that illegal payments are expected throughout the lower levels of government in the forms of bribes connected with import and export licences, exchange controls, tax assessment, police protection, or loans. Source: *International Country Risk Guide*. The index ranges from 0 (most corrupt) to 6 (least corrupt). It has been re-scaled by multiplying it by 10/6 and for ease in interpreting results, the index has been multiplied by minus one so that higher values of the index imply higher corruption.

pol = the probability of a leadership change by constitutional means. Source: Leblang (2000).

dif = Interest rate differential constructed as $\ln[(1 + i)/(1 + i^{US})]$, where i^{US} is the US interest rate corresponding to the definition used for the national interest rate. Choice of national interest rate based on maximum availability. The deposit rate was used for most countries. The money market rate was used for four countries, the Treasury Bill rate for three countries and the lending rate for one country. Source: IMF, *International Financial Statistics.*

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Technical Appendix is available for this paper: www.res.org.uk/economic/ta/tahome.asp
Dataset is available for this paper: www.res.org.uk

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