By G. D. I. Barr* and B. S. Kantor**

Interest rates, the exchange rate and money supply in South Africa

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1 INTRODUCTION

In this paper we examine the workings of interest parity relationships under two different regimes. The first is one in which forward and spot exchange rates and interest rates are determined in free markets and capital is completely mobile; the second one in which the central bank manages the exchange rate system supported by exchange control, but borrowers still have access to foreign capital. The South African system follows the second example and by developing an exchange rate expectations model, we show how this system can give rise to net capital inflows or outflows and, hence, money supply effects depending on how these exchange rate expectations have compared with officially prescribed forward rates.

2 INTEREST PARITY UNDER FREE EXCHANGE RATE MARKETS

We consider the relationship between cost/rates of return in two financial centres which have unrestricted exchange rate markets and where there are no constraints on the mobility of capital between the two centres.

Treating the centres as "home" and "world" we have at some instant of time t,

$$i^h_t = i^w_t + \frac{S^f_{t+1} - S_t}{S_t} \quad , \qquad (1)$$

where: i^h_t is the rate of return/cost on/of an asset in the home money market in some risk class (annualised)

i^w_t is the rate of return/cost on/of an asset in the world money market in the same risk class (annualised)

S_t is the home/world exchange rate determined in the market at time t.

S^f_{t+1} is the forward home/world exchange rate determined in the market at time t representing the cost now of buying foreign exchange for delivery at time t+1 and it is assumed that the contracts on which the returns are i^h_t (or i_w) run for 1 time period.

The quantity $\frac{S^f_{t+1} - S_t}{S_t}$ is expressed in annualised terms.

Note, for example, that when this quantity is positive, forward foreign currency stands at a premium to the local currency.

Such a relationship will hold for all money or capital markets linked by mobile capital and which have efficient spot and forward exchange rate markets. Any deviation from these relationships will present opportunities to make profit through arbitrage. Thus, for example, if i^h_t dropped so that the right hand side of (1) was less than the left hand side, one could borrow at I^h_t and lend at i_w covering the future foreign currency receipt and have a money-making machine.

S^f_{t+1}, the forward rate of exchange determined in the market, is closely related to the expected value of the market's perceived distribution of S_{t+1} at time t but will tend to be somewhat lower because of the risks of holding currency forward and transaction costs.

Thus:

$S^f_{t+1} = E[\tilde{S}_{t+1}]$ adjusted for risk and costs quoted

where: $\tilde{S}_{t+1}$ is the perceived distribution of S at time t + 1 in the market, given all available information.

In general, then, when the foreign currency is expected to appreciate against the local currency, it will stand at a forward premium (usually expressed in per cent per annum) to the local currency and when the foreign currency is expected to depreciate against the local currency it will stand at a forward discount.

Interest parity is, as indicated, an identity for efficient interest and exchange rate markets. It follows from maximising behaviour, specifically from attempts to borrow where costs are (expected to be) lowest or to lend where returns are (expected to be) greatest. Any deviations from interest parity will lead to adjustments of foreign or local interest rates or to spot or forward exchange rates.

3 INTEREST PARITY CONSIDERATIONS UNDER CENTRAL BANK MANAGEMENT

If the central bank should manage the spot and forward exchange rate markets, then firstly differences between local and foreign interest rates may not equal the exchange rate premium/discount as determined by the central bank and, secondly, this quoted premium/discount may imply a future exchange rate which differs considerably from what the market believes the exchange rate will be at the end of the relevant time period. We consider these situations, which are not mutually exclusive, in turn below.

In equilibrium for a managed exchange rate regime, the interest rate parity relationship with quoted forward rates will be of the following form:

$$i^h_t = i_w + \frac{S^f_{t+1} - S_t}{S_t} \qquad (2)$$

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This forward quoted rate allows a borrower to have access to two risk-free transactions to obtain funds at different costs. He may borrow locally at i_t^h or he may borrow on overseas markets at i_w but cover his foreign currency liabilities forward by buying forward foreign currency at a fixed price. For the class of risk-free transactions a borrower will thus borrow locally if

$$i_t^h < i_w + \frac{S_{t+1}^f - S_t}{S_t} ,$$

and borrow overseas if

$$i_t^h > i_w + \frac{S_{t+1}^f - S_t}{S_t} .$$

The trader is, however, not committed to obtaining forward cover and he may not do this if his exchange rate expectations deviate sufficiently from S_{t+1}^f.

In equilibrium for the managed regime our interest rate parity relationship with expected market rates will have the following form

$$i_t^h = i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \qquad (3)$$

where S_{t+1} is the distribution of S at time t+1 adjusted for risk and costs based on all available information at time t (note that part of this information will be the central bank's management record, i.e. it is a distribution *given expected intervention*).

As before, a borrower who has access to either local or uncovered foreign funds will borrow locally if

$$i_t^h < i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} ,$$

and borrow overseas if

$$i_t^h > i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t}$$

(2) and (3) are both equilibrium conditions for risk-free and at-risk finance respectively. For a borrower to be indifferent to local or overseas sources of finance, both (2) and (3) must hold.

When either of the two equilibrium conditions do not hold, the borrower takes local finance if

$$i_t^h < \min\left[i_w + \frac{S_{t+1}^f - S_t}{S_t} , i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \right]$$

covered overseas finance if

$$i_w + \frac{S_{t+1}^f - S_t}{S_t} < \min\left[i_t^h , i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \right]$$

uncovered overseas finance if

$$i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} < \min\left[i_t^h , i_w + \frac{S_{t+1}^f - S_t}{S_t} \right]$$

It is seen that the central bank may adjust its quoted rate and provide forward currency at artificially low costs in order to increase the volume of capital account inflows and thus its foreign exchange reserves. This strategy is, however, generally assymetrical in that if it is attempting to stem an inflow of funds due to the market expecting exchange rate appreciation it will be unable to do this, unless it allows local private investors foreign investment avenues (and discounts forward prices of the local currency). This is to say, allows domestic interest rates to fall.

4 MONEY SUPPLY CONTROL UNDER MANAGED EXCHANGE RATES

These capital flows will generally have domestic money supply effects unless the central bank is able to conduct open market operations that simultaneously offset the impact of the balance of payments on the cash reserves of the domestic banking system. If the central bank is successful in this and the difference between the managed and market exchange rates persisted, the foreign exchange reserves of the banks would increase (or decrease) while their domestic asset holdings decline (or grow) proportionately. There are, however, limits to such intervention by the central bank. If the exchange rates are set so as to encourage off-shore borrowing, the limits will be the foreign borrowing capacity of domestic borrowers, but the incentive to borrow will exist as long as the central bank can prevent the money supply from increasing and domestic rates from falling, while at the same time preventing the undervalued managed rate from appreciating. If they are set so as to encourage repayment of foreign debt, the limiting factor will be the central bank stock of foreign exchange reserves, with market participants active until interest rates are allowed to rise and the exchange rate to fall.

Giving borrowers access to foreign markets will enormously complicate the difficulties the monetary authorities will have in using interest rates as instruments of money supply control. In the closed economy, the successful use of interest rates as instruments of money supply control requires accurate predictions of income and the income elasticity demand for money. In the open economy context, interest rates cannot be viewed independently of exchange rate expectations and foreign interest rates. This is because the central bank is not the only source of cash reserves for the banking system and thus the authorities have to predict the income and interest rate elasticities of capital flows.

The object of central bank intervention in the money and exchange rate markets may not, of course, be the control of the money supply but rather follow from a concern for the level of interest or exchange rates themselves or the level of foreign exchange reserves. Such considerations are obviously not consistent with money supply control.

5 THE MODELLING OF CAPITAL ACCOUNT FLOWS AND INTEREST RATES UNDER MANAGED EXCHANGE RATES IN SOUTH AFRICA

The exchange rate management by the South African Reserve Bank clearly parallels the illustration outlined above. We will show below how, by using a model to obtain exchange rate expectations, we can construct the spectrum of cost-of-finance possibilities and indicate how their implications for the direction of capital flows have been consistent with the South African experience. We consider the period January 1980–April 1983, and for that period compute the costs of local, covered overseas and uncovered overseas finance. The overseas

rate is taken to be the rate on New York three-month bankers' acceptances. The local rate is taken as the South African three-month bankers' acceptance rate. The overseas covered rate was computed as the overseas rate plus the all in three-month forward dollar premium/discount. The expected cost of uncovered finance was computed as the overseas rate plus the expected forward dollar adjusted for risk.

6 GENERATION OF THE EXCHANGE RATE EXPECTATION SERIES

A series of exchange rate expectations were generated by computing regressions (variables in log form) of the exchange rate ($/R) against the gold price in dollars over a moving period of 12 months. This is assumed to capture market expectations of the Reserve Bank's management of the exchange rate, relative to the gold price. The expectation of the exchange for a particular month is then taken as the estimated value from the regression covering the preceding 12 months, calculated by substituting into the equation the average gold price for that month. The percentage deviation between the expected and actual exchange rate is taken as the expected premium/discount. The (out of period) variance of this estimate is estimated by its mean square error.*

The square root of this value is taken as a proxy for the risk associated with an exchange rate speculation, and this value in percentage form is added to the forward premium/discount to represent the increased perceived cost due to the risk. For example, if the variables are distributed normally and the Reserve bank's management of the exchange rate, relative to the gold price, remains the same, the uncovered borrower has an 82% chance of the cost of exchange rate movements over the contract costing him less than the estimate, i.e. the cost is put conservatively high.

The table on the following page gives the values for the various covered and expected uncovered forward premiums and hence finance costs.

This exercise is particularly instructive in how it demonstrates the gains to be had for South African borrowers with access to uncovered offshore finance from about August 1982. The Reserve Bank official forward rate which was implicitly predicting a decline in the rand was obviously out of line for an exchange rate, which had not moved from about 0,87 $/R and a gold price which had increased by $130. The effects on money supply over this period were, of course, moderated by massive open market operations by the Reserve Bank. The sudden decline in the gold price in late February 1983 reversed the exchange rate expectations and the expected cost of uncovered finance rose above local sources. The net inflows on capital account were thus transformed into outflows.

7 CONCLUSION

It is clear from the acceleration in the rate of growth of the money supply from approximately mid-1982 that exchange rate management over this period proved incompatible with stated money supply growth objectives. The association between changes in the gold price and changes in money supply growth over this recent period parallels developments throughout the 70s. That is, since the gold price began to fluctuate and the rand became a floating currency managed by the Reserve Bank. The association between changes in the gold price and changes in the rate of growth of the money supply between 1971 and 1983 cannot be satisfactorily explained other than in terms of deviations from expected interest parity. An analysis of the determination of such deviations has been presented above.

Gold price changes impinge on the foreign exchange reserves of the central bank and the cash reserves of the banks through the trade account and the capital account of the balance of payments. It is the net flows of funds that are of importance. If interest parity relationships held continuously, there would be no net effects of the balance of payments on the money supply. Any change in the balance of payments or in expectations of the balance of payments, would lead to simultaneous adjustments of interest rates and exchange rates to equalise the supply and demand for foreign currency. The current and capital accounts of the balance of payments would sum to zero and the central bank would neither stimulate nor run down its foreign exchange reserves.

Variables in table

1. Exchange rate in US dollars/rand
2. Gold price in US dollars
3. Expected exchange rate in US dollars/rand
4. Expected premium discount on 3 month forward dollars (per cent annualised)
5. Quoted premium/discount on 3 month forward dollars (per cent annualised)
6. Expected premium/discount adjusted for risk (per cent annualised)
7. Rate on 3-month RSA bankers' acceptances (annualised)
8. Rate on 3-month New York bankers' acceptances (annualised)
9. Rate on covered New York finance
10. Expected rate on uncovered New York finance adjusted for risk (per cent annualised)
11. Decision taken by local borrower
12. Year-on-year growth in money supply (per cent)

* If X is the n X 2 matrix of the constant term and the gold price (n = 13) in the equation

$\hat{y} = X\hat{\beta}$

M.S.E. $(\hat{y}) = E\,(\underline{y}-\underline{\hat{y}})\,(\underline{y}-\underline{\hat{y}})' = \sigma^2\,(I-X(X'X)^{-1}X')$

the 13th diagonal element of this matrix is the M.S.E. of the out-of-period gold price estimate of the exchange rate.

Table

	1	2	3	4	5	6	7	8	9	10	11	12
January 1980	1,22	674	1,26	−3,52	−2,50	−2,81	4,40	13,24	10,74	10,43	Local	13,90
	1,23	665	1,23	0,24	−2,50	0,81	4,80	14,65	12,15	15,46	Local	14,26
	1,24	553	1,22	1,70	−2,50	2,13	4,80	17,29	14,79	19,42	Local	15,58
	1,24	517	1,21	2,04	−9,75	2,67	5,40	14,39	4,64	17,06	Cover off	14,95
	1,27	514	1,22	3,80	−4,50	4,64	5,10	8,42	3,92	13,06	Cover off	17,36
	1,29	599	1,23	4,41	−4,25	5,76	5,00	8,33	4,08	14,09	Cover off	22,33
	1,31	645	1,25	4,51	−4,50	6,30	4,70	11,37	6,87	17,67	Local	24,39
	1,32	626	1,26	4,52	−5,75	6,66	4,80	8,44	2,69	15,10	Cover off	23,84
	1,33	675	1,28	3,94	−7,75	6,41	4,90	10,77	3,02	17,18	Cover off	27,05
	1,33	661	1,28	3,84	−8,25	6,49	5,20	13,71	5,46	20,20	Local	28,07
	1,33	623	1,28	4,15	−9,40	7,00	6,10	16,58	7,18	23,58	Local	28,67
	1,33	595	1,27	4,18	−11,32	7,28	7,00	13,30	1,98	20,58	Cover off	27,44
January 1981	1,34	558	1,27	4,65	−9,40	7,89	8,25	16,40	7,00	24,29	Coveroff	32,85
	1,29	500	1,26	2,28	−7,03	5,12	9,50	14,90	7,87	20,02	Cover off	34,14
	1,27	499	1,27	0,01	−5,08	2,08	9,75	13,50	8,42	15,58	Cover off	34,54
	1,23	496	1,27	−2,99	−5,36	−1,33	9,60	15,40	10,04	14,07	Local	41,89
	1,20	480	1,26	−5,80	−7,13	−4,16	12,00	16,90	9,77	12,74	Cover off	37,75
	1,15	459	1,24	−7,50	−2,21	−5,32	14,50	16,10	13,89	10,78	Uncover off	34,07
	1,09	409	1,18	−9,08	−1,63	−6,25	15,50	17,20	15,57	10,95	Uncover off	32,04
	1,05	410	1,15	−9,47	−3,76	−5,94	14,25	17,17	13,41	11,23	Uncoveroff	31,02
	1,06	443	1,16	−9,80	−3,22	−5,61	13,75	15,39	12,17	9,78	Uncover off	26,09
	1,05	437	1,13	−8,24	−1,78	−3,84	13,75	14,53	12,75	10,69	Uncover off	25,77
	1,04	413	1,08	−3,77	1,39	0,53	14,25	11,10	12,49	11,63	Uncover off	25,34
	1,03	410	1,06	−2,28	2,32	1,70	15,25	12,70	15,02	14,40	Uncover off	25,12
January 1982	1,04	384	0,98	5,23	1,90	8,47	15,75	13,60	15,50	22,07	Cover off	22,20
	1,02	374	0,97	5,42	1,24	8,99	17,25	13,50	14,74	22,49	Cover off	22,55
	0,98	330	0,90	7,99	3,82	11,40	18,00	14,30	18,12	25,70	Local	23,98
	0,95	350	0,97	−2,55	2,28	0,98	17,00	14,10	16,38	15,08	Uncover off	16,26
	0,94	334	0,95	−1,36	2,65	1,74	16,70	13,10	15,75	14,84	Uncover off	15,19
	0,90	314	0,94	−4,36	1,54	−1,59	17,20	14,80	16,34	13,21	Uncover off	17,77
	0,87	338	0,96	−10,00	2,95	−7,34	17,40	11,90	14,85	4,56	Uncover off	15,36
	0,87	363	0,98	−12,25	6,06	−9,02	16,90	10,20	16,26	1,18	Uncover off	17,78
	0,87	437	1,06	−21,82	6,10	−17,50	16,30	10,20	16,30	−7,30	Uncover off	18,84
	0,86	422	1,00	−15,56	6,94	−9,32	16,10	9,10	16,04	−0,22	Uncover off	18,99
	0,88	415	0,96	−9,04	7,15	−1,85	15,00	8,60	15,75	6,75	Uncover off	18,19
	0,92	444	0,95	−3,46	7,01	5,04	14,60	8,70	15,71	13,74	Uncover off	17,41
January 1983	0,94	481	0,96	−1,84	6,16	6,16	12,30	8,50	14,66	14,66	Local	19,25
	0,91	492	0,94	−2,92	3,27	3,83	10,20	8,10	11,37	11,93	Local	17,20
	0,92	420	0,89	2,99	1,43	8,89	11,80	8,90	10,33	17,79	Cover off	17,40
	0,92	433	0,90	1,32	2,47	4,71	11,60	8,40	10,87	13,11	Cover off	19,41