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An Analytical Approach to Interest Rate Determination in Developing Countries

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I. INTRODUCTION

The role of interest rates in the development process has been studied extensively in recent years. Following upon the seminal work of McKinnon (1973), there have been a number of theoretical and empirical studies examining the relationship between financial development and economic growth, the effect of changes in real interest rates on savings and investment, and more generally, the pros and cons of a market-oriented financial system.[1] Broadly speaking, there is now ample empirical evidence supporting the original claim by McKinnon [10] that there is a positive association between the degree of development of the financial sector, resulting primarily from a freer structure of interest rates, and the overall economic performance of developing countries.

As a number of developing countries move towards more liberalized financial systems, prompted perhaps in part by the findings of the studies mentioned above, the question of how interest rates are likely to behave in the new environment is one that policy-makers in these countries have started to face. In particular, how domestic interest rates might be expected to respond to both foreign influences and domestic monetary conditions is an issue that has received very little attention in the literature.[2] Most existing studies of interest rates typically treat only the extreme cases of either a fully open economy, in which some form of interest rate arbitrage holds, or a completely closed economy, in which interest rates are determined solely by domestic monetary factors. Developing countries, however, generally fall somewhere between these two extremes, so that the standard models of interest rate determination would not seem to be relevant to their particular case.

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[1] See, for example, Fry [7], Lanyi and Saracoglu [8], and Mathieson [13].

[2] The only studies we are aware of that include open-economy and domestic monetary factors in the analysis of interest rates are Mathieson [12; 13] on Argentina and Chile respectively, Blejer and Gil Diaz [2] on Uruguay, and Edwards [5] on Colombia.

The purpose of this paper is to outline a theoretical framework that can serve as a starting point for analysing interest rate behaviour in those developing countries which are in the process of removing controls on the financial sector and eliminating restrictions on capital flows. The approach suggested here combines elements of the standard closed-economy and open-economy models, and thus is able to directly incorporate the influences of foreign interest rates, expected changes in exchange rates, and domestic credit conditions on interest rates. An interesting feature of the resulting model is that the degree of financial openness, defined as the extent to which domestic interest rates are linked to foreign interest rates, can in fact be approximately measured from the data of the individual country.

The remainder of the paper proceeds as follows. Section II describes the closed-economy and open-economy models, and then shows how these can be combined into a general model that would be more applicable to developing countries. Section III covers some areas where the analysis could be usefully extended, including, for example, the issue of real interest rates, the determination of interest rates under changing degrees of openness, the modelling of expected exchange rate changes, and the role of currency substitution. The concluding section summarizes the main points of the paper and draws some policy implications.

II. BASIC MODELS OF INTEREST RATE DETERMINATION

This section presents three basic models that could be used for analysing interest rate behaviour in developing economies. The first model is a simple model that assumes that the country in question is completely closed to the rest of the world. Under these circumstances it is assumed that the nominal interest rate depends on the real interest rate and expected inflation. The second model considers the other extreme where the capital account is completely open. In this case, domestic interest rates are closely linked to world interest rates through the interest arbitrage condition. Finally, we consider a more general model that allows both foreign and domestic factors to affect the behaviour of the nominal interest rate, and thus contains the other two models as special cases.

Closed-economy Model

The standard Fisher approach states that the nominal interest rate is defined as equal to the real interest rate plus the expected rate of inflation:

$$i_t = rr_t + \pi^e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where

i = nominal rate of interest;

rr = real (*ex ante*) rate of interest; and

π^e = expected rate of inflation.

Generally the real rate of interest in turn has been specified as

$$rr_t = \rho - \lambda EMS_t + \omega_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where ρ is a constant, and represents the long-run equilibrium real interest rate (equal to the marginal productivity of capital). The variable *EMS* represents the excess supply of money, or a monetary shock term, λ is a parameter ($\lambda > 0$), and ω_t is a random error term. According to equation (2) the real rate of interest would deviate from its long-run value ρ if there is monetary disequilibrium, and excess demand (supply) for real money balances will result in a temporarily higher (lower) real interest rate. This relationship has been termed the "liquidity effect" in the literature Mundell [14]. In the long run, however, the money market would be in equilibrium and the variable *EMS* would play no role in the behaviour of rr_t.[3] Introducing this liquidity effect into the model basically allows the real rate of interest to be variable in the short run.

Combining equations (1) and (2), the solution for the nominal interest rate in a closed economy is therefore:

$$i_t = \rho - \lambda EMS_t + \pi^e_t + \omega_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

In order to estimate equation (3), however, some assumptions have to be made regarding the unobserved variables, such as π^e and *EMS*. The expected rate of inflation can be specified in a variety of ways, the most common being the use of the traditional adaptive-expectations model, or some type of generalized autoregressive process.[4] Similarly, there are different ways of approximating monetary disturbances, such as the excess supply of money, or the use of some type of a monetary surprise variable.

The excess supply of money is defined as

$$EMS_t = \log m_t - \log m^d_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where m is the actual stock, and m^d the desired equilibrium stock, of real money balances. In an economy which has completed the financial reform process we would expect substitution to take place between both money and goods, as well as

[3] Note that more generally EMS_t could also affect π^e_t. Furthermore, it is assumed here that changes in π^e_t have no direct effects on rr_t. On these types of effects, see Mundell [14].

[4] Both these approaches relate the expected rate of inflation to past observed rates of inflation. Other possible methods include the use of survey data, models that allow for the influence of additional economic variables other than only past rates of inflation, and, of course, the simplest perfect foresight model where actual and expected rates of inflation are the same.

between money and financial assets, so that the demand for money would be a function of two opportunity cost variables, namely the expected rate of inflation and the rate of interest, along with a scale variable (real income).[5] The equilibrium demand for money can therefore be written as

$$\log m_t^d = \alpha_0 + \alpha_1 \log y_t - \alpha_2(\rho + \pi_t^e) - \alpha_3 \pi_t^e \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

It should be noted that the long-run demand for money is assumed to be a function of the equilibrium nominal interest rate, defined as the equilibrium real interest rate (ρ) plus the expected rate of inflation, rather than the current nominal interest rate.

The model can be closed by assuming that the stock of real money balances adjusts according to

$$\Delta \log m_t = \beta[\log m_t^d - \log m_{t-1}] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

where Δ is a first-difference operator, $\Delta \log m_t = \log m_t - \log m_{t-1}$, and β is the coefficient of adjustment, $0 \leqslant \beta \leqslant 1$. If the nominal stock of money is exogenous, then equation (6) really describes an adjustment mechanism for domestic prices. Basically, this last equation ensures that the nominal interest rate returns eventually to its equilibrium level.

The working of the closed-economy model is fairly straightforward. Assume that there is an increase in the money supply so that there is an excess supply of money – equation (4). This would result in a fall in the real interest rate – equation (2) – and, given π^e, in a decline in the nominal interest rate as well – equation (3). This fall in the interest rate essentially represents the short-run liquidity effect we referred to earlier. However, this is only a temporary movement, since in the next period the (unchanged) long-run demand for money is less than the actual stock in the previous period, and therefore by equation (6) the stock of real money balances would decline until it is once again equal to the equilibrium money demand. Consequently the nominal interest rate would move back to its original level ($\rho + \pi^e$).

Equation (6) can be simplified as

$$\log m_t = \beta \log m_t^d + (1-\beta) \log m_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (6a)$$

and combining equations (4) and (6a) we obtain

$$EMS_t = (1-\beta)\,[\log m_{t-1} - \log m_t^d] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

[5] Of course, one could also introduce an "own" rate of return into the money demand formulation. This would certainly be advisable when dealing with broad definitions of money that include deposits paying positive rates of interest. See Mathieson [12; 13].

Using equations (1), (5), and (7) we can derive the reduced-form equation for the nominal interest rate.

$$i_t = \gamma_0 + \gamma_1 \log y_t + \gamma_2 \log m_{t-1} + \gamma_3 \pi_t^e + \omega_t \quad \ldots \quad \ldots \quad (8)$$

where the composite parameters are:

$$\gamma_0 = \rho + \lambda(1-\beta)(\alpha_0 - \alpha_2 \rho)$$
$$\gamma_1 = \lambda(1-\beta)\alpha_1$$
$$\gamma_2 = -\lambda(1-\beta)$$
$$\gamma_3 = [1-\lambda(1-\beta)(\alpha_2 + \alpha_3)]$$

Once π^e is replaced by some appropriate measured variable, equation (8) can be directly estimated. In the estimation it would be expected that $\gamma_1 > 0$, and $\gamma_2 < 0$; the sign of γ_3 would be negative or positive depending on whether $\lambda(1-\beta)(\alpha_2 + \alpha_3)$ is greater or less than one.

As mentioned earlier, using the excess supply of money is only one of alternative ways of representing monetary disequilibrium. For example, it can be postulated that only money surprises will influence the real interest rate Makin [11]. In such a case, the variable *EMS* would have to be replaced by some measure of unanticipated monetary changes in equation (2). Typically this would involve fitting a function relating the current rate of monetary expansion to its lagged values, and using the predicted values from this regression as an approximation to anticipated, or expected, monetary changes. The difference between the predicted values and the actual values would then yield the unanticipated values.[6]

Open-economy Model

If the economy is completely open to the rest of the world, and there are no impediments to capital flows, domestic and foreign interest rates will be closely linked. In particular, in a world with no transaction costs and risk-neutral agents, the following uncovered interest arbitrage relation will hold:

$$i_t = i_{t*} + \dot{e}_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9)$$

where i_{t*} is the world interest rate for a financial asset of the same characteristics (maturity and so on) as the domestic instrument, and $\dot{e}_t$ is the expected rate of

[6] Of course, one could also use the adaptive-expectations model to derive a series for expected monetary changes.

change of the exchange rate.[7] If, however, agents are assumed to be risk-averse, $\dot{e}_t$ should be replaced by the forward premium, or alternatively, a (time-varying) risk premium term should be added to equation (9).

Usually the analysis of interest rate behaviour in open economies has amounted to investigating the extent to which equation (9), or some variant of it, holds. One way of doing this is by adding transaction costs and defining a band within which the interest parity differential can vary, without violating the arbitrage condition. Another way of testing equation (9) is through the analysis of the time-series properties of the interest parity differential. If these time series are not serially correlated, i.e. they are white noise, it is usually concluded that the domestic interest rate depends only on open economy factors.[8]

There, of course, exists the possibility that due to frictions arising from transaction costs, information lags, etc., domestic interest rates respond with delay to any changes in the foreign rate of interest or in exchange rate expectations. This type of lagged response can be modelled in a partial-adjustment framework as follows:

$$\Delta i_t = \theta[(i_{t*} + \dot{e}_t) - i_{t-1}] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

where θ is the adjustment parameter, $0 \leqslant \theta \leqslant 1$. If the financial market adjusts itself very rapidly, this parameter θ will tend towards unity. Conversely, a small value of θ would imply slow adjustment of the domestic interest rate.[9] The solution of equation (10) in terms of the domestic interest rate is

$$i_t = \theta(i_{t*} + \dot{e}_t) + (1-\theta)i_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

The General Case

The preceding discussion has dealt with interest rate determination in the two polar cases regarding the degree of openness of the economy. If, however, the economy under consideration is one that has some controls on capital movements, as most developing countries have, it is possible to visualize that, at least in the short run, both open- and closed-economy factors will affect the behaviour of domestic interest rates. An obvious way of constructing a model for such an economy is to

[7] The exchange rate is defined as the domestic price of foreign currency.

[8] See Levich [9] for a review of the studies that have dealt with this and related issues.

[9] During the period when the parity condition does not exactly hold there would obviously be unexploited profit opportunities. The attempts by transactors to take advantage of these opportunities would set in motion the very forces that would bring about equality between domestic and foreign interest rates (adjusted for expected exchange rate changes). How long this process takes is an empirical question and would have to be estimated from the date.

combine the closed-economy and open-economy extremes. In particular, it can be assumed that the equation for the nominal interest rate can be specified as a weighted average, or linear combination, of the open- and closed-economy expressions discussed above. Denoting the weights by ψ and $(1-\psi)$ and combining equations (1) and (9), the following model for the nominal interest rate can be specified:

$$i_t = \psi(i_{t*} + \dot{e}_t) + (1-\psi)(rr_t + \pi_t^e) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (12)$$

where the parameter ψ can be interpreted as an index measuring the degree of financial openness of the country. If $\psi = 1$, the economy is fully open and equation (12) collapses into the interest arbitrage condition (9). If, on the other hand, $\psi = 0$, the capital account is closed and equation (12) becomes equal to the Fisher closed-economy equation (1). In the intermediate case of a semi-open (semi-closed) economy, the parameter ψ will lie between zero and one; the closer it is to one the more open the economy will be. In some sense, by estimating ψ from the data it is possible to determine the degree of openness of the financial sector in a particular country. This estimated degree of openness will provide some information on the actual degree of integration of the domestic capital market to the world financial market. To the extent that official capital and exchange controls are not fully effective, the empirically estimated degree of openness can be significantly higher than the degree of openness given by the system of capital controls in the country.

If we assume slow adjustment to interest parity and thus use equation (11) instead of equation (9), the appropriate form for the general case becomes

$$i_t = \psi\theta(i_{t*} + \dot{e}_t) + \psi(1-\theta)i_{t-1} + (1-\psi)(rr_t + \pi_t^e) \quad \ldots \quad (13)$$

Once again, full interest parity would require the condition $\psi = \theta = 1$; when $\psi = 0$, the Fisher closed-economy condition would emerge. It should be noted that there will be some relation between the index of financial openness, ψ, and the speed of adjustment, θ. For example, if the domestic financial market is fully integrated with the international capital markets, it is also likely that domestic interest rates would adjust themselves very rapidly.

Assuming that the excess money supply term is given by equation (4) and the demand for real money function by equation (5), we obtain from equation (13) the following expression for the nominal interest rate:[10]

[10] Note that when $\theta = 1$, the lagged interest rate term would drop from the specification, so that the equilibrium model is only a restricted version of this formulation.

$$i_t = \delta_0 + \delta_1(i_{t*} + e_t) + \delta_2 \log y_t + \delta_3 \log m_{t-1} + \delta_4 \pi_t^e + \delta_5 i_{t-1} + \epsilon_t \quad \ldots \quad (14)$$

where the reduced-form parameters δ_i are

$$\begin{aligned}
\delta_0 &= (1-\psi)[\rho + \lambda(1-\beta)(\alpha_0 - \alpha_2\rho)] \\
\delta_1 &= \psi\theta \\
\delta_2 &= (1-\psi)\lambda(1-\beta)\alpha_1 \\
\delta_3 &= -(1-\psi)\lambda(1-\beta) \\
\delta_4 &= (1-\psi)[1-\lambda(1-\beta)(\alpha_2 + \alpha_3)] \\
\delta_5 &= \psi(1-\theta)
\end{aligned}$$

Equation (14) is quite general, as it not only incorporates open-economy and closed-economy features but further permits the possibility of slow adjustment on both the foreign and domestic sides. One can see that in the case of a completely open economy with instantaneous adjustment of the domestic interest rate (i.e. $\psi = \theta = 1.0$), δ_1 becomes equal to 1.0 and $\delta_0 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$. According to equation (14), the nominal interest rate will then be equal, in both the long and short runs, to $(i_{t*} + \dot{e}_t)$. In the case of a completely closed economy ($\psi = 0$), the parameters δ_1 and δ_5 will be equal to zero, and equation (14) collapses to the closed-economy equation (8).

Estimates of this model for Colombia and Singapore, as reported in Edwards and Khan [6], yielded very plausible results. In the case of Colombia, both foreign and domestic factors were found to play a significant role, and it was determined that the Colombian economy was more open, as measured by the value of ψ, than would have been indicated by looking at the formal system of exchange restrictions and controls. In Singapore, only foreign factors were statistically important ($\psi = 1$), reflecting the fact that the financial sector is completely free and there are no hindrances to the movement of capital.

III. EXTENSIONS OF THE BASIC MODEL

Even though the model described in the previous section is adequate in many respects, it can clearly be extended to cover more complex situations. In this section we briefly discuss four possible extensions one could consider. These are: (1) the analysis of *real* interest rates in developing countries; (2) the analysis of interest rate behaviour during the process of liberalization of the capital account of the balance of payments; (3) the explicit modelling of the expected rate of devaluation in the

context of interest rate behaviour in open developing countries; and (4) the role of currency substitution in the demand for money. This list is by no means exhaustive, and is only meant to cover the areas which have attracted attention in the literature.[11]

1. Real Interest Rates in Developing Countries

Recently, some studies have empirically analysed the behaviour of real interest rates in industrialized countries, placing special emphasis on whether these rates have tended to be equalized across countries.[12] From a theoretical viewpoint, even if there are no exchange controls and the capital account is fully open, and, further, the nominal arbitrage condition holds, real interest rates can still differ across countries. For example, an expectation of a real depreciation would result in a country having a higher real interest rate than the rest of the world.[13]

The framework discussed in this paper can be easily extended to analye the process of determination of (*ex post* and *ex ante*) real interest rates. Since the *ex post* real interest rate is defined as the nominal rate minus the actual rate of inflation, a simple way of doing this is to add an explicit inflation equation to the model.[14] The resulting two-equation model could then be used to determine simultaneously the nominal interest rates and the rate of inflation, and the *ex post* real interest rates can then be directly obtained from these two equations.[15] Furthermore, if the inflation equation is used to determine the expected rate of inflation, then one can obviously calculate the *ex ante* real rate of interest as well.

To keep within the spirit of the model outlined here, the inflation equation specified should be general enough to allow both closed- and open-economy factors to play a role. In the extreme case of a fully open economy, domestic monetary conditions will have no direct effect, and the inflation rate will depend solely on world inflation and the (actual) rate of devaluation. If, in addition, it is assumed that the expected real exchange rate will remain constant, the model will predict the equality of domestic and foreign real interest rates. On the other hand, if the economy is completely closed, the domestic rate of inflation, as well as the nominal and real interest rates, will have no relation to their world counterparts.

[11] We do not, for example, deal with econometric issues that would arise in estimating the model. Such issues would include, *inter alia*, simultaneity, specification of the underlying dynamics, and the proper treatment of the error structures.

[12] For example, Cumby and Mishkin [3].

[13] On the relation between real exchange rates and real interest rates, see Dornbusch [4].

[14] Note that the adjustment equation (6) in our model could be interpreted as an inflation equation, although we do not explicitly do so.

[15] Blejer and Gil Diaz [2] specify a two-equation model for the real interest rate and inflation. Naturally, their model can be used to determine the nominal interest rate as well.

2. Interest Rates and Liberalization

One of the limitations of the model presented in this paper is that it assumes a constant degree of openness of the financial sector in the country under study. However, a number of developing countries have recently gone through liberalization processes characterized by, among other things, the relaxation or removal of existing capital controls. To the extent that these liberalization processes result in a higher degree of integration of the domestic and the world capital markets, the assumption of a constant ψ is clearly inappropriate.

There are several possible ways to proceed if the degree of openness is changing through time. The simplest way to model this would be to make the openness parameter a linear function of time as follows:

$$\psi_t = \psi_0 + \psi_{1t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (15)$$

where ψ_0 is the constant part of the openness parameter and t is a time trend. We would expect that $\psi_1 > 0$. If the level and intensity of capital controls vary smoothly and gradually over the period of study, then equation (15) would be a reasonable approximation. One could use equation (15) to substitute for ψ in the interest rate equation and then directly estimate the resulting reduced form. This simple form would obviously break down if the changes in capital controls were abrupt or erratic, and it would be necessary to consider other methods to formally capture the liberalization process. Ideally, of course, one would wish to have some type of index that directly measures the degree of openness constructed from information that is actually available on the system of capital controls in the country in question. This would, however, not be an easy task, and would very likely involve a great deal of subjectivity.

3. Expected Devaluation and Interest Rate Determination

Throughout the discussion in this paper, no mention has been made of the way in which the expected rate of devaluation is determined. During the course of the present exercise, this variable was assumed to be exogenous. This is quite a restrictive assumption and a more realistic analysis would have to recognize that the expected exchange rate change is likely to be affected by movements in domestic interest rates and, more generally, by domestic monetary conditions. However, recognizing this issue and actually doing something about it are two quite different things, since, in practice, endogenizing the expected rate of devaluation (or even the forward premium) has generally proved to be exceedingly difficult.

The way one would proceed will depend on the exchange rate system that the country in question has. If the country has a floating exchange rate, standard modern theories of exchange rate behaviour can perhaps be used. Even so, it should

be recognized that this is not very easy, since these models have not been particularly successful in predicting exchange rate movements.[16] Under fixed rates, the problem becomes even more complicated, since the probability of an exchange rate crisis has then to be modelled explicitly. Some initial attempts have been made in this direction, but the modelling of exchange rate crises is still very much in its infancy.[17]

4. The Role of Currency Substitution

In combining the closed-economy version of the interest rate model with the open-economy formulation, the basic money-demand function was left unchanged. This function, it will be recalled, allows substitution to take place between money, domestic bonds, and goods. While this is the appropriate specification in the case of a closed economy, it does prove to be somewhat restrictive, once the possibility of substitution between domestic and foreign money, defined generally as currency substitution, is admitted. In other words, one now has another asset in the system, viz. foreign money, whose rate of return also has to be taken into account. Thus, in combining the two models one has to recognize that the demand-for-money function in an open economy could be different from the function relevant for a closed economy.

The importance of the currency substitution phenomenon has been documented in a number of studies. In contrast to earlier opinion, which held that currency substitution was relevant only in countries with developed financial and capital markets, it has become evident in recent years that currency substitution takes place frequently in developing countries as well. Furthermore, it has been found to occur in countries that differ considerably in levels of financial development, the degree of integration with the rest of the world, and types of exchange rate regimes and practices. Clearly, currency substitution is a factor that should be explicitly taken into account in any realistic analysis.

How one would go out and model the effects of currency substitution is not, however, all that clear. The general consensus is that the principal determinant of currency substitution is the expected change in the exchange rate, although, as pointed out in the previous sub-section, there is a great deal of controversy on how this ought to be measured. Other things being equal, an expected depreciation of the domestic currency, for whatever reason, would cause residents to switch out of domestic money into foreign money, and vice versa. Once the difficult problems associated with the choice of an appropriate empirical proxy for exchange rate expectations are surmounted, the rest becomes relatively straightforward. The demand-for-(domestic)-money function in an open economy could be re-specified as

[16] See Levich [9] for a survey of such models for the major industrial countries.

[17] See Blanco and Garber [1] for a discussion of one such model for the case of Mexico.

$$\log m_t^d = \alpha_0 + \alpha_1 \log y_t - \alpha_2 (\rho + \pi_t^e) - \alpha_3 \pi_t^e - \alpha_4 \dot{e}_t \quad \ldots (15a)$$

The last term in this modified equation would then capture the effects of currency substitution, i.e. an expectation of a depreciation of the domestic currency would tend to shift people towards foreign currency.

IV. CONCLUSIONS

As developing countries move towards liberalizing their financial sectors and thus allow a greater role for market forces to affect interest rates and capital flows, the issue of how interest rates would in fact be determined has become a pressing one. Only when interest rate behaviour is well understood will it be possible to predict the effects of government policies on key macro-economic variables. Until very recently, there was remarkably little theoretical analysis of how interest rates are likely to be determined in developing countries, and, consequently, only limited knowledge of how government policy would affect interest rates and, through them, variables such as savings, investment, the balance of payments, and economic growth.

In this paper, an attempt was made to outline an analytical framework that could be used to study interest rate behaviour in developing countries. Although this proposed model has a fairly simple structure, it is nevertheless able to incorporate what are generally considered to be the principal determinants of interest rates, namely, foreign rates of interest, exchange rate changes, domestic money market conditions, and domestic inflation. Furthermore, the model allows one to estimate the degree to which an economy may be effectively open. This measure of "economic" openness may turn out to differ quite significantly from the "legal" degree of openness implied by the prevailing system of capital and exchange controls.

If the economy in question is completely open, then its interest rate structure will be closely linked to interest rates in foreign financial centres. Consequently, the authorities will not be able to directly influence domestic interest rates through changes in monetary policy. They will, of course, be able to affect interest rates indirectly if their actions alter exchange rate expectations. If the economy is less than fully open, any change in the domestic money supply would affect interest rates, but this effect would be short-lived. In other words, in the long run the level of domestic interest rates would be independent of monetary changes. Basically, in the semi-open economy, which is a description that would fit many, if not most, developing countries, interest rates would be determined in the long run by foreign interest rates (adjusted for changes in the exchange rate), the domestic real rate of interest, given by the marginal productivity of capital, and domestic inflation.

REFERENCES

1. Blanco, Herminio, and Peter M. Garber. "Recurrent Devaluation and Speculative Attacks on the Mexican Peso". December 1983. (Unpublished)
2. Blejer, Mario I., and Jose Gil Diaz. "On the Determination of the Real Interest Rate in a Samll Open Economy: Domestic versus External Factors". January 1984. (Unpublished)
3. Cumby, Robert E., and Frederic S. Mishkin. "The International Linkage of Real Interest Rates: The European-U.S. Connection". 1984. (Unpublished)
4. Dornbusch, Rudiger. "PPP Exchange-Rate Rules and Macroeconomic Stability". *Journal of Political Economy.* Vol. 90. February 1982. pp. 158–165.
5. Edwards, Sebastian. "Money, the Rate of Devaluation and Interest Rates in a Semi-Open Economy: Colombia 1968–1982". *Journal of Money, Credit and Banking.* Vol. 17. February 1985. pp. 59–68.
6. Edwards, Sebastian and Mohsin S. Khan. "Interest Rate Determination in Developing Countries: A Conceptual Framework". (Forthcoming *IMF Staff Papers,* September 1985)
7. Fry, Maxwell J. "Models of Financially Repressed Developing Economies". *World Development.* Vol. 10. September 1982. pp. 731–750.
8. Lanyi, Anthony, and Rusdu Saracoglu. "The Importance of Interest Rates in Developing Economies". *Finance and Development.* Vol. 20. June 1983. pp. 20–23.
9. Levich, Richard M. "Empirical Studies of Exchange Rates: Price Behavior, Rate Determination and Market Efficiency". In Peter B. Kenen and Ronald W. Jones (eds.), *Handbook of International Economics.* Amsterdam: North-Holland. 1985.
10. McKinnon, Ronald I. *Money and Capital in Economic Development.* Washington, D.C.: The Brookings Institution. 1973.
11. Makin, John H. "Effects of Inflation Control Programs on Expected Real Interest Rates". *IMF Staff Papers.* Vol. 29. June 1982. pp. 204–232.
12. Mathieson, Donald J. "Inflation, Interest Rates, and the Balance of Payments during a Financial Reform: The Case of Argentina". *World Development.* Vol. 10. September 1982. pp. 813–828.
13. Mathieson, Donald J. "Estimating Models of Financial Market Behavior during Periods of Extensive Structural Reform: The Experience of Chile". *IMF Staff Papers.* Vol. 30. June 1983. pp. 350–393.
14. Mundell, Robert A. "Inflation and Real Interest". *Journal of Political Economy.* Vol. 71. June 1963. pp. 280–283.
15. Townsend, Robert M. "Financial Structure and Economic Activity". *American Economic Review.* Vol. 73. December 1983. pp. 895–911.

Comments on "An Analytical Approach to Interest Rate Determination in Developing Countries"

In commenting on this paper, I would start by saying that I am at a bit of disadvantage since, unlike Dr Khan, I was not trained in monetary economics by Professor Rashid! As a non-expert in the field, however, I was impressed with the clarity of exposition in the paper and found it readable and instructive. The fundamental issue that it raises and discusses is one that I have always found a bit of a puzzle. The issue is this. On the one hand, the Fisher approach to the determination of interest rates tells us that the nominal rate will depend on domestic factors such as the productivity of potential domestic investment projects (the variable ρ in the paper), expected changes in the domestic price level, and domestic monetary policy. On the other hand, the theory of international finance tells us that with international capital flows, a country's nominal interest rate should depend on the world rate of interest and on the expected rate of appreciation or depreciation of the country's currency. The puzzle, of course, relates to the question: Under what conditions both of these theories can be true, and, if they are not both true, which one of them is?

Edwards and Khan (henceforth referred to as E-K) studied this question in the context of economies in which the financial system has been substantially "liberalized" so that nominal interest rates on financial assets can be taken as representing equilibrium rates determined by supply of and demand for funds. In such a system, the Fisherian approach would lead one to expect that in the long run the real rate of interest, as the nominal rate minus the expected rate of price inflation, would approach ρ, which can be interpreted as the marginal productivity of investment. In the short run, however, the two may diverge because of the conditions in the domestic money market. As E-K point out, such a divergence between the real financial rate of interest and the marginal productivity of investment may constitute an important link in the transmission mechanism between the money supply, on the one hand, and inflation and real output, on the other.

I have one minor and one major comment on the way E-K try to model this process. The minor point is that I don't quite understand the rationale for specifying the demand-for-money function. The logic of their reasoning would imply that the two relevant opportunity cost variables should be $(\rho + \pi^e)$ and i, rather than $(\rho + \pi^e)$ and π^e as they have it. This specification change would have given rise to a somewhat different reduced from.

My major comment refers to the way they "close the model" in equation (6). Firstly, the author does not take account of the fact that real y in the short run is likely to be affected by the old real rate of interest. The relationship between these two variables is likely to be the central part of the transmission mechanism referred to above. Secondly, because of the way equation (6) is specified, both the nominal and real rates of interest in the short run turn out to be independent of the nominal money supply. Yet most people would presumably argue that changes in interest rates are the main channel through which a policy of controlling the nominal money supply affects the economy. An alternative model specification that would have taken these factors into account might, instead of their equation (6), have been

$$(1) \quad y = (rr)$$

$$(2) \quad \Delta \log m = \Delta \log M - \Delta \log p$$

$$(3) \quad \Delta \log p = \theta\,(y(rr) - \bar{y}\,)$$

where M is the nominal money supply, p is the price level, $\bar{y}$ is a trend value for real output, and θ is a parameter.

I would add in this context that in my view one should be careful and should not overstate the significance of financial liberalization for the transmission mechanism. There is plenty of evidence that a high rate of monetary expansion leads to a high rate of price inflation even in highly repressed financial systems. The real significance of financial liberalization, in my opinion, lies in the fact that it improves the efficiency with which the capital market is allowed to fulfill its function of intermediation between savers and investors, and raises the overall productivity of investment in the economy.

I found the empirical results of E-K very convincing and interesting, particularly, the notion that this type of approach can tell us something about the degree of "illegal openness" of the economy.

As a final comment, it would have been nice if the author had spent a bit more time on discussing the conditions in which the closed-economy and open-economy approaches of interest rate determination are cosistent with each other. This would involve issues such as the relation between the domestic inflation rate and the rate of depreciation of the domestic currency, the effect of divergence between the domestic and foreign marginal productivities of investment on capital flows, and so on. This suggestion should not be taken as a criticism; it may be more a reflection of my unfamiliarity with the standard literature of international finance than anything else!

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