AN ECONOMETRIC MODEL OF THE FINANCIAL SECTOR OF THE ECONOMY OF GUYANA.

by

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I. ASSUMPTIONS OF THE MODEL

In this model we assume that transactors save by deciding to increase their wealth as against the separate decision as to how to allocate their wealth among different assets. This distribution of wealth depends on the different yields on the available assets in such a way that the own rate derivative is positive. We shall also assume that transactors are free of 'money illusion', thus only the real rate of return on each asset is considered by the transactor when making changes in his portfolio.

This is a portfolio balance model in which firstly, money is an asset that provides the holder with a zero rate of return, but is useful because of its liquidity. However, the real return on money varies inversely with the rate of change of output prices, i.e.

$$r_{mp} = - \frac{P_t}{P_{t-1}} + 1 \qquad \text{--- eq.(1)}$$

Secondly, the real rate of return on time and savings deposits corresponds to the current interest rate paid by banks on time and saving deposits net of the inflation rate as follows:

$$r_{TP} = r_T - \frac{P_t}{P_{t-1}} + 1 \qquad \text{--- eq.(2)}$$

In the non-bank financial sector in Guyana there are savings institutions which are dominated by the New Building Society. The real rate of return on financial assets in the New Building Society can be written as:-

$$r_{NP} = r_N - \frac{P_t}{P_{t-1}} + 1 \qquad \text{--- eq.(3)}$$

The return on government treasury bills depends on the interest rate paid by the (Central) Bank of Guyana when these assets are presented after a minimum holding period of three months. These assets face a high demand from the general public due to their liquidity, relatively high interest rate and the scarcity of other short term alternative forms of holding wealth. The real rate of return on these assets may be stated as follows:-

$$r_{TBP} = r_{TB} - \frac{P_t}{P_{t-1}} + 1 \quad \text{--- eq. (4)}$$

In the specification of this portfolio model all existing rates of return should appear in each demand function, since the sum of the cross effects is equal in absolute terms to the own price effect if wealth is held constant, i.e.

$$\sum_{j=1}^{5} \frac{\partial X_i}{\partial r_j} = 0 \quad \text{--- eq. (5)}$$

where X_i = demand for the asset

and r_j = nominal rate of return on the j^{th} asset.

Also, with wealth held constant, a change in r_j will have effects such that the sum of all changes in X's equals zero, i.e.

$$\sum_{i=1}^{5} \frac{\partial X_i}{\partial r_j} = 0 \quad \text{--- eq. (6)}$$

This yields a total of 9 independent restrictions. The general form of such a demand equation is:-

$$X_i = X_i \left(r_T, r_{TB}, r_N, \frac{P_t - P_{t-1}}{P_{t-1}}, {}_1W\right)$$

$i = 1$ ------ 5.

where $\sum_{i=1}^{5} X_i = W$ is the wealth constraint, and the five assets are money, time, and savings deposits, New Building Society assets, Treasury Bills and real assets. However, if four markets are in equilibrium, then the fifth must necessarily be in equilibrium since the sum of all the markets represents the total wealth of the private sector. Thus, we can omit the demand function for real assets and estimate only the four remaining demand equations.

In each demand equation we have included the rate of change of output prices. However, because we have a stock equilibrium model, expected price change will be estimated based on past price changes. Most developing countries are highly unstable and therefore we should expect a short lag of under two years as compared to say a seventeen year lag in income used by Friedman for the U.S. economy.[1] Also, $\frac{P_t}{P_{t-4}} - 1$ is substituted for $\frac{P_t - P_{t-1}}{P_{t-1}}$ (the inflation rate), i.e. zero or negative changes in prices may occur during a particular period. In addition, exante rates of interest are assumed to affect portfolio changes in this model, thus expected inflation is deducted from the nominal rate of interest in order to obtain the real rate of interest.

Finally, due to the paucity of the data in Guyana, it is necessary for us to use expected real income as a proxy measure of private wealth.

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1. See Friedman, "A Theory of the Consumption Function", Princeton, N.J. (1957), pp 142-152.

II. STRUCTURE OF THE MODEL

The desired level of money is MD** and can be represented by the linear equation

$$\ln MD^{**} = a_{10} + a_{11} r_{TD} + a_{12} r_{TB} + a_{13} r_N + a_{14} p^e + a_{15} \ln Y^e + U_{1t} \quad \text{--- eq (7)}$$

However, the desired level of money stock is not directly observable, but the following partial adjustment model was postulated by Nerlove:[1]

$$\ln MD - \Delta \ln MD = \gamma_1 (\ln MD^{**} - \Delta \ln MD) \quad \text{--- eq (8)}$$

where $\Delta X_t = X_t - 1$ and where the coefficient of adjustment is such that $0 < \gamma_1 < 1$, $\ln MD - \Delta \ln MD$ is the actual change and $\ln MD^{**} - \Delta \ln MD$ is the desired change.

Eq. 8 shows that the actual change in money demanded in time period t is a fraction of the desired change for that period. If $\gamma_1 = 1$, then the actual money stock is equal to the desired money stock, and if $\gamma_1 = 0$, then the actual stock at time t at the same level as in the previous period. However, we normally expect γ_1 to be between these extremes since adjustment to the desired money stock is unlikely to be complete due to the adjustment costs associated with inertia, rigidity, contractual obligations etc. Rewriting eq (8) as:

$$\ln MD_t = \gamma_I \ln MD_t^{**} (1 - \gamma_I) \Delta \ln MD_t \quad \text{--- eq (9)}$$

Now, substituting eq (7) into eq (9) gives the partial adjustment model eq (10)

$$\ln MD = \gamma_1 (a_{10} + a_{11} r_{TDt} + a_{12} r_{TBt} + a_{13} r_{Nt} + a_{14} p_t^e + a_{15} \ln Y^e + U_{1t}) + (1 - \gamma_1) \Delta \ln MD. \quad \text{--- eq (10)}$$

$$\ln MD = \gamma_1 a_{10} + \gamma_1 a_{11} r_{TDt} + \gamma_1 a_{12} r_{TBt} + \gamma_1 a_{13} r_{Nt} + \gamma_1 a_{14} p_t^e + \gamma_1 a_{15} \ln Y_t^e + (1 - \gamma_1) \Delta \ln MD_t + U_{1t} \quad \text{--- eq.(10a)}$$

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1. See Nerlove (1958)

Money Market

Money is defined as the sum of currency in circulation and demand deposits and is normally considered a good substitute for interest earning assets. Thus an increase in the yield on any interest earning asset will increase the demand for that particular asset, but there will be a fall in the demand for money.

The real demand for money function may be written as:

$$D \ln \left(\frac{M_{dt}}{P}\right) = \gamma_1 \left(\ln \left(\frac{M_{dt}}{P}\right)^{**} - \angle \ln \left(\frac{M_{dt}}{P}\right) \right) \quad \text{--- eq. (11)}$$

$$\ln \left(\frac{m_{dt}}{P}\right)^{**} = a_{10} + a_{11} r_{TPt} + a_{12} r_{TBPt} + a_{13} r_{NPt} + a_{14} P_t^e + a_{15} \ln Y_t^e + U_{1t} \quad \text{-- eq (11a)}$$

where a_{15} is expected to be positive and the other coefficients are expected to be negative. However, the supply of money is assumed to be exogenously determined by the Bank of Guyana.

Time and Savings Deposit Market

The financial asset of time and savings deposits is supplied by the commercial banks but the interest rate on these deposits is set by the Bank of Guyana. As in most developing countries these rates are fixed at levels below the free market rate, since banks are willing to accept more deposits than the amount of deposits the public wishes to hold at the prevailing rate. This implies that banks operate under their supply curve for time-saving deposits.

The real demand for time and savings deposits can be stated as:-

$$D \ln \left(\frac{T_{dt}}{P}\right) = \gamma_2 \left(\ln \left(\frac{T_{dt}}{P}\right)^{**} - \angle \ln \left(\frac{T_{dt}}{P}\right) \right) \quad \text{----- eq (12)}$$

$$\ln \left(\frac{T_{dt}}{P}\right)^{**} = a_{20} + a_{21} r_{TPt} + a_{22} \ln r_{TBpt} + a_{23} r_{Npt} + a_{24} P_t^e + a_{25} \ln Y_t^e + U_{2t} \quad \text{---- eq (12a)}$$

where, a_{21} and a_{25} are expected to be positive and the others are negative.

Treasury Bill Market

There are two types of Government securities in Guyana - treasury bills and debentures. The latter assets are mostly held by the Bank of Guyana and other financial institutions in order to fulfil a minimum requirement set by the Government. These assets are not in high demand in the private sector mainly because the minimum holding period is ten years and due to the fact that the yield is only slightly higher than shorter term assets.

Treasury Bills offer relatively high returns and the minimum holding period is only three months, thus these assets are fairly popular among private asset holders. The real demand for treasury bills can be written as:

$$D \ln \left(\frac{TB_{dt}}{P} \right) = \gamma_3 \left(\ln \left(\frac{TB_{dt}}{P} \right)^{**} - \ln \left(\frac{TB_{dt}}{P} \right) \right) \qquad \text{--- eq (13)}$$

$$\ln \left(\frac{TB_{dt}}{P} \right)^{**} = \ln a_{30} + a_{31} r_{TPt} + a_{32} r_{TBPt} + a_{33} r_{NPt} + a_{34} P_t^e + a_{35} \ln Y_t^e + U_{3t} \qquad \text{--- eq (13a)}$$

where a_{32} and a_{35} are expected to be positive and the others are negative.

The supply of treasury bills is exogenously determined by the Government.

Bank Loan Market

The supply of bank loans is considered exogenous in this model due to the fact that a large amount of bank lending is used by the Government business sector and also due to interest rates that lie below free market rates. Low lending rates also imply excess demand for loans, thus we cannot observe a demand schedule.

We can however state the observed balances of bank loans as:

$$B_L = \min (B_{Ls}, B_{Ld}) = B_{Ls}$$

where

B_{Ls} = bank loans supply,

B_{Ld} = bank loan demand.

New Building Society Deposits Market

The New Building Society is a savings institution which offered more favourable deposit rates to its members than commercial banks offer on time savings deposits, but two limited attempts at interest rate reform in 1978 and 1979 have almost removed this disparity. However, this type of deposits is particularly popular among small asset holders.

Although this institution may occasionally face Government guidelines, it has considerably more freedom than commercial banks in terms of letting market conditions determine its deposit rates.

The real demand for New Building Society deposits can be stated as:

$$D \ln \left(\frac{NB_{dt}}{P} \right) = \gamma_4 \left(\ln \left(\frac{NB_{dt}}{P} \right)^{**} - \ln \left(\frac{NB_{dt}}{P} \right) \right) \quad \text{--- eq. (14)}$$

$$\ln \left(\frac{NB_{dt}}{P} \right)^{**} = \ln a_{40} + a_{41} \ln r_{Tt} + a_{42} \ln r_{TBt} + a_{43} \ln r_{Nt} + a_{44} \cdot p^e_t + a_{45} \ln Y^e_t + U_{4t} \quad \text{---- eq. (14a)}$$

where a_{43} and a_{45} are expected to be positive.

The real supply of New Building Society deposits can be written as:-

$$\ln NB_{St} = a_{50} + a_{51} r_{Tpt} + a_{52} r_{TBpt} + a_{53} r_{Npt} + a_{54} (P_t^e)_N + a_{55} \ln (Y_t^e)_N + a_{56} \ln (BL_t^e)_N + U_{5t} \quad \text{---- eq. (16)}$$

where $(P_t^e)_N$ = inflation rate anticipated by the New Building Society,

$(BL_t^e)_N$ = bank loan balances anticipated by the New Building Society,

$(Y_t^e)_N$ = income expected by the New Building Society, and

a_{53} is expected to be negative and all others positive. The varibales $(BL_t^e)_N$ and $(Y_t^e)_N$ are included in this equation because they both serve as indicators of a booming or sagging economy in which case the New Building Society will increase or decrease its supply of deposits, respectively. The lending rate on New Building Society loans should be included in this equation because we expect that the institution will want to increase its supply of deposits when the lending rate is high so that it can offer more loans and increase its profitability, but this data is unavailable at time of writing.

The demand for New Building Society loans is in excess of the supply due to the fact that the lending rate is relatively small compared with lending rates of commercial banks. The supply of loans therefore largely depends on exogenous factors. Thus we can write the observed balances of the New Building Society loans as:

$$NB_L = \text{Min } (NB_{Ls}, NB_{Ld}) = NB_{Ls}$$

where NB_{LS} = New Building Society supply of loans,

NB_{LD} = New Building Society loan demand.

Balance of Payments Equation

To avoid simultaneity bias the model should contain three equations which explain the behavior of the external sector. These equations should be:

(a) A balance of payments equation,

(b) An identity linking money supply, domestic credit and balance of payments, and

(c) An equation explaining the behavior of domestic credit.

The equation described in (c), requires specification of relationship between Central Bank's issuance of domestic credit and the determinants of government deficits. However, due to lack of data we only have a balance of payments equation. The balance of payments will be affected by attempts to arbitrage goods and security prices between countries and by portfolio disequilibrium.

In the long run, for goods market equilibrium we will need domestic prices to increase at the same rate as foreign prices. Also, for equilibrium in the asset market, we need domestic rate plus risk premium paid by domestic borrowers to foreign lenders (i.e. interest rate parity theory) equal to the interest rate plus expected rate of depreciation of the exchange rate.[1]

Variations from either the relative purchasing power parity or interest rate parity therefore causes arbitrage flows and creates changes in holdings of foreign exchange reserves (assuming a given exchange rate policy). Also, portfolio disequilibrium will affect trade and capital movements, because monetary holdings are the most liquid assets implying that excess money supply (or money demand) can have significant short run

1. The exchange rate was not included in eq (6) because the Guyana dollar was pegged to the U.S. at a rate of G$2.55 = US$1 for almost the entire period.

effects on the balance of payments.

The overall growth of the international reserves can be represented by:-

$$D \ln R = a_{61} + a_{62} (D \ln P - D \ln P_U) + a_{63} (r_{DG} - r_{DU}) + a_{64} \left(\ln \left(\frac{MD}{P} \right)^{**} - L \ln \frac{MD}{P} \right) \quad \text{--- eq.(17)}$$

where a_{62} is expected to be negative and the other parameters positive. This equation shows that the balance of payments improves as domestic interest rates increase and deteriorates with money demand. It also shows that the balance of payments deteriorates as domestic inflation increases relative to foreign inflation.

III. ECONOMETRIC RESULTS

The model of the financial sector of Guyana was estimated by using three stage least squares (with serial correlation correction). The results were generally acceptable, but not very convincing, this is probably to be expected from the nature of the data itself (this does not rule out the possibility that a different specification of the model would provide better results), since interest rates remained at fixed levels for long periods, and this of course, was accentuated by the use of quarterly data.[1] Thus we would expect multicollinearity to exist.

The Money Demand Equation

The estimated coefficients of the money demand equation are presented in Table 1.[2] The most significant result in this equation is the negative and statistically significant coefficient of the time deposit interest rate variable. This implies that there is some substitutability between time and saving deposits on the one hand, and money on the other. It is also important to note that the correct signs were obtained with statistically significant coefficients for the wealth and expected inflation variables. Finally, the extremely low estimated adjustment parameter of 0.7 associated with a high t-statistic of 38.7 indicates that there are serious adjustment costs associated with inertia, rigidity and contractual obligations in the financial sector of Guyana. This is also an indication that the partial adjustment model might be the correct specification of the model.

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1. Fry (1980) and Mathieson (1983) are examples of similar studies with more convincing results.

2. It should be noted that the interest rates used in the actual estimat process were not deflated by the inflation rate as postulated above, in an effort to minimize errors associated in the calculation of P^e.

TABLE 1

Estimate of Parameters

Three Stage Least Squares Equation	Dependent Variable	Explanatory Variable	Parameter	Estimate	t-Ratio
1)	$\ln (\frac{M}{P})^d$	Adjust. para.	a_{10}	.07	38.7
(S.E.R.= .048)		constant	a_{11}	-6.57	-5.1
(D.W. = 2.11)		$\ln r_T$	a_{12}	-2.43	-2.5
		$\ln r_{TB}$	a_{13}	.29	.2
		$\ln r_N$	a_{14}	3.14	2.7
		P^e	a_{15}	-.14	-2.7
		$\ln Y^e$	a_{16}	.43	2.7
2)	$\ln (\frac{T}{P})^d$	Adjust. para.	a_{20}	.02	52.7
(S.E.R. = .033)		constant	a_{21}	-4.0	-2.0
(D.W. = 2.03)		$\ln r_T$	a_{22}	0.5	.4
		$\ln r_{TB}$	a_{23}	0.5	.1
		$\ln r_N$	a_{24}	1.0	.4
		P^e	a_{25}	35.5	4.6
		$\ln Y^e$	a_{26}	10.5	2.6
3)	$\ln (\frac{TB}{P})^d$	Adjust. para.	a_{30}	.34	12.1
(S.E.R. = .486)		constant	a_{31}	-9.82	-4.1
(D.W. = 1.88)		$\ln r_T$	a_{32}	-.03	-0.1
		$\ln r_{TB}$	a_{33}	-2.47	-1.1
		$\ln r_N$	a_{34}	2.41	1.2
		P^e	a_{35}	-15.53	-2.1
		$\ln Y^e$	a_{36}	21.0	4.0
4)	$\ln (\frac{NB}{P})^d$	Adjust. para.	a_{40}	.99	4.0
(S.E.R. = .058)		constant	a_{41}	8.64	.5
(D.W. = 2.02)		$\ln r_T$	a_{42}	-.0003	-2.6
		$\ln r_{TB}$	a_{43}	.0003	1.4
		$\ln r_N$	a_{44}	-1.25	-34.3
		P^e	a_{45}	.88	2.1
		$\ln Y^e$	a_{46}	-.3	-1.1

Three Stage Least Squares Equation	Dependent Variable	Explanatory Variable	Parameter	Estimate	t-Ratio
5)	$\ln \left(\frac{NB^s}{P}\right)$	constant	a_{50}	8.53	.5
(S.E.R. = .058)		$\ln r_N$	a_{51}	-1.24	-34.3
(D.W. = 2.02)		$(P^e)_N$	a_{52}	- .01	- 1.7
		$\ln (Y^e)_N$	a_{53}	- .01	- .7
		$\ln (BL^e)_N$	a_{54}	- .0001	- 6.5
6)	Dln R	constant	a_{60}	.02	.3
(S.E.R. = .653)		(Dln P - Dln PU)	a_{61}	.05	1.2
(D.W. = 1.70)		$(r_D - r_{DU})$	a_{62}	-.0003	-.01
		$\left(\ln \left(\frac{M^d}{P}\right)^{**} - \ln \left(\frac{M^d}{P}\right)\right)$	a_{63}	.09	.5

Note: Adjust. para. = Adjustment parameter.

The main criticism of the partial adjustment model is that the presence of the lagged dependent variable on the right hand side of the equation to be estimated, may overcloud the effects of the right hand side variables. Therefore an attempt was made to estimate the money demand function, assuming $\gamma_1 = 1$ by the two stage least squares procedure.[3] However, this procedure only marginally improved the statistical significance of the estimated coeffients.

Time Deposits Equation

The time deposits equation is considered as the most important equation in the model since this paper assumes that a rise in the level of these assets is the most efficient way in which larger levels of capital can be ultimately obtained. Table 1 shows a positive own rate of return, however, this coefficient is statistically insignificant.[4] However, a positive and significant wealth coefficient is a favourable feature of this equation. Again, an extremely low adjustment parameter is indicative of high adjustment costs.

Generally, the low t-ratios in Table 1 may be due to problems associated with the calculation of $\dot{P}^e$ and $\dot{Y}^e$. Firstly, we have the problem of the paucity of data. The price index in Guyana is not very representative of actual prices since a number of goods in the 'basket' are no longer available at retail establishments but are in fact bought at much higher prices on the blackmarket. Also, income is calculated only on an annual basis thus a relationship of income to exports was used to derive a quarterly income series. Secondly, large errors are likely to be associated with the calculation of expected prices and expected income.

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3. This procedure reduces simultaneity bias without loss of efficienct achieved by three stage least squares in the full adjustment model.

4. This result is still important due to the fact that negative own rates were obtained in the Treasury Bills and the New Building Society demand equations.

In addition to the problems associated with $\dot{p}^e$ and Y^e, the presence of all three interest rates in each demand equation seems to be crowding out the own rate effect. However, the present author is of the opinion that the demand function for time deposits (as well as the other financial assets) should include all five variables on the right hand side.

IV. A NATIONAL SAVING FUNCTION

Given the results of the estimation process of the financial model of Guyana, we saw in Table 1 that there is some evidence supporting the case that an increase in the time deposit rate will increase the amount of time deposits in the banking system. An attempt was made to estimate a national savings function that included only the real interest rate on time deposits as well as the rate of inflation and income.

The savings function estimated was the form:

$$\ln \left(\frac{S}{P}\right)_t = a_1 + a_2 \ln r_{Tt} + a_3 P_t + a_4 \ln \left(\frac{Y}{P}\right)_t + U_t$$

where a_2 and a_4 are expected to be positive, and a_1 and a_3 are expected to be negative. This equation was estimated via the two stage least squares procedure with monetary base, government expenditure and population included as instruments.

The estimation results were as follows:-

$$\ln \left(\frac{S}{P}\right) = -3.89 + .49 \ln r_t - .02 P_t + 2.03 \ln \left(\frac{Y}{P}\right)$$

(t-Ratio) (-3.09) (1.68) (-1.67) (4.72)

S.E.R. = 2.71 D.W. = 1.5

The above results show that all the expected signs were achieved, however the coefficients of the time deposit rate and the inflation variables were statistically insignificant (i.e. less than 2), but much greater than 1.

V. CONCLUSION

We have seen that in Guyana financial conditions do have an influence on domestic savings, however the evidence is not as convincing as similar studies carried out in other developing countries with more sophisticated financial systems.[1] The results show that there is some positive association between the interest rates paid by banks and the deposits of their customers. It was also shown that there is some degree of substitutability between money (currency and demand deposits) and time deposits. However, the evidence does not show that there is any substitution between money and either treasury bills or New Building Society deposits. In the case of treasury bills one possible explanation could be that current holders of time asset have already satisfied their desired holdings of money balances and are investing in treasury bills simply because of the lack of viable investment opportunities i.e. absence of a stock exchange system. In the case of New Building Society deposits, a possible explanation of the lack of substitutability between this asset and other financial assets is that the majority of its depositors are low income earners seeking to qualify for mortgage loans rather than earning interest income.

It may be possible therefore, to mobilize savings via a high interest rate policy, but such a policy could only be successful if applied in conjunction with other policies geared towards removing some of the constraints in the economy. Four possible constraints are (a) shrinking of private sector activity as a result of nationalizations, severe foreign exchange shortages and a generally unfavourable business environment (b) excessive bank borrowing by some public sector enterprises (c) unrealistic term structure of interest rates and (d) rapid growth in the informal sector.[2]

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1. See Fry's study of seven Asian countries.

2. Si Dam Kim (1978) has shown that an increase in interest rates in the formal sector will lead to a transfer of funds from the informal sector for South Korea. However there is reason to believe that holders of informal financial assets in Guyana are not quite as interest sensitive as their counterparts in South Korea.

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