COMMERCIAL BANK PORTFOLIO BEHAVIOUR IN JAMAICA

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Commercial banks, perhaps largely because of their predominance in the financial system, have attracted much academic interest in the Caribbean. Attention has largely centred on the implications of deposit mobilisation and allocation for economic development though issues such as market structure, economies of scale, and interest rate determination have also been treated. (See for instance Bourne (2a), Miller (5), and Thomas (8). In contrast portfolio behaviour has been virtually neglected in terms of both theoretical investigation and empirical study.

The examination of bank portfolio behaviour is of importance for at least three main reasons. Firstly, the allocation of the portfolio among the several asset has a bearing on the uses to which bank funds are put. In particular, the allocation determines the amounts of bank funds which are placed at the disposal of government, foreign borrowers, and domestic borrowers. Furthermore, since assets differ in terms of liquidity, the structure of the portfolio among different assets influences the maturity structure of bank credit and from the borrowers side the mix between long-term and short-term expenditure plans.

Secondly, the banks are among the main institutional linkages between the Jamaican economy and Euro-America. As shown in the next section, the banks acquire foreign assets as well as engage in substantial borrowing in overseas financial centres as a means of agumenting domestic loanable funds. Changes in the scale of foreign transactions and asset (liability) holdings will therefore influence the degree of financial dependence on metropolitan economies. Moreover, sudden shifts in foreign liabilities can have dramatic effects on domestic credit extended by the banks.

Thirdly, the appropriate formulation of financial policy by the governmental authorities requires a clear understanding and quantification of the main influences on bank portfolio behaviour. At the present time, interest rates and selective credit controls are the most frequently utulised policy instruments. While a small literature exists with respect to the significance of interest rate changes for deposit mobilisation (e.g. Bourne [2b]), no such literature exists with respect to bank asset portfolio behaviour. The absence of a firm theoretical and empirical framework for evaluating and guiding financial policy is a deficiency that ought to be overcome.

This paper seeks to advance the analysis of commercial banking in the Caribbean by formulating and estimating a short period model of bank portfolio behaviour for Jamaica over the period 1962 to 1971. The basic theoretical postulate underpinning the model is that of profit maximisation. Given the strong neo-classical genre of profit-maximising models, the qualitative predictions also provide a means of evaluating the applicability of neo-classical concepts to the analysis of banking firms in the Caribbean.

In the remainder of the paper, the model is constructed and three variants estimated with the use of quarterly data. Conclusions are presented in the final section.

I: THE INSTITUTIONAL FRAMEWORK

A variety of theoretical constructs of commercial bank portfolio behaviour adorn the mainstream literature. Nonetheless, the theoretical plausibility of a model must depend on its approximation to the reality of the system it is designed to analyse. As such, it is prudent to introduce the theoretical model developed in this paper by a brief review of some salient features of the banking industry in Jamaica.

Table 1 presents a statistical summary of the consolidated assets and liabilities of the banks for the initial and terminal years. Foreign liabilities (FL) are primarily the short-term debts of the banks to their overseas branches and head offices. Discounts and advances from the Bank of Jamaica represent the temporary borrowings of the commercial banks from the central bank to facilitate reserve adjustments arising out of occasional imbalances at bank clearings. Other liabilities cover an assortment of items including the equity capital of the banks. Balances at the Bank of Jamaica (BCB) represents deposits held in settlement of legal reserve requirements. Foreign assets (FA) are mainly the loans by the banks to their overseas branches and head offices. Loans and advances (BL) are credit extended to a variety of borrowers in the form of demand and term loans. Jamaica Treasury Bills (JTB) and other Jamaican Government Securities are self-explanatory. Other assets is a conglomerate of investments and fixed capital.

Throughout the period all the banks were linked as subsidiaries or branches to multinational banking corporations. This feature of the industry has special significance for the construction of formal

TABLE I

COMMERCIAL BANKS CONSOLIDATED BALANCE SHEET AT DECEMBER 31

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LIABILITIES	1961	1971	ASSETS	1961	1971
Demand Deposits (DD)	38.1	113.1	Cash in Hand (CIH)	3.6	9.8
Savings Deposits (SD)	37.5	178.5	Balances With the Bank of Jamaica (BCB)	5.0	27.9
Time Deposits (TD)	9.6	114.1	Foreign Assets (FA)	1.1	17.4
Foreign Liabilities (FL)	31.5	24.3	Loans and Advances (BL)	84.9	330.4
Discounts and Advances From the Bank of Jamaica	0	7.1	Jamaica Treasury Bills (JTB)	3.4	33.0
Other Liabilities	17.6	79.6	Other Jamaica Government Securities	36.3	15.7
			Other Assets		83.1
TOTAL	134.3	517.3		134.3	517.3

SOURCE: Bank of Jamaica Quarterly Bulletin December 1961, and Statistical Digest December 1971.

models of bank portfolio behaviour. Specifically, it makes mandatory the incorporation of elements of foreign money markets into the set of variables which determine the short-term behaviour of commercial banks in Jamaica, since the banks acquire foreign assets as well as incur foreign liabilities.

Since May 1961, the commercial banks have operated under two legal reserve constraints. The first is that not less than five per cent of their total deposit liabilities be held as deposits at the Central Bank. This constraint is referred to as the cash reserve requirement. The second constraint is that liquid assets be not less than a specified percentage of total deposit liabilities. Until June 1969, the maximum percentage was fifteen; thereafter it became seventeen and one-half per cent. This constraint is referred to the liquid assets constraint. Until August 1963, liquid assets were defined to include vault cash, deposits at the Bank of Jamaica, foreign assets, and certain eligible commercial bills. Foreign assets were disqualified in August 1963. In practice, both deposits at the Central Bank and liquid assets have generally exceeded the legal requirements.

The banks tend to hold excess cash reserves as well as excess liquid reserves. While there is some scope for volitional behaviour in relation to the mix of liquid assets, the cash reserve requirement allows none. It would assist the model-building in the next section if one were to define an item Required Cash Reserves (RCR) as balances at the central bank which exactly satisfy the cash reserve requirement. Further, one could then define another item Excess Cash Reserves (ECR) as consisting of balances at the central bank in excess of cash reserve requirements plus vault cash. Excess Cash Reserves is a volitional variable, which is presumed to have a non-zero rate of return. Required Cash Reserves do not yield any returns.

The commercial banking industry in Jamaica is imperfectly competitive. Two banking firms account for seventy-two per cent of total assets in 1961 and sixty-nine per cent in 1971. Market imperfect is evident in collusive pricing and other restrictive agreements on banking services. Deposit rates of interest as well as the prime loan rate are administered by group decision. Competition takes the form of quality variation and advertising. One consequence of this type of collusion is that no uncertainty attaches to interest rates within the short period planning horizon, though for each bank acting separately, the rates of interest may be treated as exogenously determined. However, some uncertainty may surround future deposit levels since the latter are more significantly influenced by incomes which are not controlled by the banks.[1] Despite the collusive arrangements pertaining to the prime loan rate of interest, bank loans might still be treated as a positive function of the prime loan rate. The expansion of loans might involve higher costs if greater subjective risks are involved. These increases in costs would only be worthwhile at higher loan rates of interest.

II. THEORETICAL SPECIFICATION AND ANALYSIS

To begin this section, let the representative bank be an intertemporal utility maximiser with an objective function of the following form:[2]

(1) $$\int_{t}^{T} \theta(t) \; U[\pi(t)] \, dt$$

Where τ is present time, T is the end of the bank's planning period, θ is a time discount function which is log-linear with respect to $T - \tau$, and U is assumed to be concave.

Profits are defined by:

(2) $$\pi = X_1 r_1 + X_2 r_2 + X_3 r_3$$

Where X_1 is a row vector of liquid assets other than Required Cash Reserves which satisfy the liquid assets reserve requirements; X_2 is a row vector of other controllable interest-yielding assets and foreign liabilities; X_3 is a row vector of total deposit liabilities (DEP) and the sum of all other exogenous assets and liabilities (BAL). It should be noted that BAL includes the Required Cash Reserves.

Liabilities are entered negatively. The coefficients r_1, r_2 and r_3 are column vectors of interest rates on those assets and liabilities and are assumed not to vary with the asset levels, and to be conformable for matrix multiplication. Note too that r_3 is specified as $(d\ 0)$.

In conformity with the liquid asset requirements, utility maximisation is constrained by the stipulation as to the minimum values of liquid assets for any given level of deposit liabilities. An additional constraint is that the bank's balance sheet must balance at every point in time. These two constraints can be stated as follows:

(3) $$X_1 i_1 \geq X_3 b \qquad \text{where } b \text{ is the column vector } (\beta\ 0)$$

(4) $$X_1 i_1 + X_2 i_2 + X_3 i_3 = 0$$

where i_1, i_2 and i_3 are appropriately dimensioned column vectors of unity. The control variables are defined to be X_1 and X_2. Note too that β is the difference between the liquid assets ratio and the cash reserve ratio.

At this point it is convenient to deal with the stochastic nature of bank profits. A possible approach is to assume that the bank bases its decisions on some subjective judgement about the likelihood of particular variables taking on particular values at different points in time within the planning period. This is equivalent to asserting that the bank assigns subjective probabilities to the relevant variables, with the proviso that these density functions satisfy the usual properties of a well-defined probability function. The sample space will of course be based on the bank's experience and judgement. Since π is a function of these probability distributed variables, than π itself is probability distributed.

The problem is therefore one of maximising a stochastic objective function subject to stochastic constraints, and can consequently be treated as one of expected utility maximisation. Furthermore, we invoke Malinvaud's (4) first-order certainty-equivalence theorem to justify the replacement of stochastic terms by their expected values, second and higher moments being disregarded.

The genesis of the FOCE theorem in the context of optimal policy instrument determination may raise questions about its applicability to our problem. The major difference in between the two situations is that our model does not assume that the linear relationship between the control variable and the result variable (i.e. between asset levels and profits) is random, nor does it assume that the stocha tic variables in the profits function have zero expectation.

However, this difference does not make the FOCE theorem inapplicable since its formulation is premised on the very general and reasonable initial conditions that –

(i) the result variable depends in a known way on the control variables and on the particular value the probability distributed variable takes at a specific point in time; and

(ii) that there is an error-learning process with respect to the probability distributed variable.

It is not a pre-condition of the theorem that the linear relationship between control variables and result variables be random nor that the stochastic variable has zero expectation.

On a somewhat different issue, it should be noted that the use of the FOCE theorem prevents any analytical study of the relationship between risk and portfolio selection. However, in empirical investigation of the derived demand functions by time series regression methods, one would not in any case be able to identify out the influence of the variances of probability distributed variables. This is so because the variances become parameters which are subsumed in the estimated regression coefficients of the statistical model.(3)

To return to the model being formulated, the bank selects X_2 and X_3 so as to maximise –

(1.a) $$\int_t^T e(t) \; U \left[\pi^e (t) \right] dt$$

where "e" denotes expected values,

(2.a) $$\pi^e = X_1 r_1 + X_2 r_2 + X_3^e r_3$$

Maximisation is subject to the constraints embodied in equations (3) and (4).

The Lagrangean is:

$$L = \theta U [\Pi^e] + \lambda_1 (X_1 i_1 - X_3^e b) + \lambda_2 (X_1 i_1 + X_2 i_2 + X_3 i_3) \tag{5}$$

with time subscripts being deleted for convenience.

The corresponding first order conditions for a maximum are:

$$L_1 = \theta U_{X_1} r_1 + \lambda_1 + \lambda_2 = 0 \tag{6}$$

$$L_2 = \theta U_{X_2} r_2 + \lambda_2 = 0 \tag{7}$$

$$X_1 i_1 + X_2 i_2 + X_3 i_3 = 0 \tag{8}$$

$$X_1 i_1 \geq X_3 b \qquad \lambda_1 \geqslant 0, \tag{9}$$

$$\lambda_1 (X_1 i_1 - X_3 b) = 0 \qquad \lambda_1 \geqslant 0 \tag{10}$$

By assumption of concavity for $U(\Pi)$, the second order conditions for maximum U are satisfied. The system of equations (6) to (10) can be solved to yield optimal values of X_1, X_2, and λ_i in terms of r_1, r_2, and X_3. Thus,

$$X_1^D = X_1^D (r_1, r_2, X_3^e) \tag{11}$$

$$X_2^D = X_2^D (r_1, r_2, X_3^e) \tag{12}$$

$$\lambda_i^* = \lambda_i^* (r_1, r_2, X_3^e) \tag{13}$$

A few analytical remarks are worth making about the first order conditions and the demand functions X_1^D and X_2^D. Firstly, note that from equation (7), $\lambda_2 = -\theta U_{x_2} r_2$. Substituting for λ_2 into equation (6) and re-arranging yields:

$$(14) \qquad \frac{U_{x_1}}{U_{x_2}} = \frac{r_2}{r_1} - \frac{\lambda_1}{U_{x_2} \; r_1}$$

When the constraint (4) is binding as a strict equality, $\lambda_1 > 0$. This then implies that the normal neo-classical conditions - represented in this case by the equivalence between the marginal rates of asset-substitution and the ratio of interest rates - are not satisfied. The second term on the right hand side of equation 14 would then represent the disutility stemming from the constraint. On the other hand when the constraint is satisfied as a strict inequality ($\lambda_1 = 0$), the neo-classical conditions are satisfied.

Our second remark deals with the response of asset demand to changes in interest rates on assets. To facilitate the discussion, assume that that $\lambda_1 = 0$. Then one can redefine -

$$\tilde{x} = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} \quad \text{and} \quad \tilde{r} = (r_1, r_2)$$

Substituting the equilibrium conditions for X and λ into the first-order conditions (6) and (7), and differentiating totally with respect to $\tilde{r}$ while holding X_3^e constant, we obtain:

(15) $$H \frac{\partial X^D}{\partial \tilde{r}} + \frac{\partial \lambda_i^*}{\partial r} = 0$$

or equivalently -

$$\frac{\partial X^D}{\partial \tilde{r}} = H^{-1} \frac{\partial \lambda_i^*}{\partial r}$$

where H is the Hessian and is negative definite by assumption.

Therefore,

$$\frac{\partial X^D}{\partial r} > 0 \quad \text{for } i = j \quad \text{and} \quad \frac{\partial X^D}{\partial r} < 0 \quad \text{for } i = j$$

That is, the interest rate effect is negative for competing rates, and positive for own rates.

In principle, these theoretical predictions can serve as one basis for evaluating the applicability of the utility maximisation approach to commercial bank portfolio behaviour in Jamaica. Though the interpretation of the statistical results would depend upon the validity of the a priori classification, there is no necessarily clear cut basis for determining what assets should a priori be treated as substitutes or complements. In this study, we treat all the control variables as competitive among themselves, thus our theoretical expectation is that only the coefficients on own rates of interest would be positive.

EMPIRICAL SPECIFICATION AND METHODS

Differences in specification of the components of X_3 and hence X_1 and X_2 lead to different though similar empirical models. One possibility is to define the control variables as comprised of excess cash reserves (ECR), Jamaica Treasury Bills (JTB), foreign assets (FA), bank loans (BL), and foreign liabilities (FL) while the non-controlled variables are comprised of deposit liabilities (DEP) and the balancing item (BAL). Thus in this case, the empirical model would be -

$$(16) \qquad \tilde{X} = \tilde{X}\,(\tilde{r},\ DEP^{e},\ BAL^{e})$$

However, though some elements of BAL, especially equity capital and fixed capital, can be reasonably treated as non-controlled in a short-term model, other items such as letters of credit and commercial bills are essentially controlled within the short period. Since adequate data is not readily available for purposes of further disaggregation of BAL, some idea of the magnitude of the bias might be obtained by specifying the alternative model:

$$(17) \qquad \tilde{\tilde{X}} = \tilde{\tilde{X}}\,(\tilde{r},\ DEP^{e})$$

where $\tilde{\tilde{X}}$ includes BAL.

There is some difficulty in defining empirically, the components of $\tilde{r}$. The returns on excess cash reserves are not explicit, that is to say no interest is actually earned on excess cash reserves. Nonetheless since these reserves confer some utility to the banks, one can impute a monetary value to that stream of services. It is conventional to proxy that monetary rate of return by the costs of borrowed reserves. In the Jamaican situation, it is by no means clear what is the relevant cost of borrowed reserves. The local branches of expatriate banks during the period covered met reserve deficiencies by borrowing from their overseas affiliates. Since it could not be ascertained however what rate of interest pertains to those inter-bank credits, we have chosen to utilise the UK Bank Rate (UKBR) which is the cost to UK-based banks of meeting their reserve deficiencies, and to which other market rates of interest are indexed.

The rate of interest on foreign assets presents a problem because of imprecise knowledge of the assets held. They are generally short-term but may extend into the medium term. On the argument that both short-term rates of interest and medium rates of interest move sympathetically with the UK Bank Rate, one can proxy the rate of return on Foreign Assets by the UK Bank Rate. This approach creates a fairly obvious problem in that the same variable enter as an own rate of interest in both the excess reserves and the foreign assets demand functions thereby being inconsistent with the notion that the yield on foreign assets represents an opportunity cost of holding excess reserves. The sign of the regression coefficient of UKBR in the demand for excess reserves equation is therefore a priori ambiguous.

Expected values of the variables DEP and BAL can be handled by adopting the adaptive expectation hypothesis. This resolves into a regression equation which includes the lagged dependent variable. In such cases, serial correlation is present. However, we did not have access to any sophisticated adjustment programme. Moreover there is some evidence that full adjustment generally takes place within the quarter.[4] Therefore the assumption of unitary expectations was made *so that no lagged dependent variables appear in the regression models.*

During the period two institutional changes which might possibly have had a continuing importance occurred. The first was the devaluation of the £ sterling in November 1967, and the associated possibility for the first time of a change in the exchange rate of the Jamaican £ relative to the pound sterling. This meant the introduction of an element of exchange risk not previously present in the commercial banks' portfolios. Exchange risk is consequently incorporated in the model by a dummy variable DUMRISK. The second institutional change was the introduction of selective quantitative controls on bank loans in October 1969. Though the restrictions applied only to loans to the distributive trades and to the personal sector, it might be worthwhile to determine whether there were portfolio effects. Selective credit controls are therefore represented by a dummy variable SELCON.

It now remains to describe the regression method employed. The model embodied in equations (16) or (17) consists of a system of five or six equations which has certain distinct features. Firstly, the sum of the dependent variables is always equal to some linear combination of the explanatory variables. This is a consequence of the balance sheet constraint, as are the following two features. Secondly, the cross equation sum of interest rate coefficients must equal zero, i.e. substitution effects must work themselves through the system. Thirdly, the cross equation sum of the coefficient of the "exogenous" (non-choice) balance sheet items must sum to unity, i.e. stock or wealth effects must be totally contained within the portfolio. The latter two can be expressed in the form of constraints to be imposed on the regression model.

One can stack the system of n equations into a single regression equation:

$$(18) \qquad Y = XB + U$$

where Y is a tn column vector of the n regressands, X is a tn x nk block diagonal matrix of regressors, and B is a nk column vector of regression coefficients, and U is a tn column vecto of stochastic disturbances.

$$(19) \qquad E(U) = 0$$

$$(20) \qquad E(UU') = V$$

Equation (18) is to be estimated subject to the constraints:

(i) $i'\bar{b} = 0$ where $\bar{b}$ are coefficients of the interest rates and dummy variables (and intercept terms if any).

(ii) $i'\tilde{b} = 1$ where $\tilde{b}$ are coefficients of DEP and BAL.

The last two constraints can be written generally as

$$(21) \qquad RB = r$$

An efficient estimator of β, subject to the linear constraint embodied in equation (21) is the constrained generalised least squares estimator.(5)

$$(22) \qquad \hat{\beta}_R = \hat{B} - (X'V^{-1}X)^{-1} R \left[R (X'V^{-1}X)^{-1} R' \right]^{-1} (R\hat{B} - r)$$

It will be recalled that one property of the system is that the sum of the regressands is equal to some linear combination of the regressors. Specifically, at any point in time,

(23) $$i' y = i' xb$$

which then implies that –

(24) $i' V \equiv 0$ i.e. the disturbance vector for the complete system is singular. The resulting complication can be dealt with by deleting one equation from the system and estimating that equation residually (1, 7). The coefficient estimates are invariant with respect to the equation chosen for deletion (7). In the estimations FL in variant I and BAL in variant III are the equations chosen for residual estimation.

IV. EMPIRICAL RESULTS

Tables II and III present the regression results for the variants in which the balancing item is treated as a non-choice variable and foreign liabilities is estimated residually. The equations in Table II contain an intercept term, while those in Table III do not.

Overall, the results are quite good. The equation for Excess Cash Reserves has a moderately high adjusted coefficient of determination. A priori correct signs are attached to the coefficients of total deposits, the balancing item, the bank loan rate, and the dummy variable for exchange rate risk. The coefficient of the UK Bank Rate is negatively signed thereby suggesting that the negative influence of the rate of return on foreign assets outweighs the positive influence of

TABLE II

REGRESSION RESULTS: VARIANT I

	ECR	JTB	FA	BL	FL
DEP	0.0535 (2.87)	0.091 (8.08)	0.082 (4.42)	0.762 (16.33)	0.011
BAL	0.258 (1.86)	0.374 (4.42)	0.156 (1.12)	-1.535 (-4.41)	1.747
JTBR	1.345 (0.76)	2.787 (2.59)	-0.249 (-0.14)	-1.351 (-0.30)	-2.532
UKBR	-0.833 (-1.24)	-1.153 (-2.83)	-2.226 (-3.32)	5.894 (3.51)	-1.682
BLR	-1.167 (-0.78)	-2.181 (-2.39)	0.768 (0.51)	2.095 (0.56)	0.485
DUMRISK	6.412 (2.60)	2.056 (1.37)	-6.843 (-2.78)	-13.380 (-2.17)	11.755
DUMSELC	-6.00 (-2.32)	-1.602 (-1.02)	-0.193 (-0.07)	28.348 (4.37)	-20.553
$\bar{R}^2$	0.7462	0.9414	0.6805	0.9877	
D.W.	1.08	1.71	1.43	1.28	
F.	21.59	113.49	15.91	564.44	
RMSE	3.01	1.83	3.01	7.53	
MDEPEND	9.97	15.97	7.71	150.63	
SEE	3.29	2.00	3.29	8.23	

TABLE III

REGRESSION RESULTS: VARIANT II

	ECR	JTB	FA	BL	FL
CONST	23.293 (2.11)	7.700 (1.10)	26.040 (2.40)	-60.214 (-2.19)	3.182
DEP	0.056 (3.16)	0.092 (8.17)	0.086 (4.87)	0.754 (16.94)	0.012
BAL	0.066 (0.41)	0.310 (3.04)	-0.059 (-0.37)	-1.038 (-2.59)	1.721
JTBR	2.440 (1.38)	3.149 (2.80)	0.974 (0.60)	-4.181 (-0.95)	-2.382
UKBR	-0.085 (-0.12)	-0.905 (-1.95)	-1.390 (-1.93)	3.9604 (2.17)	-1.580
ELR	-5.206 (-2.17)	-3.516 (-2.32)	-3.748 (-1.59)	12.536 (2.10)	-0.066
DUMRISK	9.075 (3.40)	2.937 (1.73)	-3.866 (-1.47)	-20.264 (- 3.04)	12.118
DUMSELC	-5.209 (-2.08)	-1.340 (-0.84)	0.692 (0.28)	26.299 (4.21)	-20.442
$\bar{R}^2$	0.7685	0.9417	0.7178	0.9890	
D.W.	1.29	1.77	1.54	1.46	
F.	20.92	98.01	16.26	535.40	
RMSE	2.83	1.80	1.54	7.07	
MDEPENDENT	9.97	15.97	7.71	150.63	
SEE	3.14	1.99	3.09	7.83	

the implicit returns on excess reserves. The coefficients of the interest rate variables are not statistically significant in the first variant, though that of the bank loan rate is significant when the equation includes an intercept term. It is worth noting that the Durbin-Watson statistics are quite low.

The equations for Jamaica Treasury Bills have a high adjusted coefficients of determination. Moreover, the coefficients of all the variables except DUMSELC are correctly signed and statistically significant at the 5 per cent or 10 per cent level. The standard error of estimate and the root mean squared error are also quite small in relation to the mean value of the dependent variable. The Durbin-Watson statistic is inconclusive with respect to auto-correlation.

The adjusted coefficients of determination for Foreign Assets are only modestly large, indicating that the model 'explains' about 68 per cent of short-run movements in Foreign Assets in the banks' portfolio. A priori correct signs are obtained for the scale variables, i.e. DEP and BAL, and for the Jamaica Treasury Bill Rate and DUMRISK, while the signs on the other variables are contrary to expectations. JTBR it must be remembered was ambiguously signed. Only the coefficients of DEP, BLR (in the model with an intercept), UKBR, and DUMRISK are statistically significant. The root mean square error and the standard error of estimate are also large in relation to the mean value of Foreign Assets. On the whole, this equation is not efficiently estimated.

In contrast, the equations for Bank Loans are very good. The adjusted coefficient of determination is 0.99, and the standard errors of estimate are very small in relation to the mean value of the dependent variable. The coefficients of DEP, BAL, DUMRISK, UKBR and BLR (in the equation containing an intercept) are statistically significant at the 5 per cent level. A priori correct signs have been obtained for DEP, JTBBR, BLR and DUMRISK.

For the residual equation FL, the signs on the coefficients of JTBR, BLR and DUMRISK are not in accord with theoretical expectations, while those on UKBR and DUMSELC are. One would also have expected a negative sign on DEP though in terms of borrowing capacity a positive relationship might exist.

Essentially to provide a comparison with the foregoing results, a third variant which treats BAL as the residual asset was estimated. The results are summarised in Table IV. Since the equations were fitted with an intercept, the comparisons are made with Table III.

For Excess Cash Reserves the results are nearly identical. In variant III, however, UKBR is negatively signed. For Jamaica Treasury Bills, the results are slightly less good, though in no way dissimilar. Likewise for the equations for Foreign Assets. The results for Bank Loans are slightly less good for variant II. The only dissimilarity of note is that in Model II, the coefficient of UKBR is not statistically significant, whereas in variant I it is.

For the foreign liabilities equation, variant II generates a priori correct signs on the coefficients for DEP, JTBR, BLR and DUMRISK. However, the coefficients for this equation are generally statistically insignificant, and the adjusted coefficient of determination is quite low. Overall, there is not much difference between variant I and variant II.

Analytically, from the results of all three sets of regressions, it appears that total deposit liabilities exert the main influence on short-period portfolio allocation by the commercial banks. Furthermore the 1967 devaluation of the pound sterling seemed to have served as a kind of watershed in the sense of biasing bank transactions against foreign assets and liabilities. Interest rate effects, apart from those of own rates of interest, have not been pronounced.

The computation of elasticities at the point of means helps to amplify these findings. From the details summarised in Table V, it can be seen that cross-elasticities which measure substitution effects are generally low, except for the Bank Loan Rate. It is worth noting that the own-rate-elasticity for bank loans is very small when BAL is a non-choice variable and when the intercept is suppressed. The elasticities of the dependent variables (except FL) with respect to total deposit liabilities are in the vicinity of unity or greater. A rather weak relationship exists between total deposits and the foreign indebtedness of the banks.

In terms of financial policy, the weak interest rate sensitivities of the asset portfolios suggest that the financial authorities should not realistically hope to influence commercial bank assets and by logical extension, the direction nor the maturity structure of bank credit by manipulating market rates of interest. Moreover, since, as a study by Bourne [2b] indicated, interest rates also have very little bearing on short-period movements in bank deposits, commercial banks' loan capacities are practically independent of interest rates. Thus altogether interest rate policy is largely irrelevant to commercial bank credit supply functions. Increases in market rates of interest in such situations merely result in higher costs of financing bank cus-

TABLE V

ELASTICITIES AT POINT OF MEANS

	ECR	JTB	FA	BL	FL
VARIANT I					
DEP	1.01	1.07	2.00	0.95	0.10
JTBR	0.57	0.73	-0.14	-0.04	-0.50
UKBR	-0.51	-0.44	-1.78	0.24	-0.49
BLR	-0.85	-0.99	0.72	0.10	0.16
VARIANT II					
DEP	1.06	1.08	2.10	0.94	0.11
JTBR	1.03	0.83	0.53	-0.12	-0.47
UKBR	-0.05	-0.35	-1.11	0.16	-0.46
BLR	-3.75	-1.60	-3.53	0.60	-0.02

tomers, inclusive of government agencies and the Treasury, without causing an expanded flow of credit.

SUMMARY AND CONCLUSIONS

In this study, three variants of a model of commercial bank portfolio behaviour in Jamaica were formulated and tested. The theoretical model was tailored to take account of the structural features of the industry, particularly the legal reserve requirements, collusive practices with respect to interest rates, and the partial integration of the banks into the United Kingdom money markets. The theoretical model generated strong a priori results on the qualitative relationships between variables which serve not only as a means of evaluating the empirical results, but as a yardstick for assessing the relevance of the general profit maximisation hypothesis to commercial banking in a dependent underdeveloped economy such as Jamaica.

The model was estimated subject to cross equation restrictions. In each case, one equation within the system was estimated residually to overcome a problem of singularity in the matrix of disturbance variables.

On the basis of the statistical results, the following conclusions can be made. Firstly, deposit liabilities are the main single determinant of short-period changes in the portfolios of the banks. Only the demand for foreign liabilities is weakly influenced by deposit changes. Secondly, interest rate changes are not quantitatively significant influences on portfolio allocation, except for the prime loan rate which exerts relatively strong substitution effects on bank asset portfolios. Thirdly, the devaluation of the U.K. pound in 1967 and the associated recognition by the banks of their exposure to foreign exchange risks, introduced a marked discontinuity in portfolio allocation, biasing the portfolio choice away from foreign assets and foreign liabilities.

Fourthly, one can infer from the results that interest rate policy has only negligible short-period implications for the portfolio choices of the banks. Other measures have to be relied upon for manipulating the composition and the term structure of bank credit in Jamaica.

Finally, the profit-maximising model appropriately formulated to reflect the specifics of the Jamaican environment is seen to be an adequate theoretical and empirical construct for the analysis of commercial bank portfolio behaviour in Jamaica. The theoretical predictions of the model are shown to be generally consistent with the empirical situation.

Notwithstanding the above conclusions, two bits of research might be profitably undertaken in the future to give a greater degree of validity and generality to the results. The first would be the re-estimation of the model with adjustments for serial correlation. The second would be the replication of the study for other Commonwealth Caribbean countries.

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N O T E S

1 An implicit assumption is that banks always accept deposits. This assumption is generally valid. For statistical evidence on the role of incomes, see Bourne (2b).

2 It is possible to adopt a specific utility function. A popular one in the literature on finance is the quadratic utility function. Parkin (6) in his study of U.K. banks utilised a log-normal utility function in which profits are postulated to be normally distributed. This function however is subject to the serious defect that it does not encompass situations of negative profits.

3 To illustrate, Parkin (6) derives the optimal solution for the control variable as:

$$V_1 = b \;\; GM_1 + HV_2$$

where V_1 is the vector of the optimal values of the control variables, M_1 is the vector of associated interest rates, V_2 is the vector of non-controlled assets, b is a constant, and G and H are variance-covariance matrices of the probability distributed variables. In the regression model, bG and H evidently would appear as parameters to be estimated.

4 Bourne (3) with a slightly different model estimated mean adjustment lags of 2.7 quarters for excess reserves, one month for Jamaica Treasury Bills, one and a half months for Foreign Assets, one week for Foreign Liabilities, and between one week to 2.3 quarters for five categories of bank loans.

5 For fuller developments of the econometric statements in this section, see Barten (1), Powell (7), Zellner (9), and White (10).

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TABLE IV

REGRESSION RESULTS: VARIANT III

	ECR	JTB	FA	BL	FL	BAL
CONST	25.847 (2.87)	19.727 (3.08)	23.764 (2.69)	-100.487 (-4.11)	4.016 (0.27)	27.133
DEP	0.059 (3.54)	0.104 (8.78)	0.083 (5.10)	0.716 (15.85)	-0.008 (-0.30)	0.046
JTBR	2.309 (1.34)	2.533 (2.07)	1.091 (0.64)	-2.119 (-0.45)	0.652 (0.23)	-4.466
UKGR	0.025 (0.04)	-0.385 (-0.80)	-1.489 (-2.25)	2.217 (1.21)	2.013 (1.81)	-2.381
BLR	-5.406 (-2.34)	-4.458 (-2.71)	-3.569 (-1.57)	15.690 (2.50)	0.603 (0.16)	-2.861
DUMRISK	9.075 (3.44)	2.938 (1.56)	-3.866 (-1.49)	-20.269 (- 2.83)	-11.682 (- 2.36)	23.804
DUMSELC	-5.350 (-2.18)	-2.004 (-1.15)	0.818 (0.34)	28.521 (4.28)	19.553 (4.83)	-41.538
$\bar{R}^2$	0.7738	0.9284	0.7245	0.9871	0.5087	
D.W.	1.29	1.24	1.54	1.25	1.10	
F	24.95	91.82	19.41	538.32	8.25	
RMSE	2.84	2.02	2.79	7.71	4.69	