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MONEY AND OUTPUT INTERACTION IN NIGERIA: AN ECONOMETRIC INVESTIGATION USING MULTI VARIATE COINTEGRATION TECHNIQUE

By

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This paper derives and estimates a Barro-type reduced-form equation for domestic real output from a simple structural model of an open developing economy in which markets clear continuously and expectations are rational. The form in which open economy variables appeared was explicitly derived from an underlying structural model. The model was adapted to Nigerian economy by according an important role to imported intermediate goods. The empirical result provided support for the open economy model of output determination in Nigeria.

I INTRODUCTION

Over the past two decades, macro-economists have debated whether policy makers can systematically use aggregate demand policies to stablise output around its full employment or "natural" level (Montiel, 1987). Specifically, proponents of "new classical" macroeconomics argued that since only unanticipated aggregate demand shocks can affect the distribution of output about its natural level; aggregate demand policy cannot be systematically used to stabilise output, and may only succeed in destabilising the price level. The theoretical arguments for these propositions were buttressed with empirical evidence in the form of reduced form output equation developed by Barro (1977, 1978, 1979 and 1981) which demonstrated that only the unanticipated component of monetary policy contributed to explaining deviations of output from its natural level in the United States. Barro's tests have also been applied to small open economies but these applications have either used the original reduced-form output equation or have added ad-hoc variables to take account of the openness of the economies under study. In other words, the estimated reduced form output equation has typically not been derived from an underlying structural model suitable for a small open economy.

The neglect of this issue is particularly surprising for developing countries, where the short-run effects on the level of economic activity of restrictive monetary and fiscal policies associated with adjustment programmes have long been controversial, and where the adoption of such measures has often been postponed for fear of recessionary consequences.

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Indeed, ascertaining the empirical relevance of new classical analysis for developing countries is an important step in assessing the short-run costs of adjustment in these economies. Estimating Barro-type reduced form output equations derived from dependent economy structural models for developing countries and testing for systematic effects of anticipated policy changes would appear to be a logical place to start. There have been several attempts at these estimations but more commonly, variables thought to be relevant to open economies or to developing countries have been added to the reduced-form output regression in ad-hoc fashion (see Hanson, 1980; Attfield and Duck, 1983; Edwards, 1983; and Sheehey, 1984). The exclusion of relevant open-economy variables from the regression is likely to result in omitted-variable problems and unless the reduced-form output equation is derived from the underlying structural model, it is difficult to ascertain the form in which the open economy variables should appear.

This paper therefore derives and estimates a Barro-type reduced form equation for domestic real output from a simple structural model of open developing economy in which markets clear continuously and expectations are rational. Unlike the existing literature, the form in which these variables appear is explicitly derived from an underlying structural model. The model is adapted to a dependent developing country setting by according an important role to imported intermediate goods. The resulting equation was estimated for Nigeria using the observed data (1960-1995). Section II presents the theoretical framework. Section III discusses the econometric methodology and analyses the empirical results. And finally, section IV concludes the paper.

II THEORETICAL FRAMEWORK

We start by assuming a simple structural model of a small open economy under fixed exchange rates (Chopra and Montiel, 1986). The model is characterised by continuous market clearing and rational expectations. Production is assumed to require the importation of intermediate goods. However, the presence of an effective system of foreign exchange rationing ensures that the quantity of such goods imported each period is policy determined. The domestic economy is completely specialised in the production of a (composite) exportable commodity which is an imperfect substitute for the output of the rest of the world. The home country possesses some market power over the price of this commodity. The imported commodity is used only as an intermediate good and the home country is small in the market for this commodity, so its price is taken as exogenously determined (Mundell, 1960; Fleming, 1962; and Montiel, 1987). Thus the short run production function for domestic output is given by:

$$y = a_0 + a_1 n + a_2 z + a_3 t + \epsilon_1 \qquad (2.1)$$

where y is the log of domestic real output; n is the log of employment; z is the log of real quantity of the intermediate goods used in production; t is the time trend which captures the effects of technological progress and capital accumulation. The parameters a_1 and a_2 are each positive and less than unity, $a_1 + a_2 < 1$. and $a_3 < o$. $\in_1$ is a random shock which is serially uncorrelated with zero mean and time variance. In the course of administering the exchange control regime, the authorities set an upper bound $\bar{z}$ on the quantity of intermediate goods that will be allowed to enter the country. Thus z must satisfy $z \leq \bar{z}$. This constraint is assumed to be binding. Domestic firms therefore maximise profits by choosing the optimum level of employment subject to the constraint $z = \bar{z}$. This yields the familiar first order condition that the real wage be equal to the (constrained) marginal product of labour:

$$\mathbf{w - p = K_0 - (1 - a_1)n + a_2 z + a_3 t + \in_{1,}}$$

where $K_0 = \mathbf{a_0} + \text{Log}\, a_1$;

w is the log of nominal wage; p is the log of domestic price level. This equation can be solved for the labour demand function:

$$n^D = K_1 - 1/1\text{-}a_1(w\text{-}p) + a_2/1\text{-}a_1(\bar{Z}) + a_3/1\text{-}a_1(t) + 1/1\text{-}a_1(\in_1) \qquad (2.2)$$

where $K_1 = (a_0 + \log a)/(1\text{-}a_1)$ is a positive constant. Equation (2.2) is an effective labour demand function, since it is conditional on the rationed quantity of the intermediate goods (Clower, 1973).

The aggregate supply of labour embodies the Friedman-Phelps natural rate hypothesis, that is the supply of labour depends on expected real wage. Thus it can be written as:

$$n^s = b_0 + b_1 (w\text{-}p^e) + \in_2 \qquad (2.3)$$

where p^e is the log of the price level expected to prevail in the current period, based on information available last period, that is, $p^e = E(p/\Omega_1)$ where Ω_1 is the information set available one period earlier. Labour market equilibrium holds continuously in this model. Setting $n^s = n^D$ and solving for the market clearing real wage after substituting from equations (2.2) and (2.3) yields:

$$w\text{-}p = K_2\text{-}\{b_1(1\text{-}a_1)/1\text{+}b_1(1\text{-}a_1)\}[p\text{-}p^e] + \{a_2/1\text{+}b_1(1\text{-}a_1)\}[\bar{z}] + \{a_3/1\text{+}b_1(1\text{-}a_1)\}[t] +$$

$$\{\in_1\text{-}(1\text{-}a_1)\in_2/1\text{+}b_1(1\text{-}a_1)\} \qquad (2.4)$$

with $K_2 = [a_0\text{-}\log a_1\text{-}\, b_0(1\text{-}a_1)]/[1\text{+}b_1(1\text{-}a_1)$

and noting that a domestic price level "surprise" lowers the equilibrium real wage. Substituting equation (2.4) in equation (2.2) produces the equilibrium level of employment:

$$n = K_3+\{b_1/1+b_1(1-a_1)\}[p-p^e]-\{a_2b_1/1+b_1(1-a_1)\}]\{\bar{z}] +\{a_3b_1/1+b_1(1-a1)\}[t]+$$

$$[b_1\in_1-/\in_2 1-b_1(1-a_1)] \qquad (2.5)$$

with $K_3 = \{b_0+b_1(a_0+\log a_1)\}/(1-b_1)-a_1)\}$

To derive the aggregate supply curve for domestic output, substitute equation (2.5) into the production function (2.1):

$$y^s=\beta_0+\beta_1(p-p^e) +\beta_2\,\bar{z} +\beta_3 t +\in_3 \qquad (2.6)$$

with the parameters given by

$$\beta_0=\{a_0(1+b_1) +a_1(b_0 +b_1\log a_1)/1+b_1(1-a_1)\}>0$$
$$\beta_1=\{a_1b_1/1+b_1\ (1-a_1)\}>0$$
$$\beta_2=\{a_2(1+b_1)/1+b_1(1-a_1)\}>0$$
$$\beta_3=\{a_3(1-b_1)/1+b_1(1-a_1)\}<0$$
$$\in_3=(1+b_1)\in_1+a_1\in_2/1-b_2(1-a_1\}$$

The aggregate supply relationship is quite similar to those that appear in closed-economy equilibrium business cycle models. We note that open-economy considerations enter only through the presence of imported intermediate goods. If such goods are not present, that is if $a_2= 0$ in equation (2.1) then $\beta_2= 0$, and equation (2.6) takes the familiar form:

$$y^s = \beta_0 +\beta_1 (p-p^e) + \beta_3 t + \in_3.$$

With imported intermediate goods and in the presence of foreign exchange rationing, the "normal" level of output, denoted y^n (the level of output produced in the absence of unanticipated shocks), is a function of the availability of intermediate goods:

$$y^n=\beta_0+\beta_2\,\bar{z} +\beta_3 t.$$

Thus. administration of the exchange control regime provides policy-makers with direct leverage over the supply side of the economy. Aggregate demand policies, on the other hand, can affect the domestic level of output only to the extent that they produce price level surprises. Again, since the home country's exportable and importable commodities are imperfect substitutes, the rest of the world's demand for domestic output depends on relative prices (p_f - p) and on foreign real income, y_f. And as in equilibrium business cycle models, real domestic demand is taken to be a function of the real domestic money supply. These considerations therefore suggest the aggregate demand relationship:

$$y^D=\alpha_0+\alpha_1(m-p) + \alpha_2 (p_f-p) +\alpha_3 y_f +\epsilon_4 \qquad (2.7)$$

where m is the log of the domestic money supply, and all parameters are positive. The inclusion of m in equation (2.7) reflects the alternative assumption that capital is imperfectly mobile. This is due in part to the existence of controls on capital movements and in the presence of controls, domestic residents are prevented from achieving their desired portfolio allocations and the authorities thereby retain control over the domestic money supply.

To derive the reduced-form expression for domestic output, set $y^s = y^D$ to impose equilibrium in the commodity market from equations (2.6) and (2.7); this yields the equilibrium value of the domestic price level as a function of the expected price level:

$$p=(\beta_1+\alpha_2)-1[(\alpha_0-\beta_0)+\alpha_1 m+\beta_1 p^e +\alpha_2 p_f + \alpha_3 y_f -\beta_2 \bar{z}-\beta_3 t+(\epsilon_4-\epsilon_3)] \qquad (2.8)$$

Taking expectations conditional on information available the previous period and solving for p^e:

$$p^e= (\alpha_1 {}_{+} \alpha_2)^{-1}[(\alpha_0-\beta_0)+\alpha_1 m^e +\alpha_2 p_f^e + \alpha_3 y_f^e-\beta_2 \bar{z}^e-\beta_3 t] \qquad (2.9)$$

Using equation (2.9) to eliminate p^e from equation (2.8):

$$p= (\beta_1+\alpha_1+\alpha_2)-1 \{(\alpha_0-\beta_1)[1+\beta_1(\alpha_1 +\alpha_2)]+\alpha_1 m+\alpha_2 p_f + \alpha_3 y_f-\beta_2 \bar{z}+\beta_3[1+\beta_1/(\alpha_1+\alpha_2)]t+$$

$$\beta_1(\alpha_1 {}_{+}\alpha_2)^{-1}(\alpha_1 m^e+\alpha_2 p_f^e+\alpha_3 y_f^e-\beta_2 \bar{z}^e)+(\epsilon_4 -\epsilon_3)\} \qquad (2.10)$$

The unanticipated portion of the domestic price level can be derived by subtracting equation (2.9) from equation (2.10):

$$p-p^e=(\beta_1+\alpha_1 +\alpha_2)^{-1}[\alpha_1(m-m^e)+\alpha_2(p^f-p_f^e)+\alpha_3(y_f-y_f^e)-\beta_2(\bar{z}-\bar{z}^e)-(\epsilon_4-\epsilon_3)] \qquad (2.11)$$

This price level "surprise results from innovation in monetary policy, from unforeseen external price and output shocks, and from other unforeseen disturbances to aggregate demand and supply. The reduced-form expression for domestic output can thus be derived by substituting equation (2.11) in the aggregate supply equation (2.6):

$$y=\Pi_0+\Pi_1(m-m^e)+\Pi_2(p_f-p_f^e)+\Pi_3(y_f-y_f^e)+\Pi_4(\bar{z}-\bar{z}^e)+\Pi_5\bar{z}+\Pi_6 t+\epsilon_5 \qquad (2.12)$$

where

$$\Pi_0=\beta_0;$$

$$\Pi_1=\alpha_1\beta_1/(\beta_1+\alpha_1+\alpha_2)>0;$$

$$\Pi_2=\alpha_2\beta_1\ /(\beta_1+\alpha_1+\alpha_2)>0;$$

$$\Pi_3=\alpha_3\beta_1\ /\ (\beta_1+\alpha_1+\alpha_2)>0;$$

$$\Pi_4=\beta_2\beta_1/(\beta_1+\alpha_1+\alpha_2)<0)$$

$$\Pi_5=\beta_2>0;$$

$$\Pi_6=\beta_3<>0;$$

$$\epsilon_5=\beta_1\epsilon_4+(\alpha_1+\alpha_2)\epsilon_3/\beta_1+\alpha_1+\alpha_2$$

According to equation (2.12), deviations of real output from its "normal" level are serially uncorrelated. However, measures of cyclical economic activity in industrial countries are well known to exhibit substantial persistence overtime, so that empirical applications of the closed-economy version of equation (2.12) typically include distributed lags of the independent variables or at least one lag of the dependent variable. One way to motivate the inclusion of a lagged dependent variable in this model is to interpret the aggregate supply equation(2.6) as a long-run relationship to which gradual adjustment is optional owing to the presence of increasing costs associated with changes in production levels. However, the resulting supply equation would no longer be consistent with profit maximising behaviour on the part of firms, since the labour demand function (2.2) would be unchanged. To remedy this problem, we assume that convex adjustment costs are specially associated with variations in the level of employment. Thus n^D is the long-run desired level of employment, and the short-run demand for labour adjusts gradually to this level according to:

$$n-n_{-1}=\lambda(n^D-n_{-1}),\quad 0<\lambda<1 \qquad (2.13)$$

The short-run demand for labour therefore becomes

$$n^D = \lambda K_1 - [\lambda/1-a_1](w-p) + [\lambda a_2/1-a_1](\bar{z}) + [\lambda a_3/1-a_1](t) + (1-\lambda)n_{-1} + [\lambda/1-a_1]\epsilon_1 \quad \text{..........(2.2a)}$$

Using equation (2.2a) instead of equation (2), the aggregate supply equation therefore becomes:

$$y^s = \bar{\beta}_0 + \bar{\beta}_1(p-p^e) + \bar{\beta}_2 z + \bar{\beta}_3 t + \bar{\beta}_4 n_{-1} + \bar{\epsilon}_3 \quad \text{.............(2.6a)}$$

with $\bar{\beta}_0 = [a_0(\lambda a_1 b_1 + \phi_1) + a_1\lambda(b_0 + b_1 \log a_1)]/\phi_1; \bar{\beta}_1 = \lambda a_1 b_1/\phi_1 > 0; \bar{\beta}_2 = a_2(\lambda a_1 b_1/\phi_1)\phi_1 > 0;$

$\bar{\beta}_3 = a_3(\lambda a_1 b_1/\phi_1)/\phi_1 \gtrless 0; \bar{\beta}_4 = a_1 b_1(1-\lambda)(1-a_1)/\phi_1 > 0; \epsilon_3 = [(\lambda a_1 b_1 + \phi_1)\epsilon_1 + \lambda a_1 \epsilon_2]/\phi_1;$ and

$\phi_1 = \lambda + b_1(1-a_1) > 0.$

Equation (2.6a) is a generation of equation (2.6) and reduces to equation (2.6) when $\lambda = 1$ and the coefficient on lagged employment, β_4 becomes zero in this case. Otherwise, it is bounded between zero and one. Using equation (2.6a) together with the aggregate demand (2.7) produces a new reduced-form expression for real output which is similar to equation (2.12) except for the addition of a term in lagged employment. This term can be eliminated by lagging the production function one period, solving it for n_{-1} and substituting yields the final reduced-form expression:

$$y = \bar{\Pi}_0 + \bar{\Pi}_1(m-m^e) + \bar{\Pi}_2(p_f - p_f^e) + \bar{\Pi}_3(y_f - y_f^e) + \bar{\Pi}_4(z-z^e) + \bar{\Pi}_5 z + \bar{\Pi}_6 t + \bar{\Pi}_7 y_{-1} + \bar{\Pi}_8 z_{-1} + \epsilon_5 \quad (2.12a)$$

where

$\bar{\Pi}_0 = \beta_0 + [(a_3 - a_0)(1-\lambda)b_1(1-a_1)/\lambda + b_1(1-a_1)]:$

$\bar{\Pi}_1 = \alpha_1[\lambda a_1 b_1/(\lambda a_1 b_1 + \phi_1\phi_2)] > 0;$

$\bar{\Pi}_2 = \alpha_2[\lambda a_1 b_1/(\lambda a_1 b_1 + \phi_1\phi_2)] > 0;$

$\bar{\Pi}_3 = \alpha_3[\lambda a_1 b_1/(\lambda a_1 b_1 + \phi_1\phi_2)] > 0;$

$\bar{\bar{\Pi}}_4 = -\alpha_2[(\lambda a_1 b_1 + \phi_1)\lambda a_1 b_1/\phi_1(\lambda a_1 b_1 + \phi_1\phi_2)] < 0;$

$\bar{\bar{\Pi}}_5 = \alpha_2[(\lambda a_1 b_1 + \phi_1)/\phi_1)] > 0;$

$\bar{\Pi}_6 = \alpha_3[\lambda a_1 b_1/\phi_1] > 0$

$\overline{\Pi}_7 = (1-\lambda)[b_1(1-a_1)/\phi_1] > 0;$

$\overline{\Pi}_8 = \alpha_2(1-\lambda)[b_1(1-a)\phi_1] > 0;$

$\overline{\epsilon}_5 = [(\lambda a_1 b_1 \epsilon_4 + (\lambda a_1 b_1 + \phi_1)\phi_2 \epsilon_1 + \lambda a_1 \phi_2 \;\; \epsilon_2(\lambda a_1 b - \phi_2 \epsilon\} - \{(1-\lambda)b_1(1-a_1)/\phi_1\}\epsilon_1 + 1;$

$\phi_2 = a_1 + a_2] > 0;$

And these coefficients, will obey certain restrictions:

$0 < \overline{\Pi}_7 < 1; 0 < -\overline{\Pi}_8/\overline{\Pi}_7 = a_2 < 1;$

$(\lambda a_1 b_1 + \phi_1)/\phi_1 = [\overline{\Pi}_5 \overline{\Pi}_7/\overline{\Pi}_8 / > 1;$

$-1 < \overline{\Pi}_7/\overline{\Pi}_5 = [(-\lambda a_1 b_1)/(\lambda a_1 b_1 + \phi_1 \phi_2)[< 0.$

III. METHODOLOGICAL AND EMPIRICAL ANALYSIS

The above theoretical model can now be applied to the Nigerian economy over the period, 1960-1995. Nigeria was considered to be particularly suitable for illustrating the model since it is an open economy that possesses several of the characteristics that were stressed in the theoretical framework, at least to first approximation. Firstly, foreign exchange and import rationing have been prevalent in Nigeria since the early 1960's. These exchange and trade restrictions have been alternatively strengthened and relaxed over the years, but they have been in place in one form or another over most of the period. Secondly, the structure of Nigerian merchandise imports indicates that the bulk of imports consists of intermediate goods rather than final goods. In the recent past a greater percentage of Nigerian imports consisted of machinery, transport equipment and other manufactured goods. And thirdly, Nigeria has begun to rely increasingly on exports of manufactured goods to enhance its growth prospects. Such goods are more likely to be imperfect substitutes for the output of the rest of the world than would be true for primary commodities.

Foreign exchange rationing and import restrictions is consistent with the specification of aggregate supply in the theoretical model. The exports of some manufactured goods is consistent with the aggregate demand side of the model while imports of mainly intermediate goods plays a role in the specification of both aggregate supply and aggregate demand. The closed-economy version of the model which does not take these special characteristics into account, has been estimated for some developing countries (see Attfield and Duck, 1983; Kormendi and Meguire, 1984). These studies examined the influence of unanticipated money growth on real output. It would be useful and interesting to evaluate the empirical success of the open-economy version of the model, allowing for the special characteristics of economies such as Nigeria. The empirical application of the reduced-form output equation necessitates the choice of the data counterparts for variables such as y_f, p_f, m, and z. For modelling purposes, these variables (in logarithms) are labelled as y_f = LFRII; p_f =LIPII; m=LMS2 and z = LIMZ. The foreign real income variable used for LFRII is industrial country real GDP. The foreign price variable LIPII needs to be expressed in domestic currency units, and therefore its choice is limited by the exchange rate series that are available for Nigeria. Since an exchange rate for the Nigerian naira against the aggregate of industrial countries or the world is not available, the United States wholesale price index and the naira/US dollar exchange rate are supposed to be used to construct the series. The wholesale price index is therefore chosen over the other indexes since it contains the highest proportion of traded goods. The choice for the monetary variable is rather more complex. As it is well known, there is a scant theoretical guidance for the selection of a monetary variable between narrow money (LMSI) and broad money (LMS2). Broad money (LMS2) was chosen, since it has been used in most similar studies. For the import variable, LIMZ, it would be ideal to use only imports of intermediate goods rather than total imports. However, a time series of imports of intermediate goods in Nigeria is not readily available, and hence a series for total import volume is used. These time series (including other explanatory variables) used are presented and explained in the appendix.

Next we investigate the time series characteristics of our data so as to ensure consistency in subsequent econometric modelling. In Table (3.1), we present evidence on the presence of unit roots in our variables, using two commonly applied tests: Dickey-fuller tests and Augmented Dickey-Fuller tests which uses the regression:

$$\Delta X_t = \beta X_{t-1} + U_t \qquad U_t \sim IN(0, \sigma^2) \qquad (3.1)$$

to test the null hypothesis of non-stationarity for the series X_t by using the t-statistic on the β parameter. The t-statistic is compared with special critical values constructed by Dickey and Fuller (1979, 1981) and Engle and Granger (1987) using a numerical simulation method. However, the problem is that the residuals from equation (3.1) should be found to be white noise. Otherwise, the equation (3.1) has to be modified to take into account higher order autoregressive process namely:

$$\Delta X_t = \beta X_{t-1} \sum_{i=1}^{n} \Delta X_{t-1} + U_t \qquad (3.2)$$

where the n is chosen large enough so as to ensure that the residuals are white noise. The t-statistic from equation (3.2) is used to implement an Augmented Dickey-Fuller Test (ADF) which is also reported in Table (3.1) for the variables under consideration.

TABLE 3.1: UNIT ROOT TESTS

VARIABLE X	UNIT ROOT IN X		VARIABLE ΔX	UNIT ROOT IN ΔX	
	DF	LAG LENGTH		DF	LAG LENGTH
LIMZ	-0.0118	0	ΔLIMZ	-3.8697*	0
LINR	-2.2038	0	ΔAINP	−6.8969*	0
LIPII	−3.2718**	0	ΔLIPII	-2.7249	0
LIM2	1.0683	0	ΔLIM2	-2.1489	0
LWM2	-1.4130	0	ΔLWM2	-2.5822	0
LFRII	-1.9180	0	ΔLFRII	-4.5980*	0
LMS2	-1.6487	0	ΔLMS2	-3.8550*	0
RLGDP	-1.3572	0	ΔRLGDP	-3.8046*	0
	ADF	LAG LENGTH		ADF	LAG LENGTH
LIMZ	-1.8502	4	ΔLIMZ	-3.2888**	1
LINR	-1.8290	4	ΔLINR	-4.4521*	1
LIPII	-2.9028	4	ΔLIPII	-3.4108**	1
LIM2	-0.39964	4	ΔLIM2	-2.3446	1
LWM2	-2.000	4	ΔLWM2	-2.8706	1
LFRII	-1.7851	4	ΔLFRII	-4.0725*	1
LMS2	-2.9519	4	ΔLMS2	-3.3329**	1
RLGDP	-1.3579	4	ΔRLGDP	-3.4634**	1

**Indicates statistical significance at 5% level*
*** Indicates statistical significance at 10% level*
95% critical value for the Augmented Dickey-Fuller Statistics =-3.55
90% critical value for the Augmented Dickey-Fuller Statistics =-3.18

Looking at the levels of the variables, there is (not surprising) strong evidence in favour of null hypothesis of non-stationarity. All the test statistics (absolute values) are lesser than the critical values at 5% and 10% significant levels; except for the variable LIPII (which is significant at 10% level). But turning to the first differences of the variables, the tests overall provide support to reject the null hypothesis of non-stationarity of the series, leading us to conclude that all the original series seem to be I (I). The only exceptions were the variables LIM2 and LWM2 (which indeed are not significant) as shown by their test statistics. Having examined the series, the next practical estimation problem however, is the estimation of anticipated components of ΔLFRII, ΔLIPII, ΔLMS2, ΔLIMV. Clearly, misspecification is always in danger, if these proxies include a measurement error. Such misspecification will lead to an error-in-variables bias in the coefficients of the reduced-form output equation. It is assumed that all expectations are formed rationally. That is expectations are assumed to be equivalent to optimal, one period ahead forecasts conditional on available information. This assumption of rational expectations implies the condition:

$$X^e_t = E(X_t/\Omega 1) = X_t - \delta_1 \qquad (3.3)$$

where $E(X_t/\Omega_1)$ denotes the expectation of X_t conditional on the past values of set of variables included in the information set Ω and δ denotes a random term orthogonal to Ω_1, $E(\delta/\Omega_1)=0$. Thus, the prediction equations and the output equation may be estimated separately in a two-step procedure using cointegration techniques and autoregressive modelling approach. In the first step, the prediction equations for DLFRII, DLIPII, DLMS2, and DLIMV are estimated using error correction mechanism. The fitted values from this equation are used as anticipated component (while the saved residuals are used as unanticipated component) in the second stage equation explaining real domestic output, DRLGDP (using Cochrane-Orcutt iterative techniques.

Engle and Granger (1987) noted that even though economic series may wonder through time, economic theory often provide a rationale why certain variables should obey equilibrium constraints. That is, there may exist some linear combination of the variables that overtime converges to an equilibrium. If the separate economic series are stationary only after differencing but a linear combination of their levels is stationary, then the series are said to be cointegrated. However, this test does not distinguish between the existence of one or more cointegrating vectors. Also, the test relies on a superconvergence result and applies an OLS estimates to obtain estimates of the cointegrating vector (see Hafer and Jansen, 1991; Nwaobi, 1993a; Nwaobi, 1993b). In contrast, Johansen (1988) and Johansen and Juselius (1990) provide a procedure to examine the question of cointegration in a multivariate setting. This approach yield maximum likelihood estimators of the unconstrained cointegrating vector and also allows one to explicitly test for the number of cointegrating vectors.

Following this approach therefore, consider:

$$X_t=\pi_1 X_{t-1}+\ldots..+\pi_k X_{t-k}+\in_\tau \qquad (t=1,\ldots..T) \qquad (3.4)$$

where X_t is a sequence of random vectors with components $(X_{1t},\ldots..X_{,pt})$. The innovations of this process, $\in_1\ldots\ldots\in_{T\cdot}$, are drawn from a p-dimensional i.i.d Gaussian distribution with covariance Λ and $X_{k+1}\ldots\ldots\ldots..,X_0$ are fixed. Letting Δ represent the first difference operator, (3.4) could be written in the equivalent form:

$$\Delta X_t=\Gamma_1\Delta_{t-1},+\ldots\ldots+\Gamma_{k-1}\Delta X_{t-k+1}-\pi X_{t-k}+\in_\tau \qquad (3.5)$$

where $\Gamma_i=-1+\pi_1+\ldots\ldots+\pi_k$ $\quad (i=1\ldots\ldots.k-1)$ and

$$\pi=1-\pi_1-\ldots.-\pi_k \qquad (3.6)$$

It is this π matrix that conveys information about the long-run relationship between the X variables. If X_t is non-stationary in levels but ΔX_t is stationary then X_t is integrated of order one. Cointegration can be detected by examining the π matrix . If P x P matrix π has rank 0 then all elements of X_t have unit roots and first differencing might be recommended. If it is of full rank p them all elements of X_t are stationary in levels. If the rank of π denoted as r is 0, then there are p stochastic trends among the p elements of X. Likewise, if r=p, then there are p linear combinations of the elements of X that are stationary. The interesting case is when $0<\text{rank}(\pi)=r<p$. Here, it is said that there are r cointegrating relations among the elements of X_t, and p-r common stochastic trends. If π has rank r $<p$, this implies that $\pi=\alpha\beta'$, where α and β are p x r matrices. The β is interpreted as a matrix of cointegrating vectors and α is a matrix of error correction parameters.

Johansen et al (1990) demonstrate that β, the cointegrating vector can be estimated as the eigen vector associated with the r largest statistically significant eigen values found by solving

$$|\lambda S_{kk}-S_{ko}S_{00}^{-1}S_{ok}|=0 \qquad (3.7)$$

where S_{oo} is the residual moment matrix from a least squares regression of ΔX_t on $\Delta X_{t-1},\ldots,X_{t-k+1}$; S_{kk} is the residual moment matrix from a least squares regression of X_{t-k} on ΔX_{t-k+1} and S_{ok} is the cross product moment matrix. Using these eigen values, one may test the hypothesis that there are at most r cointegrating vectors by calculating the likelihood test statistic

$$(-2)\text{In}(Q) = -T\sum^{p}_{r+1} \text{In}(1-\hat{\lambda}_1) \quad (3.8)$$

where $\hat{\lambda}_{r+1,...,}\hat{\lambda}_p$ are p-r smallest eigen values. This test was called trace test. They also develop a likelihood ratio test called the maximal eigen value test. In that test, the null hypothesis of cointegrating vectors is tested against the alternative of r + 1 cointegrating vectors. The relevant likelihood ratio test statistic is

$$(-2)\ \text{In}(Q)=T\sum^{r}_{1}\text{In}(1-\hat{\lambda}^{*}_{i}) \quad /(1-\hat{\lambda}^{*}_{i})\} \quad (3.9)$$

where $\hat{\lambda}^{*}_{i}$ are the largest eigen values from solving (3.8) under the restrictions being imposed while $\hat{\lambda}^{*}_{i}$ are the r largest eigen values under no restrictions. This test statistic is distributed with χ^2 with r (p-s) degrees of freedom. Table 3.2 reports the cointegration test results of this paper.

TABLE 3.2

TESTING FOR THE NUMBER OF COINTEGRATING VECTORS (r) ASSUMING UNRESTRICTED INTERCEPTS AND NO TRENDS

(A) TEST BASED ON MAXIMAL EIGEN VALUE AND TRACE OF THE STOCHASTIC MATRIX

HO: null hypothesis	H0: alternative hypothesis	Maximal Eigen Values	95% Critical Values	90% Critical Value	Trace Statistics	95% Critical Value	90% Critical Value
r=0	r=1	49.0839	39.8300	36.8400	133.7846	95.8700	91.4000
r=1	r=2	32.4875	33.6400	31.0200	84.7007	70.4900	66.2300
r=2	r=3	27.4466	27.4200	24.9900	52.2132	48.8800	45.7000
r=3	r=4	12.8797	21.1200	19.0200	24.7672	31.5400	28.7800
r=4	r=5	7.3412	14.8800	12.9800	11.8875	17.8600	15.7500
r=5	r=6	4.5463	8.0700	6.5000	4.5463	8.0700	6.5000

(B) TEST USING MODEL SELECTION CRITERIA

RANK	LL	AIC	SIB	HQC
r=0	253.9269	211.9269	179.8733	200.9957
r=1	278.4688	225.4688	185.0203	211.6747
r=2	294.7126	232.7126	185.3954	216.5761
r=3	308.4356	239.4356	186.7761	221.4772
r=4	314.8754	240.8754	184.4001	211.6157
r=5	318.5460	241.5460	182.7811	211.5055
r=6	320.8192	242.8192	183.2911	222.5184

LL⇒ MAXIMIZED LOG-LIKELIHOOD
AIC⇒ AKAIKE INFORMATION CRITERION
SBC⇒ SCHWARZ BAYESIAN CRITERION
HQC⇒ HANNAN-QUINN CRITERION

Irrespective of which set of critical values one uses, there is a clear agreement between the test results based on the maximum eigen value statistic and the trace statistic. Assuming unrestricted intercepts and no trends in the model, the maximum eigen value statistic does not reject r=3, while the trace statistic does not equally reject r=3. Turning to the model selection criteria, we find that AIC, SBC, and HQC chooses r=6. Our data therefore seems inconclusive on the appropriate choice of r. But for the purpose of this paper, we choose r = 2 and proceed to estimate the error correction model for the prediction variables, as shown in Table 3.3.

TABLE 3.3: ERROR CORRECTION MODEL FOR THE PREDICTION VARIABLES

(A) FOREIGN PRICE PREDICTION EQUATION

$$\Delta LIPII = \underset{(0.58611)}{0.49982} - \underset{(-0.72251)}{0.084456}\Delta RLGDP_{t-1} - \underset{(-0.75780)}{0.025535}\Delta LIMZ_{t-1} + \underset{(0.37516)}{0.030609}\Delta LMS2_{t-1} +$$

$$\underset{(0.76483)}{0.48156}\Delta LFRII_{t-1} + \underset{(3.7364)}{0.73131}\Delta LIPII_{t-1} + \underset{(1.7187)}{0.10906}\Delta LINR_{t-1} + \underset{(0.75729)}{0.033506}ecm1_{t-1} + \underset{(0.096579)}{0.0042731}ecm2_{t-1} \quad (3.10)$$

[R^2 = 0.68456, σ=0.044245, $F(8,25)$ = 6.7818, DW=1.7481, $\xi_1(1)$=2.0784, $\xi_1(1,24)$=1.5626 $\xi_2(1)$ =2.2205, $\xi_2(1,24)$ = 1.6769, $\xi_3(2)$ = 0.36578, $\xi_3(2)$ = 0.36578, $\xi_4(1)$ 3.5503, $\xi_4(1,32)$ = 3.7310]

(B) FOREIGN INCOME PREDICTION EQUATION

$\Delta LFRII = 0.028923 + 0.039356\Delta RLGDP_{t-1} + 0.0048654\Delta LIMZ_{t-1} - 0.032884\Delta LMS2_{t-1}$
(1.0286) (1.0211) (0.43789) (-1.2223)

$0.082790\Delta LFRII_{t-1} = 0.12256\Delta LIPII_{t-1} - 0.0037266\Delta LINR_{t-1} - 0.013365ecm1_{t-1} + 0.0046318ecm^2_{t-1}$
(0.39877) (-1.8990) (-0.17810) (-0.91612) (0.31748)

(3.11)

[$R^2 = 0.50663$, $\sigma = 0.14589$, $F(8,25) = 3.2089$, $DW-1.8627$, $\xi_1(1) = 1.0554$, $(1,24) = 0.76882$ $\xi_2(1) - 0.46654$, $\xi_2(1,24) = 0.032977$, $\xi_t(2) = 7.4751$, $\xi_4(1) = 0.0047197$, $\xi_1(1,32) = 0.004427$]

(C) MONEY PREDICTION EQUATION

$\Delta LMS2 = 0.30466 - 0.10276\Delta RLGDP_{t-1} - 0.13012\Delta LIMZ_{t-1} + 0.40167\Delta LMS2_{t-1} - 1.4077\Delta LFRII_{t-1}$
(1.1171) (-0.27488) (-0.27488) (-1.2074) (-0.69909)

$+0.55759\Delta LIPII_{t-1} - 0.43017\Delta LINR_{t-1} + 0.37215ecm1_{t-1} + 0.23891ecm2_{t-1}$ (3.12)
(0.89075) (2.1197) (2.6299) (1.6883)

[$R^2 = 0.41597$, $\sigma = 0.14151$, $F(8,25) = 2.2257$, $DW = 2.1530$, $\xi_1(1) = 1\ 3236$, $\xi_1(1,24) = 0.97216$, $\xi_2(1) = 0.006901$, $\xi_2(1,24) = 0.004871$, $\xi_2(2) = 2.2887$, $\xi_3(1) = 0.51700$, $\xi_4(1,32) - 0.048733$]

(D) IMPORT PREDICTION EQUATION

$\Delta LIMZ = 1.4955 - 0.92466\Delta RLGDP_{t-1} - 0.18947\Delta LIMZ_{t-1} - 0.45654\Delta LMS2_{t-1} - 1.1634\Delta FRII_{t-1}$
(-4.2836) (-0.19322) (-1.3734) (1.3668) (-0.45134)

$+3.1981\Delta LIPII_{t-1} + 0.37978\Delta LINR_{t-1} + 0.060917ecm1_{t-1} + 1.0226ecm2_{t-1}$ (3.13)
(3.9911) (1.4619) (0.33630) (5.6456)

[$R^2 = 0.72705$, $\sigma = 0.18114$, $F(8,25) - 8.3242$, $DW - 1.9405$, $\xi_1(1) = 0.067942$, $\xi_1(1,24) - 0.048055$, $\xi_2(1) - 3.1055$, $\xi_2(1.24) = 2.4124$, $\xi_3(2) = 3.6456$, $\xi_4(1) = 0.0068908$, $\xi_4(1,32) = 0.0064868$]

NOTES: *Values in parenthesis are estimated t-ratios; T=1960 -1995; $\xi_2 \Rightarrow$lagrange multiplier test of residual serial correlation (χ^2 and F versions); $\xi^2 \Rightarrow$ Ramsey's reset test using the square of the fitted values; $\xi_3 \Rightarrow$Normality test based on a test of skewness and kurtosis of residuals; $\xi_4 \Rightarrow$Heteroscedasticity test based on the regression of squared residuals on filled values.*

From the above prediction equations(3.10) - (3.12), the saved fitted values and saved residuals are respectively the anticipated and unanticipated components. The anticipated components are labelled as YDLIMZ, YLMS2, YDLFRII, and YDLIPII; while the unanticipated components are labelled as RDLIMZ, RLMS2, RDLFRII, and RDLIPII. Concerning the statistical attributes of the estimated equations, the various diagnostic checks are insignificant (if regarded as test statistics) and indicate design of a model congruent with the information available. From the reported diagnostic tests, the residuals are white noise, there is no ARCH, RESET, or heteroscedastic evidence of mis specification; the residuals are approximately normally distributed. In the second stage of the estimation process, the derived equation components are used in the reduced form output equation presented in section two. The estimation method employs the Cochrance-Orcutt (1949) iterative procedure to compute the maximum likelihood estimators of the regression model.

$$Y = X\beta + U \qquad (3.13)$$

where Y is the n x 1 vector of observations on the dependent variable; X is the n x k matrix of observations on the regressors; and U is the n x 1 vector of disturbances (errors). This computation is under the assumption that the disturbances, U_t, follow the AR(M) process

$$U_t = \sum^{m}_{i=1} P_i U_{t-i} + \varepsilon_t \qquad \varepsilon \sim N(0, \sigma^2_t), \quad t = 1, 2, \ldots\ldots, n \qquad (3.14)$$

with 'fixed initial' values. The fixed initial value assumption is the same as treating the values $y_1, y_2, \ldots y_m$ as given or non-stochastic. This procedure in effect ignores the possible contribution of the distribution of the initial values to the overall log-likelihood function of the model. This log-likelihood function is defined

by $$LL_{co}(\theta) = -[(n-m)/2]\log(2\pi\sigma^2_\varepsilon) - (1/2\sigma^2_\varepsilon)\sum^{n}_{t-m+1} \epsilon^2_t + C \qquad (3.15)$$

where $\theta = (\beta', \sigma^2_\varepsilon, P')'$ with $P = (P_1, P_2, \ldots P_m)'$. The constant C is undefined and is usually set equal to zero. The Cochrance-Orcutt(co) method maximises $LL_{co}(\theta)$ or equivalently minimises $\sum^{n}_{t-m+1} \epsilon^2_t$ with respect to θ by the iterative method of 'successive substitution' (Pesaran and Pesaran, 1997). This method therefore is applied in estimating the required domestic output equations as presented in Table 3.4.

TABLE 3.4: ESTIMATED DOMESTIC OUTPUT EQUATIONS USING COCHRANE-ORCUTT ITERATIVE TECHNIQUES

VERSION A: CONVERGENCE AFTER EIGHT ITERATIONS

ΔRLGDP = -0.093982 + 0.60538ΔRLGDPt-1 + 0.017448RDLIPII + 0.34762YDLIPII +
(-0.35690) (3.8759) (0.047053) (0.64691)

0.42509RLMS2 + 0.027966YLMS2 + 3.6929RDLFRII + 0.0011902TTR - 0.0444268SAD +
(3.4002) (0.11653) (3.7280) (0.35248) (1-.2767)

0.13292WAD + 1.3047YDLFRII (3.15)
(3.0794) (0.31536)

[R2 = 0.67111, σ= 0.068863, F(12,19) = 3.2309, DW = 1.9923]

VERSION B: CONVERGENCE AFTER SEVEN ITERATIONS

ΔRLGDP = 0.096319 + 0.67105ΔRLGDPt-1 + 0.27620ΔRDLIPII - 0.024285ΔYDLPII + 0.3930RLMS2
(0.36892) (3.4409) (0.73790) (-0.048499) (3.6196)
+0.052040YLMS2 + 4.3786RDLFRII - 1.6785YDLFRII - 0.078763YDLIMZ + 0.15548RDLIMZ-
(0.22111) (4.8415) (-0.39554) (-0.88780) (1.7646)

0.0018969TTR - 0.018744SAD + 0.11163WAD (3.16)
(-0.48433) (-0.62450) (3.09885)

[R2 = 0.75657, σ= 0.062632, F(14,17) = 3.7740, DW = 2.1063]

VERSION C: CONVERGENCE AFTER NINE ITERATIONS

ΔRLGDP=0.12212 + 0.68476ΔRLGDPt-1 + 0.47129RLMS2 + 0.35258YLMS2 + 4.4372RDLFRII -
(0.71783) (3.9467) (5.0485) (0.16406) (5.3791)

-2.0838YDLFRII + 0.023102RDLIMZ - 0.033429DLIMZ - 0.065328 DLIMZt-1 - 0.0022670TTR
(0.74942) (2.9665) (-0.46927) (-1.6123) (-0.67882)

-0.026661SAD + 0.095669WAD (3.17)
(-1.0540) (3.1885)

[R2 = 0.77741, σ= 0.058204, F(13,18) = 4.8358, DW = 2.1820]

NOTES: *The values in parenthesis are estimated T-ratios and the estimation period is from 1960 to 1995.*

Looking at Table 3.4, version A is an open economy version that includes unanticipated foreign income(RDLFRII) and unanticipated foreign prices (RDLIPII). The versions B and C are complete versions which include the import variables besides the other closed and open economy variables. In version A, the estimated coefficient on anticipated foreign income (RDLFRII) has the correct sign and very significant at 5 and 10 percent levels. On the other hand, the coefficient on unanticipated foreign prices has the correct sign but not significant. However, the complete models, versions B and C performs exceptionally well. Most coefficients have the signs predicted by theory. In particular, the coefficients on lagged imports have the correct sign while the coefficient on unanticipated imports is significant at 10 per cent, 5 per cent and 1 per cent levels. Also, the restrictions on the magnitudes of the coefficient on lagged output (DRLGDPt-1) is positive and less than unity. The estimate of a_2 (derived from $-\prod_8/\hat{}\prod_7$ =0.065328/0.68476) is 0.09540, which falls between the bounds of zero and one. The quantity $\hat{}\prod_5 \hat{}\prod_7/\hat{}\hat{}\prod_8$ - =[0.33429 (0.68476)/-0.065328] is 3.5039 and it is greater than unity, as expected, while the quantity$\hat{}\prod_4/\hat{}\prod_5$=0.23102/-0.03342=- 6.91 which is negative and greater than minus one.

Our regression results (using Nigerian data) therefore provides support for the open-economy model of output determination as presented in this paper. However, on the basis of the three regressions, two tests of exclusion of three import variables were performed. Firstly, we tested for the exclusion of three import variables (RDLIMZ, DLIMZ, and $DLIMZ_{t-1}$) as well as anticipated components; and obtained the following test statistic: F(9,22)=4.8010 (significant at 5% level). We can thus reject the null hypothesis that these variables should be excluded from the regression. And secondly, we tested for the exclusion of all the open economy variables (RDLIMZ, DLIMZ, DLIMZ(-1) RDLFRII, and RDLIPII) as well as anticipated components; and obtained the following test statistic: F(7,24) = 3.3159 (significant at 5 per cent level). Hence, the null hypothesis that all the open economy variables should be excluded from the regression can also be rejected.

IV SUMMARY AND CONCLUSION

This paper has presented a simple "new classical" structural model to take account of features that are likely to be important in a small open dependent developing economy. Previous attempts to estimate Barro-type reduced-form equations for developing countries have either estimated regressions appropriate to closed-economy models or added open economy variables in an arbitrary fashion. There are many ways to 'open-up' closed economy new classical models and what we have presented is a simple example consisting of an adaptation of the Mundell-Fleming framework with imported intermediate goods, limited capital mobility and foreign exchange rationing. The presented model assumed the irrelevance of anticipated monetary policy for short-run deviations of domestic output from its "natural level". Thus, only the unanticipated components of external price changes and of changes in the level of external economic activity cause domestic output to deviate from natural.

In contrast, both anticipated and unanticipated changes in the availability of imported intermediate goods affected output, since these variables operate through the supply side of the economy. Though the model is rather specialised and therefore unlikely to be applicable to a majority of developing countries, it produced good empirical results for the Nigerian economy. From the theoretical analysis, the monetary tightening since it is anticipated, would have no effect on real domestic output in the short run. This result, was indeed seen from the insignificant nature of the anticipated components variables in our regression model. Indeed, the effect of any stabilisation programme is an increase in domestic output and an improvement in the economy's competitiveness. Whether the domestic price level, the real money supply, and real domestic absorption will increase or decrease depends on the magnitudes of various measures adopted and the parameters that characterise a specific economy. It is certainly possible that these measures could simultaneously increase domestic output, reduce the rate of inflation, and improve the balance of trade. In these directions therefore, it is hoped that our findings will quantitatively assist the Nigerian government in their economic reform programmes.

Finally, the open dependent economy version of the simplest new classical macroeconomic model generates reduced-form output equations that are quite different from its closed-economy counterpart, so a reformulation of the theoretical model is essential before empirical testing can proceed. However, the simple version of an open dependent economy, new classical model has proved to be empirically possible. In view of its important policy implications, it merits further development and empirical testing against a well formulated realistic alternative in a developing country setting.

APPENDIX

DATA SOURCES , COLLECTION AND DEFINITIONS

(1) FRI is defined as foreign real income which is proxied by GDP at constant prices(percent changes over theprevious period). It is derived from international monetary fund (IMF) international financial statistics (IFS) yearbook line 110.99 BPX.

(2) FRI is also defined as foreign real income which is proxied by GAP at constant prices(1990 = 100) it is derived from IMF-IFS year book line 110.99 BPX.

(3) MS2 is defined as money plus quasi money (millions of naira). It is derived from IMF-IFS yearbook line 351 = line34 +line35.

(4) MSI is defined as money (millions of naira) and derived from IMF-IFS yearbook line34.

(5) QMS is defined as quasi money (millions of naira) and is derived from IMF-IFS yearline 35.

(6) INR is defined as interest rate(discount rate percent per annum). It is derived from IMF-IFS yearbook line 60.

(7) MS3 is defined as broad money supply (millions of naira) and is derived from IMF-IFS yearbook line 37r + 351.

(8) MMS is defined as other money items (millions of naira) and is derived from IMF-IFS yearbook line 37r.

(9) DCR is defined as domestic credit (millions of naira) and is derived from IMF-IFS yearbook line 32.

(10) FOR is defined as foreign exchange (sdr millions) and is derived from IMF-IFS yearbook line ids.

(11) IMZ is defined as imports volume (billions of u.s. dollars) and it is derived from IMF-IFS yearbook line 71d.

(12) IMV is defined as imports c.i.f(millions of naira) and it is derived from IMF-IFS year book line 71.

(13) RES is defined as international reserves that is, total reserves minus gold (millions of U.S. dollars) and it is derived from IMF-IFS yearbook line ii.d.

(14) EXC is defined as naira per u.s. dollars exchange rate (principlal rate) and it is derived from IMF-IFS year book line rf.

(15) WPI is defined as the u.s. wholesale price index (% change over the previous period) which is used to proxy foreign price index (IPI), it is derived from IMF-IFS yearbook line 63x.

(16) WPI is defined as u.s. wholesale price index(1990=100) which is used to proxy foreign price index (IPII) and it is derived from IMF-IFS yearbook line 63x.

(17) PRC is defined as consumer prices(1990=100) and it is derived from IMF-IFS yearbook line 64.

(18) CPI is also defined as consumer prices (% change over the previous years calculated from indexes) and it is derived from IMF-IFS yearbook line 64x.

(19) GDD is defined as GDP deflator(1990=100) and it is derived from IMF-IFS yearbook line 99bip.

(20) GDP is defined as gross domestic product(millions of naira) and it is derived from IMF-IFS yearbook line 99b.

(21) GNP is defined as gross national product (millions of naira) and it is derived from IMF-IFS yearbook line 99a.

(22) TTR is defined as time trend.

(23) SAD is defined as structural adjustment programme dummy.

(24) WAD is defined as war dummy.

(25) IM2 is defined as industrial country money which is proxied by GDP deflators and derived from IMF-IFS yearbook line 110.99bix.

(26) WM2 is defined as world money which is proxied by GDP deflators and derived from imf-ifs yearbook line 001.99bix.

(27) Note that for the variables labelled world money, foreign real income, industrial country money, foreign price index and GDP deflators, an index conversion procedures were used in converting the series from 1985 base year to 1990 base year: as well as in up dating missing years (1960-1966)

OBS.	FRI	FRII	MS2	MSI	QMS	INR
1960	4.9000	35,1000	296.0000	241.0000	55.0000	5.6200
1961	4.7000	36.6000	314.0000	243.0000	71.0000	5.5000
1962	5.8000	38.9000	333.0000	253.0000	80.0000	4.5000
1963	5.1000	40.7000	362.0000	269.0000	93.0000	4.0000
1964	6.5000	43.2000	431.0000	318.0000	113.0000	5.0000
1965	5.7000	45.4000	469.0000	328.0000	141.0000	5.0000
1966	5.8000	47.8000	520.0000	357.0000	163.0000	5.0000
1967	3.9000	48.1000	454.0000	323.0000	131.0000	5.0000
1968	5.1000	50.6000	522.0000	339.0000	184.0000	4.5000
1969	5.1000	53.1000	663.0000	447.0000	215.0000	4.5000
1970	3.0000	56.0000	979.0000	643.0000	337.0000	4.5000
1971	3.4000	58.0000	1042.0	670.0000	372.0000	4.5000
1972	5.0000	60.9000	1204.0	747.0000	457.0000	4.5000
1973	5.9000	64.5000	1370.0	788.0000	582.0000	4.5000
1974	.70000	64.9000	2592.0	1619.0	973.0000	4.5000
1975	-.10000	64.9000	4035.0	2463.0	1572.0	3.5000
1976	4.5000	67.8000	5708.0	3728.0	1979.0	3.5000
1977	3.7000	70.3000	7675.0	5420.0	2255.0	4.0000
1978	4.1000	73.2000	7522.0	5101.0	2420.0	5.0000
1979	3.3000	75.7000	9849.0	6147.0	3702.0	5.0000
1980	1.5000	76.3000	14390.0	9227.0	5163.0	6.0000
1981	1.4000	77.4000	15239.0	9745.0	5494.0	6.0000
1982	-.30000	77.2000	16694.0	10049.0	6645.0	8.0000
1983	2.8000	79.4000	19034.0	11283.0	7752.0	8.0000
1984	4.5000	82.9000	21243.0	12204.0	9039.0	10.0000
1985	3.3000	85.7000	23153.0	13227.0	9926.0	10.0000
1986	2.8000	88.2000	23605.0	12663.0	10942.0	10.0000
1987	3.2000	91.0000	28895.0	14906.0	13989.0	12.7500
1988	4.3000	94.9000	38406.0	21446.0	16960.0	12.7500
1989	3.2000	97.9000	43371.0	26664.0	16707.0	18.5000
1990	2.1000	100.0000	57554.0	34540.0	23014.0	18.5000
1991	1.1000	101.2000	79067.0	48708.0	30360.0	15.5000
1992	1.7000	102.9000	125622.0	75810.0	49812.0	17.5000
1993	1.0000	103.0000	190334.0	116276.0	74058.0	26.0000
1994	2.9000	107.0000	259808.0	176303.0	88505.0	13.5000
1995	2.1000	109.2000	311580.0	200325.0	111255.0	13.5000

OBS.	MS3	MMS	DCR	FOR	IMZ	IMV
1960	291.0000	-5.0000	50.0000	343.0000	.60400	432.0000
1961	329.0000	15.0000	92.0000	287.0000	.62300	445.0000
1962	380.0000	47.0000	147.0000	269.0000	.56900	406.0000
1963	418.0000	56.0000	233.0000	185.0000	.57900	414.0000
1964	417.0000	40.0000	331.0000	203.0000	.71100	508.0000
1965	525.0000	56.0000	353.0000	214.0000	.77000	550.0000
1966	596.0000	76.0000	436.0000	187.0000	.71800	513.0000
1967	519.0000	65.0000	491.0000	84.0000	.62600	447.0000
1968	667.0000	145.0000	621.0000	89.0000	.54000	385.0000
1969	856.0000	193.0000	823.0000	101.0000	.69600	497.0000
1970	1219.0	240.0000	1142.0	174.0000	1.0590	757.0000
1971	1307.0	265.0000	1127.0	333.0000	1.5140	1079.0
1972	1400.0	196.0000	1274.0	269.0000	1.5050	990.0000
1973	1543.0	173.0000	1261.0	385.0000	1.8620	1225.0000
1974	3035.0	443.0000	-314.0000	4495.0	2.7720	1737.0000
1975	4503.0	468.0000	1018.0	4502.0	6.0410	3722.0000
1976	6050.0	342.0000	2940.0	4063.0	8.2130	5148.0000
1977	8560.0	885.0000	5946.0	3078.0	11.0950	7160.0000
1978	8777.0	1256.0	7782.0	1016.0	12.8210	8137.0000
1979	11448.0	1599.0	8693.0	3808.0	10.2180	6161.0000
1980	15756.0	1366.0	10732.0	7522.0	16.6600	9096.0000
1981	17598.0	2359.0	15781.0	2662.0	20.8770	12920.0000
1982	21575.0	4881.0	21527.0	1421.0	16.0610	10771.0000
1983	27310.0	8276.0	27708.0	920.0000	12.2540	8904.0000
1984	30592.0	9348.0	30471.0	1481.0	9.3640	7178.0
1985	32225.0	9062.0	31920.0	1517.0	8.8770	7933.0
1986	38700.0	15096.0	36459.0	884.0000	4.0340	5971.0
1987	44332.0	15437.0	40311.0	821.0000	3.9120	15694.0
1988	55255.0	16849.0	50752.0	484.0000	4.7270	21446.0
1989	59516.0	16145.0	46021.0	1343.0	4.1900	30860.0
1990	96398.0	38844.0	61665.0	2715.0	5.6880	45718.0
1991	116017.0	36950.0	70609.0	3100.0	9.2410	89488.0
1992	85134.0	-40488.0	161677.0	703.0000	8.1190	143152.0
1993	144380.0	-45954.0	269734.0	999.0000	7.5080	165629.0
1994	243406.0	-16402.0	379717.0	2715.0	6.5510	143226.0
1995	326785.0	15205.0	421260.0	971.0000	9.3320	656572.0

OBS.	RES	EXC	WPI	WPII	PRC	CPI
1960	343.0000	.71400	.10000	5.2000	2.4000	5.4000
1961	269.0000	.71400	-.40000	5.2000	2.5000	6.3000
1962	269.0000	.71400	.20000	5.3000	2.6000	5.3000
1963	190.0000	.71400	-.30000	5.3000	2.5000	-2.7000
1964	208.0000	.71400	.20000	5.4000	2.5000	.90000
1965	219.0000	.71400	2.0000	5.5000	2.6000	4.1000
1966	195.0000	.71400	3.3000	5.6000	2.9000	9.7000
1967	92.0000	.71400	.30000	5.7000	2.8000	-3.7000
1968	97.0000	.71400	2.5000	5.8000	2.8000	-.50000
1969	112.0000	.71400	3.9000	6.0000	3.1000	10.2000
1970	202.0000	.71400	3.6000	6.4000	3.5000	13.8000
1971	408.0000	.71300	3.3000	6.6000	4.1000	16.0000
1972	355.0000	.65800	4.4000	7.0000	4.2000	3.5000
1973	559.0000	.65800	13.1000	8.0000	4.4000	5.4000
1974	5602.0	.63000	18.8000	9.9000	5.0000	12.7000
1975	5586.0	.61600	9.2000	11.1000	6.7000	33.9000
1976	5180.0	.62700	4.6000	12.5000	8.3000	24.3000
1977	4232.0	.64500	6.1000	14.0000	9.5000	13.8000
1978	1887.0	.63500	7.8000	15.3000	11.50000	21.7000
1979	5548.0	.60400	12.5000	17.6000	12.9000	11.7000
1980	10235.0	.54700	14.1000	21.0000	14.2000	10.0000
1981	3895.0	.61800	9.1000	24.2000	17.1000	20.8000
1982	1613.0	.67300	2.0000	27.5000	18.4000	7.7000
1983	990.0000	.72400	1.3000	31.4000	22.7000	23.2000
1984	1462.0	.767000	2.4000	36.5000	31.0000	39.6000
1985	1667.0	.89400	-5.0000	41.5000	34.1000	7.4000
1986	1081.0	1.7550	-2.9000	44.3000	36.0000	5.7000
1987	1165.0	4.0160	2.6000	50.0000	40.1000	11.3000
1988	651.0000	4.5370	4.0000	60.7000	61.9000	54.5000
1989	1766.0	7.3650	5.0000	78.0000	93.1000	7.4000
1990	3864.0	8.0380	3.6000	100.0000	100.0000	18.5000
1991	4435.0	9.9090	.20000	113.3000	113.0000	13.0000
1992	967.0000	17.2980	.6000	128.9000	163.4000	44.6000
1993	1372.0	22.0650	1.5000	150.7000	256.8000	57.2000
1994	1386.0	21.9960	1.3000	179.1000	403.3000	57.0000
1995	1443.0	21.8950	3.6000	196.0000	696.9000	72.8000

OBS.	GDD	GDP	GNP	TTR	SAD	WAD
1960	3.4000	2400.0	2401.0	1.0000	0.00	0.00
1961	3.2000	2378.0	2373.0	2.0000	0.00	0.00
1962	3.2000	2516.0	2526.0	3.0000	0.00	0.00
1963	3.5000	2946.0	2912.0	4.0000	0.00	0.00
1964	3.5000	3145.0	3127.0	5.0000	0.00	0.00
1965	3.7000	3361.0	3302.0	6.0000	0.00	0.00
1966	4.1000	3614.0	3532.0	7.0000	0.00	0.00
1967	4.2000	2951.0	2869.0	8.0000	0.00	1.0000
1968	3.6000	2878.0	2802.0	9.0000	0.00	1.0000
1969	3.8000	3851.0	3682.0	10.0000	0.00	1.0000
1970	4.3000	5621.0	5125.0	11.0000	0.00	0.00
1971	4.5000	7098.0	6853.0	12.0000	0.00	0.00
1972	4.6000	7703.0	7133.0	13.0000	0.00	0.00
1973	6.6000	11199.0	10578.0	14.0000	0.00	0.00
1974	9.9000	18811.0	18376.0	15.0000	0.00	0.00
1975	11.8000	21779.0	21559.0	16.0000	0.00	0.00
1976	13.5000	27572.0	27298.0	17.0000	0.00	0.00
1977	14.8000	32747.0	32272.0	18.0000	0.00	0.00
1978	17.6000	36084.0	35610.0	19.0000	0.00	0.00
1979	20.5000	43151.0	42535.0	20.0000	0.00	0.00
1980	22.9000	50849.0	49759.0	21.0000	0.00	0.00
1981	25.0000	50749.0	49839.0	22.0000	0.00	0.00
1982	25.0000	51709.0	50547.0	23.0000	0.00	0.00
1983	29.8000	57142.0	56168.0	24.0000	0.00	0.00
1984	35.0000	63608.0	62009.0	25.0000	0.00	0.00
1985	36.4000	72355.0	70732.0	26.0000	0.00	0.00
1986	35.6000	73062.0	68681.0	27.0000	0.00	0.00
1987	53.4000	108885.0	97225.0	28.0000	1.0000	0.00
1988	64.7000	145243.0	132503.0	29.0000	1.0000	0.00
1989	93.3000	224797.0	207173.0	30.0000	1.0000	0.00
1990	100.0000	260637.0	238624.0	31.0000	1.0000	0.00
1991	118.7000	324011.0	299511.0	32.0000	1.0000	0.00
1992	195.0000	549808.0	485408.0	33.0000	1.0000	0.00
1993	244.0000	701472.0	627910.0	34.0000	1.0000	0.00
1994	313.8000	914334.0	848626.0	35.0000	1.0000	0.00
1995	502.1000	1436649	1430579	36.0000	1.0000	0.00

OBS	IM2	WM2
1960	12.0000	2.7000
1961	13.0000	3.0000
1962	14.5000	3.2000
1963	16.2000	3.6000
1964	17.8000	4.0000
1965	19.6000	4.5000
1966	21.4000	4.9000
1967	23.0000	5.4000
1968	23.3000	5.6000
1969	24.4000	5.9000
1970	25.5000	6.2000
1971	27.0000	6.6000
1972	28.7000	7.1000
1973	31:1000	7.9000
1974	35.0000	9.4000
1975	39.2000	10.8000
1976	42.7000	12.3000
1977	46.5000	13.8000
1978	50.5000	15.5000
1979	55.1000	17.9000
1980	60.6000	21.1000
1981	66.4000	24.1000
1982	71.3000	27.1000
1983	75.2000	31.7000
1984	79.0000	36.3000
1985	82.4000	41.6000
1986	85.5000	46.1000
1987	88.2000	52.6000
1988	91.4000	63.2000
1989	95.7000	79.1000
1990	100.0000	100.0000
1991	104.2000	116.5000
1992	107.3000	137.1000
1993	110.0000	164.6000
1994	112.2000	198.1000
1995	115.2000	215.2000

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