SOME ASPECTS OF FORECASTING THROUGH STRUCTURAL CHANGE

John W. Robinson
Bank of Jamaica

Abstract

Some Aspects of Forecasting Through Structural Change

Simulations of GDP for Jamaica and its main expenditure categories, using an Aggregate Demand model developed in 1986 are presented for the period 1985 -1988 . By comparison with the actual data for these years, it is shown that the margins of error in these forecasts progressively widen. The explanation offered is that structural change occurred in the economy during this time in response to relatively sharp and sustained changes in macroeconomic policies. Discussion of these policy changes leads to the conclusion that the economy is not likely to revert to previous patterns of output and expenditure and that evolving relationships are more likely to reflect wider hemispheric and world trends.

In addressing this altered forecasting environment, a remedy is attempted by treating GDP as a spline function consisting of several segments, each corresponding with a different macroeconomic policy regime. Structural breaks, it is argued, are manifested in and transmitted by the reallocation of resources between the public and the private sectors and, inter-sectorially, through shifts in the loan portfolio of the financial system. Marked changes in the availability of credit to the private sector are therefore used as "join points" in estimating the components of domestic absorption and the demand for imports. These modifications are exploratory and reveal the need for further work on expanding the data set. Over time, in a post adjustment environment, this model will necessarily be succeeded by specifications which more closely reflect the new realities.

1. Introduction

Wherever they have been pursued, stabilization and structural adjustment policies have posed new challenges for policy makers and their advisors. Despite the apparent and almost doctrinaire similarity in structural adjustment policies across countries, the optimal pace and order of reforms seem to vary with every case. In arriving at a judgement as to the proper route to follow, policy makers are often faced with information gaps relating to the expected magnitude and timing of responses to policies which are being contemplated. One response to this need has been the development of macroeconomic models to support better financial programming and medium term forecasting.

Since the mid-1980s, several such macroeconomic models have been developed to assist policy making in Jamaica. [1] Drawing on a fairly well-developed statistical database dating back to the pre-independence period, behavioral models have been built which, at the time of their construction, appeared to form good foundations for statistical forecasting. Some of these have proven to be too large and data intensive to be used at short notice. For those which have been relied on, the assumption was, as in other countries, "that at least in the short run, the financial programme

[1] For a fuller discussion on existing models see Davis-Panton, N:"Current Approaches to Macro-modelling in Jamaica",Macroeconomic Report, Bank of Jamaica, Apr 1992; and Manhertz, Huntley G:"An Exploratory Model of Jamaica" SES, Dec.,1971, for earlier examples.

being simulated would affect the performance of a given economic structure and would not fundamentally alter the structure itself".[2] Eventually, however, if structural adjustment policies are successfully implemented, fundamental alterations do occur and when they do, even short term forecasting becomes more difficult.

The aim of this paper is to show, firstly, that in the case of Jamaica, a structural break occurred in the mid 1980s. This alteration in the pattern of income and expenditure followed a period of deep adjustment between 1983 and 1985. During that time, the degree of macroeconomic imbalance which had been manifested in a deteriorating external current account balance, the loss of net international reserves and a widening public sector deficit was substantially reversed by an austere stabilization programme. The centrepiece of the programme was the realignment of relative prices between tradeables and non-tradeables as a basis for medium term viability in the balance of payments. Significantly, by 1985, the Jamaica dollar had depreciated by some 36% in real effective terms relative to 1980. This improvement in export competitiveness when combined with the relative stability in the nominal rate of exchange which was eventually achieved induced a shift in resources towards the production of exportables, with tourism services taking the lead. A number of supply-side policy changes also took effect during the period in a bid to stimulate export agriculture,

---

manufacturing and information services.[3]/

Following this period of economic stabilization, the change
in the pattern and volume of investment, consumption and growth in
the post-1986 period was enabled and transmitted by the changes in
the financial sector and by complementary changes in the state of
public finances. The financial sector reform programme, implemented
in 1985 increased the ability of the intermediaries to respond to
investment needs while the reduction in the public sector borrowing
requirement released more resources for this purpose. While it is
true that the external environment was particularly accommodating
during the post-1985 period with energy prices and interest rates
falling, and alumina prices rising, internal macroeconomic policy
laid a foundation for sustainable change. The stated aim of the
strategy was to promote private sector led, export-driven economic
expansion.

The most pervasive aspect of the reform was the move to
separate, as far as was practicable, the effect of fiscal deficits
on monetary policies. To effect this, it was necessary to sharply
reduce the borrowing requirement of the public sector. The
expenditure reduction which had begun during the stabilization
period was buttressed by a revamping of the tax system. The system

---

[3]/ Jamaica's structural adjustment programme has been
extensively documented and appraised. See, for example Lumsden
(1991) and Robinson (1992) as well as various World Bank Project
Performance reports covering SALs and SECALs through 1990.

of sharply progressive rates of tax, with a marginal rate of 57.5% at higher income levels, was replaced by a proportional tax of 33.3% for both individuals and corporations. The lowering of the rate and the removal of a wide range of exemptions and credits which formerly facilitated evasion helped to broaden the tax base and boosted revenue dramatically. At the same time, the restructuring and divestment of public entities reduced the drag on central government resources. The overall public sector borrowing requirement, which had risen to 19.6% of GDP in 1983/84, fell sharply in 1986/87 to 6.5% which fall was followed in subsequent years by further but smaller reductions.

The contraction in the public sector's financing needs resulted, in the first instance, in more resources being made available to the rest of the economy. The allocation of resources was influenced by measures to increase efficiency within the financial system. Credit ceilings and administered interest rates were discontinued while the statutory reserve requirements which had formerly been related to the financing needs of the public sector, were gradually reduced from almost 50% to the level of a prudential cash reserve requirement at 20% of deposit liabilities. Control of banking system excess liquidity was effected by the issue and redemption of Certificates of Deposit by the Bank of Jamaica on its own account, as well as the regular issues of Treasury Bills on behalf of Central Government. The change to market based controls on liquidity, a growth in the range, size and

number of near banks to meet longer term credit demand and the
stabilization of inflation all helped to widen and deepen the
financial system and to move increasing flows of financial savings
into new investments.

Table 1 below juxtaposes the changes in the reserve
requirements of commercial banks, the evolution of the public
sector borrowing requirement and the expansion of loans to the
private sector.

Table 1
Selected Financial Indicators

	F81	F82	F83	F84	F85	F86	F87	F88
Res. Ratio	40	40	40	44	44	35	20	20
PSBR/GDP *	16.0	15.9	19.6	15.3	14.2	6.5	6.4	4.1
%ch MerBank credit +	31.0	72.6	-12	-11	106	159	145	84
%ch. CommBnk Credit +	37.9	34.5	27.8	13.7	5.3	20.5	32.0	35.

* includes divestment proceeds
+ Calendar year changes

Source: Statistical Digest, BOJ; and Ministry of Finance

The sustained expansion in credit to the private sector has
been associated with the continuous growth in GDP since 1986, and
contrasts with the crowding out/austerity effects on private credit
in preceding periods. For the decade 1970-80, the average stock of
commercial bank credit to the private sector decreased in real
terms by 46.4%. In the 1980-88 period, real loans increased by 60%.
Between 1986 and 1988 the average stock of bank credit increased by

30% in real terms. Growth in near bank assets after 1984 was also rapid, partly as a response to the tight control on commercial bank credit and partly as an institutional response to the demand for investment funding in a high interest rate environment. The lower reserve requirement for these near banks became a major spur in their development.

In view of the foregoing, a second purpose of the paper is to show that standard behavioral models based on preadjustment patterns would be rendered inefficient by such fundamental changes. The structure of the BOJ model based on these preadjustment patterns is set out in the Section that follows and its progressive inefficiency to forecast post 1986 GDP is established. The remainder of the paper explores specifications which take advantage of knowledge of a structural break in adaptive forecasting. The issues, those resolved and those outstanding, are summarized in the concluding Section.

2. The Basic Model

The basic model is a Keynesian aggregate demand model in which GDP is computed as the sum of domestic absorption and net exports. Expenditure is measured in 1974 Jamaica dollars. The model consists of 20 equations and identities, 11 of which equations are stochastic. Private expenditure on consumption and investment as well as the demand for imports are derived endogenously; export levels are predetermined by output capacity and market conditions while government expenditure is treated as a policy variable. Its budget constraint is a function of tax revenue and the availability of deficit financing. The other equations determine the changes in the general price level and serve as links with the financial sector. The presentation here focuses on private consumption, investment and the demand for imports.

Private Consumption
RCONS = F{RCONS(-1),RALPS, DRNPI}

Sample	c	RC(-1)	RALPS	DRNPI	Adj R	DW	Tech
62 -84	199.6 (4.1)	0.63 (8.8)	0.68 (5.0)	0.17 (1.2)	.98	1.94	TSLS
62-88	164.3 (3.2)	0.68 (8.8)	0.61 (3.9)	0.32 (2.2)	.97	2.0	TSLS

where   RCONS= Real Private Consumption
         RALPS= Real Average Loans Outstanding to Pvt Sector
         DRNPI= Annual Change in real national disposable Income

Underlying the specification was a consideration of the permanent income hypothesis where lagged consumption emerged as a good proxy for this measure. A strong explanatory variable was also

the degree of liquidity constraint as represented by the volume of loans available from the banking system. Over a long period, direct controls on credit were often used to regulate overall demand especially during periods of foreign exchange shortage. Although most loans are "business" loans, it would appear that a relaxation in credit conditions affects the terms of sale of consumer goods and spurs pending throughout he economy. As the economy has become increasingly service-oriented, that category of commercial bank loans - " Professional and other Services" has been expanding at a faster rate than the rest of the portfolio and is likely to prove significant in explaining recent changes. The income variable that best helped to explain consumption was the change in disposable income. This variable captured net transfers from abroad as well as changes in the tax regime.

Private Investment

$RFI = F\{RALPS, GOS\}$

Sample	c	RALPS	RGOS	Adj R	DW	Tech
62 -84	-227 (3.3)	0.12 (1.3)	0.59 (4.6)	.88	1.7	LS
62-88	227	0.10 (1.0)	.62 (4.6)	.84	2.1	LS

Gross Operating Surplus
RGOS=F{RGDP,RW}

Sample	c	RGDP	RW	Adj R	DW	Tech
62 -82	207 (204)	0.43 (7.4)	-0.13 (2.5)	.90	1.6	TSLS
62-88	199.7	0.42 (9.7)	-0.12 (3.3)	.92	1.7	TSLS

where

RFI= Real Fixed (Private and Non central Gov) Inv

RGOS = Real Gross Operating Surplus

RW = Real Wages

Private fixed capital formation was estimated as a function of firms' access to loan financing as well as their capacity to finance expansion from their own resources. The generation of operating surpluses, in turn, depended firstly on capacity utilization and secondly, on the share accruing to labour. Nominal increases in wages have been strongly influenced since the mid-1970s by recurring wage guidelines which have gradually reduced the real share of the value of output paid to labour.

Imports

Four categories of imports are distinguished: consumer goods, raw materials, capital goods and fuel. The demand for consumer goods and for capital goods would be expected to reflect domestic spending on consumption and investment and are driven directly or

indirectly by those same factors which determine the level of domestic absorption. The real exchange rate is established as having a moderating effect on some categories of imports. Both fuel and non-fuel raw material imports are linked to output levels and are less responsive to international price changes.

Consumer Imports

RMC{RALPS,RPM}
RPM=Real Exchange rate

Sample	c	RALPS	RPM	Adj R	DW	Tech
65-84	80.5 (5.4)	0.13 (5.7)	-.95 (3.3)	.92	2.0	LS
65-88	2.6 (6.0)	0.13 (6.1)	-0.93 (4.0)	.93	2.0	LS

Raw Material Imports
RMRM=F{RMRM(-1),RGDP}

Sample	c	RMRM (-1)	RGDP	Adj R	DW	Tech
66 -84	-101 (2.0)	0.58 (4.2)	.08 (2.3)	.89	2.1	TSLS
66-88	-72 (1.5)	0.65 (5.2)	.059 (1.8)	.85	2.1	TSLS

Capital Goods Imports

Sample	c	RFIO	RFICG	RPM	Adj R	DW	Tech
66 -84	-0.4	0.542 (17.2)	0.815 (11)	-1.51 (6.8)	.90	2.3	LS
66-88	-0.1	0.535 (15.4)	0.026 (10.3	-1.72 (9.7)	.88	2.0	LS

Fuel Imports

Sample	c	RGDP	RPMF	Adj R	DW	Tech
66 -84	7.9	0.08 (6.9)	.09 (0.4)	.81	1.82	TSLS
66-88	9.9	0.07 (6.9)	.129 (0.6)	.79	2.1	TSLS

where:

RPM=Real exchange rate: (USCPI*ExRate)/GDP Deflator

RPMF = Real ex rate as it relates to fuel : (Int. Fuel Price

Index * ExRate deflated by GDP Deflator)

With exports and government expenditure determined exogenously, the seven foregoing equations essentially account for domestic absorption and net exports of goods and non-factor services. The remaining equations complete the investment categories (inventory investment), determine the price level and the budget constraints of Central Govt. and the private sector. The full set of equations are attached as Appendix 1.

Forecasts

The following tables show the performance of the preadjustment behavioral equations in forecasting the four years following the base year 1984. The exogenous values used were actual data for 1985-88. Data for the years 1989-1992 are currently being prepared for publication and, when they appear, will provide a more definitive test of the hypothesis advanced. Far reaching changes in the relative size of the public sector has been further reduced. These are likely to have exposed further deviation from preadjustemt patterns of income, consumption and investment.

Series ($1974)	1985	1986	1987	1988
Pvt Consumption (A)	1328.9	1294.5	1430.0	1542.5
(F)	1311.2	1298.8	1325.3	1423.3
Pvt Investment (A)	373.0	253.3	348.0	432.0
(F)	288.2	288.9	294.5	367.8
Consumer Imports A	66.2	81.6	92.9	107.0
(F)	69.4	75.7	86.0	99.9
Raw Materials (A)	140.2	135.9	165.3	193.3
(F)	178.6	188.8	203.9	215.3
Capital Goods (A)	118.2	100.0	137.3	172.7
(F)	127.5	110.6	169.6	224.0
Fuel Imports (A)	163.2	169.4	158.3	162.1
(F)	151.2	182.6	160.5	167.5

The Residual Mean Squared Error associated with each of the forecasting equations were:

Private Consumption: 79.83

Private Investment: 73.5

Consumer Imports : 5.9

Capital Goods   : 31.1

Fuel Imports   : 9.4

Raw Materials   : 39.5

For 1985 and 1986, good fits were obtained for domestic expenditure categories and for consumer and capital imports. For private consumption, for example, the margin of error in 1985 was less than 1% followed by an even smaller variance in 1986. In the following two years, however, the deviation of forecast from actual values rose to 7% in both years. With consumption expenditure typically over 70% of GDP, deviations of this magnitude in the estimation of this aggregate create potentially large errors in related projections such as money growth. The forecasts of private investment underestimated the actual outcome in 1987 and 1988 by 15% and 14% respectively.

The effect of the fall in fuel prices in 1986 were not fully simulated by the forecasting equation in that year but the gap

between forecast and actual fuel imports narrowed in the following year. Again, while the estimation of total imports was satisfactory in the initial years, the changing distinction between raw materials and finished goods was not well simulated by the model. Part of the explanation for this is related to the adjustments in the tariff regime over this period when the general lowering of tariffs on all categories of imports reduced the incentive to disguise finished consumer goods as raw materials. Further, the other structural changes, particularly the abandonment of import restrictions was gradually making import substituting manufacturing less profitable and, in consequence, led to a relatively slower increase in raw material imports than in consumer goods. Raw materials projections thus tended to be consistently higher than actual landings. The margins of forecast error in all categories tended to widen after 1986.

Several aspects of the adjustment process were especially apparent during the 1987-1988 period. With the reintroduction of wage guidelines, the maintenance of export profitability through fiscal incentives (export rebate system) and the tendency of the traditional banks to finance projects backed by their own well-established clients, a shift in the distribution of income became more apparent. Further, much the growth in the non bank financial sector was directed by well established manufacturing and trading companies who formed deposit accepting institutions to raise capital for diversification of their holdings. Some of this shift

was reflected in a sharp increase in consumption and in consumer imports which did not appear to be related to the trends in wage or other income of the broad population. Similar hikes also appeared in new fixed capital formation in 1987 and 1988 which would not have been predicted by the trend in commercial bank credit.

Future modifications to the model will need to take account of the spread and impact of private non-bank financial institutions and specialized development entities. The following section attempts a respecification of the main equations using the existing data base.

4. A Possible Approach to the Incorporation of Structural Breaks

It is quite common in empirical research to encounter instances when, because of some extraordinary event, the phenomenon under observation, say income, takes on a value which is unrelated to the general trend. These can sometimes be isolated as being related to seasonal and/or cyclical factors and are usually adequately represented in a regression exercise by the proper use of dummy variables. A limitation on the adequacy of dummy variables, however, is that while it allows for shifts in slope and/or intercept, there is no implicit restriction that the line being estimated is continuous.

An extension of the idea of simulating shifts in the slope/intercept as would be the case in the event of a structural break is the application of piece-wise linear regression methods. These are usually discussed in the context of a larger set of relationships called spline functions which are characterized as continuous lines with several distinct segments. The points at which these pieces are joined represent points of structural change.

As an example, consider the consumption function described above where

$$RCONS = a1 + a2\ RCONS(-1) + a3\ RALPSt + a4\ (RALPSt - RALPSto)Dt + e$$

As above, RCONS = Real Private Consumption

RALPSt = Real Avg. Bank Loans Outstanding

RALPSto = loans in the year in which the structural break

occurred

and Dt = 1 if t > to

= 0 otherwise

For the years before and including the break, Dt = 0

so that   E(RCONSt)=a1+a2 RCONS(-1) + a3 RALPS

After the break, Dt = 1, so that

E(RCONSt)=a1+a2CONS(-1)+a3RALPSt+a4RALPSt-a4RALPSto

= (a1+a2RCONS(-1)-a4RALPSto) + (a3+a4)RALPS

Before the break, the line has the slope (a2 + a3) but changes to

(a2+a3+a4)

There is no discontinuity since

E(RCONSto)=a1+a2CONS(-1)+a3RALPSto

= a1+a2CONS(-1)+a3RALPS +(a4-a4)RALPS

=a1+a2rcons(-1)+a3RALPS

From the estimating equation, where a4=0, then the line reduces to a simple straight line. Thus the t-statistics on a4 provide a simple test of structural change.

The following respecification of the consumption, investment and consumer import functions are based on the notion that several structural breaks have occurred in the Jamaican economy. Visual inspection of plots of the data on GDP, Consumption and imports

suggest that these breaks occurred in the mid-1970s, 1980, 1983 and 1986. In keeping with the premise that the conduit for the transmission of such change has been bank credit, the variable RALPS has been split into segments such that,

RALPS= the full series

RALPS1: =0(1962-75); =RALPS-RALPS(75) 1975 to 1983

RALPS2 = 0 (1962-80) = RALPS-RALPS(80) 1981 to 1983

RALPS3 = 0 (1962 - 83); = RAPLS-RALPS(83) 1984 to 85

RALPS4 = 0 (1962-85); = RALPS-RALPS(85) 1986 to 1988

One would expect, a priori, that the coefficient on RALPS would be positive;

RALPS1 would be negative;

RALPS2 would be positive;

RALPS3 would be negative;

RALPS4 would be positive.

Early results of the explorations are set out below.

The first report, "Run 1", shows the estimation of the respecified consumption function. While the overall explanatory power of the model is good, the a priori expectations have not been borne out. RALPS has the expected sign and is significant at the 1% level. RALPS1, while showing the correct sign, is not significantly different from zero. RALPS2 has stronger t-statistics but is not of the expected sign while RALPS4 has the

TSLS // Dependent Variable is RCONS
Date: 11-15-1993 / Time: 12:47
SMPL range: 1962 - 1988
Number of observations: 27
Instrument list: C RCONS(-1) RALPS RALPS1 RALPS2 RALPS3 RALPS4 RNPI(
-1)

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	249.67487	63.425704	3.9364935	0.001
RCONS(-1)	0.5181531	0.1235810	4.1928234	0.000
RALPS	0.9229305	0.2415629	3.8206636	0.001
RALPS1	-0.1588867	0.2152004	-0.7383199	0.469
RALPS2	-0.3254014	0.1980837	-1.6427472	0.117
RALPS3	-0.2764090	0.3903181	-0.7081635	0.487
RALPS4	0.7494740	0.4351646	1.7222772	0.101
DRNPI	0.1386495	0.1449366	0.9566217	0.351

R-squared	0.980950	Mean of dependent var	1221.477
Adjusted R-squared	0.973931	S.D. of dependent var	245.4636
S.E. of regression	39.63219	Sum of squared resid	29843.51
Durbin-Watson stat	2.205122	F-statistic	139.7655
Log likelihood	-132.9178		

RESIDUAL ——ACTUAL ----FITTED
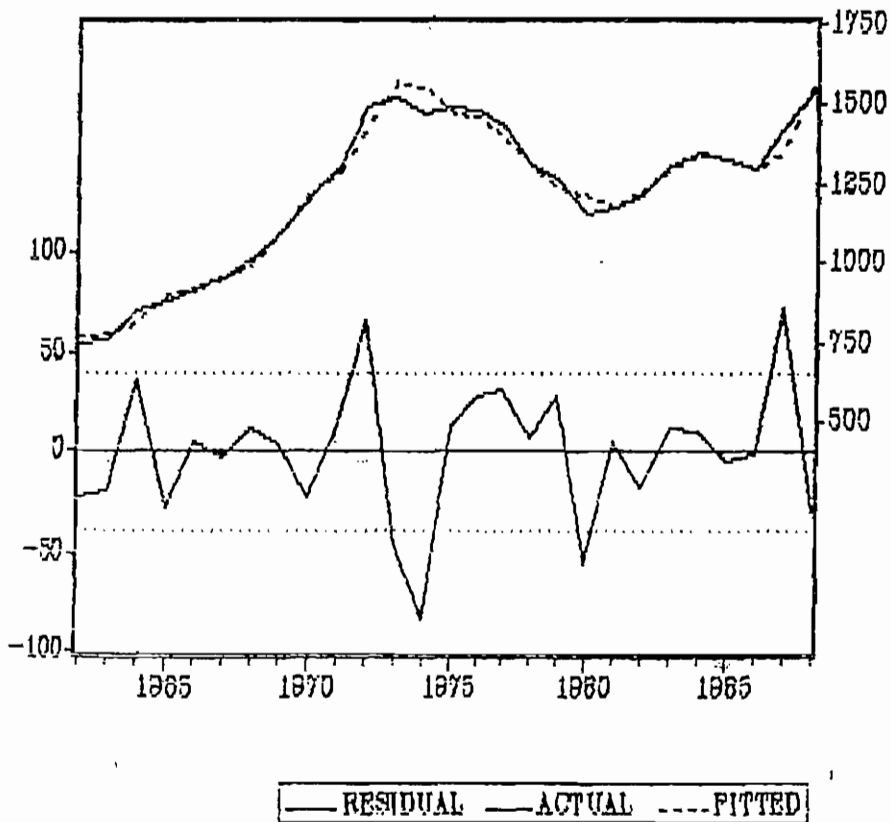
TSLS // Dependent Variable is RCONS
Date: 11-15-1993 / Time: 12:42
SMPL range: 1962 - 1988
Number of observations: 27
Instrument list: C RCONS(-1) RALPS RALPS1 RALPS2 RALPS3 RALPS4 RGDP(
-1)

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	278.68455	115.67046	2.4092975	0.026
RCONS(-1)	0.4627383	0.2023417	2.2869150	0.034
RALPS	1.0177650	0.3325661	3.0603388	0.006
RALPS1	-0.1799275	0.2548217	-0.7060921	0.489
RALPS2	-0.3581880	0.2208071	-1.6221758	0.121
RALPS3	-0.1146616	0.3504069	-0.3272243	0.747
RALPS4	1.0006774	0.3424473	2.9221356	0.009
RGDP	0.0029212	0.2308367	0.0126547	0.990

R-squared	0.981489	Mean of dependent var	1221.477
Adjusted R-squared	0.974669	S.D. of dependent var	245.4636
S.E. of regression	39.06760	Sum of squared resid	28999.27
Durbin-Watson stat	2.271817	F-statistic	143.9134
Log likelihood	-132.5304		

RESIDUAL ——ACTUAL ----FITTED
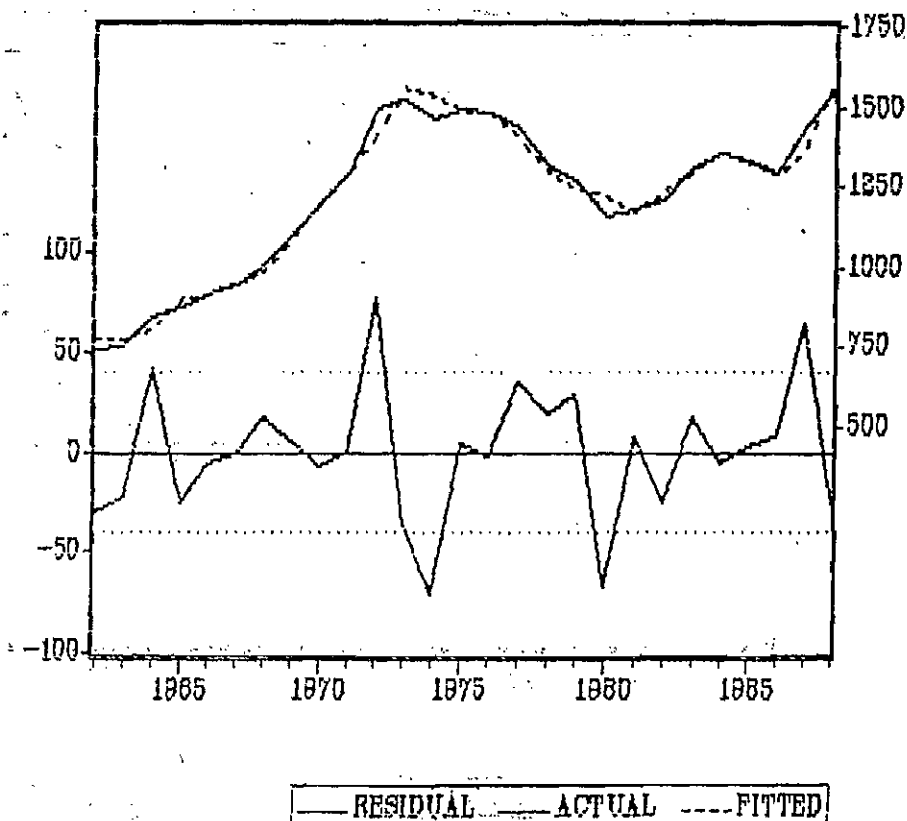
Date: 11-15-1993 / Time: 14:51
SMPL range: 1962 - 1988
Number of observations: 27

Series	Mean	S.D.	Maximum	Minimum
RALPS	373.78310	125.64278	575.34500	147.99240
RALPS1	-28.279388	69.164818	2.021E-05	-212.80790
RALPS2	15.027370	47.851043	202.20600	0.0000000
RALPS3	-6.4006665	24.467527	0.0008911	-115.88930
RALPS4	6.0491111	23.798430	116.12880	0.0000000

|	Covariance	Correlation
RALPS,RALPS	15201.438	1.0000000
RALPS,RALPS1	1386.6132	0.1657002
RALPS,RALPS2	1455.6407	0.2514292
RALPS,RALPS3	-261.46383	-0.0883231
RALPS,RALPS4	625.03149	0.2170733
RALPS1,RALPS1	4606.5954	1.0000000
RALPS1,RALPS2	424.96484	0.1333419
RALPS1,RALPS3	-181.00693	-0.1110735
RALPS1,RALPS4	171.06516	0.1079241
RALPS2,RALPS2	2204.9178	1.0000000
RALPS2,RALPS3	96.191859	0.0853193
RALPS2,RALPS4	-90.902233	-0.0828944
RALPS3,RALPS3	576.48729	1.0000000
RALPS3,RALPS4	38.718343	0.0690508
RALPS4,RALPS4	545.38877	1.0000000

LS // Dependent Variable is RFIO
Date: 11-15-1993 / Time: 12:56
SMPL range: 1962 - 1988
Number of observations: 27

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	45.720390	106.02011	0.4312426	0.671
RALPS	0.2556528	0.2169213	1.1785508	0.252
RALPS1	0.7894656	0.2822054	2.7974854	0.011
RALPS2	−0.4051809	0.2935904	−1.3800890	0.183
RALPS3	−0.3048567	0.6393634	−0.4768128	0.639
RALPS4	0.4640197	0.6741559	0.6882973	0.499
RGOS	0.2265976	0.2522610	0.8982665	0.380

|			
R-squared	0.652595	Mean of dependent var	275.4563
Adjusted R-squared	0.548373	S.D. of dependent var	100.3036
S.E. of regression	67.40724	Sum of squared resid	90874.73
Durbin-Watson stat	1.235711	F-statistic	6.261609
Log likelihood	−147.9502		
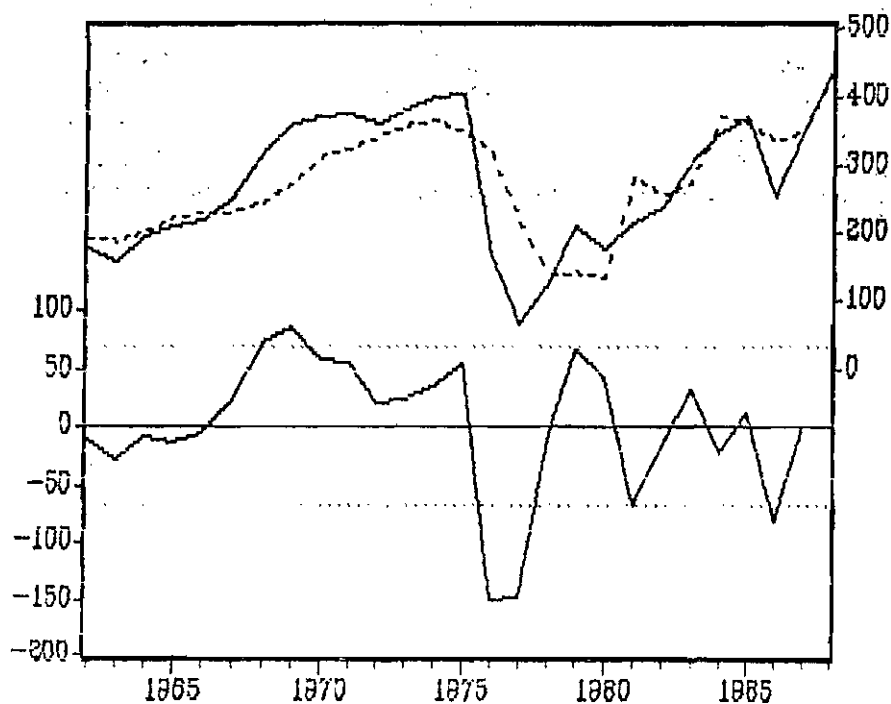
RESIDUAL ——ACTUAL ----FITTED

LS // Dependent Variable is RFIO
Date: 11-15-1993 / Time: 14:31
SMPL range: 1963 - 1988
Number of observations: 26
Convergence achieved after 8 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-40.233596	191.89518	-0.2096644	0.836
RGOS	0.3086929	0.2496508	1.2364986	0.232
RALPS	0.2346353	0.3443300	0.6814258	0.504
RALPS1	0.2841661	0.3086645	0.9206310	0.369
RALPS2	0.0787897	0.3764500	0.2092967	0.837
RALPS3	-1.0534056	0.5220675	-2.0177575	0.059
RALPS4	0.8522352	0.7593194	1.1223673	0.276
AR(1)	0.7363831	0.2136914	3.4460121	0.003

R-squared	0.740923	Mean of dependent var	279.2443
Adjusted R-squared	0.640171	S.D. of dependent var	100.3012
S.E. of regression	60.16640	Sum of squared resid	65159.92
Durbin-Watson stat	1.636376	F-statistic	7.353934
Log likelihood	-138.6369		

—RESIDUAL ——ACTUAL ----FITTED
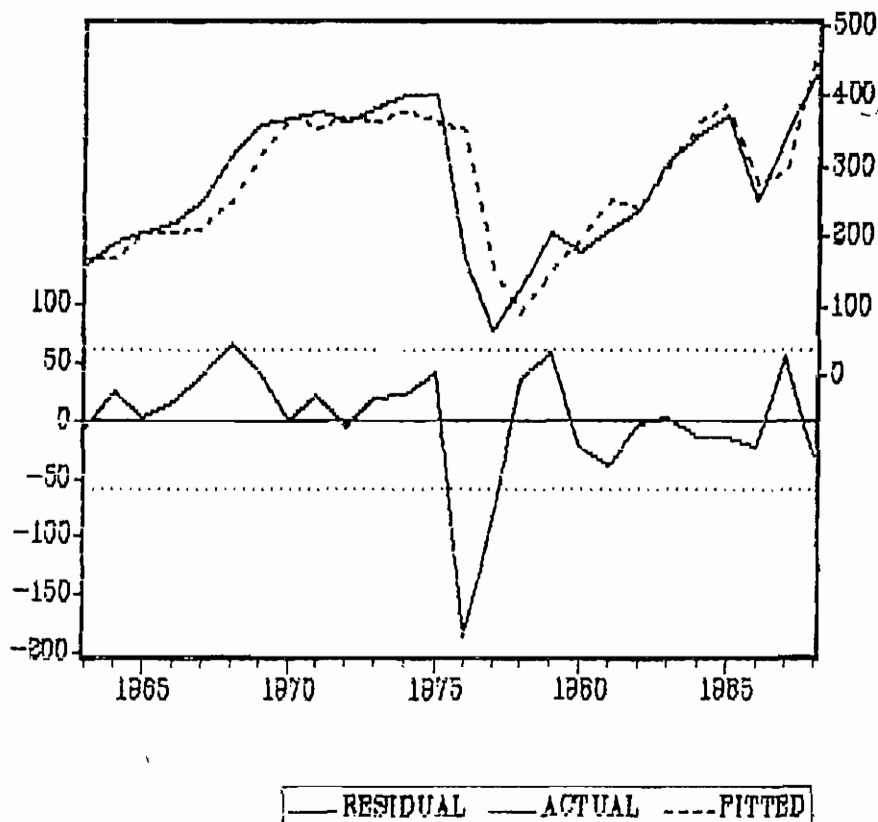
correct sign but is significant only at the 10% level. The income variable in this specification is also not statistically different from zero. Replacing it with real GDP does not improve the results. Descriptive statistics on the credit variables which are attached (2A) show no evidence of multicollinearity.

Estimates of private investment along similar lines are presented in Runs 3 and 4. The results in RUN3 suggest that the error are serially correlated and this is corrected in RUN4. The critical regression statistics - t-stats and overall explanatory power- are all unacceptable. Estimates using dummy variables performed better at tracking the 1975-80 period and the fluctuations in the 1980s suggesting that there may be variables missing from the specifications centered on credit. The clear periodicity in the path taken by both consumption and investment expenditure, however, continues to hold out the promise of isolating causal factors common to all phases of the period and which define points of structural change.

5.   Summary and Conclusions

Structural change in the pattern of consumption and investment creates forecasting difficulties in the initial stages.   The prevailing economic orthodoxy has also led to the gradual removal of restrictions on capital movements, on tariff differences and more generally to an economy which is more sensitive to and dominated by external developments.   In this respect, it becomes even more important to incorporate international market conditions into the estimation of exports, capital flows, interest rates and other important determinants of the level of activity and the profitability of enterprises.   International market conditions would then be explicitly recognized as a principal consideration in the construction of financial programmes.   This is a major objective which must be met if models of this nature are to be relied upon as a tool for policy makers.

Another area requiring further development is the modelling of the impact of the widened, internationalized financial sector on domestic investment.   This suggests a broadening of the data base and the construction of a sub-model which would yield forecasts of interest rates and the demand for credit.   The modular approach with a fully elaborated external sector, financial sector, price/wage block and the real sector would have the potential of tracing and explaining structural breaks emanating from policy changes.   As less reliance is placed on exchange rate policy for

influencing expenditure, it will also become more important to be able to accurately assess the impact of monetary and fiscal policy on the achievement and maintenance of domestic and external balance.

References

Bank of Jamaica, Statistical Digest, various issues 1975-92

Davis-Panton,N: "Current approaches to Macro-modelling" in Macroeconomic Report, Economic Policy and Programming Dept., Bank of Jamaica, April 1992.

Mathieson, Donald J. "Estimating Models of Financial Market Behavior During Periods of Extensive Structural Reform: The Experience of Chile"; IMF Staff Papers, June 1983 pp 350-393

Pindyck R.S & Rubinfeld D.L Econometric Models and Economic Forecasts; McGraw-Hill, New York, 1981.

Poirier, D.J The Econometrics of Structural Change, Amsterdam, North Holland, 1976.

Robinson, J.W. A Short Term Indicative Model for Jamaica Occasional Paper #3, Economic Policy and Programming Dept, Bank of Jamaica.

_____ "Lessons from the Structural Adjustment Process in Jamaica"; Paper presented at 24th Annual RPMS Conf. Nassau, Bahamas, November,1992.

Structural Equations

(1) Private Consumption Expenditure
RCONS= a1 + a2RCONS(-1) + a3RALPS + a4 DRNPI

(2) Private Fixed Capital Formation
RFI= b1 + b2RALPS + b3RGOS

(3) Firms' Gross Operating Surplus
RGOS= c1 + c2RGDP + c3RW

(4) Inventory Investment
RII= d1 + d2RII(-1)

(5) Imports of Consumer Goods
RMC= e1 + e2RALPS + e3RPM

(6) Imports of Capital Goods
RMK= f1 + f2RFI + f3RFICG + f4RPM

(7) Imports of Fuel
RMF= g1 + g2RGDP +g3RPMF

(8) Imports of Raw Materials
RMRM= h1 + h2RMRM(-1) + h3RGDP

(9) Tax Revenue
RT= tRGDP

(10) Price Equation
lnPGDP= lnp1 + p2lnPMF + p3lnW + p4 lnPM + p5 lnPGDP(-1)

(11) Money Demand
lnM2= ln m1 + m2 lnGDP + m3 ln PGDP

Balance Equations

(12) Fiscal Budget
RG= RT + RIT + RBXL + RNTR - RGO - RNDPI + RFLG + RNDLG - RFICG

(13) Real National Disposable Income
RNPI = RGDP + RNFP + RTRF - RD - RT

(14) External Balance
RFLPS= RX + RNXS- (RMC+RMK+RMF+RMRM) + RNFP + RTRF + RFLG + RNFA

(15) Domestic Fiscal Budget Support
    RNDLG= RNLG(BoJ) + RNLG(Banks) + RNLG(NonBanks)

(16) Central Bank Credit to Government
    NLG(BoJ) = CU + R - NFA - NOA(BoJ)

(17) Commercial Bank Lending to Government
    NLG(Banks) = D - R - LPS - NOA(Banks)

(18) Banking System
    NDA = M2 - NFA

(19) Currency Liabilities of Central Bank
    CU = cM2

(20) D = M2 - CU

Overall Equilibrium Condition
    RGDP = RCONS + RFI + RII + RFICG + RG + RX
(RMC+RMK+RMF+RMRM)

List of Variables

Endogenous Variables

RCONS   Real Private Consumption
RFI   Real Private Fixed Capital Formation
RII   Real Inventory Investment
RGOS   Real Gross Operating Surplus of Firms
RMC   Real Imports of Consumer Goods
RMK   Real Imports of Capital Goods
RMRM   Real Imports of Non-Fuel Raw Materials
RMF   Real Imports of Fuel
RT   Real Taxes
PGDP   Domestic Price Deflator
M2/P   Demand for Real Money Balances by the private sector
RG   Real Consumption Expenditure by Central Govt.
RNPI   Real National Disposable Income
DRNPI   Change in RNPI
RPM   Real Price of Imports (E*USCPI)/PGDP
RPMF   Real Price of Imported Fuel (E*IPF)?PGDP
CU   Currency Liabilities of Central Bank
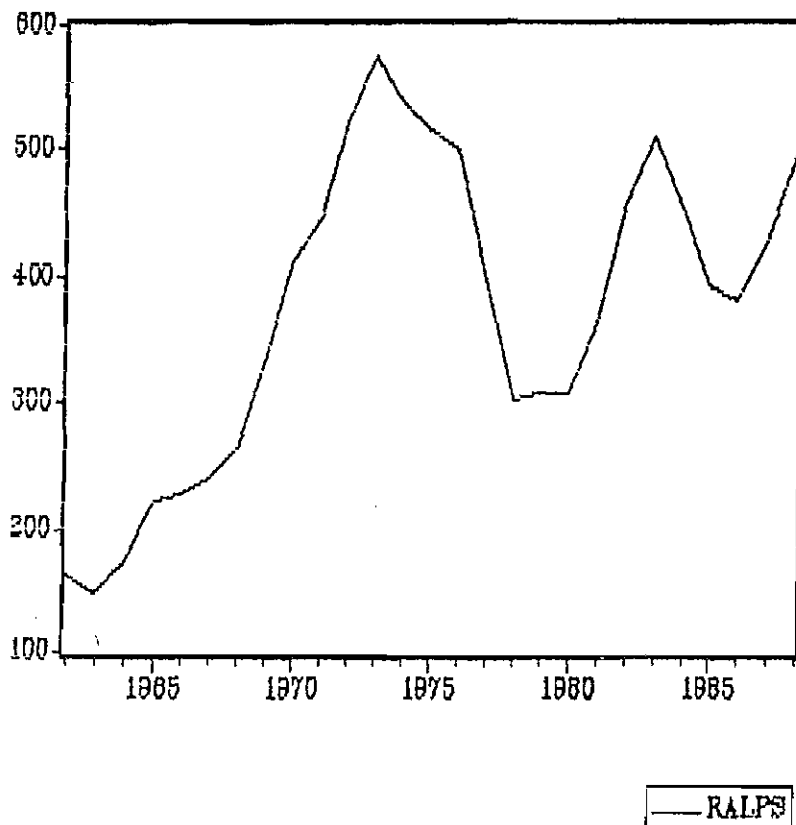D   Commercial Bank Deposit Liabilities

Exogenous Variables

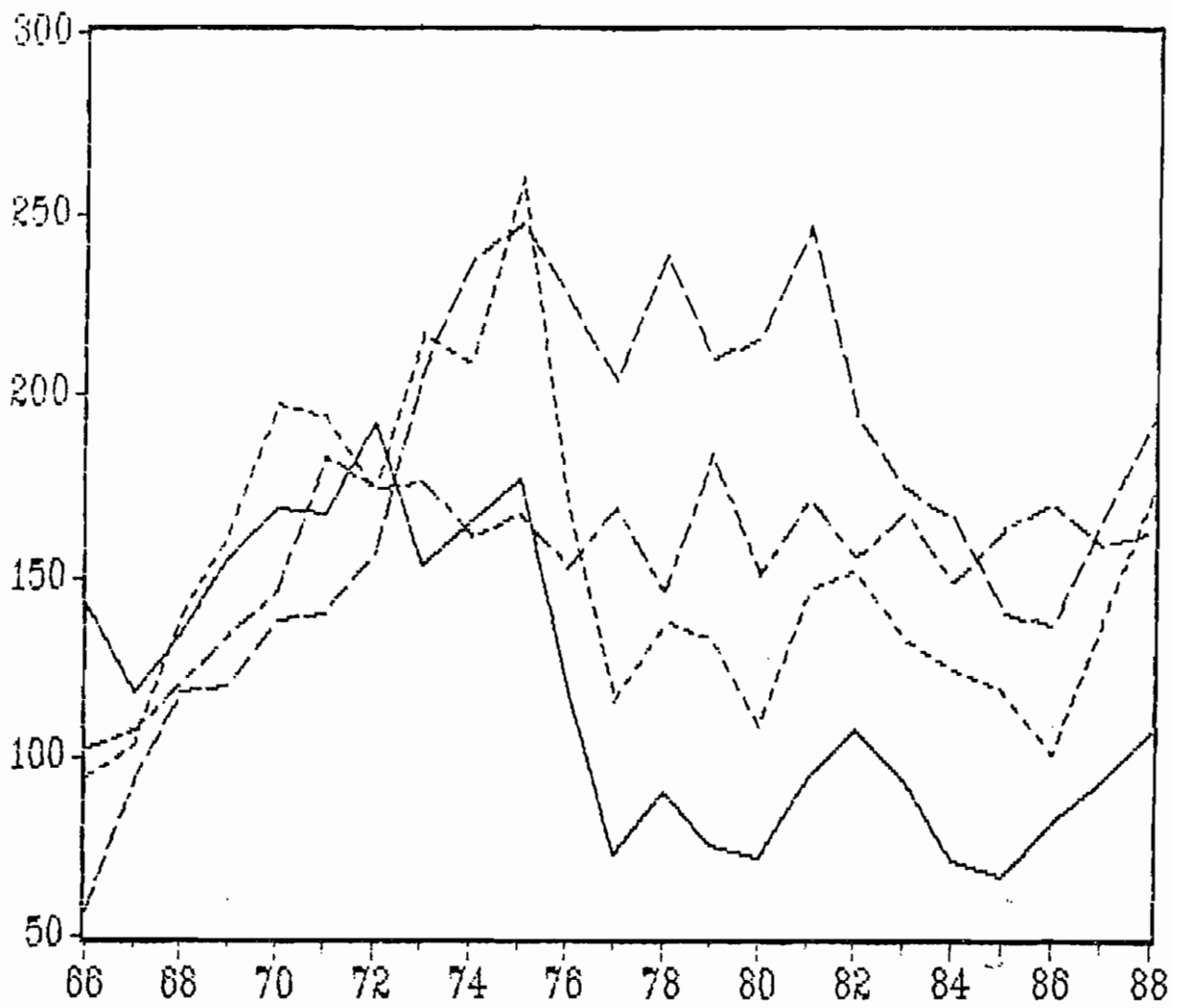|	
RALPS	Real Average Loans Outstanding to the Pvt. Sector
RW	Real Average Non Agricultural Wage Income
E	Nominal Exchange Rate Ja/US
USCPI	United States Consumer Price Index
RFICG	Real Fixed Investment by Government
IPF	International Price of Crude Index
RIT	Real Indirect Taxes
RBXL	Real Bauxite Levy Income
RNTR	Real Non Tax and Capital Revenue
RG	Real Consumption Expenditure by Government
RNDPI	Real Net Deficit of Public Enterprises
RFLG	Real Foreign Loans to Govt
RD	Real Depreciation
RTRF	Real Net Transfers from Abroad
RNDLG	Real Net Domestic Lending to Government
RNFA	Real Net Foreign Assets of the banking system
R	Reserve requirements of commercial banks
RGO	Real Other Government Expenditure
RNFP	Real Net Factor Payments from Abroad
RFLPS	Real Foreign loans to the private sector
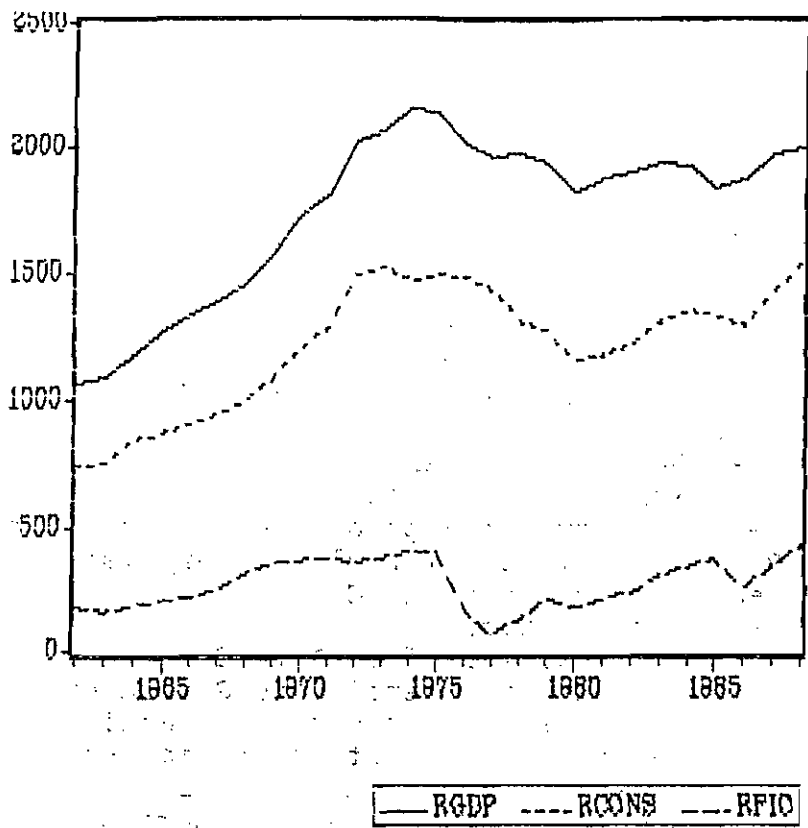
Average Commercial Bank Loans Outstanding 1962 – 88

RGDP ----RCONS ----RFIO

RALPS

	RMC	RMRM
	RMK	RMF