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**MACRO ECONOMIC MODEL OF THE INDIAN ECONOMY
1962-63 TO 1983-84**

BUILT ON AGGREGATE AND PER CAPITA
ANNUAL SERIES.

Tapas Kumar Chakrabarty*

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ABSTRACT

The motivation for reestimation of the annual aggregative model of the Indian Economy comes from the need to test the behavioural relationships among different macro variables, using the recent available data both of annual aggregate and per capita levels. In the process, attention is also devoted to respecify some individual equations for making them more pragmatic equations which incorporate also institutional features of the economy.

Besides, it is useful to assess the likely impacts of some policy variables which are expected to be changed in the near future. Finally, it is strongly felt that the simple aggregative macro economic model, if reasonably reliable in forecasting, is expected to be more useful to the policy makers for the macro economy.

The present model highlights linkages among various sectors namely, Real (domestic and foreign), Fiscal and Monetary sectors of the Indian economy. The General Price Level, not the sectoral prices, is determined in the model. The model is essentially dynamic due to stock and flow adjustment, lagged response and price expectations. However, the treatment of expectations in this model is very weak. The model consists of thirty two equations of which stochastic equations are thirteen. Some equations are estimated by the two stage least squares method, in order to solve the over identification of this model. All the equations have estimated in linear specifications using either log value or annual absolute data for the period from 1962-63 to 1983-84. All equations are also estimated on per capita annual data for the same period.

The policy simulation results suggest that the non monetised method of financing the public investment provides the double benefits of real output growth and lower Prices. This supports the recommendations of the Chakravarty Committee on the monetary reforms in India. Other policy simulation results lead us to advocate for the liberalisation of the interest rate and exchange rate policies for the Indian economy.

The present study is divided into four sections. Barring the introduction in section I, section II deals with the theoretical framework of the model. Section III reports the estimated model. Finally, section IV highlights results of the simulations and broad conclusions of the study. The results of the per capita model are presented in the appendix.

I INTRODUCTION:

Many econometric models of the Indian economy have already been prepared. The first one was finalised under the guidance of Professor Tinbergen, the pioneer in building the econometric model (1). The framework of that model was influenced by the Keynesian thinking. In this context, the debate on the use of the Keynesian framework, particularly in the sense of demand deficiency, for building macro economic models of the developing economies may be noted. Specifications highlighting the demand determining output, are probably more pragmatic to the analysis of the structure of the developed economies. The availabilities of capital, land and rawmaterials are perhaps more influential factors for the growth of output of a developing economy (2). However, the Keynesian framework of aggregate demand and aggregate income spurred abstract model building and also the compilation of data based on social accounting concepts.

Many of the Indian macro models may be termed as synthetic models based on both neoclassical and Keynesian specifications perhaps due to the fact that the 'demand oriented' framework is not adequate to analyse the structure of the Indian economy. The neoclassical production function and various components of the Keynesian aggregate demand are dealt in those models (3). The models are more or less aggregative annual models built around the national accounting framework. The emphasis on sectoral disaggregation and the stress on the determination of some particular key macro variables, besides the period of study, differentiate one model from other models.

So far no attempt has been made to build a joint model that deals both National Income Account variables and Input-Output variables, due to non availability of systematic data for input-output analysis. Similarly there is no study relating to financial behaviours of different agents of the Indian economy (4). It may not be out of reference to state that as the formulation of the financial model needs to meet certain features namely (a) disaggregation of assets and agents (b) an explicit supply/demand modeling of assets markets and

the yield structure, the financial modeling of the Indian economy is quite a difficult exercise. Although the Indian economy has experienced the financial deepening, interest rates on various financial instruments are not structurally linked. The flow of funds through different instruments can not be properly linked to the yield structure so far. The finance market is highly captive in India (5). Besides, the data on interest rates prevailing in the curb market are also not properly available.

Although all macro models are built around the national accounting framework, in most cases, the Income Expenditure identity is not adhered. The data discrepancies of higher magnitude, as revealed in the Indian National Accounts data, create some technical problem in the simulation, but the theoretical framework should include the stocks (flow) identity when the economy faces the partially administered general price level (6). The outstanding stocks are assumed to have some impact on the private investment behaviour.

The motivation for re-estimation of the annual aggregative model of the Indian economy highlighting the economic logic of the system as indicated by its main lines of causation among different macro variables, comes from the need to test the behavioural relationships using the recent available data. In the process, attention is also devoted to respecify some individual equations for making them more pragmatic equations which incorporate institutional features of the economy. Besides, it is useful to assess the likely impacts of some policy variables which are expected to be changed in the near future. Finally, it is strongly felt that the simple aggregative model, if reasonably reliable in forecasting, is more useful to the policy makers. It is clear that models are only a rough, and often flawed, representation of reality; it is therefore important to be able to explain why simulation results are what they are, and to ensure that they are related to important economic linkages and not to errors of specification. This is much easier to do for a small model than for a large one (7).

As this study describes MINIMOD (a small Indian macro economic model), no comparative study between small

and large Indian economic models to highlight differences, is made. The present study is divided into four sections. Section II deals with the theoretical framework of the model. Section III reports the estimated model. Finally, section IV highlights results of the policy simulations and broad conclusions of the study.

SECTION - II

It may be useful to indicate some salient features of the Indian economy before the discussion on the theoretical framework of the model. The theoretical framework of the model incorporates the institutional features and other arguments.

SALIENT FEATURES OF THE ECONOMY (8)

1. The government sector as a creator of the infrastructures, is the crucial sector of the economy.
2. Activity wise, the agriculture sector is an important sector. The key point that needs notice is the continuing addition of the working force at the back of the labour surplus phenomenon of the economy.
3. Policy variables cover interest rate, exchange rate, prices of some commodities etc.
4. The budgetary deficits implying the Reserve Bank net credit to the government, is a notable portion of the overall fiscal deficits. The domestic borrowings of the government is highly institutionalised. The commercial foreign borrowings are also very limited.
5. Physical controls through different policies are exercised on private industrial, export and import activities. The use of foreign exchange reserves is officially controlled.

Some economic indicators are presented in the Appendix-I.

THEORETICAL FRAMEWORK

The model highlights linkages among various sectors namely, Real (domestic and foreign), Fiscal and Monetary Sectors. The model deals with the determination of the general price level. It does not cover the sectoral prices.

The real and fiscal sectors are connected through the fiscal expenditures and receipts, while the tax rate is assumed to affect the general price level.

The demand for components of money connects the real and monetary sectors. The fiscal and monetary sectors are linked through the budgetary deficits and the high powered money.

REAL SECTOR

Domestic (9)

Real output

The gross domestic product at constant prices (YR) is the central variable of the model. It is assumed that output is largely affected explicitly by three major factors namely, (a) gross sown area (GSA), (b) imports of rawmaterials (IMRR) and (c) total stock of capital (TKS).

The usual labour factor has not been considered due to the labour surplus phenomenon of the economy. However, it is recognised that the availability of the trained working force influences the growth of output but the lack of proper macro data hinders the empirical verification of the output changes due to labour.

Regarding the technological progress it may be argued that to a large extent, a smooth linear trend has the same time path as the stocks of capital and so the trend variable in the output specification has not been included. The influence of weather can not also be explicitly captured as the gross sown area specially in

the Indian economy, largely depends on weather and the irrigation facility.

EQUATION 1 : REAL OUTPUT (YR)

$$YR = A1 + B1 (TKS) + C1 (IMRR) + D1 (GSA)$$

GSA = Gross sown area (Exogenous variable)

TKS = Total capital stock

IMRR = Imports of rawmaterials (real)

EQUATION 2 : CAPITAL STOCK IDENTITY

$$TKS = KSG + KSP$$

KSG = Capital stock (government)

KSP = Capital stock (private)

EQUATION 3 : CAPITAL STOCK IDENTITY (Government)

$$KSG = KSG (-1) + KFGR - DEPGR$$

KSG (-1) = KSG of one period lag

KFGR = Gross fixed capital formation (real, government) (Exogenous)

DEPGR = Depreciation (real, government) (Exogenous)

EQUATION 4 : CAPITAL STOCK IDENTITY (Private)

$$KSP = KSP (-1) + KFPR - DEPPR$$

KSP(-1) = KSP of one period lag

KFPR = Gross fixed capital formation (real, private)

DEPPR = Depreciation (real, private) (Exogenous)

PRIVATE INVESTMENT BEHAVIOUR (REAL)

Actual investment expenditure is the final stage in the investment process. The investment behaviour in this model is not divided into different stages of the investment process. The usual important determinant of the private investment is the potential demand for output which is assumed in this model to be captured impli-

citly through the private stocks (Real, Outstanding) (STKPR). It is expected that the private stocks (outstanding) of the current period influences the private fixed investment negatively.

Another commonly used variable namely, the user cost of capital which is the implicit rental or "Shadow price" of capital services, is not directly used in this specification due to the problem of measurement. However, the profitability which influences the sources of funds for investment is assumed to be reflected through the use of an argument like the annual average real return on corporate shares (VDYR).

Regarding the impact of the size of private capital stock on the private investment is assumed to be a positive phenomenon at the macro level particularly in a developing country where the capital stock are to be expanded as fast as possible. So the use of the lagged private capital stock as an argument in the private investment specification is not considered here. On the other hand, as private investment depends upon the infrastructure supports from the government and hence on public capital stock, an attempt has been made to capture the impact of the government capital stock of the current period which includes the current government net fixed capital formation and the lagged government capital stock on the private investment behaviour. This in fact, attempts to capture whether there is any "crowding out" effects of the public spending on the private investment behaviour. One of the salient features of the Indian economy suggests the possibility of the complementary effect of the public capital (KSG).

Institutional features like controls on imports, some industrial ventures etc., and fiscal incentives for some industrial ventures, exports etc., influence the private investment behaviour in the Indian economy. The attempt here is to highlight the likely impacts of some policies on the private investment through the argument of the foreign exchange reserves (real, stock) (FAR), in the private investment specification. The availability of the foreign exchange reserves which is officially

controlled, is assumed to have the positive impact on the private investment.

EQUATION 5 : GROSS FIXED CAPITAL FORMATION
(REAL, PRIVATE) (KFPR)

$$KFPR = A5 + B5 (KSG) + C5 (VDYR) + D5 (FAR) - E5 (STKRP)$$

KSG = Capital stock (government)

VDYR = Annual average yield (real) on corporate shares (EXGN)

FAR = Foreign exchange reserves (real, stock) (EXGN)

STKRP = Private stocks (real, outstanding)

PRIVATE CONSUMPTION FUNCTION

The consumption function follows the traditional Keynesian specification. The real private consumption depends on the real private disposable income during the same period of time. However, the lagged private consumption may be used as an argument to reflect the consumer habit change or hysteresis on the part of consumers, but the serial correlation in the consumption series is so high (as indicated in many studies) that it obscures the influence of other probable variables on the real private consumption.

EQUATION 6 : PRIVATE CONSUMPTION (REAL) (PCONR)

$$PCONR = A6 + B6 (PDISYR)$$

PDISYR = Private disposable income (real)

EQUATION 7 : PRIVATE DISPOSABLE INCOME (REAL)
(PDISYR)

$$PDISYR = A7 + B7 (YR)$$

FOREIGN SECTOR (10)**IMPORTS OF RAWMATERIALS (REAL) DEMAND FUNCTION**

The determinants of the demand for real imports of raw materials which is endogenous input in the production function, capture the income and relative price effects following the traditional theory of international trade. The real exchange rate implying the price effect, which is more or less captive, is expected to have very nominal negative impact on the real imports of raw materials. However, in this specification of the real demand for raw materials the lagged real exchange rate is used assuming some lag impact, instead of immediate impact of the more or less captive variable. The institutional feature like import controls is assumed to be implicitly captured through the argument of the lagged imports (rawmaterials). The global phenomenon like the first oil shock of 1973-74 is assumed to be reflected through the dummy variable in this specification.

EQUATION 8 : DEMAND FUNCTION (REAL) IMPORTS RAWMATERIALS (IMRR)

$$\text{IMMR} = A_8 + B_8 (\text{YR}) + C_8 (\text{IMRR} (-1)) - D_8 (\text{EXRR} (-1)) - E_8 (\text{IMDYS})$$

EXRR (-1) = Real exchange rate of one period lag

IMRR (-1) = IMRR of one period lag

IMDYS = Dummy using unit value for 1973-74 and zero for other periods

EQUATION 9 : TOTAL IMPORTS (REAL) IDENTITY(RIM)

$$\text{RIM} = \text{IMRR} + \text{OIMR}$$

OIMR = Other imports (real) (Exogenous)

TOTAL EXPORTS (REAL) (MAINLY DEMAND)

In most of other models exports are not determined endogenously. In this model an attempt has been made

to endogenise the real exports variable highlighting mainly demand phenomenon and partly supply phenomenon induced by the policy decisions.

The world income (real, expressed in index), the lagged real exchange rate and dummy variable highlighting the continuous hike in government spending for subsidies to induce exports are assumed to have impacts on real total exports.

EQUATION 10 : TOTAL EXPORTS (REAL) EXR

$$EXR = A10 + B10 (WY) + C10 (EXRR (-1)) + D10 (EXSDY)$$

WY = Real world income (index) (EXGN)

EXSDY = Dummy having unit value after 1974-75 for all periods of substantial rise in subsidies and zero value for all periods from and before 1974-75.

FISCAL SECTOR (11)

EQUATION 11 : TOTAL GOVERNMENT EXPENDITURE
IDENTITY (GTE)

$$GTE = GCE + GKE$$

GCE = Government current expenditure (nominal)

GKE = Government capital expenditure (nominal)

GOVERNMENT CURRENT EXPENDITURE (NOMINAL)

As usual, it is assumed that the government current expenditure depends on the nominal national income (the source of revenue) and the lagged level of government expenditure implying the built in rigidity of fiscal operations.

EQUATION 12 : GOVERNMENT CURRENT EXPENDITURE
(NOMINAL) (GCE)

$$GCE = A12 + B12 (Y) + C12 (GCE (-1))$$

Y = Nominal National Income

GCE (-1) = GCE of one period lag

EQUATION 13 : GOVERNMENT CAPITAL EXPENDITURE
(NOMINAL) IDENTITY (GKE)

$$GKE = KFGN + GOKT$$

KFGN = Gross fixed capital formation
(government, nominal)

GOKT = Other capital expenditure (government, nominal)
(Exogenous)

EQUATION 14 : GROSS FIXED CAPITAL FORMATION
(GOVERNMENT, NOMINAL) KFGN

$$KFGN = KFGR * KP$$

KP = Government capital price deflator (EXGN)

GOVERNMENT REVENUE RECEIPTS (NOMINAL)

The determinants of the government revenue receipts are the tax rate, nominal income, lagged revenue level implying some institutional feature like tax administration etc.

EQUATION 15 : GOVERNMENT REVENUE RECEIPTS (GR)

$$GR = A15 + B15 (Y) + C15 (ATR) + D15 (GR (-1))$$

Y = Nominal National Income

ATR = Effective Tax Rate (EXGN)

GR (-1) = GR of one period lag

EQUATION 16 : GOVERNMENT CAPITAL RECEIPTS
IDENTITY (GCR)

$$GCR = GMB + GNMB + GEB$$

GMB = Government market borrowings (domestic, net
of Reserve Bank net credit, flow) (net)

GNMB = Government non-market borrowings (domestic, net)

GEB = Government external borrowings (net)

GOVERNMENT NET DOMESTIC MARKET BORROWINGS
(NET OF RESERVE BANK NET CREDIT, FLOW) (GMB)

The government market borrowings are assumed to be affected by the nominal bank deposits and lagged borrowing level implying institutional phenomenon of the government borrowings.

EQUATION 17 : GOVERNMENT MARKET BORROWINGS
(GMB)

$$GMB = A17 + B17 (D) - C17 (GMB (-1))$$

D = Bank deposits (nominal)

EQUATION 18 : GOVERNMENT TOTAL RECEIPTS IDEN-
TITY (GTR)

$$GTR = GCR + GR$$

BUDGETARY DEFICITS

In this model the budgetary deficits refer to the Reserve Bank net credit to the Government.

EQUATION 19 : BUDGETARY DEFICITS IDENTITY

$$DLRBCG = GTE - GTR$$

DLRBCG = Change in Reserve Bank net credit to government

MONETARY SECTOR (12)

RESERVE BANK NET CREDIT TO GOVERNMENT (STOCK)

This is an identity which establishes the linkage between the fiscal and monetary sectors.

EQUATION 20 : RESERVE BANK CREDIT (NET) TO
GOVERNMENT IDENTITY (RBCG)

$$RBCG = RBCG (-1) + DLRBCG$$

HIGH POWERED MONEY IDENTITY

This indicates the various channels through which the Reserve Bank provides credits into the economy. This model does not discuss the Reserve Bank non-government credit channels.

EQUATION 21 : HIGH POWERED MONEY (STOCK) (H)

$$H = RBCG + RBCC + RBFA - NOL$$

RBCC = Reserve Bank credit to non-government sector
(EXGN)

RBFA = Reserve Bank foreign assets (net) reserves
(EXGN)

NOL = Net non monetary liabilities (adjusted with the
government currency liabilities to the public)
(EXGN)

MONEY SUPPLY (BROAD)

The money supply is assumed as a function of the high powered money.

EQUATION 22 : MONEY SUPPLY EQUATION (MS)

$$MS = A22 + B22 (H)$$

DEMAND FOR MONEY (REAL)

In this framework the demand for money has been specified in terms of the real demand for (a) currency and (b) bank deposits. The actual stock of money balances might be assumed to adjust to the difference between the demand for real balances in the current period and the actual stock in the preceding period.

REAL CURRENCY DEMAND

The demand for real currency is a function of the change in real income and the lagged currency demand.

EQUATION 23 : DEMAND FOR CURRENCY (REAL)
(CURR)

$$\text{CURR} = A23 + B23 (\text{YR}-\text{YR}(-1)) + C23 (\text{CURR} (-1))$$

DEMAND (REAL) DEPOSITS

The demand for bank deposits (real) is assumed to be a function of (a) real income, (b) own rate of return and (c) lagged deposits.

EQUATION 24 : DEMAND FOR DEPOSITS (REAL) (DR)

$$\text{DR} = A24 + B24 (\text{YR}) + C24 (\text{TDRTN}) + D24 (\text{DR} (-1))$$

TDRTN = One year time deposit rate (nominal)(EXGN)

NOMINAL INCOME, DEPOSITS AND STOCKS (REAL) (13)EQUATION 25 : NOMINAL INCOME (Y)

$$Y = \text{YR} * \text{GDPD}$$

GDPD = Gross Domestic Product Deflator (EXGN)

EQUATION 26 : NOMINAL DEPOSITS (D)

$$D = \text{DR} * \text{GDPD}$$

EQUATION 27 : GOVERNMENT CONSUMPTION (REAL)
(GCONR)

$$\text{GCONR} = \text{GCE}/\text{GCD}$$

GCD = Government consumption deflator (EXGN)

EQUATION 28 : AGGREGATE EXPENDITURE (REAL)
(YE)

$$\text{YE} = \text{PCONR} + \text{GCONR} + \text{KFGR} + \text{KFPR} + \text{EXR} - \text{IMR}$$

REAL TOTAL STOCKS (FLOW)

The stocks (flow) is assumed to relate output and demand in this framework. However, it should not be treated as an inventory formulation. It simply solves the problem of identity between output and aggregate demand as per the national accounts framework.

EQUATION 29 : TOTAL STOCKS (FLOW, REAL) (TSTR)

$$TSTR = YR - YE$$

EQUATION 30 : PRIVATE STOCKS (FLOW, REAL) (STPR)

$$STPR = TSTR - STGR$$

STGR = Government stocks (flow, real) (EXGN)

PRIVATE STOCK (REAL, OUTSTANDING)

The private stock connects the flow and lagged stock in the real terms. This is a factor in the investment function highlighting some adjustment of production with the potential demand.

EQUATION 31 : PRIVATE STOCK (REAL, OUTSTANDING) (STKRP)

$$STKRP = STKRP (-1) + STPR$$

THE GENERAL PRICE LEVEL (14)

The price equation implies the probable effects of real output, nominal demand through the money supply, and some institutional features namely tax effects etc. The price expectations are assessed through the probable effect of the lagged price level on the general price level.

EQUATION 32 : GENERAL PRICE LEVEL (WPI)

$$WPI = A32 + B32 (MS) + C32 (ETR) - D32 (YR) + E32 (WPI (-1))$$

ETR = Effective Excise Tax Rate

WPI (-1) = WPI of one period lag

SECTION - III

EMPIRICAL RESULTS (15)

This section reports the results of the estimated equations of the model.

The construction of MINIMOD is undertaken mainly to have a readily understandable and transparent model of manageable size suitable primarily for policy analysis. Though the theoretical framework of the present model covered the aggregate expenditure and other stocks equations (Five equations), but due to data problem those equations could not be considered in the simulation exercise (Appendix-II). However, the reduced model of 27 equations is well simulated highlighting the forecasting ability. The model is essentially dynamic due to stock and flow adjustment, lagged response and price expectation. The treatment of expectations in this model is very weak. This deserves more attention in the further works.

The model consists of thirty two equations of which stochastic equations are thirteen. The sector-wise details are as follows; the real sector six equations including import and export functions, the fiscal sector four equations, the monetary sector two equations and the general price level equation.

Subject to the usual conditions of independence and consistency of equations, the model is determinate. However, regarding the identification problem, this model may be criticised as an over identified one, due to the finding that in each structural equation the number of predetermined variables excluded from the given equation is more than the number of endogenous variables included in the equation less one. Thus, many structural equations of this model which consists of both simultaneous and recursive blocks, are estimated by the Two Stage Least Squares (TSLS) procedure, using instrumental variables (mainly lagged endogenous variables) for each endogenous explanatory variables in the equation to be estimated. Rest of the equations are estimated by the ordinary least squares method (O.L.S.).

Parameters of the equation system have been estimated in linear specifications using either log value or absolute value on the basis of annual aggregate data for the period from 1962-63 to 1983-84. The equations are estimated also on per capita data for the same period. The estimated per capita equations are presented in the Appendix - III.

ESTIMATED EQUATIONS PERIOD 1962-63 - 1983-84
AGGREGATE DATA

OLS = Ordinary Least Squares
INST = Instrumental Variables used
L = Log

Different types of functional relationships explaining the behaviour of the variables were attempted and the regression equations either of log or non-log specifications are satisfying both economic criteria i.e., the magnitude and the sign of the regression coefficient as expected by the theoretical consideration, and statistical measures namely the coefficient of determination $\bar{R}^2$, Durbin Watson Statistic (D-W), and t value of the regression coefficient, mean of the dependent variable and standard error of the regression. The trend component in the macro time series may lead to multicollinearity in the variables, thus reducing the efficiency of the estimation procedure. The estimated equations are presented sector wise below. The per capita estimated equations are in the Appendix - III.

REAL SECTOR

DOMESTIC SECTOR

EQUATION 1 : REAL OUTPUT INST LOG

$$\text{LYR} = 1.37 + 0.25 \text{ LTKS} + 1.05 \text{ LGSA} + 0.17 \text{ LIMRR}$$

(t value) (0.76) (3.71) (2.46) (3.00)

$$\text{D-W} = 1.68 \quad \bar{R}^2 = 0.976 \quad \text{Mean} = 10.679 \quad \text{SEE} = 0.036$$

$$\text{Inst} = \text{LTKS} (-1), \text{LGSA}, \text{LOIMR}$$

EQUATION 23 : DEMAND FOR CURRENC (REAL)
(CURR)

$$\text{CURR} = A23 + B23 (\text{YR} - \text{YR}(-1)) + C23 (\text{CURR}(-1))$$

DEMAND (REAL) DEPOSITS

The demand for bank deposits (real) is assumed to be a function of (a) real income, (b) own rate of return and (c) lagged deposits.

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(GCONR)

$$\text{GCONR} = \text{GCE} / \text{GCD}$$

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(YE)

$$\text{YE} = \text{PCONR} + \text{GCONR} + \text{KFGR} + \text{KFPR} + \text{EXR} - \text{IMR}$$

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The stocks (flow) is assumed to relate output and demand in this framework. However, it should not be treated as an inventory formulation. It simply solves the problem of identity between output and aggregate demand as per the national accounts framework.

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$$STPR = TSTR - STGR$$

STGR = Government stocks (flow, real) (EXGN)

PRIVATE STOCK (REAL, OUTSTANDING)

The private stock connects the flow and lagged stock in the real terms. This is a factor in the investment function highlighting some adjustment of production with the potential demand.

EQUATION 31 : PRIVATE STOCK (REAL, OUTSTANDING) (STKRP)

$$STKRP = STKRP (-1) + STPR$$

THE GENERAL PRICE LEVEL (14)

The price equation implies the probable effects of real output, nominal demand through the money supply, and some institutional features namely tax effects etc. The price expectations are assessed through the probable effect of the lagged price level on the general price level.

EQUATION 32 : GENERAL PRICE LEVEL (WPI)

$$WPI = A32 + B32 (MS) + C32 (ETR) - D32 (YR) + E32 (WPI (-1))$$

ETR = Effective Excise Tax Rate

WPI (-1) = WPI of one period lag

- b) The low and less significant value of one year lagged real exchange rate is quite consistent with the captiveness of exchange rate in the economy.
- c) The significant impact of the one year lagged imports indicates some impact of the institutional factor on the real imports of rawmaterials.

EQUATION 6 : EXPORTS (REAL)

	OLS	LOG
LEXR =	4.62 + 0.54 LWY + 0.16 LEXRR (-1) + 0.36 EXSDY	
(t value)	(3.94) (1.61) (0.63)	(4.16)
D-W =	1.62	
$\bar{R}^2$ =	0.903	
Mean =	7.661	
SEE =	0.109	

The real exports function is also well specified. The world income elasticity is around 0.54 and the export promotion impact implies the marginal impact of the order of 0.36. As expected, the real exchange rate was not a significant factor.

FISCAL SECTOR

EQUATION 7 : GOVERNMENT CURRENT EXPENDITURE INST LOG

LGCE =	-1.71 + 0.50 LY + 0.61 LGCE (-1)
(t value)	(-0.68) (0.68) (1.02)
D-W =	1.94
$\bar{R}^2$ =	0.998
Mean =	9.170
SEE =	0.041
Inst =	LY (-1), LGCE (-1)

The equation 7 is not so significant in explaining the government current expenditure. However, the higher coefficient value associated with the lagged current expenditure indicates the presence of the fiscal rigidities built in, which affect the fiscal deficits and other variables.

EQUATION 8 : GOVERNMENT REVENUE RECEIPTS INST

GR =	-3544.18 + 29849.95 ATR + 0.11 Y + 0.54 GR (-1)
(t value)	(-2.60) (1.98) (3.09) (2.89)
D-W =	1.45
$\bar{R}^2$ =	0.998
Mean =	13795.9
SEE =	444.925
Inst =	Y (-1), GR (-1)

The equation 8 is quite well specified to explain the government revenue earnings. Both tax rate and nominal income are significant explanatory variables which are quite consistent with other findings.

EQUATION 9 : GOVERNMENT DOMESTIC MARKET

	<u>BORROWINGS</u>	
	<u>OLS</u>	<u>LOG</u>
LGMB	= -1.98 + 1.00 LD - 0.14 LGMB (-1)	
(t value)	(-1.60) (4.19) (-0.61)	
D-W	= 2.09	$\bar{R}^2 = 0.741$ Mean = 6.482 SEE = 0.576

The equation 9 implies that the government domestic market borrowings were highly institutionalised during the period of the study because of the captive finance market.

MONETARY SECTOR

EQUATION 10 : MONEY SUPPLY (BROAD) OLS

MS	= -4042.38 + 3.17 H
(t value)	(-8.29) (80.58)
D-W	= 1.85 $\bar{R}^2 = 0.997$ Mean = 27264.2 SEE = 1351.67

The money supply equation highlights the significant relationship between the broad money and high powered money. The money multiplier which is the coefficient value of H was around 3. It is quite consistent with other findings.

EQUATION 11 : DEMAND FOR REAL CURRENCY

	<u>OLS</u>	
CURR	= 142.74 + 0.07 (YR - YR (-1)) + 0.96 CURR (-1)	
(t value)	(0.22) (1.48) (6.86)	
D-W	= 1.89 $\bar{R}^2 = 0.710$ Mean = 4590.66 SEE = 379.400	

It may be inferred from the significant estimated currency function that the transaction demand for real currency was more influenced by the past behaviour in consideration with impacts of changes in real income.

EQUATION 12 : DEMAND FOR REAL DEPOSITSOLS LOG

$$\text{LDR} = -6.71 + 0.95 \text{LYR} + 0.63 \text{LDR}(-1) + 0.01 \text{LTDRTN}$$

(t value) (-3.51) (3.50) (5.47) (0.05)

$$\text{D-W} = 1.71 \quad \bar{R}^2 = 0.989 \quad \text{Mean} = 9.057 \quad \text{SEE} = 0.059$$

The demand for real deposits was well explained by the real income and lagged deposits during the period of the study. The high (around 0.95) income elasticity of real deposits is quite consistent with low income effect on the demand for real currency. It might be interpreted as the progress of the banking habit over the period of time.

PRICE DETERMINATIONEQUATION 13 : GENERAL PRICE LEVELINST:LOG

$$\text{LWPI} = 10.82 + 0.50 \text{LMS} + 0.75 \text{LWPI}(-1) + 0.02 \text{LETR} - 1.46 \text{LYR}$$

(t value) (0.94) (2.03) (3.47) (0.13) (-1.16)

$$\text{D-W} = 1.81 \quad \bar{R}^2 = 0.986 \quad \text{Mean} = 0.324 \quad \text{SEE} = 0.060$$

$$\text{INST} = \text{LMS}(-1), \text{LWPI}(-1), \text{LETR}, \text{LYR}(-1)$$

The general price level was influenced more or less significantly by all the explanatory variables, barring the tax variable during the period of study. The price expectations and the money supply reflecting nominal demand for goods and services were more significant in effects than the real output. This may be interpreted that the monetary phenomenon of price changes in the Indian economy more pronounced during the period of the study. This observation supports other findings.

SECTION - IVPOLICY SIMULATIONS AND CONCLUSIONS (16)

The earlier description of the model equations provides an understanding about the structure of the model. However, in order to test the properties of the model as a whole, it is necessary to simulate the whole model

to test its historical relevance for the reliable forecasting.

The present section reports the results of the dynamic simulation and also some dynamic multiplier effects of some policy variable changes on some key endogenous variables.

As indicated earlier, the full model of thirty two equations could not be simulated due to some data discrepancies regarding income and expenditure. The simulated model of twenty seven equations excluding stocks identities, etc., consists of three blocks i.e., two recursive and one simultaneous blocks.

The model was run for both static and dynamic simulations during the period from (A) 1963-64 to 1983-84, and (B) 1973-74 to 1983-84. The computer programming of the Time Series Processor (T.S.P.) has been used for the estimation and simulation. The simultaneous equations converged within five iterations. The ROOT MEAN SQUARED ERRORS (PERCENT) (PRMSE) of the dynamic simulation results are shown in Table 1, while the THEIL STATISTIC values are produced in Table 2. The results of the per capita model are reported in the Appendix - IV.

It may be observed that the values of PRMSE with almost all endogenous variables are satisfactory. The more or less same results may be noticed regarding the Theil Inequality Statistic which measures the accuracy of the turning point predictions. Thus the forecasting power of this simple model might be encouraging. It may be pointed out that the performance of the aggregate data model is better than that of the per capita data model during the same period of time.

TABLE 1

DYNAMIC SIMULATION AGGREGATE DATAROOT MEAN SQUARED ERRORS : PERCENT (PRMSE)

LONG RUN PATH	1963-64 TO 1983-84	1973-74 TO 1983-84
<u>ENDOGENOUS VARIABLES</u>	<u>PRMSE</u>	<u>PRMSE</u>
REAL OUTPUT	2.14	1.72
PRICE	6.79	4.97
MONEY SUPPLY	1.72	0.77
BUDGETARY DEFICITS	4.58	3.87
REAL IMPORTS	13.73	6.59
REAL EXPORTS	0.75	0.59
REAL PRIVATE INVESTMENT	1.13	1.00
REAL CURRENCY	2.09	4.87
REAL DEPOSITS	5.59	7.00
REAL PRIVATE CONSUMPTION	2.39	1.65

BEST VALUE OF PRMSE = 0

TABLE 2
DYNAMIC SIMULATION AGGREGATE DATA
THEIL STATISTIC (I.S.)

MEAN SQUARED ERRORS OF FIRST DIFFERENCES (I.S)

LONG RUN PATH	1963-64 TO 1983-84	1973-74 TO 1983-84
<u>VARIABLES</u>	<u>I.S</u>	<u>I.S</u>
REAL OUTPUT	0.38	0.38
PRICE	0.67	0.92
MONEY SUPPLY	0.26	0.14
BUDGETARY DEFICITS	0.86	1.67
REAL IMPORTS	1.22	1.05
REAL EXPORTS	0.29	0.58
REAL PRIVATE INVESTMENT	1.00	1.07
REAL CURRENCY	1.17	1.96
REAL DEPOSITS	1.90	1.82
REAL PRIVATE CONSUMPTION	1.33	0.26

BEST VALUE of I.S = 0

POLICY SIMULATION

Assuming parameter invariance with respect to policy regimes implying the fact that generally individuals do not change their behaviours in response to a shock, some policy simulations have been tried to examine the reaction of the model to a range of different types of disturbances namely, fiscal (change in public investment), monetary (nominal interest change) and also change in real exchange rate. It may be pointed out that the Lucas critique of conventional economic models of parameter invariance across alternative policy regimes

is just another error in the model specification. However, at any rate, how important the Lucas point is quantitatively currently an open question.

The Chakravarty Committee (Reserve Bank of India, 1985) reviewing the working of the monetary system, has recommended that the monetisation of the public debt should be controlled through a suitable restructuring yields on the government securities, etc. Thus it is quite demanding to trace the impact of change in nominal interest rate, on some key endogenous variables.

In our exercise it is assumed that one year fixed deposit rate was hiked by two percentage points in 1969-70 while some major banks were nationalised. The dynamic multiplier effects as reported in the Table 3 highlight that the total changes of real deposits during 1969-70 to 1973-74 accounted for 0.36 in response to one percent point rise in one year fixed deposit rate in 1969-70.

TABLE 3

**POLICY CHANGE : NOMINAL INTEREST RATE HIKE
BY 2 PERCENT POINTS IN 1969-70**

**DYNAMIC MULTIPLIER EFFECT (%) AGGREGATE DATA
MODEL**

	REAL DEPOSITS
1969-70	0.18
1970-71	0.05
1971-72	0.05
1972-73	0.04
1973-74	0.04
SUM =	0.36

Other two high level committees (chaired by A. Hussain, and m. Narasimhan, Govt. of India, 1985, 1986) have recommended to move as far as feasible, from case by

case discretionary physical controls for regulating trade etc. This motivates us to know the impact of an increased real exchange rate particularly and directly on real imports and real exports.

For this purpose it is assumed that in 1965-66, the year of rupee devaluation, the real exchange rate was hiked by two percentage points. The dynamic multiplier effects as reported in the Table 4 highlight that real exports increased and once, by 1.85 per cent in response to one per cent point rise in the real exchange rate in 1965-66. The real imports declined by about 10.32 per cent during 1966-67 to 1969-70.

TABLE 4
POLICY CHANGE : 2 PERCENT POINTS RISE IN REAL
EXCHANGE RATE IN 1965-66

DYNAMIC MULTIPLIER EFFECTS (%) AGGREGATE
DATA MODEL

	IMPORTS (REAL)	EXPORTS (REAL)
1966-67	- 2.88	1.85
1967-68	- 2.50	-
1968-69	- 2.63	-
1969-70	- 2.31	-
SUM :	-10.32	1.85

Finally, following the conventional policy simulation of earlier models, it is assumed that the government fixed investment (real) was raised by ten percent during the first annual plan in 1965-66, and the increased investment was totally monetised for this exercise. Alternatively, it is also assumed that the increased public investment was not at all monetised. The financing came through the public non-market domestic borrowings. Table 5 which reports the dynamic multiplier effects of the change of public investment (full monetisation), suggests that during 1965-66 to 1969-70, the sum of changes of real output accounts for about

+ 0.24(%), while the rise in the price level was about 2.37 (%) in response to one per cent rise in the public investment in 1965-66. This leads to a trade off in favour of the prices. However, the changes in the prices are not so alarming.

TABLE 5
POLICY CHANGE : 10 PERCENT RISE IN PUBLIC
REAL INVESTMENT (KFGR) IN
1965-66 AND MONETISATION OF
THE SAME AMOUNT

DYNAMIC MULTIPLIER EFFECTS (%) AGGREGATE
DATA MODEL

	REAL OUTPUT	MONEY SUPPLY	PRICES
1965-66	0.03	0.74	0.33
1966-67	0.04	0.63	0.51
1967-68	0.05	0.48	0.55
1968-69	0.06	0.37	0.52
1969-70	0.06	0.30	0.46
SUM :	0.24	2.52	2.37

From the Table 6 which reports the multiplier effects of the rise of the public investment, financed through the public non-market domestic borrowings (GNMB), it may be observed that the Economy is benefited by both ways i.e., the rise in real output and the fall in the price level. The sum of rise in output was around 0.24 (%), while it was around 0.96 (%) in case of the price level during the same period.

The results of the alternative methods of financing the public investment lead us to advocate the rise in the public investment, to be financed through the non-monetised public borrowings.

TABLE 6

**POLICY CHANGE : 10 PERCENT RISE IN THE PUBLIC
REAL INVESTMENT AND ADJUSTED
RISE IN GOVERNMENT NON-
MARKET BORROWINGS IN 1965-66**

DYNAMIC MULTIPLIER EFFECTS (%) AGGREGATE
DATA MODEL

	REAL OUTPUT	PRICES
1965-66	0.03	-0.05
1966-67	0.04	-0.11
1967-68	0.05	-0.19
1968-69	0.06	-0.27
1969-70	0.06	-0.34
SUM :	0.24	-0.96

The policy simulation results of the per capita model are reported in Appendix-V.

CONCLUSIONS

Broad conclusions are reproduced below :

- a) The present estimated model of only 27 equations highlights significantly the linkages among major key variables of the economy during 1962-63 to 1983-84.
- b) The overall forecasting performance of both the annual aggregate and per capita models are quite encouraging. However, the performance of the aggregate data model is more encouraging than that of the per capita data model covering the same period of study.
- c) The policy simulation results suggest that the non-monetised method of financing the public invest-

ment provides the double benefits of output growth and lower prices. This supports the recommendations of the Chakravarty Committee on the monetary reforms in India.

It may be useful to refer to the salient features of the Indian economy as cited earlier. The government investment (real) affects the real output of the economy, directly through the increase in the public capital stock, and indirectly through the impact on the private investment in positive direction which affects the private capital stock and ultimately the real output. The private investment is influenced positively due to the complementary feature of the public investment of the Indian economy. In estimated private real investment function in Section-III, the co-efficient value around 0.27 of government capital stock (KSG) is statistically significant and supports the hypothesis of the complementary feature of the public investment in India.

Regarding the impact on the general prices it may be noted that prices are affected negatively by the real output due to supply impact while the nominal demand for output is not affected due to non-monetisation of the public investment expenditure. The co-efficient of the real output in the general price equation is found around -1.46. Consequently the non-monetised public investment expenditure leads to depress the price changes.

However, it may be argued that due to non-monetisation of the public investment expenditure, the availability of funds to the private sector may be reduced due to credit controls and may affect the private investment negatively which may lead to fall in real output. But it should be added that the rise in the public investment may create additional savings which is implicit in this model through the private consumption (real) and the private disposable (real) income functions.

The coefficient value of private disposable income (PDISYR) in the private consumption function (PCONR) is around 0.85 while the coefficient value of real income (YR) in the private disposable (real) income function (PDISYR) is around 0.785. As interest rates are more or less administered, the public expenditure does not create any demand impact on the prices in the financial market. However, in order to encourage the flow of funds from the non-government units to finance the public investment it is desirable to make interest rates more adjustable. It may affect the cost of public borrowings and the fiscal deficits, but in the long run it may increase the efficiency of the public expenditures.

- d) The policy simulation results also lead us to advocate for the liberalisation of the interest rate and exchange rate policies for the Indian economy. The properly adjusted exchange rate induces the economy in imports and rise in exports which eases the balance of payment problem of the economy.

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APPENDIX 1
ECONOMIC INDICATORS

VARIABLES	UNIT			
		1950-59	1960-69	1970-85
1. N.N.P (1970-71 PRICES)	GROWTH RATE (ANNUAL AVERAGE)	3.82 neg : 2 max : 8.5 min : -2.2	2.34 1 6.9 -5.9	3.97 2 10.1 -5.2
2. PER CAPITA INCOME (D O.)	"	1.97	0.39	1.52
3. PRIVATE CONSUMPTION	"	4.20	2.06	3.17
4. CAPITAL FORMATION	RATE	9.10	12.50	18.00
5. DOMESTIC SAVINGS	"	7.41	10.40	14.77
6. EXPORTS (% OF G.D.P.)	"	4.76	3.56	5.83
7. IMPORTS	"	6.53	5.54	8.37
8. EXPORTS (% OF WORLD EXPORTS)	"	1.74	0.95	0.65
9. FOREIGN DEBT (STOCK) (% OF GDP)	"	3.54	13.62	10.61
10. DOMESTIC DEBT	"	33	43	44
11. DOMESTIC CREDIT	"	24	27	61

APPENDIX I (Contd.)

<u>VARIABLES</u>	<u>UNIT</u>	<u>1950-59</u>	<u>1960-69</u>	<u>1970-85</u>
12. FOREIGN DEBT SERVICE (% OF EXPORTS) "		3	16	15
13. PRIMARY SECTOR (% OF NNP) "	"	52	50	40
14. SECONDARY SECTOR " "	" "	19	20	21
15. TERTIARY SECTOR " "	" "	29	30	39
16. C.P.I. (% CHANGE) "	"	4.30	7.30	9.30
17. TAX RECEIPTS (% OF GDP) "	"	6	8	11
18. GOVT. EXPD. (LESS NET LENDING) "	"	9	10	16.03
19. FISCAL DEFICITS " "	" "	4	4	7
20. FOREIGN AID (% OF 19) "	"	4	5	6
21. FOREIGN BORROWINGS " "	" "	17	40	14
22. DOMESTIC BORROWINGS " "	" "	79	55	80
23. ADVANCE RATE "	"	4.7	7.5	15
24. 1 YR. TIME DEPOSIT RATE "	"	2.7	5.5	8.5
25. LONG YIELD ON GOVT. BOND "	"	4.6	5.2	7.6
26. EXCHANGE RATE (PER U.S.\$) "	"	4.8	6.3	8.3

APPENDIX I (Contd.)

	1950-59	1960-69	1970-85
<u>EXPORT ORIENTATION</u>			
27. PRIMARY PRODUCTS (% OF TOTAL EXPORTS)	57	52	43
28. OTHER TRADITIONAL PRODUCTS "	41	40	35
29. NEW PRODUCTS "	2	8	22
<u>IMPORT SUBSTITUTION</u>			
30. PRIMARY PRODUCTS (% OF TOTAL IMPORTS)	42	40	6
31. RAWMATERIALS (FUEL ETC.) "	20	21	63
32. MACHINERIES "	38	39	31
<u>WELFARE (% OF TOTAL HOUSEHOLD EXPD.)</u>			
33. FOOD AND OTHER NECESSITIES "	75	76	72
34. MEDICAL CARE "	1.6	2.0	2.4
35. RECREATION "	0.06	0.07	0.09
36. EDUCATION "	2.3	3.0	2.0
37. LORENZ RATIOS OF CONSUMER EXPD.			

APPENDIX I (Contd.)

	<u>RURAL</u>	<u>URBAN</u>
1953-54	0.334	0.371
1960-61	0.312	0.357
1970-71	0.278	0.327
1973-74	0.272	0.304

38. PERSONS BELOW THE POVERTY LINE (MILLION) (% OF TOTAL POPULATION)

1979-80	316 (47.00)
1984-85	215 (30.00)

SOURCES :

- a) NATIONAL ACCOUNTS STATISTICS
- b) REPORT ON CURRENCY AND FINANCE, RESERVE BANK OF INDIA
- c) INTERNATIONAL FINANCIAL STATISTICS, I.M.F.
- d) CHATTERJEE, G.S. AND BHATTACHARYYA, N. "ON DISPARITIES IN PER CAPITA HOUSEHOLD CONSUMPTION IN INDIA" IN POVERTY AND INCOME DISTRIBUTION IN INDIA, ED. SRINIVASAN, T.N. AND BARDHAN, P.K. (STATISTICAL PUBLISHING SOCIETY, CALCUTTA, 1974).

APPENDIX II

SIMULATION PROGRAMMING

1. IDENT KGEQ KSG = KSG (-1) + KFGR - DEPGR;
2. FRML EXEQ EXR = EXP (SAI) * (WY ** SBI) * (EXRR(-1) ** SCI) * (EXP (SDI * EXSDY));
CONST SAI 4.62 SBI 0.54 SCI 0.16 SDI 0.36;
3. FRML GCEQ GCE = EXP (SA2) * (Y ** SB2) * (GCE (-1) ** SC2);
CONST SA2 -1.71 SB2 0.49 SC2 0.61;
4. IDENT GKEQ GKE = KFGN + GOKT;
5. IDENT NGEQ KFGN = KFGR * KP;
6. IDENT GEEQ GTE = GCE + GKE;
7. FRML GREQ GR = SA3 + SB3 * ATR + SC3 * Y + SD3 (GR (-1));
CONST SA3 -3544.18 SB3 29849.95 SC3 0.11 SD3 0.54;
8. FRML CREQ CURR = SA4 + SB4 * (YR - YR(-1) + SC4 * CURR (-1));
CONST SA4 142.74 SB4 0.07 SC4 0.96;
9. FRML DREQ DR = EXP (SAS) * (YR ** SB5) * (DR(-1) ** SC5) * (TDRTN ** SD5);
CONST SA5 -6.71 SB5 0.95 SC5 0.63 SD5 0.01;
10. IDENT DNEQ D = DR * GDPD;
11. FRML YREQ YR = EXP (SA6) * (TKS ** SB6) * (GSA ** SC6) * (IMRR ** SD6);
CONST SA6 1.37 SB6 0.25 SC6 1.05 SD6 0.17;
12. IDENT TKEQ TKS = KSG + KSP;
13. IDENT KPEQ KSP = KSP (-1) + KFPR - DEPPR;
14. FRML KFEQ KFPR = SA7 + SB7 * KSG - SC7 * STKRP + SD7 * VDYR + SE7 * FAR;
CONST SA7 727.27 SB7 0.27 SC7 1.34 SD7 6.93 SE7 0.87;
15. FRML PCEQ PCONR = SA8 + SB8 * PDISYR;
CONST SA8 1240.13 SB8 0.85;
16. FRML DYEQ PDISYR = SA9 + SB9 * YR;
CONST SA9 1709.03 SB9 0.78

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17. FRML RMEQ IMRR = EXP (SA10) * (YR ** SB10) *
(IMRR (-1) ** SC10)/(EXRR (-1) ** SD10)/(EXP
(SE10 * IMDYS));
CONST SA10 -12.12 SB10 1.50 SC10 0.61 SD10 0.50
SE10 0.26;
18. IDENT IMEQ RIM = IMRR + OIMR;
19. FRML GMEQ GMB = EXP (SA11) * (D ** SB11)/
(GMB (-1) ** SC11);
CONST SA11 -1.98 SB11 1.00 SC11 0.14;
20. IDENT YNEQ Y = YR ** GDPD;
21. IDENT KREQ GCR = GEB + GMB + GNMB;
22. IDENT GYEQ GTR = GCR + GR;
23. IDENT GDEQ DLRBCG = GTE - GTR;
24. IDENT RGEQ RBCG = RBCG (-1) + DLRBCG;
25. IDENT HMEQ H = RBCG + RBCC + RBFA - NOL;
26. FRML MSEQ MS = SA12 + SB12 * H;
CONST SA12 -4042.38 SB12 3.17;
27. FRML WPEQ WPI = EXP (SA13) * (MS ** SB13)
* (WPI (-1) ** SC13 * (ETR ** SD13)/(YR ** SE13);
CONST SA13 10.82 SB13 0.51 SC13 0.75 SD13 0.03
SE13 1.46;

LIST TKC KGEQ EXEQ GCEQ GKEQ NGEQ GEEQ GREQ
CREQ DREQ DNEQ YREQ TKEQ KPEQ KFEQ PCEQ
DYEQ RMEQ IMEQ GMEQ YNEQ KREQ GYEQ GDEQ
RGEQ HMEQ MSEQ WPEQ;

LIST T ENDOG KSG EXR GCE GKE KFGN GTE GR
CURR DR D YR TKS KSP KFPR PCONR PDISYR
IMRR RIM GMB Y GCR GTR DLRBCG RBCG H MS
WPI;

FORMULAS

$$1. \text{ PRMSE} = \left[\left[\frac{\sum (S_t - A_t)^2}{\sum A_t^2} \right] \times 100 \right]^{\frac{1}{2}}$$

S = Simulated Value A = Actual Value

$$2. \quad I S = \sum (s_t - a_t)^2 / \sum a_t^2$$

s = 1st difference a = 1st difference

3. Multiplier Formulas (interpreted as the % change in Y due to 1% or 1% point change in X above control value)

$$(a) \quad M(Y, X) = \frac{(Y_s - Y_c)/Y_c}{(X_s - X_c)/X_c} \quad (\text{for \% change})$$

$$(b) \quad M(Y, X) = \frac{(Y_s - Y_c)/Y_c}{(X_c - X_c)/X_c} \times 100$$

Y_s = Shocked simulated endogenous value

X_s = Shocked variable new value

Y_c = Historical simulated value of Y

X_c = Old value of X

APPENDIX III

ESTIMATED EQUATIONS PER CAPITA DATA 1962-63 - 1983-84

O L S = ORDINARY LEAST SQUARES
 INST = INSTRUMENTAL VARIABLES USED
 L = LOG VALUE
 P = PER CAPITA VARIABLE

REAL SECTOR

DOMESTIC SECTOR

EQ. 1 REAL OUTPUT (PYR) INST LOG

$$LPYR = 1.45 + 0.47 LPTKS + 1.18 LPGSA + 0.20 LPIMRR$$

(t value) (0.63) (2.56) (1.52) (2.03)

D-W = 1.79 $R^2 = 0.830$ Mean = 6.619 SEE = 0.039

INST = LPTKS (-1), LGSA, LPOIMR

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EQ. 2 PRIVATE REAL INVESTMENT (PKFPR) OLS INST

$PKFPR = 23.30 + 0.22 PKSG - 1.14 PSTKRP + 0.11 VDYR + 0.77 PFAR$
 (t value (1.68) (2.64) (2.39) (0.63) (2.80))
 $D-W = 2.02 \quad \bar{R}^2 = 0.54 \quad \text{Mean} = 71.232 \quad SEE = 5.574$
 $INST = PKSG (-1), PSTKRP(-1), VDYR, PFAR$

EQ. 3 PRIVATE REAL CONSUMPTION (PPCONR) O L S INST

$PPCONR = 59.79 + 0.79 PPDISYR$
 (t value) (2.56) (20.98)
 $D-W = 1.07 \quad \bar{R}^2 = 0.968 \quad \text{Mean} = 549.296 \quad SEE = 7.660$
 $INST = PPDISYR (-1)$

EQ. 4 PRIVATE DISPOSABLE REAL INCOME (PPDISYR) OLS INST

$PPDISYR = 78.23 + 0.72 PYR$
 (t value) (3.91) (27.15)
 $D-W = 2.25 \quad \bar{R}^2 = 0.985 \quad \text{Mean} = 620.488 \quad SEE = 6.834$
 $INST = PKFGR$

FOREIGN SECTOR

EQ. 5 REAL IMPORTS OF RAW MATERIALS (PIMRR) OLS INST

$PIMRR = -33.67 + 0.06 PYR + 0.64 PIMRR (-1) - 0.08 EXRR (-1) - 3.40 IMDYS$
 (t value) (1.19) (1.10) (2.39) (0.06) (0.76)
 $D-W = 2.32 \quad \bar{R}^2 = 0.812 \quad \text{Mean} = 21.535 \quad SEE = 4.183$
 $INST = PYR (-1), PIMRR (-1), EXRR (-1), IMDYS$

EQ. 6 REAL EXPORTS (PEXR) O L S

$PEXR = 2.73 + 0.11 WY + 0.37 EXRR(-1) + 0.52 PEXR(-1)$
 (t value) (0.64) (0.97) (0.38) (2.58)
 $D-W = 1.96 \quad \bar{R}^2 = 0.811 \quad \text{Mean} = 37.522 \quad SEE = 3.902$

FISCAL SECTOREQ. 7 GOVERNMENT CURRENT EXPENDITURE
(PGCE) OLS INST

$$PGCE = -58.37 + 0.23 PY$$

$$(t \text{ value}) (8.95) \quad (46.77)$$

$$D-W = 0.94 \quad R^2 = 0.991 \quad \text{Mean} = 209.744 \quad SEE = 14.251$$

$$INST = PY(-1)$$

EQ. 8 GOVERNMENT REVENUE RECEIPTS (PGR)
OLS INST

$$PGR = -72.87 + 627.46 ATR + 0.11PY + 0.52 PGR(-1)$$

$$(t \text{ value}) (3.15) \quad (2.54) \quad (3.16) \quad (2.87)$$

$$D-W = 1.44 \quad R^2 = 0.998 \quad \text{Mean} = 216.884 \quad SEE = 6.767$$

$$INST = ATR, PY(-1), PGR(-1)$$

EQ. 9 GOVERNMENT DOMESTIC MARKET BORROW-
INGS (PGMB) OLS LOG

$$LPGMB = -2.11 + 0.85 LPD$$

$$(t \text{ value}) (2.84) \quad (6.19)$$

$$D-W = 2.31 \quad R^2 = 0.651 \quad \text{Mean} = 2.422 \quad SEE = 0.566$$

MONETARY SECTOREQ. 10 MONEY SUPPLY (BROAD) (PMS) OLS

$$PMS = -83.92 + 3.25 PH$$

$$(t \text{ value}) (9.61) \quad (68.85)$$

$$D-W = 1.74 \quad R^2 = 0.996 \quad \text{Mean} = 424.648 \quad SEE = 21.361$$

EQ. 11 DEMAND FOR REAL CURRENCY (PCURR)

O L S INST

$$PCURR = 5.14 + 0.02 PYR + 0.71 PCURR(-1)$$

(t value) (0.20) (1.07) (3.99)

$$D-W = 1.72 \quad \bar{R}^2 = 0.428 \quad \text{Mean} = 78.70 \quad SEE = 5.66$$

INST = PYR(-1), PCURR(-1)

EQ. 12 DEMAND FOR REAL DEPOSITS (PDR) OLS

$$PDR = -185.28 + 0.29 PYR + 0.75 PDR(-1) + 2.17 TDRTN$$

(t value) (3.88) (3.84) (7.80) (0.64)

$$D-W = 1.70 \quad \bar{R}^2 = 0.982 \quad \text{Mean} = 161.132 \quad SEE = 9.996$$

PRICE DETERMINATION

EQ. 13 GENERAL PRICE LEVEL (WPI) LOG INST

$$LWPI = 20.11 + 0.59 LPMS + 0.72 LWPI(-1) - 3.53 LPYR$$

(t value) (0.88) (1.42) (2.56) (0.93)

$$D-W = 2.04 \quad \bar{R}^2 = 0.964 \quad \text{Mean} = 0.324 \quad SEE = 0.099$$

INST = LPMS(-1), LWPI(-1), LPYR(-1)

APPENDIX IV

TABLE - 1

DYNAMIC SIMULATION RESULTS PER CAPITA MODEL

ROOT MEAN SQUARED ERRORS : PERCENT (PRMSE)

<u>LONG RUN PATH</u>	1963-64 TO 1983-84	1973-74 TO 1983-84
<u>ENDOGENOUS VARIABLES</u>	<u>PRMSE</u>	
REAL OUTPUT	4.97	2.71
PRICE	9.79	7.50
MONEY SUPPLY	3.40	6.52
BUGETARY DEFICITS	5.00	8.20
REAL IMPORTS	15.33	8.20
REAL EXPORTS	1.35	1.36
PRIVATE REAL INVESTMENT	4.50	3.23
REAL CURRENCY	2.29	1.60
REAL DEPOSITS	19.97	8.05
PRIVATE REAL CCNSUMPTION	3.66	2.16

BEST VALUE OF PRMSE = 0

TABLE - 2

DYNAMIC SIMULATION RESULTS PER CAPITA MODEL

THEIL STATISTIC (I S)MEAN SQUARED ERRORS OF FIRST DIFFERENCES (I S)

<u>LONG RUN PATH</u>	1963-64 TO 1983-84	1973-74 TO 1983-84
<u>VARIABLES</u>	<u>I S</u>	
REAL OUTPUT	0.78	0.68
PRICE	1.15	1.54
MONEY SUPPLY	0.27	0.76
BUDGETARY DEFICITS	2.27	1.92
REAL IMPORTS	1.52	2.79
REAL EXPORTS	0.90	0.80
PRIVATE REAL INVESTMENT	2.85	4.29
REAL CURRENCY	0.97	0.95
REAL DEPOSITS	3.90	1.68
PRIVATE REAL CONSUMPTION	0.69	0.27

BEST VALUE OF I S = 0

APPENDIX V

TABLE - 1

POLICY CHANGE : NOMINAL INTEREST RATE HIKE
BY 2 PERCENTAGE POINTS IN 1969-70

DYNAMIC MULTIPLIER EFFECTS (%) PER CAPITA MODEL

<u>YEAR</u>	<u>REAL DEPOSITS</u>
1969-70	0.725
1970-71	0.475
1971-72	0.305
1972-73	0.205
1973-74	0.135
SUM :	1.845

TABLE - 2

POLICY CHANGE : 2 PERCENTAGE POINTS RISE IN
REAL EXCHANGE RATE IN 1965-66

DYNAMIC MULTIPLIER EFFECTS(%) PER CAPITA MODEL

	<u>REAL IMPORTS</u>	<u>REAL EXPORTS</u>
1966-67	-0.210	1.260
1967-68	-0.155	0.645
1968-69	-0.135	0.320
1969-70	-0.595	0.170
SUM :	-0.595	2.395

TABLE - 3

POLICY CHANGE : 10 PERCENT RISE IN PUBLIC
REAL INVESTMENT (PKFGR) IN 1965-66 AND
MONETISATION OF THE NOMINAL AMOUNT

DYNAMIC MULTIPLIER EFFECTS (%) PER CAPITA MODEL

	<u>REAL OUTPUT</u>	<u>MONEY SUPPLY</u>	<u>PRICES</u>
1965-66	0.062	1.338	0.667
1966-67	0.079	1.062	0.841
1967-68	0.086	0.682	0.534
1968-69	0.089	0.544	0
1969-70	0.091	0.500	0
SUM :	0.407	4.126	2.042

TABLE - 4

POLICY CHANGE : 10 PERCENT RISE IN THE PUBLIC
REAL INVESTMENT (PKFGR) AND NOMINAL AMOUNT
RISE IN GOVERNMENT NON-MARKET BORROWINGS
IN 1965-66

DYNAMIC MULTIPLIER EFFECTS (%) PER CAPITA MODEL

	<u>REAL OUTPUT</u>	<u>PRICE</u>
1965-66	0.062	0
1966-67	0.079	0
1967-68	0.086	-0.538
1968-69	0.089	-0.645
1969-70	0.091	-0.806
SUM :	0.407	-1.989

APPENDIX VI

In this model of thirty two equations, there are thirty two endogenous variables. They are in order of appearance:

YR (REAL OUTPUT), TKS (TOTAL CAPITAL STOCK), KSG (GOVERNMENT CAPITAL STOCK), KSP (PRIVATE CAPITAL STOCK), KFPR (PRIVATE GROSS FIXED CAPITAL FORMATION), PCONR (PRIVATE REAL CONSUMPTION), PDISYR (PRIVATE DISPOSABLE REAL INCOME), IMRR (REAL IMPORTS OF RAW MATERIALS), EXR (REAL EXPORTS), GTE (GOVERNMENT TOTAL EXPENDITURE), GCE (GOVERNMENT CONSUMPTION EXPENDITURE), RIM (REAL TOTAL IMPORTS), GKE (GOVERNMENT CAPITAL EXPENDITURE), KFGN (GOVERNMENT GROSS FIXED CAPITAL FORMATION, NOMINAL), GR (GOVERNMENT REVENUE), GCR (GOVERNMENT CAPITAL RECEIPTS), GMB (GOVERNMENT DOMESTIC NET MARKET BORROWINGS), GTR (GOVERNMENT TOTAL RECEIPTS), DLRBCG (BUDGETARY DEFICITS), RBCG (RESERVE BANK NET CREDIT TO GOVERNMENT, STOCK), H (HIGH POWERED MONEY), MS (BROAD MONEY SUPPLY) CURR (REAL CURRENCY), DR (REAL DEPOSITS), Y (NOMINAL INCOME), D (NOMINAL DEPOSITS), YE (AGGREGATE EXPENDITURE), GCONR (GOVERNMENT REAL CONSUMPTION), TSTR (TOTAL REAL STOCKS, FLOW), STPR (REAL PRIVATE STOCKS, FLOW), STKRP (PRIVATE REAL STOCK, OUTSTANDING) AND WPI (WHOLESALE PRICE INDEX OF 1970-71 BASE).

In this model there are thirty five predetermined variables—twenty three exogenous including two dummy variables, eleven lagged endogenous variables and one lagged exogenous variable. The predetermined variables are as follows :-

GSA (GROSS SOWN AREA), KFGR (GOVERNMENT GROSS FIXED CAPITAL FORMATION, REAL), DEPGR (DEPRECIATION, GOVERNMENT, REAL), DEPPR (DEPRECIATION, PRIVATE, REAL), VDYR (YIELD ON SHARES, REAL), FAR (REAL FOREIGN EXCHANGE RESERVES, OUTSTANDING), OIMR (REAL OTHER IMPORTS), WY (REAL WORLD INCOME, INDEX OF

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1970-71 BASE), GOKT (GOVT. OTHER CAPITAL EXPENDITURE), GNMB (GOVERNMENT NON MARKET BORROWINGS, NET), GEB (GOVERNMENT EXTERNAL NET BORROWINGS), TDRTN (1 YR. TIME DEPOSIT RATE, NOMINAL), RBCC (RESERVE BANK CREDIT TO NON-GOVERNMENT SECTOR), RBFA (RESERVE BANK NET FOREIGN ASSETS RESERVES, OUTSTANDING), NOL (NET NON MONETARY LIABILITIES OF RESERVE BANK), TSGR (TOTAL REAL STOCKS, GOVERNMENT, FLOW), ATR (EFFECTIVE TAX RATE), ETR (EFFECTIVE EXCISE TAX RATE), GDPD (GDP DEFLATOR OF 1970-71 BASE), GKD (GOVERNMENT CAPITAL DEFLATOR OF 1970-71), GCD (GOVERNMENT CONSUMPTION DEFLATOR OF 1970-71), IMDYS (IMPORTS DUMMY FOR OIL SHOCK OF 1973-74), EXSDY (EXPORTS DUMMY FOR SUBSIDIES AFTER 1974-75),

YR(-1), KSG(-1), KSP(-1), IMRR(-1), GCE(-1), GR(-1), GMB(-1), RBCG(-1), CURR(-1), STKRP(-1), and EXRR(-1).

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APPENDIX VII

DATA BASE

RUPEES CRORES
(10 MILLIONS)

AGGREGATE DATA

<u>YEAR</u>	<u>KSG</u>	<u>EXR</u>	<u>GCE</u>	<u>GKE</u>	<u>GTE</u>
1962 -63	12379	1369	2287	1584	3871
-64	14538	1615	2734	1906	4640
-65	16928	1611	3006	2307	5313
-66	19456	1110	3411	2431	5842
-67	21618	1366	3856	2956	6812
-68	23564	1639	4264	2710	6974
-69	25531	1646	4742	2631	7373
-70	27466	1675	5318	2898	8216
-71	29411	1639	5666	3181	8847
-72	31568	1608	6933	3578	10511
-73	34200	1604	8317	4002	12319

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>KSG</u>	<u>EXR</u>	<u>GCE</u>	<u>GKE</u>	<u>GTE</u>
-74	36748	2126	9167	4315	13482
-75	38961	1971	10457	5798	16255
-76	41601	2511	12486	7426	19912
-77	44945	2741	14449	7849	22298
-78	48474	2964	15807	8615	24422
-79	51965	2940	18335	9859	28194
-80	55531	3171	21334	10336	31670
-81	59238	3179	24882	14278	39160
-82	63323	3165	29346	15133	44479
-83	68066	3382	35119	16938	52057
1983-84	72963	3608	41286	18703	59989
<u>YEAR</u>	<u>GEB</u>	<u>GR</u>	<u>CURR</u>	<u>DR</u>	<u>CUR</u>
1962-63	360	2424	4164	3988	2386
-64	516	2999	4291	4187	2612
-65	587	3330	4113	4239	2775

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>GEB</u>	<u>GR</u>	<u>CURR</u>	<u>DR</u>	<u>CUR</u>
-66	662	3689	4199	4484	3052
-67	785	4026	3861	4610	3197
-68	713	4361	3661	4650	3383
-69	496	4848	4036	5264	3685
1969-70	574	5392	4242	5618	4021
-71	382	5810	4388	6201	4388
-72	378	6840	4566	7020	4822
-73	286	8233	4701	7727	5462
-74	492	9286	4526	8059	6322
-75	758	11616	3629	7505	6347
-76	1757	14344	3876	9074	6705
-77	1393	15858	4463	11217	7873
-78	700	17257	4645	13027	8631
-79	713	19762	5506	15993	10231
-80	890	22188	5356	16168	11654

MACRO ECONOMIC MODEL

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>GEG</u>	<u>GR</u>	<u>CURR</u>	<u>DR</u>	<u>CUR</u>
-81	1670	25591	5218	16299	13426
-82	1301	30432	5145	17103	14474
-83	1591	34752	5778	19432	16659
1983-84	1611	39099	6203	20948	19603

<u>YEAR</u>	<u>D</u>	<u>FAR</u>	<u>YR</u>	<u>TKS</u>	<u>KSP</u>
1962-63	2285	132	29130	27695	15316
-64	2550	174	30886	31116	16578
-65	2861	140	33272	35066	18138
-66	3260	67	31924	39176	19720
-67	3817	120	31887	43056	21438
-68	4297	161	34554	47105	23541
-69	4806	285	35757	51214	25683
-70	5325	544	38038	55389	27923
-71	6201	530	40263	59477	30066

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>D</u>	<u>FAR</u>	<u>YR</u>	<u>TKS</u>	<u>KSP</u>
-72	7412	585	41193	63877	32309
-73	8979	418	40931	68522	34322
-74	11258	306	42446	73129	36381
-75	13125	136	42539	77599	38638
-76	15698	325	46803	82806	41205
-77	19787	1000	47298	88661	43716
-78	24205	1717	51163	95229	46755
-79	29715	1597	54562	101879	49914
-80	35181	1347	51938	107964	52433
-81	41937	1270	55373	114403	55165
<u>YEAR</u>	<u>D</u>	<u>FAR</u>	<u>YR</u>	<u>TKS</u>	<u>KSP</u>
1981-82	48110	705	58586	121069	57746
-83	56022	446	60714	128309	60243
1983-84	66195	414	65350	136192	63229

MACRO ECONOMIC MODEL

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>KFPR</u>	<u>PCONR</u>	<u>PDISYR</u>	<u>IMRR</u>	<u>RIM</u>
1962-63	2194	22038	24228	700	1778
-64	2478	22604	25399	694	2004
-65	2785	24571	27722	644	2119
-66	2972	23836	26352	857	1664
-67	3110	24383	26745	677	2034
-68	3603	26271	29339	802	2201
-69	3702	27056	29947	830	1824
-70	3978	28082	31689	729	1680
-71	3911	29838	33255	888	1902
-72	4038	30709	33722	1036	2091
-73	3892	30093	33779	803	1712
-74	3925	30914	35562	769	1366
-75	4244	31189	35242	1053	1624
-76	4571	33531	38670	973	1811
-77	4586	33288	38158	1117	2159

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>KEPR</u>	<u>PCONR</u>	<u>PDISYR</u>	<u>IMRR</u>	<u>RIM</u>
-78	5169	36772	42112	1665	2469
-79	5256	38438	44468	1434	2183
-80	4884	36565	42416	1728	2526
-81	5226	40803	46146	2596	3619
-82	5179	42216	47637	2640	3858
-83	5129	42896	48792	2800	4074
1983-84	5748	47149	53281	3056	4498

<u>YEAR</u>	<u>YER</u>	<u>TSTR</u>	<u>STPR</u>	<u>STKRP</u>	<u>GMB</u>	<u>Y</u>	<u>GNMB</u>
1962-63	28119	645	423	1373	110	17099	779
-64	29704	603	414	1722	156	19656	768
-65	32223	612	427	2046	192	23044	1084
-66	32024	421	179	2137	44	24112	1031
-67	32277	861	755	2558	383	27662	1525
-68	34642	642	313	2502	756	32294	978
-69	36104	182	120	2817	580	33279	1207

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>YER</u>	<u>TSTR</u>	<u>STPR</u>	<u>STKRP</u>	<u>GMB</u>	<u>Y</u>	<u>GNMB</u>
-70	37838	596	525	3138	256	36851	1981
-71	39681	1039	660	3704	351	40263	1978
-72	41172	1273	928	4455	360	43356	2087
-73	41383	418	429	4682	714	47865	2303
-74	43076	1683	1100	4832	428	58940	2515
-75	42758	2303	1494	5370	1026	69628	2433
-76	46809	1939	718	6151	760	73926	2791
-77	47668	1365	532	6474	804	80198	3940
-78	52123	779	916	7246	2360	89848	3936
-79	54687	2221	1532	8582	716	97748	5389
-80	53013	2218	1373	8656	1953	107444	3836
-81	57283	2461	1570	9058	1612	127514	5648
-82	59676	2378	1342	9352	1667	147392	7082
-83	62057	1734	1212	10186	4167	164740	9039
1983-84	67852	2033	1676	11280	2582	193841	12710

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>GCR</u>	<u>GTR</u>	<u>DLRBCG</u>	<u>RBCG</u>	<u>H</u>	<u>MS</u>	<u>OD</u>
1962-63	1249	3673	198	2266	2537	4701	30
-64	1440	4439	201	2467	2791	5195	32
-65	1863	5193	120	2587	2971	5673	36
-66	1736	5426	416	3003	3256	6333	20
-67	2693	6719	93	3096	3462	7043	29
-68	2447	6808	166	3262	3695	7711	31
-69	2283	7131	242	3504	4000	8572	81
-70	2811	8203	13	3517	4444	9405	58
-71	2711	8521	326	3843	4822	10649	60
-72	2825	9665	846	4689	5381	12314	79
<u>YEAR</u>	<u>GCR</u>	<u>GTR</u>	<u>DLRBCG</u>	<u>RBCG</u>	<u>H</u>	<u>MS</u>	<u>OD</u>
1972-73	3303	11536	783	5472	6033	14492	51
-74	3435	12721	761	6233	7273	17624	45
-75	4217	15833	422	6655	7604	19550	78
-76	5308	19652	260	6915	7807	22480	77

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APPENDIX VII (Contd.)

YEAR	GCR	GTR	DLRBCG	RBCG	H	MS	OD
-77	6137	21995	303	7218	9798	27781	121
-78	6996	24253	169	7387	10941	32906	70
-79	6818	26580	1614	9001	14083	40112	166
-80	6679	28867	2803	11804	16573	47226	391
-81	8930	34521	4639	16443	19452	55774	411
-82	10050	40482	3997	20440	20998	62752	168
-83	14797	49549	2508	22948	23110	72868	186
1983-84	16903	56002	3987	26935	28993	86089	291

YEAR	WPI	GSA	KFGR	DEPGR	DEPPR	VDYR	OIMR	EXRR(-1)
1962-63	0.573	158	2191	241	1179	1.05	1078	5.61
-64	0.609	157	2408	249	1215	-1.38	1310	4.93
-65	0.675	159	2685	295	1296	-5.26	1475	5.39
-66	0.725	155	2826	298	1390	-1.21	807	5.15
-67	0.828	155	2494	332	1451	-7.88	1357	7.83
-68	0.924	161	2321	375	1500	-5.18	1399	7.07
-69	0.913	159	2354	387	1556	6.51	994	6.90

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>WPI</u>	<u>GSA</u>	<u>KFGR</u>	<u>DEPGR</u>	<u>DEPPR</u>	<u>VDYR</u>	<u>OIMR</u>	<u>EXRR(-1)</u>
-70	0.948	158	2307	372	1738	0.66	951	7.24
-71	1.000	159	2394	449	1768	0.04	1014	7.37
-72	1.056	165	2648	491	1794	0.89	1056	7.30
-73	1.162	162	3167	535	1873	-3.11	909	8.14
-74	1.397	170	3135	587	1856	-14.63	597	8.13
-75	1.749	164	2679	466	1917	-21.40	571	7.87
-76	1.730	171	3161	521	2010	4.33	838	8.23
-77	1.764	167	3916	572	2075	4.17	1043	9.38
-78	1.858	172	4179	650	2130	1.14	804	8.69
-79	1.858	175	4184	693	2333	5.66	750	9.41
-80	2.176	167	4298	732	2365	-11.29	795	10.05
-81	2.573	173	4510	803	2494	-12.36	1022	9.98
-82	2.813	175	5019	934	2598	-3.82	1218	11.62
-83	2.883	169	5828	1085	2632	3.37	1274	12.63
1983-84	3.160	176	6078	1181	2762	-4.43	1442	14.57

MACRO ECONOMIC MODEL

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>WY</u>	<u>EXSDY</u>	<u>KFGN</u>	<u>GOKT</u>	<u>IM</u>	<u>RBCC</u>	<u>RBFA</u>	<u>NOL</u>	<u>TDRTN</u>
1962-63	68.30	0	1331	253	1209	222	90	41	3.99
-64	72.50	0	1552	354	1363	267	118	61	4.00
-65	76.50	0	1796	511	1526	357	101	74	4.87
-66	80.70	0	2013	417	1464	287	59	93	6.00
-67	83.60	0	2026	930	2115	365	125	124	6.00
-68	88.10	0	1992	718	2201	370	161	98	5.96
-69	92.90	0	2090	541	1897	442	296	242	5.50
-70	96.10	0	2165	733	1747	595	566	234	5.50
-71	100.00	0	2394	787	1902	774	530	325	5.63
-72	105.40	0	2802	776	2175	763	608	679	6.00
-73	111.90	0	3619	383	2328	746	569	754	6.00
-74	113.80	0	4009	306	2950	1291	661	912	6.00
-75	114.90	0	4272	1526	4417	1644	369	1064	6.00
-76	120.60	1.0	5573	1853	5143	2049	924	2081	6.50
-77	125.80	1.0	7048	801	5614	2302	2599	2321	8.00

APPENDIX VII (Contd.)

YEAR	WY	EXSDY	KFGN	GOKT	IM	RBCC	RBFA	NOL	TDRTN
-78	131.30	1.0	7697	918	6517	1880	4532	2858	6.00
-79	136.00	1.0	8376	1483	7423	2367	5431	2715	6.00
-80	138.90	1.0	9974	362	10094	2746	5388	3365	7.00
-81	141.70	1.0	11680	2598	13603	2976	4775	4751	7.50
-82	142.10	1.0	14577	556	14816	3717	2706	5888	8.00
-83	145.00	1.0	18498	-1560	15806	4615	1729	6182	8.00
1983-84	162.20	1.0	20649	-1946	17632	5816	1624	5382	8.00

APPENDIX VII (Contd.)

<u>YEAR</u>	<u>GDPD</u>	<u>UVI</u>	<u>GCONR</u>	<u>DISCR</u>	<u>STGR</u>	<u>IMDYS</u>	<u>POP</u>	<u>ATR</u>	<u>ETR</u>	<u>KP</u>
1962-63	0.59	0.68	2105	-453	222	0	45.40	.112	.014	0.61
-64	0.64	0.68	2604	-200	189	0	46.40	.117	.017	0.64
-65	0.69	0.72	2691	-580	185	0	47.40	.109	.017	0.67
-66	0.76	0.88	2944	-1630	242	0	48.50	.107	.022	0.71
-67	0.87	1.04	2958	-2587	106	0	49.50	.121	.021	0.81
-68	0.93	1.00	3009	-1854	329	0	50.60	.104	.016	0.86
-69	0.93	1.04	3169	-885	62	0	51.80	.091	.013	0.89
-70	0.97	1.04	3474	-405	71	0	52.90	.081	.011	0.94
-71	1.00	1.00	3801	-983	379	0	54.10	.081	.013	1.00
-72	1.05	1.04	4259	-2218	346	0	55.40	.089	.016	1.06
-73	1.17	1.36	4338	-1086	-11	0	56.70	.091	.018	1.14
-74	1.39	2.16	4342	-793	583	1.0	58.00	.089	.017	1.28
-75	1.64	2.72	4298	-1828	809	0	59.30	.105	.019	1.59
-76	1.58	2.84	4846	-545	1222	0	60.70	.117	.019	1.76
-77	1.70	2.60	5297	-573	832	0	62.00	.117	.019	1.80

APPENDIX VII (Contd.)

YEAR	GDPD	UVI	GCONR	DISCR	STGR	IMDYS	POP	ATR	ETR	KP
-78	1.76	2.64	5506	-747	-137	0	63.40	.118	.020	1.84
-79	1.79	3.40	6063	-832	689	0	64.90	.125	.024	2.00
-80	2.07	4.00	6619	-1999	845	0	66.40	.147	.027	2.32
-81	2.30	3.76	7183	-5248	891	0	67.90	.156	.027	2.60
-82	2.52	3.84	7956	-4854	1035	0	69.40	.153	.029	2.90
-83	2.71	3.88	8896	-4461	521	0	70.90	.150	.031	3.17
1983-84	3.00	3.92	9767	-6314	357	0	72.40	.147	.029	3.40

The Per Capita Data have been generated.

SOURCES :

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REGIONAL DISPARITIES IN INDUSTRIAL DEVELOPMENT

D.V.S. Sastry & Ujwala R. Kelkar*

INTRODUCTION

The states into which the country is divided vary very widely in the levels of natural resources and infrastructural facilities and thus contribute on varying scales to the national income of the country. This basic unevenness in the distribution of natural resources creates imbalances between the areas blessed with abundant natural resources and those areas which have only scant natural resources or infrastructural facilities such as, hilly tracks and area with scanty rain fall. It has been observed all over the world that industries tend to develop and concentrate in areas where the availability of natural resources and infrastructural facilities already exist, thus facilitating economies of operation. This process, however, does not offer unendingly economies to the scale and thus a state of congestion sets in followed by several constraints in the economy. In order that industrialisation benefit the economy of the country as a whole, it is important that disparities in the levels of development among different regions should progressively be reduced. This has in fact been a major policy plan of the Government of India.

The industrial policy resolution of 1956 conceptualised and articulated the basic frame work underlying our industrial policies which laid stress on the reduction of imbalances in the various parts of the country through an orderly and regulated growth of industries. Since then planning was directed not only to accelerate growth of industry and employment but also

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to achieve certain socio-economic objectives such as dispersal of growth, promotion of village and small-scale industries, prevention of monopolies and reducing economic imbalances. In a country like India where planned development is laid down as a basic tool of economic growth, the dispersal of industries is necessary not only to achieve balanced regional development but also to give relief from increasing pressures on availability of natural resources as well as factors of production. The infrastructure development have, therefore, to be deliberately improved in the backward areas as a policy measure to attract more industries to the backward areas thereby reducing the regional imbalances over the years. The Government of India has, therefore, enunciated several measures to promote growth of village and small-scale industries, fiscal concessions to industries to be set up in the backward districts etc.

Thus in earlier plan periods, a variety of measures were taken to this effect, viz., location of public sector projects in backward areas, fiscal concessions, incentives and other benefits, specific plans for infra-structural development etc. Consequently, there has been a substantial diversification of industrial base over the last three decades, the diversification of industrial base has taken place in a wider range of industrial products as also diffusion of the industrial scene through wider area.

The main objective of this study is to assess in quantitative terms whether or not regional imbalances have reduced overtime in the context of the various efforts made by Government of India and the extent of success or otherwise of these policy measures.

In order to assess the effects of various measures several indicators such as number of factories, number of industrial workers, level of capital investment, value of output etc., can be used and analysis can be carried out. However, this procedure involves comparison of the levels in these values rather than the study of the distribution of test statistics. This procedure also has another disadvantage as it measures the overall increase/decrease rather than the variation among those regions

which are formed by clubbing some States. The later is relevant because some states having made a relatively greater progress in industrialisation grow at faster rate than those states where industrialisation has just taken place. Also, alongwith the growth of large scale industries there is a tendency among small industries which cater to the large scale industries and ancillary industries to grow. Thus, it is logical that the extent of growth in states which are industrially developed is different from that in states which are not so much developed. Therefore, a measure which segregates the inequality into components as within regions and between the regions will be beneficial to understand the growth process of the region as well as regional imbalances. As states are the ultimate units in the study, the measurement of between variation becomes possible when regions are formed by clubbing states which have homogeneous characteristics. Though the formation of region in this manner itself to some extent determines the nature of variation among the different regions so formed, the study brings out the variations in a quantifiable manner which facilitates a proper understanding to the extent and direction of disparities obtaining between regions and within regions. There are many types of measures for measuring the inequality. The most commonly used measures are Gini Index and Theil Index. Theil developed a measure based on the concepts of entropy. This measure has a definite advantage over Gini Index because of its additive property. That is, when data is grouped into states/regions/occupations, it is possible to decompose the overall inequality into inequality between the groups and inequality within groups. This kind of decomposition can be helpful for policy formulation. Many researchers have used this measure in the field of social sciences. Divatia⁽¹⁾ had estimated the inequality in the distribution of rural household assets in India based on AIDIS 1971-72 data through Theil's measure. He decomposed the total inequality into contribution of inequality between occupations and within occupations. He also decomposed the total

1. Divatia V.V., "Inequalities in Asset Distribution of Rural Households", Reserve bank Staff Occasional Papers, June 1976.

inequality into inequality between household size groups and within household size groups. This facilitated him to draw conclusions on how differences in, say occupations, lead to differences in the asset holdings of the households.

Gupta (1985)⁽²⁾ and Shekar (1982)⁽³⁾, by applying the techniques like Williamson's inequality measures, Hirschman Herfindahl Index and Theil's Index, have pointed out that there has been a decline in the inter-state industrial disparities over time. Further, to corroborate his findings and to observe the changes in the locational pattern of industries among the states over a period, Gupta has applied two measures of locational change, viz., Magnitude Rating and Increase Rating and concluded that developed states are witnessing a decline with regard to these measures whereas backward states are observing an increase in these Ratings implying thereby that backward states are catching up with the developed ones in the process of industrial development.

Strictly speaking, such a conclusion may not be tenable. It is entirely plausible for some middle ranking states to grow a little faster than the top ranking states, thus enabling the index to go down. At the same time the position of the bottom ranking states may get worsened. Thus the overall index would fail to capture the very important aspect of regional concentration of growth performance in such a vast economy as in India. It is therefore desirable to bring in to sharp focus, the regional dimension of the growth experience of various states, the regions being defined in a suitable manner. Per capita value added is used as an indicator to group the states into regions. As states are of unequal size it is necessary to eliminate the size effect by introducing some scaling factor like population.

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2. Gupta, Deepak, "Inter-state Industrial Disparities in India - the Changing Scene, "RBI Occasional Papers, Vol. 6, No. 1, June 1985; pp. 54-68.
 3. Shekar, Uday., "Trends in Inter-State Disparities in Industrial Development in India - 1961 to 1975" Indian Economic Journal, October - December 1982, pp. 17-26.

DATA AND METHODOLOGY

The data for the study have been taken from the Annual Survey of Industries (factory sector) published by the Central Statistical Organisation and Basic Statistics Relating to Indian Economy, published by the Centre for Monitoring Indian Economy.

The total inequality in value added among the states as defined by Theil⁽⁴⁾ is

$$I(Y : X) = \frac{1}{n} \sum_{i=1}^n Y_i \log Y_i / X_i$$

where n is the total number of states, Y_i is the proportion of value added of the i th state to the total value added and X_i proportion of population of the i th state to the total population. The states can be grouped into G regions $R_1, R_2, \dots, R_G$, so that each state belongs to one and only one region. Then the above inequality could be written as -

$$I(Y : X) = \sum_{g=1}^G \sum_{i \in R_g} Y_i \log Y_i / X_i$$

With a little algebra, this can be decomposed as -

$$\begin{aligned} I(Y : X) &= \sum_{g=1}^G Y_g \sum_{i \in R_g} P_i \log P_i / \pi_i + \sum_{g=1}^G Y_g \log Y_g / X_g \\ &= \sum_{g=1}^G Y_g I_g(Y : X) + I_0(Y : X) \end{aligned}$$

where P_i is the proportion of value added of the i th state to the total value added of the region to which

4. Theil, H., Economics and Information theory (Chicago : Rand Mc Nally and Company; Amsterdam : North-Holland publishing Company, 1967)

it belongs & π_i the proportion of population of the i th state to the total population of the region to which it belongs. The first component is the weighted average of 'within region' inequality $I_g(Y : X)$, weights being the proportions of value added of the region to the total value added and second the 'between region' inequality $I_0(Y : X)$.

For the purpose of the study, the states have been grouped into three regions based on the per capita value added (Statement-1). Region-1 consists of the industrially developed states, namely Maharashtra, Gujarat, West Bengal, Tamil Nadu, Haryana and Punjab; Region-2 consists of states that are developing, i.e., Karnataka, Kerala, Himachal Pradesh, Madhya Pradesh, Andhra Pradesh and Rajasthan, while the remaining states fall under Region-3 where industrialisation has just started or industrially backward.

THE RESULTS

In order to test the classification procedure adopted for the study, the contribution of between regions inequality to the total inequality has been calculated. Table I gives the decomposition of Theil's inequality.

TABLE : 1

DECOMPOSITION OF THEIL'S INEQUALITY

Year	Total inequality	Within inequality	Between inequality	Between inequality as a percentage of total inequality	Within inequality
1960-61	0.16133	0.04953	0.11180	69.30	30.70
1970-71	0.10735	0.02385	0.08350	77.78	22.22
1980-81	0.09747	0.01353	0.08394	86.12	13.88

It is clear from the above table, that a major part of the total inequality is accounted by the 'between regions', viz., 69 per cent, 78 per cent and 86 per cent at the respective time points. This is not surprising as the grouping is based on the per capita value added. Since the contribution of between regions is more, Theil points out that this may be regarded as a test of quality of the classification procedure. Thus we can infer the above classification is appropriate for further analysis.

The total inequality has reduced from 0.16133 in 1960-61 to 0.10735 in 1970-71 and further to 0.09747 in 1980-81. The decline in inequality is due to both; the reduction in within inequality as well as between inequality in the decade 1960-61 to 1970-71. Table 2 gives the within inequality of each region in the different periods.

TABLE : 2
REGIONWISE WITHIN INEQUALITIES

Period	Region I	Region II	Region III
1960-61	0.05482	0.03387	0.04631
1970-71	0.02765	0.02672	0.00780
1980-81	0.01825	0.00789	0.00309

Over the period, the 'within inequality' in respect of all the regions has reduced so also its contribution to total inequality (Table : 1) indicating that the disparities within regions have decreased. The 'between inequality' also declined over the period 1960-61 to 1970-71 but its contribution to the total inequality has increased substantially. Thus the imbalances in industrial development among the regions are not only still existing but seem to have accentuated further during the decade 1970-71 to 1980-81. The decline in inequality indicates the reduction in the industrial concentration and

generally may lead to inference that backward states did catch up with the developed states during 1960-61 to 1970-71. However, before arriving at such conclusion, one has to look into factors contributing to it. The inequality measure depends both on the share of value added as also the population share. If the regionwise/statewise distribution of population is constant over a period, the contribution of region/state to the total value added over a period would tell us which are the regions/states that are industrially developing. This will be clear from Table 3.

TABLE : 3
THE DISTRIBUTION OF VALUE ADDED AND
POPULATION AMONG THE REGIONS

Year	Region I		Region II		Region III	
	A	B	A	B	A	B
1960-61	68.49	33.59	12.62	30.01	16.93	34.64
1970-71	63.86	33.97	18.64	30.11	15.50	33.91
1980-81	62.55	33.50	21.59	30.19	13.26	34.01

A. Percentage share of each region in total value added.

B. Percentage share of each region in total population.

It can be seen from the above table that the region-wise distribution of population over the period under study has remained more or less constant whereas the distribution of value added has undergone changes. The share of Region-I has declined from 68.5 per cent to 62.6 per cent and that of Region-3 from 16.9 per cent to 13.3 per cent, while the Region-2 has registered significant growth as its share increased from 12.6 per cent to 21.6 per cent.

On examination of the state-wise shares over the three time points (Statement-2), it can be seen that the

REGIONAL DISPARITIES IN INDUSTRIAL DEVELOPMENT 273

shares of states in Region-3 have either remained constant or declined except for Orissa and Jammu & Kashmir. The shares of states in Region-2 have increased substantially, thereby implying a growth in industrial development. Considering the states in Region-1, the shares of Maharashtra, Gujarat have remained more or less stable while that of West Bengal has declined. The contribution of these 3 states together ranges between 45 to 60 per cent in the total value added. Thus the reduction in inequality is attributable to the progress of developing states (Region-2) as also to the slow pace of growth of some states in Region-1.

CONCLUSIONS

There has been a decline in the inequality among the states over the last two decades, due to overall industrial development; the decline being not prominent in the latter half of the period, i.e., 1970-71 to 1980-81. The decline in inequality is on account of both the factors, viz., 'within inequality' as well as 'between inequality'. However, the contribution of 'between inequality' to total inequality has been increasing significantly implying thereby that although the disparities within the regions are declining, imbalance do exist between the regions. The decline in 'between regions' inequality in the period 1960-61 to 1970-71 is not noticed in the next decade 1970-71 to 1980-81.

STATEMENT - 1

PER CAPITA VALUE ADDED IN FACTORY SECTOR -
1960-61, 1970-71 AND 1980-81

(Amount in Rs.)

Region/State	1960-61	1970-71	1980-81
<u>Region-I</u>			
Maharashtra	68	167	487
West Bengal	59	97	257
Gujarat	52	108	343
Tamil Nadu	24	75	259
Haryana	-	70	277
Punjab	15	52	237
<u>Region-II</u>			
Karnataka	14	62	167
Kerala	16	42	156
Himachal Pradesh	8	37	148
Madhya Pradesh	8	27	118
Andhra Pradesh	9	29	112
Rajasthan	11	26	101
<u>Region-III</u>			
Assam	26	28	60
Bihar	14	31	73
Uttar Pradesh	9	24	69
Orissa	5	27	77
Jammu & Kashmir	3	7	31

STATEMENT - 2

THE STATE-WISE DISTRIBUTION OF VALUE ADDED
AND POPULATION

States	1960-61		1970-71		1980-81	
	a	b	a	b	a	b
<u>Region-I</u>						
Maharashtra	26.71	9.01	26.80	9.20	25.03	9.16
West Bengal	20.45	7.95	13.62	8.08	11.53	7.97
Gujarat	10.47	4.70	9.15	4.87	9.55	4.97
Tamil Nadu	7.93	7.67	9.81	7.52	10.30	7.06
Haryana	-	1.73	2.22	1.83	2.90	1.89
Punjab	2.94	2.54	2.25	2.47	3.24	2.45
<u>Region-II</u>						
Karnataka	3.23	5.37	5.75	5.34	5.05	5.42
Kerala	2.74	3.85	2.86	3.89	3.28	3.71
Himachal Pradesh	0.10	0.64	0.41	0.63	0.52	0.62
Madhya Pradesh	2.45	7.37	3.56	7.60	5.05	7.62
Andhra Pradesh	3.13	8.19	3.97	7.94	4.90	7.82
Rajasthan	0.98	4.59	2.09	4.70	2.80	5.00
<u>Region-III</u>						
Assam	3.03	2.47	1.40	2.67	1.10	2.90
Bihar	6.46	10.57	5.53	10.28	4.20	10.20
Uttar Pradesh	6.36	16.79	6.61	16.12	6.28	16.18
Orissa	0.98	4.00	1.87	4.00	1.66	3.85
Jammu & Kashmir	0.10	0.81	0.10	0.84	0.15	0.87

a. Share of State in the total value added.

b. Share of State in the total population.

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Review Article - 1

**THE MYTH OF FREE TRADE PATTERNS OF
PROTECTIONISM SINCE 1945**

By

Harry Shutt

(Basil Blackwell, London, 1985 pp. 193; £ 17.50)

The main theme that the author seeks to establish in this book is that the widely-held belief that international trade under the regime of GATT in the post-World War II period was, in spite of the many practices of interference and distortion, basically free and open, was more a myth than a reality. The author argues, as one of the essential conclusions of the book, that even the commitment of policy makers to free and open trade was hardly any deeper or any more genuine in the post-World War II period than ever before. Indeed, in his very first sentence of the book, Shutt calls into question that management of the national economies of the industrialized West (not to speak of those of the less developed) was in fact in conformity with the tenets of free market. Throughout the book, the author seeks to drive home the point that the justification of interventionist policies and practices in the domestic economies, seen as an important pre-condition to domestic stability and prosperity, was used to lend legitimacy to interventions by national Governments on the foreign trade sector as well.

Nations pursued and espoused free trade only to the extent of their expectations of national gains from such a policy. As a striking illustration of this approach, we have the glaring case of the U.S.A. urging in 1950 exclusion of agricultural trade from the purview of GATT at a time when America was nursing huge surpluses in farm produce. However, in the 1980s the U.S.A. has become an ardent champion of free trade in agricultural products.

Shutt ascribes the popular belief in the reality of free international trade in the post-war period to what he characterises as superficial coincidence of events: World trade (excluding the trade of the East European countries including the U.S.S.R.) grew by 400 per cent in real terms in the period between 1948 and 1973, a growth rate far exceeding that in any previous comparable period; there was also an unprecedented economic boom in the industrialised countries during this period. From these developments, it was deduced that the pursuit of free and open trade policies by national governments is an important contributor to the economic boom, and thus a vindication of the classical doctrine of the benefits of free trade in terms of optimum economic performance with given endowments of productive factors and levels of technology. The successive bouts of trade liberalisation, mainly in the form of tariff reduction, under the auspices of the GATT framework and the impressive growth figures of world trade in statistical terms served to reinforce the credibility of free trade policy.

The boom in world trade witnessed between the Second World War and 1973 was not altogether a matter of coincidence as the author seems to believe. His contentions would deny the positive role played by institutions like GATT and UNCTAD in spreading the ethos of free trade, even though it was an environment in which the developed countries did not have strong reasons for questioning such an ethos. Shutt would have nothing of these; he even refuses to credit the post-War period with having been freer than in any previous epoch since the Industrial Revolution. According to Shutt, several factors in the objective economic conjuncture of the world militated against translation into actual practice of frequent official pronouncements on the virtues of free trade.

In the first place, at the national level, governments felt obliged to interfere with, and manipulate, market forces in the interest of macro-economic stability and/or distributional equity. But once the legitimacy of interference with market forces was conceded or at least claimed at the national level, it became increas-

ingly difficult to resist the pleas and demands for similar interference and manipulation of those forces at the international level. Moreover, the form and degree of state intervention varied considerably as between national economies. This uneven application of state interventions injected "inconsistencies and inequities" into the individual national economic systems. The author brings out at later stages of the book that these disparate interventionist practices on the part of national governments in regard to their domestic economies engendered a general feeling, particularly among governments and business enterprises, that the superior comparative advantage of other countries was not natural, but the result of control and cultivation of the economic variables, and hence it was not incumbent on them to conduct trade with other countries in accordance with perceived comparative advantage of different nations at the given point of time (especially pp. 172-173).

A forceful argument made by the author to substantiate his contention regarding the inherent nature of interventionist proclivity on the international trade scene is his observation about UNCTAD. UNCTAD was the product of the recognition by the international community of the handicaps imposed on the less developed countries by both rules and operations of the GATT. Its proclaimed objective was to "bring about changes in the structure and mechanisms of inter-national trade which would benefit the LDCs" (p. 21). But, to accomplish this, UNCTAD's strategy was not based on removal of the anomalies in the GATT so as to create conditions of free and fair competition in inter-national trade, but on creation of new distortions therein, calculated to favour LDCs. This tendency is exemplified by two of the main planks of policy which UNCTAD sought to have implemented : commodity price stabilization and tariff preferences for LDCs.

Another factor that increasingly drove countries to contravene dictates of free trade doctrine was the unemployment problem (in particular pp. 122-23 and 166-68). Indeed, in the post-war period, a central pre-occupation of economic policy makers was the need to minimize unemployment (p. 122). In this context,

he reveals the stark reality of the unemployment problem in the OECD countries : in the decade between 1973 and 1983, the "number of recorded unemployed" increased from under 10 million to over 32 million (or from little over 3 per cent to around 9 per cent of the labour force). The author puts the attitudinal reality at the policy making level succinctly, when he says that "the commitment to fight unemployment is stronger among most governments than their commitment to the rules of the GATT" - here he is referring to the OECD governments (p. 122).

A crucial factor reinforcing the impact of employment question on trade policy has been the fact that technological unemployment, far from being a myth, as many economists had previously imagined, had become a reality in OECD countries, at least since the early 1970s. The OECD governments fostered what are called "the new technology industries" for strategic reasons with lavish state subsidies. But the impact of these new technology developments on employment was mainly negative because of the enormous productivity gains which they bring with them (p.123). This has meant progressively smaller employment gains from higher economic growth. Shutt even maintains that the relevance of orthodox trade theory is limited by chronic and massive excess supply over demand for productive factors in general and for labour in particular (p.173). In this connection, he cites Joan Robinson in her The New Merchantilism to the effect that full employment is one of the principal assumptions of the classical free trade theory. From this presumed postulate of classical trade theory, he goes on to portray a very pessimistic future for a policy of free trade among nations, when he affirms that "even with sustained world wide growth rates far higher than those attained in the 1950s and 1960s, it is inconceivable that it will be possible to absorb the global supply of manpower into the labour market on the basis of what is conventionally understood as full employment" (p.173).

At this stage, one is entitled to take issue with Shutt. The above argument (including that of J. Robinson cited in the context) involves the acceptance of the employment argument for protection. Students of international

economics are aware of the effective demolition of this employment case for protection by Professor Haberler in one of his classic contributions*. In particular, it may be pointed out that the case for free trade is not necessarily weakened by the presence of unemployment. For, given the comparative inefficiency of the import-competing industry, more jobs would be created in the economy as a whole by deploying the productive factors in the export or purely domestic (non-traded) industries instead of deploying them in the former, especially since higher national income, which results from relatively higher efficiency in the latter, makes for higher aggregate demand, and hence higher aggregate employment. Moreover, viewed in the global setting, any employment gain in the import competing industry in a country is bound to be offset by employment losses in its export industry, since one country's import competing industry is another's export industry, and country A, seeing Country B solving its unemployment problem through protection of import competing industry, is likely to emulate the latter sooner or later. Indeed, Shutt's own finding of a more than three-fold increase in the numbers of jobless in the OECD countries between 1973 and 1983 (referred to above) even in the face of an increasingly protectionist trade policy in these countries casts serious doubt on the possibility of lasting employment gain from a protectionist trade policy. Of course, this is not to gainsay the fact that mounting unemployment has been the major political and psychological pressure behind interventionist commercial policy in the industrialized countries since the late 1960s. But this policy stance has been due to the generally incorrect and inadequate comprehension on the part of politicians and the public of the theoretical import and practical lessons of international economics.

The author has many illuminating instances to say regarding the excessive export-bias on the part of policy makers in the post-war era, a bias which very much contributed to distortions in trade flows. Even at the height of post-war enthusiasm for open trade, there has

* "Some Problems in the Pure Theory of International Trade"; Economic Journal, June 1950.

always been a preference on the part of countries to be in surplus rather than in deficit on their external account. "This perception obviously leads to a tendency to regard exports as more desirable than imports..."(p.94) As regards the obsession with, or at any rate over-emphasis on, exports, the author's observations on the developed countries' approach even to development aid to LDCs as a means of export promotion, bring out certain interesting examples (pp. 96-101). The export promotion motive is so overwhelming that the aid budgets of the OECD countries have often been used to finance even projects of countries that are not normally recipients of aid from the particular government concerned. He demonstrates the blatant manner in which development aid has been systematically deployed for the purpose of export promotion in that in many instances, even the project costs incurred in the currency of the recipient country were excluded from the the scope of aid so as to tie the entire amount of aid to purchases of goods or services in the donor country (p.100).

There are several other peripheral points and observations which Shutt makes either as circumstantial causes or as practical outcomes of national distortions of trade flows or simply as some of the objective features thereof. Of these, only a few may be mentioned. For instance, concerning the role of multinationals, he makes the observation that their intra-company trading significantly influences the pattern and volume of world trade. He gives what he calls his rough estimate that well over 40% of exports and imports effected by multinationals are in fact transfers between the subsidiaries of the same group, thus by definition virtually immune to any genuine competitive pressure (p.54). He then goes on to make the logical deduction from this fact to the effect that the observed spectacular growth in world trade in the post-war period cannot all be attributed to an active pursuit of free trade policy by governments.

Regarding the debt crisis of developing countries. Shutt brings out its two main adverse effects on the world trading system (pp.132-133). First, its immediate direct impact is to reduce the imports of LDCs, as they

have to set aside increasing proportion of their foreign exchange earnings for debt servicing; this cannot but have a depressing effect on the overall quantum of world trade. However, a more long-term and far reaching effect of the debt crisis has been the increasing resort to barter, or as it has come to be known in modern parlance, "countertrade". Since the late 1970s, LDCs, with their hard currency foreign exchange reserves severely depleted, have found barter to be the only means of paying for essential imports. A very noteworthy point in this connection is his allusion to an "authoritative estimate" that share of world trade accounted for by counter-trade increased from under 15 per cent in 1979 to nearly 30 per cent in 1982.

Although, Shutt describes copiously the tendencies towards, and actual measures of, interference with and distortions of market forces in general at the national level and trade in particular at the international level, his conclusions are far from adverse to the desirability of trade or even more trade among sovereign nations. For, as he puts it so categorically in the penultimate chapter (entitled "The Inevitability of Managed Trade"): "However, in rejecting the notion that free trade is a pre-condition of prosperity it is important to avoid falling into the opposite conventional trap of assuming that the road of protectionism can lead to long-term salvation". "For whatever reservations one may have as to the orthodox arguments in favour of 'free' trade, the economic history of the post-war world surely does confirm the view that the opportunity of engaging in trade with other countries makes possible the attainment of far higher levels of prosperity than would be the case under conditions of traditional protectionism or economic isolationism" (p.161).

Since Shutt is of the firm conviction that free trade in the classical sense of complete absence of governmental restrictions or any other sort of interference can only be a myth and since as a corollary, manipulations, patronages and controls are already inseparable features of trade among nations, he prescribes "managed trading" in the sense of nationally conceived and co-operatively operated system of interventions as the best possible dispensation for durability and growth of international trade (in particular pp.162, 173, 174, 176,

177 and 183). This is because he believes that a regime of nationally formulated and operated system of interventions in the market entails "international instability and disintegration" (p.174). Indeed, according to his perception, the trend has already set in during the 1980s towards collaboration rather than competition in the pattern of commercial relations among countries (p.173). What is necessary is to make this collaborative approach globally planned and much more broad-based. According to him, cartelization and barter-trading would inevitably be prominent features of a planned world trading system (p.176). Regarding cartelization, he maintains that moves towards cartelizing the export markets for steel among EEC & USA and the Multi-Fibre Agreement already in force may provide the model for stabilizing other world markets in chronic over-supply. He even points out that already many other markets for manufactured goods are cartelized to a considerable extent, as a result of growing trend towards joint ventures and collaboration in marketing between multinational companies (p.177). As a precondition to the system of planned and managed world trade, he calls for a change of emphasis, and the essence of this change must be explicit recognition of subordination of principles of competition, to requirements of equity and stability (p.182). Viewed in the light of such a standpoint, his advocacy of cartelization should cause no surprise. He also stresses that a global regime of planned trade should be linked to creation of a machinery for collective allocation amongst countries of productive capacity in the main sectors entering international trade.

Finally, it needs to be pointed out explicitly that the author's analysis and judgement of trade policies in the post-war world centre on the developed countries. Of course, there are allusions to, and even some descriptions of, conditions and policy approaches of developing countries. But on closer examination, they turn out to be a mere adjunct to the overall picture that he seeks to portray of the conditions, attitudes and policy measures of the developed countries.

Y. Kalyanaraman*

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Review Article - 2

OUTLIERS IN STATISTICAL DATA

By

Vic Barnett and Toby Lewis

(John-wiley & Sons, New York, 1984, Page 422, \$ 54.95)

The treatment of outliers has fascinated many experimentalists since the earliest attempts to interpret data because the outliers, though forming a part of the data set cast substantial influence on the estimated parameters and other statistical measures. Ever since man attempted to collect data and used the implicit information to analyse the world he lives in, the problem of doubtful values has been recognised and several procedures have been evolved for their treatment. As early as in 1777, Daniel Bernoulli in his writings about the combination of astronomical observations felt that there are certain observations (data points) which are inconsistent with the remaining data. Some researchers like Bernoulli, Bessel, and Baeuer felt that one should not reject an observation simply because of its large deviation, whereas others like Boscovich (1755) and Legendre (1805) recommended the rejection of some such observations altogether. Those who recommended rejection felt that such numbers were unrepresentative, 'spurious' or 'mavericks' or 'rogues'. Thus, controversy about the treatment of such observations in data analysis has been an age-old topic in statistical literature. In this fascinating area of statistics, the recent book *Outliers in Statistical Data* by Vic Barnett and Toby Lewis, which is based on recent results, is a welcome one. Work on this subject is scattered throughout the literature and the Authors have drawn up the material for the Book from more than 400 references. The book contains 13 chapters and an Appendix of Statistical tables. These Statistical tables will be very useful for the practical workers in the usage of different procedures.

An outlier, in a set of data, is an 'observation' (or a sub-set of observations) which appears to be inconsistent with the remainder of that data set. Here the phrase 'appears to be inconsistent' is really crucial as a matter which acquires a subjective character being subject to judgement. The problem posed by outliers is, how should one react to the outliers and what methods should be used to support rejecting them or adjusting their values prior to processing the mass of data. To a large extent the answer depends on the population under consideration. The purpose of evolving statistical methods for examining outliers is, in broad terms, to provide means of assessing whether the subjective declaration on the presence of outliers in a particular set of data has important objective implications for further analysis of the data.

Before we go in for the actual methods for identifying and deriving tests for outliers, it is important to distinguish between various terms like extreme values, outliers, contaminants etc. Suppose we have a random sample of size n

$$X_1, X_2, \dots, X_n$$

from a distribution whose form we denote by F . If we order the sample in any chosen manner as

$$X(1) \quad X(2) \quad \dots \quad X(n)$$

then the observations $X(1)$ and $X(n)$ are regarded as extremes; whether they are termed as outliers depend on their relation to the postulated model. Therefore, the extreme values may or may not be outliers but the outliers however, are always extreme. Suppose that not all of the above observations are from the distribution ' F ' but one or two are from a distribution ' G ', then these observations coming from ' G ' are called 'contaminants'. The 'contaminants' may appear as outliers but they neednot always be so. Of course we have no means of knowing fully whether or not an observation is contaminant.

Outliers arise from purely deterministic reasons : viz., reading, recording or calculating error in the data.

When it is obvious that outlier is due to deterministic reasons, the remedy is simple. Such sample values should be removed from the sample or they may be replaced by corrected values. Execution faults in assembling the data can also yield outliers of deterministic nature for e.g., from the sample of men, one of the sample member is a woman. As long as they can be identified, no statistical procedure is required to tackle such outliers, but if there is no tangible explanation for source of an outlier, and its presence can be considered as inexplicable or random, then the statistical approach for their treatment becomes relevant. Different ways in which outliers arise may be categorised into three simple categories :-

1) Inherent variability

Observations vary over the population and such a variation is a natural phenomenon of the population.

2) Measurement error

Inadequacy in the measuring instrument while making measurements superimpose a further degree of variability.

3) Execution error

Imperfect collection of data. An obvious measurement error supports rejection of the offending observation and the outlier in the form of execution error may also lead to rejection but it could warrant a modified model.

Relevant Statistical Procedures for Handling Outliers

The book under review is the second edition incorporating additional and latest research work being done in the field of detection and testing of outliers. The first two chapters are more or less introductory in nature explaining the earlier attempts for tackling the problem of outliers and give a brief review of various tests under alternative hypotheses for testing the outliers. The broad procedures are indicated below :-

a) Accommodation of outliers

Statistical methods designed to draw valid inference about the population from which a random sample has been obtained and which will not be seriously distorted by the presence of outliers will be termed as 'accommodation procedures' i.e., they accommodate the outliers at no serious inconvenience or are robust against the presence of outliers.

In the case of accommodation of outliers, the extreme prospect is that we decide to reject the outliers prior to estimation or testing either because of clear tangible explanations of their presence or following a test of discordancy based on a confidently assumed model. But interest in robustness against testing of outliers denies any great confidence in the appropriate model and preliminary tests of discordancy may not be feasible or desirable (See Chapters 3 & 4).

b) Discordancy tests

The Second type of statistical method for handling outliers is that of testing of outliers with the prospect of rejecting it from the data set. If the interest is directed towards inferring characteristics of the basic model, then outliers have only nuisance value and one should employ robust methods of analysis to minimise their impact. On the other hand, when one wishes to reject discordant outliers as manifestation of contamination, discordancy tests have to be used (See Chapter 5).

Chapter 3 focusses attention on the principles of robust estimation and testing for univariate samples of n observation of F . Assuming that F is normal, ideas have been developed and later on extended to other types of distributions also. Detailed proposals for practical uses in univariate samples are reviewed in Chapter 4.

Chapter 5 deals with construction of discordancy test statistics, their basis for construction and their performance. This chapter also deals with multiple outlier problems and the corresponding discordancy tests.

Based on these general principles and procedures for discordancy tests, Chapter 6 presents detailed information on a wide range of useful tests. The useful means firstly that the test performs reasonably well in relation to some meaningful alternative hypothesis and secondly some information on percentage points is available - at least an inequality if not an extensive tabulation. The useful tests for the main type of distributions like Gamma and Normal distributions are examined in detail. Some tests for samples from other distributions including Log-normal, Truncated Exponential, Uniform, Weibull, Pareto, Binomial and Poisson distributions are also discussed in this Chapter.

Situations often arise where the data are in the form of directions in a plane or in the space. Directional data are often met in astronomy, biology, geology, medicine and meteorology. Procedures for accommodating or by discordancy testing with consequent identification or rejection of outliers in the directional data, have been developed since 1970. The authors present an account of the treatment of outliers on the circle, and outliers on the sphere in Chapter 7.

Chapter 8 deals with a different type of outlier problem which arises in situations where a set of data has been divided into distinct subsamples. Chapter 9 deals with the problem of outliers in multi-variate data. Accommodation of outliers in multivariate data are some what less developed. In this chapter methods that are available have been reviewed and discordancy tests have been developed.

In Chapter 10, the authors discuss the outlier problems for structured data. Structured situations arise where a variable of principal interest vary with value of other variables or with time. The former leads to regression models and the latter to time series models. The influence of different qualitative or quantitative factors on the principal variable leads to additive model which can be analysed by analysis of variance techniques. In structured situations, outlier is not a simple extreme value but has a more pattern disrupting form. It will have an influence on the analysis of the underlying relationship. It can, for example, distort the estimates

of intercept and slope parameters and will certainly inflate their standard errors in the case of linear models. Many published results on outliers in structured models examine the disruption of pattern by the outliers through the behaviour of residuals. The authors in this chapter review the available literature of treatment of outliers in the context of linear regression, general linear models and designed experiments and suggested various tests.

In Chapter 11, outliers that arise in time series models are dealt with. The authors feel that much remains to be done in developing the procedures for handling outliers in time series.

Chapter 12 on 'Bayesian approach to outliers' deals in detail with some of the specific Bayesian proposals that have been made for testing the discordancy of outliers or for coping with their presence in 'contaminated' data. The chapter concerns mainly with univariate data since most contributions are in this area. The authors cite references, particularly for multivariate or structured-data situations.

The authors mention in Chapter 13, in perspective, that current research activity centres largely on informal methods in highly structured situations and on refinements of understanding of familiar univariate and multivariate single sample procedures. Eventhough more results are available, the authors have suggested that much more remains to be done. Many of the outlier-generating models warrant further investigations. The authors conclude emphasizing that outliers exist as part of experimentalists' reality and of the analyst's inescapable responsibility.

Some topics are treated rather briefly and the brevity defeats the author's aim of providing a springboard for further exploration of this fascinating statistical area. This book is for the graduate level in statistics and the authors have used elegant abbreviations for cataloguing discordancy tests for outliers in univariate samples. Of course, some common practices are omitted. For example, there is no mention of modifying the sample mean after detecting outliers by using

methods based on principles of Quality Control. Shippage tests are out of place in the context of outliers.

As much of the analyst's work is based on data generated under circumstances which are not under his control, this book presents a highly useful material for treatment of outliers in different situations and helps them to draw proper and justifiable conclusions.

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