Specification of Integrated Social Sector Revenue and Expenditure Planning Model

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INTEGRATED SOCIAL SECTOR REVENUE AND EXPENDITURE PLANNING MODEL

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OUTLINE OF THE REPORT

CHAPTER ONE

INTRODUCTION

Existing government (federal/provincial/local) practice of expenditure planning does not employ an integrated method for the delivery of public services. Consequently, public investment allocations are made on *an adhoc* short-term basis independently of resource mobilisation strategies and furthermore without proper assessment of government financing constraints, particularly of downstream recurring expenditures arising from development outlays. This type of planning exercise is also incapable of linking the quantum of funds required for public investments to the need for additional resources which will be viable and sustainable in the long-run.

During an earlier phase of the CIDA commissioned work, an expenditure planning model for the social sectors was prepared. However, no attempt was made to capture its links with the resources available to the provinces, the links that such social sector investments have with the rest of the macro-economy and the inter-relationship of the provinces with the federal government and the local governments. There are however, two other econometric models on Pakistan's economy one developed by the *Pakistan Institute of Development Economics* and the other by the *Applied Economics Research Centre*. The *PIDE Macroeconometric Model* is comprehensive and was developed with a view to address the policy issues only at the macro level. On the other hand the the *AERC Public Finance Model* is rich on public finance side wherein they have developed fiscal linkages between diffferent levels of governments and addressed issues primarily pertaining to resource mobilisation. Both these models were developed without incorporating the social sectors problems and issues and its ensuing impact on the macroeconomy.

In his recent speech (August 20th, 1993) outlining the comprehensive "Economic Package Program" the Caretaker Prime Minister reiterated the need and importance of the social sector development in Pakistan. In fact, one of the four key points of his pakage program pertains to "restore health to the social order". In his speech, he also committed to revamp and expediate the implementation of the existing "Social Action

Programme (SAP)" by providing additional funds of 50 percent of current allocations for this purpose.

In view of these considerations the objective of this paper is to develop a comprehensive integrated planning macroeconometric model which will establish linkages between macroeconomy, public finance and expenditure as well as the social sector. Within the framework of this planning model we will be able to address a number of issues. These include the sustainability of the Social Action Programme, the implications for future resource generation by the provinces and local governments, the extent of devolution that can take place, the optimal investment mix for the ADPs, the size of the resource gap and the modalities for financing this and the implications of SAP on the macroeconomy at large.

To attain these objectives the work will need to be completed in two stages. Stage I, which consists of the output of this paper identifies the framework and develops the specifications for the integrated social sector planning model. Data collection, estimation, validation of the model and policy simulations will be undertaken in Stage II of the project.

CHAPTER TWO

STRUCTURE OF THE MODEL

The model consists of three modules as follows:

(i) macro economy module
(ii) fiscal module
(iii) social sector module

Within each module, there are blocks of equations as given in the following sections.

2.1 MACRO ECONOMY MODULE

This module consists of five blocks as follows:

(i) macro production block
(ii) macro input block
(iii) macro expenditure block
(iv) trade block
(v) monetary block

The first block contains equations for the level of output in different sectors of the economy, the second for factor inputs into different sectors, the third for expenditure components like consumption expenditure, investment, etc. in the GNP, the fourth for imports and exports and the last for changes in money supply and the price level.

2.2 FISCAL MODULE

This module has eight blocks as follows:

(i) federal revenue block
(ii) federal expenditure block
(iii) federal budget deficit block
(iv) provincial revenue block
(v) provincial expenditure block
(vi) provincial budget deficit block
(vii) local revenue block
(viii) local expenditure block

For each of government we have in the revenue block equations for the principal sources of revenue and in the expenditure block for major components of expenditure. There is no local budget deficit block because, in the absence of access to borrowing, it is assumed that on the average local budgets are balanced.

2.3 SOCIAL SECTOR MODULE

The social sector module consists of four blocks as follows:

(i) planning targets
(ii) social sector output
(iii) human capital index
(iv) public health index

The first block determines expenditure requirements for development of the social sector based on planning targets while the second quantifies outputs from the education system and entrants into the labor force along with the level of health coverage. The former is used for constructing the human capital index and the latter for deriving the public health index.

CHAPTER THREE
THE MACRO MODULE

The Macro Module is divided into five separate blocks namely, Macro Production Block, Macro Input Block, Macro Expenditure Block, Trade Block and Monetary Block. Altogether there are twenty three (23) equations in the Macro Sub-Module of which eleven are behavioural and twelve are identities. With the exception of one behavioural equation in the Monetary Block all remaining equations are simultaneous in nature. In the following we discuss the specifications, structure and economic rationale for each block.

3.1 MACRO PRODUCTION BLOCK

Out of the six equations in the Production Block, three of them are behavioural and the other equations are identities. The first identity essentially defines the total output produced within the national boundaries known as gross domestic product (Y) which is simply the sum of value added in manufacturing (Y_M), agriculture (Y_A), and other services (Y_O). When net factor income from abroad (NFI) is added to the gross domestic product it generates gross national income (Y_N). The third identity simply determines the non-agricultural value added (Y_{NA}) residually from Y. These value added measures considered are expected to influence directly the Fiscal Module in the form of tax bases. The three identities in the Macro Block are defined as follows:

$$Y = Y_A + Y_M + Y_S \qquad (1)$$

$$Y_{NA} = Y - Y_A \qquad (2)$$

$$Y_N = Y + \overline{NFI}$$

Since the major focus of this study is on social sector development, along with the standard factor inputs viz., labour and capital we have also introduced two key socio-economic variables namely, human capital index (HCI) and public health index (PHI). The rationale for including these variables is based on the theoretical argument that the production technology is **Hicks-neutral** with regard to the social variables. That is, an increment in either HCI or PHI at the margin will not only make labour more efficient

but it will also enable the worker to use capital effectively. Thus at the margin an increase in HCI or PHI will lead to a saving of both labour and capital inputs in the production process. Under a competitive free market every thing else being equal HCI or PHI will be output augmenting. The two social variables are assumed to be exogenous and the procedure to construct them are explained in Sections 6.5 and 6.6. The production functions for agriculture, manufacturing and other services are given as:

$$Y_A = f(L_A, \overline{HCI_A}, \bar{A}, \bar{T}) \quad (4)$$

$$Y_M = f(K_M, L_M, \overline{HCI_M}, \overline{PHI}) \quad (5)$$

$$Y_S = f(Y_A + Y_M, I, \overline{RM}, RE, \overline{HCI_o}) \quad (6)$$

The agriculture sector production function represented by Equation (4) also includes two other essential inputs e.g., total cultivated ares (A) and number of tractors (T) which are assumed to be exogenous.

It is important to note that the production function for other services sector, shown in Equation 6, is a non-standard one wherein we have introduced outputs from manufacturing and agriculture sectors, total investment (I), public consumption or recurring expenditure (RE), remittances (RM) and human capital index for other services (HCI_o). The arguments for including these variables are as follows. The production of other service sector (Y_o), which consists of outputs such as transport and communications, etc., is basically driven by outputs produced in the manufacturing and agriculture sectors. A higher growth in these sectors will place demand for the output in the services sector and thus stimulate production for Y_o. Total investment (I) variable on the other is simply a proxy for capital used in the services sector while the inclusion of RE may be rationalized on grounds that public consumption also creates demand for services. The flow of funds through remittances in Pakistan have been quite significant and it is believed that a portion of this money is expended in the service sector, particularly in the construction industry. The rationale for incorporating HCI_o is same as explained earlier for other two production functions. It must be noted that the social variable PHI will also have impact on Y_o indirectly through the presence of Y_M or Y_A. RM and HCI_o are assumed to be exogenous to the system.

3.2 MACRO INPUT DEMAND BLOCK

Input Demand Block contains two behavioural equations and an identity. Current input demand for capital stock in the manufacturing sector (K_M) which is an identity is simply defined as the last year's capital stock adjusted for depreciation rate (δ) plus the current new investment in manufacturing (I_M). Ideally, the input demand for capital should be a function of output and relative prices derived from first order condition of profit maximization. However, since the methodology of generating the capital stock series data for Pakistan is not theoretically sound, we have therefore opted to use the definitional approach to generate the capital stock data for manufacturing sector using the following equation:

$$K_M = (1 - \delta) * K_{M-1} + I_M \qquad (7)$$

The two labour input demand variables, one for manufacturing (L_M) and the other for agriculture (L_A), are determined behaviourally by the equations given below:

$$L_M = f(Y_M, K_M) \qquad (8)$$

$$L_A = f(Y_A, \overline{PROP}) \qquad (9)$$

Again both input demand functions are based on a pragmatic approach consistent with Pakistan's economy and on the availability of reliable data. Due to lack of free competitive market determined interest and wage rates we have alternatively used capital stock and rural population (RPOP) variables as a proxy for opportunity cost of labour input demand.

3.3 MACRO EXPENDITURE BLOCK

There are three behavioural equations and six identities in Macro Expenditure Block. Of the three behavioural equations two of them represent the investment demand for total private sector (I_P) and manufacturing (I_M) sector, respectively and the third one is simply the demand for total private consumption (C_P).

The behaviour of total private consumption (C_P) is based on the Keynesian approach wherein C_P is determined by national income (Y_N) and exogenous interest rate (INT). The exogenous remittance (RM) coming from abroad is expected to affect consumption positively because of wealth effect.

$$C_P = f(Y_N, C_{P-1}, \overline{INT}, \overline{RM}) \quad (10)$$

Factors determining the investment demand functions are based on standard neoclassical theory where changes in income ($\triangle Y$) representing "accelerator" influence investment positively while interest rate, assumed to be exogenous, reflects the opportunity cost and is expected to have negative impact. The predetermined lagged investment variables (I_{P-1} or I_{M-1}) capture the adjustment cost of capital. We have also introduced development expenditures (DE) to allow for the impact of public infrastructure building on private investment demand. A positive value on this coefficient will establish the complementarity of public investment vis-a-vis private investment. Due to crucial importance of remittances on Pakistan's economy this variable is also included in the investment demand function and its is expected to complement the investment. Investment demand for sectors other than manufacturing is residually determined by subtracting it from total private investment. The two behavioural equations and an identity for private investment are given below:

$$I_P = f(\triangle Y, INT, I_{P-1}, [DE_P + DE_p], \overline{RM}) \quad (11)$$

$$I_M = f(\triangle Y_M, \overline{INT}, I_{M-1}, DE\ \overline{RM}) \quad (12)$$

$$I_O = I_P - I_M \quad (13)$$

The total recurring expenditure (RE) is simply the sum of outlays expended at all three levels of government while the total development expenditure (DE) is the sum of corresponding federal (DE_F) and provincial expenditures (DE_p). The local component of development expenditure is relatively insignificant thus it has been excluded from the development expenditure. The two identities representing public recurring and development expenditure are given as:

$$RE = \overline{RE_P} + \overline{RE_p} + \overline{RE_I} \quad (14)$$

$$DE = DE_p + DE_p \quad (15)$$

Given Equations 11 to 14 the total investment (I) is simply the sum of private and public investment while the total consumption (C) is the aggregate of consumption by these two sectors. The identities for total consumption and investment (I) are shown below:

$$I = I_p + DE \qquad (16)$$

$$C = C_p + RE \qquad (17)$$

With total gross domestic output (Y) determined from the Production Block and consumption and investment obtained from the Macro Expenditure Block the resources gap (RG) position of the country is simply the difference between total expenditure (C+I) and income as given below:

$$RG = C + I - Y \qquad (18)$$

3.4 TRADE AND MONETARY BLOCK

The Trade and Monetary Block is highly aggregated and accommodates only the broad macro aggregates. The basic module contains five equations of which three are behavioural and the other two are identities. Among the three behavioral equations two of them represent the trade sector while the other one is a price equation which exogenously determines the price index (PI) on the basis of lagged money to gross domestic income ratio ($(M/Y)_{-1}$), import prices (PI_{IMP}) and last years price index (PI_{-1}) as given below:

$$PI = f(\overline{PI_{IMP}},\ (M/Y)_{-1},\ PI_{-1}) \qquad (19)$$

The import demand (IMP) and export supply (X) equations are based on the standard macroeconomic theory. Pakistan being a small open economy compared to rest of world, the import demand is thus expected to be determined negatively due to higher exogenous relative import prices (PI_{IMP}) and positively due to domestic income and lagged imports (IMP_{-1}). On the other hand, export supply should respond positively due to higher relative world price for export (WPI_x), and outputs in the manufacturing and agricultural sectors. It should be noted that relative prices for import and world prices for export (WPI_x) are implicitly adjusted for exchange rates. The import demand and export supply functions are given below:

$$IMP = f(\overline{PI_{IMP}}, Y, IMP_{-1}) \quad (20)$$

$$X = f(\overline{WPI_x}, Y_A, Y_M) \quad (21)$$

Given imports and exports from Equations 20 and 21, the current account gap (CG) identity is represented by the following identity:

$$CG = \overline{PI_M} * IMP - \overline{WPI_x} * x - \overline{RM} * PI \quad (22)$$

Following Aghevli and Sassanpour (1991) approach, the monetary expansion identity can be written as:

$$\triangle M = (BDEF_F + BDEF_P) * \overline{PI} + CG + \gamma(PI*Y) \quad (23)$$

The first two variables on the right hand side of the above equation represent the total federal ($BDEF_F$) and provincial ($BDEF_P$) deficit in constant rupees. Multiplying these two variable by the price index converts the deficit in current value. The last entity in the above equation, γ (PI*Y), is a proxy for domestic credit creation.

CHAPTER FOUR

THE FISCAL MODULE

4.1 FEDERAL REVENUE BLOCK

4.1.1 Discretionary Changes in Taxes

The first four equations in this block specify exogenously the discretionary change in tax revenues from the four major federal taxes, viz., import duties, sales tax, excise duty and income tax, respectively. Therefore, it is possible through these equations to capture different levels of resource mobilization in any particular year as embodied in taxation proposals announced in the federal budget for any particular year.

4.1.2 Revenue from Taxes

The next four equations are for revenues from the respective tax sources. In each equation we have one variable for the tax bases. For example, in the case of import duties it is the total value of imports, in the case of income tax it is the gross domestic product, and so on. Another variable represents the discretionary change in revenues during a particular year [$DESF_k$] while the third variable measures the level of fiscal efforts, as follows:

$$IF_t = \sum_{i-t}^{t} \left| \frac{DC_k}{TB_k} \right|_{t-i} \qquad (1)$$

where,

IF_t = Index of Fiscal Effort in year t,

DC = Discretionary Change in revenues and

TB = Tax Base.

Therefore, revenues from major sources are given by:

$$TRF_k = f(TB_k, DESF_k, IF_k) \qquad (2)$$

where

TB_k = Tax base for the kth tax

4.1.3 Non-Tax and Miscellaneous Revenues

Non-tax and miscellaneous revenues, which account for an relatively small portion of federal revenue receipts, are assumed to be exogenous to the model.

4.1.4 Receipts from Public Enterprises

These are taken to depend upon the national income and revenues in the previous year. Specifically, receipts from public enterprises [RPA_F] are given by :

$$RPA_F = f(RPA_{F-1}, Y) \qquad (3)$$

4.1.5 Divisible Pool Transfers from Federal Taxes

This is an important variable and constitute the primary link between the federal and the provincial revenue blocks. The transfer depends upon revenues from income tax, sales tax and excise duty, which form part of the divisible pool.

4.1.6 Total Divisible Pool Transfers

This includes the revenues share of provinces in federal taxes [$DPTX_F$] and from other sources like the royalty on crude oil, profits from hydro-electricity and the development surcharge on natural gas [$SURO_F$]. That is, total divisible pool transfers [DPT_F] are:

$$DPT_F = DTPX_F + \overline{SURO_F} \qquad (4)$$

4.1.7 Net Revenue Receipts

The different revenue heads are aggregated together to yield the net revenue receipts after deducting divisible pool transfers.

4.1.8 Self Financing by Autonomous Corporations

The self financing by autonomous corporations (WAPDA, PTC and OGDC) is assumed as exogenous to the model as it depends largely on the policy adopted for fixing the level of administered prices. However, following the exclusion of WAPDA and PTC from the budget this variable has become of marginal importance.

4.2 FEDERAL EXPENDITURE BLOCK

4.2.1 Total Recurring Expenditure

Total recurring expenditure of the federal government consists of defence expenditure, interest on domestic and external debt, special grants to provinces and other recurring expenditure consisting of costs of general administration, services and subsidies. Defence expenditure is exogenous to the model.

4.2.2 Interest on Domestic Debt

Interest on domestic debt depends upon the total volume of outstanding debt at the end of the previous year [$DDEBT_F$] and the level of interest rates in the economy [INT]. Specifically,

$$INTDD_F = f(DDEBT_F, \overline{INT}) \qquad (5)$$

4.2.3 Interest on Foreign Debt

Here again, interest payment is taken as a function of the level of outstanding external debt. The interest rate is not explicitly included because of the limited change in terms of foreign borrowings over time.

4.2.4 Other Recurring Expenditure

Other recurring expenditure [ORE_F] is assumed to depend upon the resource position of the federal government as indicated by the level of net revenue receipts [NRR_F] and the level of this expenditure in the previous year. That is,

$$ORE_F = f(NRR_F, ORE_{F-1}) \qquad (6)$$

4.2.5 Development Expenditure

Development expenditure [DE_F] is taken to depend upon the 'throw forward' as represented by the level of this expenditure in the previous year, the gross inflow of foreign aid [GFB] and the resource position as indicated by net revenue receipts. Specifically,

$$DE_F = f(DE_{F-1}, \overline{GFB}, NRR_F) \quad (7)$$

4.2.6 Repayment of External Debt

This also depends upon the level of outstanding external debt.

4.3 FEDERAL BUDGET DEFICIT BLOCK

4.3.1 Outstanding External Debt

This is given by the identity whereby outstanding external debt at the end of particular year is equal to the debt at the beginning of the year plus net external borrowing during the year.

4.3.2 Outstanding Domestic Debt

This is equal to the outstanding debt at the beginning of the year plus domestic (bank and non-bank) borrowing.

4.3.3 Budget Deficit

The budget deficit [$BDEF_F$] corresponds to the gap between total expenditure consisting of recurring and development expenditure and total revenue as measured by the sum of net revenue receipts and self-financing by autonomous corporations. That is,

$$BDEF_F = DE_F + RE_F - NRR_F - \overline{SAB_F} \quad (8)$$

where

RE_F = Total Federal Recurring Expenditure,

SAB_F = Self Financing by Autonomous Corporations

4.4 PROVINCIAL REVENUE BLOCK

Revenue receipts of provincial governments consists of revenues generated from various tax and non tax sources (legislatively a subject of provincial governments), revenue sharing transfers from the federal government under the divisible pool and non-development grants from the federal government. On the development side, receipts by and large consist of development transfers from the federal government under the ADP. Therefore, for estimation purpose we have divided the provincial revenue block into the following categories.

4.4.1 Revenues from Own Taxes

Major tax sources of the provincial government include stomp duties on properties and other financial assets, motor vehicle tax, property tax (shared with the local governments) and other smaller sources like professional, trade and callings tax, entertainment tax, hotel tax, electricity duty, provincial excises etc. Revenues from major taxes are estimated behaviorally as a function of the Gross domestic Product (GDP) estimated in the macro production block. Besides, tax revenue equations capture both the cumulative impact of taxation proposals made historically, and revenue impact of taxation proposals announced in the provincial budget in a particular year. The latter is exogenously determined while the former is estimated by the index of fiscal effort, IFP_{kt}, as follows:

$$IFP_{kt} = \sum_{i-1}^{t} \left[\frac{DC_k}{TB_K} \right]_{t-i} \qquad (9)$$

where,

DC_k = Discretionary change in the 'kth' Tax and

TB_k = Tax base of the 'kth' Tax.

Therefore, tax revenues from the 'kth' source, TRP_k is estimated as:

$$TRP_k = f[Y, \overline{DESP_k}, \overline{IFP_k}] \qquad (10)$$

where

$DESP_k$ = Discretionary change from tax proposals from the kth source.

4.4.2 Non-Tax Revenues

User charges from various social and economic services are estimated recursively as a function of the recurring expenditure on particular services and its cost recovery ratio. This formulation allows the flexibility of changing cost recovery ratios in line which changes in policy. Specifically, non-tax revenue from the 'kth' source, $MTRP_k$, is given by:

$$NTRP_k = \lambda_k \overline{REP_k} \qquad (11)$$

where

Ξ_k = Cost recovery ratio for the 'kth' source,

REP_k = Recurring expenditure on the 'kth' services, which is determined outside the model.

4.4.3 Total Revenue Receipts

Total revenue receipts, GRR_p, are therefore, given by:

$$GRR_p = \sum_{k-1}^{n} TRP_k + \sum_{k-1}^{n} NTRP_k + \overline{DPT_F} + \overline{GP_p} \qquad (12)$$

where

DPT_F = Divisible pool transfers from the federal government,

GP_p = Non-development grants from the federal government.

Note that both these are determined in the federal revenue block and are exogenous to the provincial revenue block.

4.4.4 Development Transfers

Share of provincial governments in National annual development program (NADP) has historically been determined by the federal government and has largely remained exogenous to the provincial fiscal system. However, this model assumes that enhanced priority to social sectors ensure that funds required for social services will be made available. Therefore, development fund requirement of the provincial governments for the social sectors, based on the target coverage levels, are protected in the model. Development fund transfers for other sectors continue to be determined exogenously by the federal government. That is, development transfers to the provincial governments, $DETF_p$, is given by

$$DETF_p = \overline{DES_p} + \gamma[DE_f - \overline{DES_p}] \quad (13)$$

where

DES_p = Provincial development expenditures on social services,

μ = Share of provinces in NADP,

4.5 PROVINCIAL EXPENDITURE BLOCK

The Provincial Expenditure Block is divided in two sub-blocks. The first estimates the development expenditures of the provinces and the second the recurring expenditures incurred on governance, operations and maintenance.

4.5.1 Development Expenditure

In the social sectors, the development expenditures incurred by the federal and local governments are extracted from the target driven estimate of required expenditure to arrive at the estimate of development expenditure on social sectors [DES_p] by the provinces. Thus these are determined exogenously from the simultaneous equations framework of the main integrated expenditure planning model and the estimation equation is an accounting identity, given by equation 14, which sums the development expenditure on education [$DEED_p$], health [DEH_p], public health [$DEPH_p$] and population welfare [$DEPW_p$].

$$\overline{DES_p} = \overline{DEED_p} + \overline{DEH_p} + \overline{DEPH_p} + \overline{DEPW_p} \quad (14)$$

The principal economic service which the provinces provide is irrigation water. As this service has a considerable potential for revenue through increased user charges, the estimate of expenditure has been derived specifically (equation 15). The development expenditure on irrigation [$DEIR_p$] , and similarly on other services [$DEOT_p$], shown in equation (16), are explained by the residual of the development transfers from the federation and the development expenditure incurred on social sectors, revenue surplus (deficit) of the provinces and the development expenditure on the service(s) incurred in the previous year.

$$DEIR_p = f((DETF_p - \overline{DES_p}), RSD_p, DEIR_{p-1}) \quad (15)$$

$$DEOT_p = f((DETF_p - \overline{DES_p}),\ RSD_p,\ DEOT_{p-1}) \qquad (16)$$

4.5.2 Grants to Local Governments

The objective of devolution to local governments can be achieved only if a policy for support to local goverments is implemented. This can be encouraged by providing grants [GR_p] to these lower tiers of government such that the additional development work undertaken by local governments do not create a recurring liability which exceeds their ability to finance. Thus the level of grants (equation 17) will be determined by the local governments and is therefore exogenous (and thus recursive) to the provincial expenditure block.

$$GR_p = \overline{GR_p} \qquad (17)$$

The total development expenditure [DE_p] is an accounting identity (Equation 18) which sums the individually estimated expenditures.

$$DE_p = \overline{DES_p} + DEIR_p + DEOT_p + \overline{GR_p} \qquad (18)$$

As development expenditure by the provinces is financed from interest bearing transfers [$DETF_p$] from the federation, the current debt servicing [DS_p] is estimated by the recursive equation (19), which shows the relationship to be exogenous to the model and is based on the presious year's debt servicing and development transfers.

4.5.3 Recurring Expenditure

One of the principal concerns of provincial governments has been the long term downstream recurring expenditure [RE_p] (for salaries, operations, maintenance, etc.) impact of all development projects (both social and economic infrastructure). These have been estimated exogenously for each of the sectors shown in section 4.5.1 (see Chapter 5 for details). The following equation (20) aggregates these individually determined recurring expenditures.

$$RE_p = \overline{RRED_p} + \overline{REH_p} + \overline{REPH_p} + \overline{REPW_p} + \overline{REIR_p} + \overline{REOT_p} + DS_p \quad (20)$$

4.6 Provincial Budget Deficit Block

The budget deficit [$BDEF_p$] of the provincial governments is a function of the revenue surplus or deficit [RSD_p]. The latter is endogenous to the simultaneous equations model and is the residual of the gross revenue receipts [GRR_p] and the recurring expenditures [RE_p]. The former is the residual of the revenue surplus or deficit, the development expenditure and the development tranfers from the federation. These may be expressed as:

$$RSD_p = GRR_p - RE_p \quad (21)$$

$$BDEF_p = -RSD_p + DE_p - DETF_p \quad (22)$$

4.7 LOCAL REVENUE BLOCK

Turning to local finances, the model includes a block for local revenues and expenditures and is specified in such a way that a financially sustainable level of decentralisation is estimated.

4.7.1 Revenues from Taxes

The single largest source of urban local councils income is octroi levied on goods entering municipal limits for consumption directly or for processing by industries. In the case of rural areas, export tax, levied at the point of exit of goods from the district, is an important source of revenue. We estimate revenues from both these sources behaviourally. Revenues from octroi are made a function of private consumption and imports which constitute tax bases for the tax. Besides, the impact of past fiscal effort and taxation proposals in a particular year is also captured. Specifically, tax revenue from octroi, OCT_L is given by:

$$OCT_L = f[C_p, IMP, \overline{DESOCT_L}, \overline{INOCT_L}] \quad (23)$$

where

C_p	=	Private consumption
$DESOCT_L$	=	Discretionary changes
$INOCT_L$	=	Index of fiscal effort in octroi estimated in a similar manner as equation (1) and (9)

The tax base for export tax is taken to be value added in agriculture, value added in manufacturing (to account for rural industrialisation) discretionary tax changes and the fiscal effort index. Other local taxes are made a function of the GDP, discretionary tax changes and the index of fiscal effort.

4.7.2 Non-Tax Revenue

Like in the case of provincial non-tax revenues, user charges at local level are also made a function of recurring expenditures on particular services and the cost recovery rate. The rationale for this specification is the same as that for the provincial user charges. Cost recovery rate is used in the model as a policy parameter. That is:

$$NTRL_k = \alpha_k \; REL_k \quad (24)$$

4.7.3 Total Revenue Receipts

Total revenue receipts of local government is an aggregation of various tax and non-tax revenues.

4.8 LOCAL EXPENDITURE BLOCK

As in the case of provincial governments, local government recurring expenditures on various social services are estimated outside the main model. This is so because recurring expenditures on different sectors are not simultaneously affected by any variable within the model. By and large recurring expenditure on major social sectors are taken as a function of the throw-forward and the previous year's recurring expenditures. Therefore, these equations are essentially recursive to the model. Total recurring expenditure of the local government is an aggregation of local sectoral expenditures.

One of the important features of this model is that it estimates the financially sustainable level of devolution to the local government level. Financially sustainable level of devolution is defined to be that level of development expenditure, the entailing recurring liabilities of which are within the fiscal capacity of the local governments. For decentralisation to be meaningful and feasible it is important that development grant transfers from higher level of government are not used to finance recurring expenditures. Therefore, the model estimates total local development expenditures in such a way that all development grants from the provincial government are absorbed on the development side. Specifically,

$$DE_L = GRR_L + G_p + RE_L$$

$$\text{subject to } \mathbf{GRR_L > RE_L} \qquad (25)$$

where

DE_L = Total local development expenditure

GRR_L = Total local revenue receipts

RE_L = Total local recurring expenditure.

It may be noted that the specification of the local finance model ensures balanced budget. This specification is in line with the legislative requirement of balanced budget in the case of local governments.

CHAPTER FIVE

THE SOCIAL SECTOR MODULE

The social sector consists of a basket of services needed to improve the quality of life. The range of these services is vast and includes diverse sectors such as education, health, public health, population planning, social welfare, hygiene education, medical education, immunisation, etc. We have aggregated these into four sub-modules, namely, education, health, public health and population welfare. The Government of Pakistan has specified targets for a number of these sectors and for others has only stated the policy which will be adopted generally to improve the conditions in the sector. These are contained in the Social Action Programme, the proposed Eighth Five Year Plan and the Perspective Plan ending in 2003.

5.1 PLANNING TARGETS

It is generally felt that a rapid expansion in the provision of services in the social sectors would be unsustainable for two reasons. First, the time horizon specified for achieving target delivery levels is too small and cannot be achieved given both the absorptive capacity of the line departments and the ability to generate sufficient resources to match the target driven needs. Second, given the historical profile of fiscal effort by the provinces, the political feasibility of generating the resources to match the needs, even over a longer time horizon, is uncertain. The social sector output module will simulate the impact on expenditure (both development and recurring) and within the simultaneous equations framework establish the most feasible quantum of additional resources that could be generated to meet the revised targets. Thus the changes in the targets are parametric and are therefore a policy variable. These could, for instance, specify that female literacy would be lower than specified, that instead of constructing more schools, male schools could be also used for female education by introducing an additional shift. Another possible option could be to vary the role of the private sector and of community participation.

5.2 DETERMINATION OF OUTPUT FROM EDUCATION

The education sub-sector consists of primary education (with the principal objective of improving the literacy of the population), secondary education (ranging from classes 6

to 12), college education which also includes the post high school vocational education and post-graduate education provided through the universities.

The sub-module has been developed as a series of recursive equations the output of which feeds into the macro and fiscal modules. The recursivity has been developed such that the succeeding higher level links into the out-turn of the preceding lower level. The sub-module also provides an estimate of the quantum of drop-outs from the level of education at each level and uses a target specified drop-out rate for each level. Thus these can be varied to increase or decrease the output from the sector. Starting at the entry level the sub-module traces the flow of the relevant cohort of entrants until successful completion of education at the university level. This may be seen from the series of equations presented in Appendix 2.

The estimation equations are based on the demand for education and are used to determine the supply (the annual construction programme). The sub-module estimates the output and therefore the related costs separately for females and males, except in the case of university education.

5.2.1 Primary Education

The functional form of the initial equation (26) is behavioural in character. In a supply constrained situation the level of enrollment at the entry level is constrained by the numbers of available schools. Thus the dependant variable used is a measure of the rate of capacity utilisation, enrollment per school [ENRS]. This is explained by the number of teachers available for the first class at each level in each institution, the population of children at the entry level [TS], a lagged female literacy ratio [FLR], and the oppotunity cost of not entering the labour force in the urban, an illiterate worker's wage in the manufacturing sector [MWR] and in the rural areas, measured as ratio of the value added in agriculture per person in the rural labour force [Y_A/RLFS].

$$ENRS_t = \alpha_0 + \alpha_1 TS_{t-1} + \alpha_2 POP_{t-1} + \alpha_3 FLR_{t-i} + \alpha_4 MWR + \alpha_5 Y_A/RLFS \quad (26)$$

Total enrollment is the product of the enrollment per school and the number of schools available. The latter is exogenously determined such that targets are achieved in the

terminal year. Continuation of education beyond the entry level is a product of a policy variable, the continuing rate [δ] and the previous year's enrollment in the preceding class. It is this number which joins the labour force and is treated as illiterate. Total enrollment in primary schools is the result of summing the individual class enrollments for the year. This is controlled such that the enrollment rate [ENRR] does not exceed the target specified for the primary school going age group.

The total development cost of primary school education is determined as the product of the unit cost [UC], the number of schools started or completed in previous years [PS] and the share of expenditure incurred in each of two years [α, ß respectively for years 1 and 2]. This is shown functionally in equation (27)

$$DEST = \alpha\ UC\ PS_{t+2} + ß\ UC\ PS_{t+1} \qquad (27)$$

5.2.2 Secondary Education

The structure of the sub-module and the functional form of the initial estimation equation for entry at the level of class 6 is essentially the same. However, some of the explanatory variables are different. A comparison of equations (27) and (28) shows that the relevant age population has been replaced by the number of students completing primary school successfully in the previous year [$\delta_5\ ENR_{t-1}^5$]. In addition the opportunity cost has been captured by the average wage rate in manufacturing industry [MWR].

$$ENRS_t = \alpha_0 + \alpha_1\ TS_{t-1} + \alpha_2\ \delta_5\ ENR_{t-1}^5 + \alpha_3\ FLR_{t-1} + \alpha_4 MWR \qquad (28)$$

Subsequent throughput, from classes 7 to 12, have been aggregated and estimated as the product of the previous year's enrollment in class 6 [ENR^{56}] and the ratio of students continuing with their education [δ_6].

The costs of development have been estimated somewhat similarly to the stimation for primary education. However, the equation reflects the existing pattern of funds release, that is, three years for a secondary school. This can however be varied by changing the values of the allocation ratios for the three years [α_S, $ß_S$, σ_S].

5.2.3 College Education

This sub-set includes both general college education leading to a first degree and also vocational and technical education leading to the award of a diploma. The functional form and the structure of the estimation equations are the same as for secondary education.

5.2.4 University Education

The enrollment in and output from universities have been estimated separately for females and males. The functional form of the enrollment equation is shown in equation (29). Estimated separately for females and males the enrollment [ENRU] is explained by college throughput [CCOMP], a measure of non-agricultural income [Y_{NA}/ELF_{NA}] and the student ; teacher ratio [UT/ENRU].

$$ENRU_t = \alpha_0 + \alpha_1 CCOMP_{t-1} + \alpha_2 (Y_{NA}/ELF_{NA})_{t-1} + \alpha_3 (UT/ENRU)_{t-1} \quad (29)$$

The total enrollment is merely the result of aggregation. University completion is however determined by the product of an exogenously determined pass rate [δ_u] and enrollment.

The development expenditure on the universities is the sum of the previous year's expenditure on university education and a proportion of the approved throwforward cost of projects in the pipeline (equation 30) where [$\triangle_u$], the exogenous policy parameter governs the extent to which the throwforward [$THROW_U$] is to be met in the current year.

$$DEST_{Ut} = DEST_{Ut-1} + \triangle_u THROW_U \quad (30)$$

5.2.5 Costs of the Education Sector

The costs of the individual components of the education sector are aggregated in equation (31) to arrive at the estimate of development expenditure required to meet the targets [$DEST_{ED}$] specified by the planners.

$$DEST_{EDt} = \Sigma_i DEST_t \quad (31)$$

The expenditure incurred by the provincial governments is estimated by equation (32) and is the residual after deducting from the target driven expenditure, the total expenditure incurred by the federal [$DEST_U$] and local governments [$DDED_L$] and the amount invested by the private sector. This latter is determined as a share of the targeted expenditure requirements [α_{ped}].

$$DEED_{Pt} = DEST_{EDt} - \alpha_{ped} DEST_{EDt} - DEED_{Lt} - DEST_{Ut} \quad (33)$$

The recurring expenditure is dependant on the previous year's recurring and development expenditures (equation 34)

$$REED_{Pt} = f(REED_{Pt-1}, DEED_{Pt-1}) \quad (34)$$

5.3 DETERMINATION OF OUTPUT FROM PUBLIC HEALTH

Public health includes the provision of safe drinking water in both urban and rural areas, sanitation in the latter and sewage disposal in the former. Estimates of output are driven by targets and a non-linear capacity expansion path has been assumed to help achieve these targets. Appendix 2 contains the full set of estimation equations.

The output is measured as the numbers of people with access to the service [PCOV] and is the product of the pre-determined growth rate [GRATE] and the coverage in the previous year (equation 35). The functional form of the equation is the same for each of the four services. The growth rate can be varied to either accelerate or decelerate the coverage.

$$PCOV_t = GRATE * PCOV_{t-1} \quad (35)$$

The develpment cost incurred in each year to expand coverage is the per caput cost multiplied by the additional coverage for the year. Once again the functional form is the same for each of the four services, namely

$$DEST_t = (PCOV_{t+1} - PCOV_t)\ UC \quad (36)$$

The total development expenditure of the public health sector required to achieve tagets [$DEST_{PH}$] is the summation of all four services and is expressed as

$$DEST_{PHt} = \Sigma_t\ DEST_t \quad (37)$$

The provincial development expenditure on the sector is the residual of the local government expenditure [$DEPH_L$] deducted from the target driven outlay :

$$DEPH_{Pt} = DEST_{PHt} - DEPH_{Lt} \quad (38)$$

and the recurring expenditure incurred by the provinces [$REPH_p$] has the same functional form as for education, and is shown as :

$$REPH_{Pt} = f(REPH_{Pt-1},\ DEPH_{Pt-1}) \quad (39)$$

5.4 DETERMINATION OF OUTPUT FROM HEALTH

The health sector includes curative health care, through both primary (Basic Health Units [BHUs] and Maternity and Child Health Centres [MCH]), tertiary health care provided through the provision of hospital beds [BEDS], medical education (including the and preventive health care which is itself a basket of services. These latter include hygiene education, immunisation programmes, programmes designed to improve maternity and child health for reducing infant mortality and birth related deaths.

5.4.1 Curative Health Care

The output is measured as the number of BHUs, MCHs, and BEDS provided. The output of the first two has been measured as the gap between the targeted need and the existing availability, and this has been divided by the number of years between the base year and the target year. The output of beds is based on the previous year's availability of beds, BHUs and MCHs on the premise that an expansion will only be feasible if the support infrastructure is already present.

The target driven development costs for each component is estimated with an equation such as in (40) which estimates the development costs for BHUs :

$$DEST_t^{BHU} = \Sigma \alpha_{BHU} UC_{BHU} BHU_{t+1} \quad (40)$$

5.4.2 Medical Education

The output is meaured as the number of doctors [DOCT], nurses [NURS] and paramedics [PMED] paramedics trained and produced. The estimation equations for each of these outputs are given below and are self explanatory.

$$DOCT_t = f(BEDS_{t+i}, BHU_{t-i}, MCH_{t-i}) \quad (41)$$

$$NURS_t = f(DOCT_t, BEDS_{t-i}, BHU_{t-i}, MCH_{t-i}) \quad (42)$$

$$PMED_t = f(DOCT_t, BEDS_{t-i}, BHU_{t-i}, MCH_{t-i}, PMED_{t-1}) \quad (43)$$

The target development cost is determined with the help of

$$DEST_{MEt} = f(DEST_{MEt-1}, DOCT_{t+i}, NURS_{t+i}, PMED_{t+i}) \quad (44)$$

5.4.3 Preventive Health Care

The development costs of providing preventive health care is based on the future infant mortality rate [IMR], the number of females of child bearing age [FPOP] and the number of children aged upto and including 5 years and some measure of the previous year's expenditure. The functional form is :

$$DEST_{PHCt} = f(IMR_{t+n}, DEST_{PHCt-1}, FPOP_t, 5POP_t) \quad (45)$$

5.4.4 Expenditure on Health

The total development expenditure of the health sector required to achieve tagets [$DEST_H$] is the summation of all the three segments services and is expressed as :

$$DEST_{Ht} = \Sigma_i DEST_t \quad (46)$$

The provincial development expenditure on the sector is the residual (equation 47) of the local government expenditure [DEH_L] deducted from the target driven outlay,

$$DEH_{Pt} = DEST_{Ht} - DEH_{Lt} \quad (47)$$

and the recurring expenditure incurred by the provinces [REH_p] has the same functional form as for education, and is shown in equation (48)

$$REPH_{Pt} = f(REPH_{Pt-1}, DEPH_{Pt-1}) \quad (48)$$

5.5 POPULATION WELFARE

It is generally accepted that expenditure on population welfare impacts directly on the overall quality of life primarily as the result of a reduction in the population growth rate [PGR]. The impact is felt after a considerable time lage. Therefore, establishing the causality between the expenditure and the PGR requires data both on the explanatory variables and for a considerably long period of time. Such data is not available for Pakistan. As an alternative, an internal cross-sectional approach could be used. Information on a number of countries would be collected for both LDCs and NICs from available published statistics of the UN, its agencies and relevant journals.

The possible data needed would be female literacy ratio, overall level of literacy in the population, the per caput availability of medical facilities and personnel, the infant mortality rates, the level of immunisation achied by children and expenditure on population welfare. The functional form of the equation is :

$$PGR = f(FLR, LR, MCH/FPOP, DOCT/POP, NURS/POP, PMED/POP, DEST_{PWt-i}, IMR, IMM) \quad (49)$$

The derived coefficients would then be applied to the outputs from the earlier segments to estimate the PGR and thence the level of develoment expenditure.

5.5.1 Costs of Population Welfare

The development expenditure [$DEST_{PW}$] is a function of the PGR, the previous year's development expenditure on the sector and some proportion of the approved

throwforward (see equation 50). This proportion could be varied as a policy parameter to reduce the population growth rate and thus reduce the overall rates for achieving targets.

$$DEST_{PWt} = f(PGR, DEST_{PWt-1}, \triangle_{pw}THROW_{PW}) \quad (50)$$

The development and recurring expenditures by the provinces are deriveed in a somewhat similar manner to that for the health and other social sectors. The first is as a residual of the target driven requirement and expenditure by the other levels of government, and the second is a function of the preceding year's outlays.

5.6 HUMAN CAPITAL INDEX (HCI)

Two broad categories of indices representing social sector attributes are constructed in this section. The first group named *human capital index* **(HCI)** is expected to capture the quality aspect of labour based on their level of education and experience. *Public health index* (PHI) is the other type of index which will reflect the composite features of health and public health facilities. The methodology of constructing HCI is discussed first followed by PHI.

Theoretically, an index (I) consisting of n variables (X) expressed in same units can be constructed by first summing the weighted values of all n variables at period t. The changing profile of the index over a given period is then developed by deflating the weighted aggregate values by the base period figure. Given α_i as the weight for the ith variable, we can mathematically express the index as:

$$I_t = (\Sigma_{in}\ \alpha_i\ X_{i,t}) * 100 / (\Sigma_i\ \alpha_i^n\ X_{i,o}) \quad (51)$$

In developing the human capital index the weight assigned to each category of labour should reflect the level of education and skill. In order to capture these qualitative human attributes we have used the relative wage rates as the appropriate weight. This is based on the premise that in a free competitive market wage rate at the margin must be equal to the value of marginal productivity of a worker. Presumably, the productivity of labour is a direct reflection of the worker's education and skill levels.

In this study, we have constructed human capital index for manufacturing (M), agriculture (A) and other (O) sectors. For each sector, the labour has been categorized by level of education and profession reflecting human skills. Education levels are classified as:

a) Illiterate (I);
b) Primary (P);
c) Secondary (SD); and
d) College and other Technical and Professional degrees (CG).

On the other hand, the professional skills of the workers are divided into eight separate categories as given below:

a) Professional and Technical (PR);
b) Administrative and Managerial (MG);
c) Clerical (C);
d) Sales (S);
e) Service (SV);
f) Agricultural, Animal Husbandry, Forestry and Hunters(AA);
g) Production and Transport (PD); and
h) Other Occupation (O).

The construction of HCI requires explicit data on labour by both level of education and profession. However, the social expenditure module, as discussed earlier, only produces labour data by level of education. In order to convert the labour data by both categories simultaneously we have used the "Labour Force Survey" on percentage distribution. For example, given the probabilities that a manufacturing labour having administrative and managerial skills ($P(L_M \text{ and } L_{MG})$) and that the same worker also having a college degree ($P(L_{MG} \text{ and } L_{CG})$), the probability of an administrative worker in the manufacturing sector also having a college degree can thus be written as:

$$P(L_M \text{ and } L_{CG}) = P(L_M \text{ and } L_{MG}) * P(L_{MG} \text{ and } L_{CG}) \quad (52)$$

If we multiply the total number of labour having college education (provided by the expenditure module) with the above probability we obtain the data on total administrative manufacturing workers with college education ($L_{M,MG,CG}$).

Given the wage rates of an administrative manufacturing worker with college education ($L_{M,MG,CG}$) and considering the wage rate of the professional manufacturing worker with same education ($W_{M,PR,CG}$) as a numeraire the weight for the former worker is simply the ratio of the two wage rates.

Based on the formula for constructing an index as defined in Equation (1), the human capital index for kth sector at period t can be written as:

$$HCI_{kt} = \frac{(\sum_i^4 \sum_j^8 L_{k,i,j,t} * (W_{kj}/W_{k,PR})) * 100}{\sum_i \sum_j L_{k,i,j,o}} * (W_{kj}/W_{k,PR}) \qquad (53)$$

Where

i	=	level of education
j	=	professional occupation
t	=	1,...n
k	=	sector

An expanded version of the above equation used for constructing the human capital index for all three sectors namely, manufacturing (M), agriculture (AA) and other service (OS) sectors are presented separately in Appendix 3.

5.7 PUBLIC HEALTH INDEX (PHI)

As opposed to having variables in homogenous units for the composite index of human capital (i.e., labour), the indicators used to construct the public health index (PHI) entails health facilities in multiple units and dimensions. Thus relative price (in the form of wages) approach employed earlier to assign weights to each health indicator will be inappropriate. In order to circumvent the problems of "adding apples and oranges" in constructing the composite human capital index two techniques are commonly used in the literature (e.g. Pasha et. al. (?)). The first method involves generating standardized "Z-scores" values on each indicator with zero mean and unit variance. These standardized "Z-scores" on all indicators are then summed to construct the required composite health index. The Z-score technique is simpler but it is less appealing since it attaches equal weights to all indicators regardless of its importance.

The second approach entails generating weights for each "multidimensional" indicator based on "principle component analysis (PCA)" technique. Essentially, PCA generates

components in declining order based on their significance. Using the factor weights derived from principle component analysis (PCI) technique, the required PHI is constructed. In this study, we adopted the second approach to construct the PHI. Individual health indicators selected to design PHI are Hospitals, Dispensaries, Basic Health Units (BHU), Sub-Health Centres (SHC), Maternity & Child Health Centres (MCH), Rural Health Centres (RHC), T.B. Centres, Total Beds, Doctors, Dentists, Nurses, Midwives, Paramedics, Lady Health Visitors, Rural Water Supply (RWS), Urban Water Supply (UWS), Calorie intake per day, Protein intake per day, Crude Birth Rate, Crude Death Rate and Infant Mortality Rate.

CHAPTER SIX
LINKAGES IN THE MODEL

As already mentioned we have developed an integrated social sector econometric model which traces the impact of changes in different spheres of the economy on social sectors. As such, there are substantial linkages both within and between different modules described in the previous chapters. The purpose of this chapter is to identify and briefly indicate the nature of these inter-and intra-modular linkages.

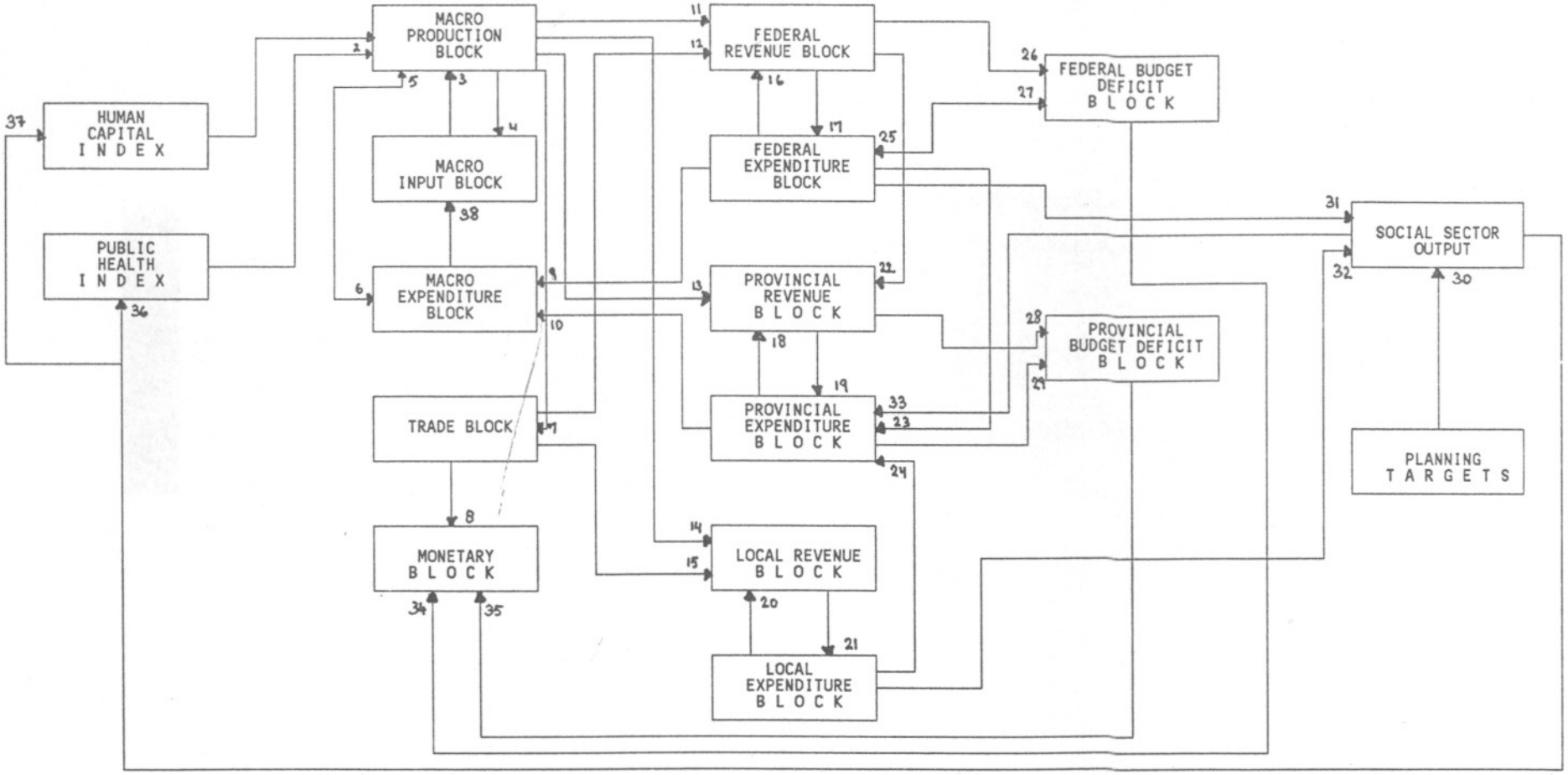
6.1 LINKAGES BETWEEN DIFFERENT MODULES AND SUB-MODULES/BLOCKS

As indicated in chapter 2, the model has been divided into three large modules - macro, fiscal and social sectors. Each module in turn consists of sub-modules or blocks. On the whole there are 17 blocks in the model, five in the macro module, eight in the fiscal module and four in the social sector module. Chart 1 gives the schematic diagram of the model along with the direction of intra-block linkages. In all there are thirty eight major linkages in the model. Seven of these are within the macro module, twelve within the fiscal module and three within the social sector output module. Major linkages within macro module consists of, for example, the two way linkage to and from the macro production block and macro input blocks (links 3 and 4). This link is due to the dependence of sectoral value added on the factors of production and input demand functions on the value of production. Similarly, two-way linkages between the macro production and macro expenditure block (link 5 and 6) arise due to the partial dependence of value added in services sector on public expenditure and the causality between income and private consumption. Link between macro production block and trade block (link 7) is due to the fact that value of imports and exports depend on the level of economic production activity. The trade gap effects the level of money supply captured by link 8.

Important linkages in the fiscal module consist of the simultaneous dependence of revenues of various levels of government and their expenditures. Non-tax receipts of governments have been made of function of their recurring expenditure on particular services via cost recovery ratios. Similarly, the level of government expenditure is

CHART 1

SCHEMATIC DIAGRAM OF LINKAGES IN THE MODEL



effected by that government's level of resource generation. Important vertical links between levels of government includes the fiscal transfers in the form of divisible pool transfers, non-development grants and ADP loans from federal to provincial governments (link 22) and development grant requirements (in line with the feasibile level of decentralisation) of the local governments (link 24). Link between federal and provincial governments budget deficit and their revenues and expenditures is obvious.

Within the social sector module there exists a link between planning targets and the level of social sector output which in turn impacts upon the human capital and public health indices.

Beside linkages within modules there also exist important linkages between the modules. There are nine linkages between the macro and fiscal modules. Fiscal blocks are affected by the macro blocks through tax bases of different levels of governments. For example, federal tax bases for sources like sales tax, income tax, excise duties are affected by the GDP. Likewise provincial tax bases are also a function of the GDP. Some taxes like federal import duties and octroi are linked to the trade block which provides the tax base for these taxes. On the other hand, level of public consumption and investment are determined in the fiscal block (link 9 and 10). The other important link is between the federal and provincial deficit blocks and the monetary block. Fiscal deficits affect changes in money supply in the economy (link 34 and 35).

Level of federal and local government expenditures influence the level of social sector output in the country. A part of the planned coverage level is catered for by these levels of government. In Pakistan, however, the provincial governments have the prime responsibility of provision of social services. Therefore, the part of target coverage which the federal and the local governments are unable to meet, the provincial governments have to provide. As such, expenditures at the provincial level have been taken to depend on the social sector target outputs (link 33). The opposite holds true for the other levels of government (links 31 and 32).

Finally, the linkages between social sector output block and the macro block is via the impact of HCI and PHI on the macro production block. As already mentioned,

improvements in social sector output affect productivity through increased efficiency and Hicks-neutral improvements.

6.2 TYPES OF LINKAGES

The linkages in the model, described above, are of varying nature. In some cases, the linkage is simultaneous, in which equations in a block are not only determining equations in another block but are also determined by them. Examples include the linkage between the macro production and input block, the production and macro expenditure blocks and the fiscal revenues and expenditure blocks. These simultaneous equations may be behaviourally determined or may just be identities. On the other hand, some relationships are one way only and as such particular equations or blocks, may in fact be estimated outside the main model. Examples of this type of recursive equations/blocks include the provincial and local expenditure blocks, the planning target block and HCI and PHI.

On the whole, there are 77 equations in the different blocks of the main model. Fifty eight of these are simultaneous in nature (see Table 1). Out of these thirty one are behaviorally determined. Recursive equations estimated within the main model include 2 behavioral equations and 17 identities. 75 recursive equations are determined outside the main model, some of which are fed in exogenously in the main model.

TABLE 1

TYPE OF VARIABLES AND EQUATIONS

	BLOCKS/SUB MODULES	BEHAVIOURIAL EQUATIONS	IDENTITIES/ DEFINITIONS
A.	MACRO PRODUCTION BLOCK		
	Simultaneous	3	3
	Recursive	-	-
B.	MACRO INPUT DEMAND BLOCK		
	Simultaneous	2	1
	Recursive	-	-
C.	MACRO EXPENDITURE BLOCK		
	Simultaneous	3	6
	Recursive	-	-
D.	FEDERAL REVENUE BLOCK		
	Simultaneous	6	2
	Recursive	-	7
E.	FEDERAL EXPENDITURE BLOCK		
	Simultaneous	5	1
	Recursive	-	-
F.	FEDERAL BUDGET DEFICIT BLOCK		
	Simultaneous	-	3
	Recursive	-	-
G.	PROVINCIAL REVENUE BLOCK		
	Simultaneous	4	3
	Recursive	-	6
H.	PROVINCIAL RECURRING EXPENDITURE BLOCK		
	Simultaneous	2	2
	Recursive	1	2
I.	PROVINCIAL BUDGET DEFICIT BLOCK		
	Simultaneous	-	2
	Recursive	-	-
J.	LOCAL REVENUE BLOCK		
	Simultaneous	3	2
	Recursive	-	1
K.	LOCAL EXPENDITURE BLOCK		
	Simultaneous	-	1
	Recursive	-	1

L.	**TRADE BLOCK**		
	Simultaneous	2	1
	Recursive	-	-
M.	**MONETARY BLOCK**		
	Simultaneous	-	1
	Recursive	-	1
TOTAL SIMULTANEOUS EQUATIONS		30	28
TOTAL RECURSIVE EQUATIONS		2	17
TOTAL NUMBER OF EQUATIONS IN THE MAIN MODEL		77	
TOTAL NUMBER OF RECURSIVE EQUATIONS ESTIMATED OUTSIDE THE MAIN MODEL		75	

CHAPTER SEVEN

SUGGESTED POLICY SIMULATIONS

One of the salient features of the model is that it allows flexibility to change important policy parameters and trace through their impact on various spheres of the economy including the social sectors. As such, an important purpose of this study is to undertake policy simulations by varying certain important macro, fiscal and social sector policy parameters and see how they affect social sector output. Some of the proposed policy simulations are described below.

7.1 CHANGES IN MACRO POLICY PARAMETER

7.1.1 Overall Population Growth Rate

An important macro parametric change that will be simulated in the model is a change in the population growth rate. Through change in the required coverage, this change is likely to have a significant affect on the key magnitudes in the model.

7.1.2 Interest Rate Policies

Changes in interest rates, through their impact on investment, in particular, affects various spheres of the economy including social sector outputs.

7.1.3 Foreign Aid

For financing development, in particular social sector development, governments in Pakistan have depended on foreign aid. The model will undertake simulations with exogenous changes in this parameter also.

7.1.4 Target Budget Deficit to GDP Rate

Another important policy simulation will be with the target budget deficit to GDP ratio, which the government has been trying to bring down in recent years. It will be interesting to see what impact this has social sector outputs.

7.2 CHANGES IN FISCAL POLICY PARAMETERS

7.2.1 Discretionary Changes in Federal, Provincial and Local Taxes

As part of the overall resource mobilization strategy, taxation proposals will be introduced to improve revenue generation at all levels of governments. Such an exercise will help in determining the absorbable level of reform and their quantitative impact for each level of government.

7.2.2 Cost Recovery Ratio

The model also has scope for changes in the cost recovery ratio. If, for example, as part of improvement in social sector strategy the government goes in for a more meaningful cost recovery policy, which currently is almost non-existent, its impact on overall resource position and social sector outputs can readily be seen.

7.2.3 Introduction of New Sources of Income

Simulations will also be undertaken with introduction of new tax and non-tax sources which are part of the resource mobilization strategy recommended by the micro studies which will be undertaken in stage II of this phase.

7.2.4 Federal-Provincial Revenue Sharing Formula

The NFC award under which revenue sharing is currently taking place in the country is due to expire in 1995-96. Since our model projections will be upto the year 2000 we will have to simulate changes in inter-governmental fiscal relations between the federal-provincial governments.

7.2.5 Role of Private Sector

Among changes on the expenditure side, simulation will be undertaken with varying role of the private sector which partially caters to demand for social services.

7.2.6 Decentralisation to the Local Governments

The model has the flexibility to allow decentralisation of social services to the local governments. This constitutes an important policy parameter in the model. The impact of decentralisation on social sector output will be quantified and a feasible level of decentralisation estimated.

7.2.7 Share of Provincial Governments in National ADP

Simulations with varying assumptions of the share of provincial governments in National ADP will also be made.

7.3 CHANGES IN SOCIAL SECTORS

7.3.1 Social Sector Targets

The model will simulate various social sector targets including the targets specified in the perspective plan till the year 2000. In the process we will be able to specify the feasible level of targets also.

7.3.2 Unit Costs of Provisions

The model will be able to quantify the impact of various cost effectiveness measures on the social sector output through the unit cost of provisions.

7.3.3 School Drop-out Rates

These will be varied as a policy parameter to measure the impact on ouput and therefore, the HCI, etc.

7.3.4 School Construction Programme

A faster or lower growth rate in the construction of schools effects both the HCI and the speed at which targets are achieved.

CHAPTER EIGHT

DATA AND DATA SOURCE

The data needed for the model would be collected from various departments and agencies listed overleaf.

Ministry of Food and Agriculture, Government of Pakistan	Agricultural Statistics of Pakistan
Ministy of Finance, Government of Pakistan	Annual Budget Statement, Public Finance Statistics, Budget in Brief Explanatory Memorandum of the Budget Economic Survey CBR Year Book Budget Speeches of Finance Ministers
Finance Departments, Provincial Governments	Annual Budget Statement, Demand for Grants and Expenditures Annual Development Plan, Budget Speeces of Finance Ministers
Ministry of Local Government and Rural Development, Government of Pakistan	Computerised data on Local Government Finances
Statistics Division, Government of Pakistan	Foreign Trade Statistics Labour Force Survey Survey of Wages in Manufacturing Industry Census of Manufacturing Industry Pakistan Statistical Yearbook
State bank of Pakistan	Annual Report
Bureaux of Statistics, Provincial Governments	Development Statistics School Education Statistics College Education Statistics
University Grants Commission	Higher Education Statistics
Local Governments	Annual Budget
Planning Commission	Seventh Five Year Plan And Perspective Plan Social Action Plan Working Group Reports for the Eighth Five Year Plan
Population Census Commission	Population Census 1972, 1981
United Nations	Human Development Report

APPENDIX 1

LIST OF VARIABLES FOR THE MACRO AND THE FISCAL MODULES

A	Cultivated Area
$BDEF_F$	Federal Budget Defict
$BDEF_P$	Provincial Budget Deficit
C	Total Consumption
CG	Current Account Gap
C_P	Private Consumption
CRE_P	Provincial Cost Recovery Ratio for Education
CRH_P	Provincial Cost Recovery Ratio for Health
$CRIR_P$	Provincial Cost Recovery Ratio for Irigation
$CRNT_L$	Cost Recovery Ratio for Local Services
$CROT_P$	Provincial Cost Recovery Ratio for Other Services
$CRPH_P$	Provincial Cost Recovery Ratio for Public Health
DCE_F	Descretionary Changes in Excise Duties
DCI_F	Descretionary Changes in Income Tax
DCM_F	Descretionary Changes in Import Taxes
DCS_F	Descretionary Changes in Sales Tax
$DDEBT_F$	Outstanding Domestic Debt
DE	Total Development Expenditure
$DEED_L$	Local Social Development Expenditure on Education
$DEED_P$	Provincial Social Development Expenditure on Education
DE_F	Total Development Expenditure Federal
DEF_F	Defence Expenditures
DEH_L	Local Social Development Expenditure on Health
DEH_P	Provincial Social Development Expenditure on Health
$DEIR_P$	Provincial Development Expenditure on Irrigation
DE_L	Total Development Expenditure Local
DEO_L	Local Social Development Expenditure on Other Services
$DEOS_P$	Provincial Social Development Expenditure on Other Services
$DEOT_P$	Provincial Development Expenditure on Other Services
DE_P	Total Provincial Development Expenditure
$DEPH_L$	Local Social Development Expenditure on Public Health
$DEPH_P$	Provincial Social Development Expenditure on Public Health
DES_P	Provincial Development Expenditure for Social Sector
$DESET_L$	Discretionary Changes in Local Export Tax
$DESMV_P$	Discretionary Changes in Motor Vehicles Tax
DESO	Development Expenditure for Social Service by Private Sector
$DESOCT_L$	Discretionary Changes in Local Octroi
$DESOT_P$	Discretionary Changes in Other Provincial Taxes
$DESOT_L$	Discretionary Changes in Other Local Taxes
$DESPT_P$	Discretionary Changes in Provincial Property Tax
$DESSD_P$	Discretionary Changes in Provincial Stamp Duty

DEST	Total Development Expenditure for achieving Social Sector Targets
$DETF_P$	Development Transfers to Provinces
DPT_P	Divisible Pool Transfers
DPTX	Divisible Pool Transfers from Taxes
DS_P	Debt Servicing
$EDEBT_P$	External Outstanding Debt
ET_L	Local Export Tax
ETR_F	Federal Revenues from Excise Duties
GFB_F	Gross Foreign Borrowings
GP_F	Grants to Provinces (Non-Obligatory)
GR_P	Grants to Local Governments
GRR_L	Gross Local Revenue Receipts
GRR_P	Gross Provincial Revenue Receipts
GTR_F	Gross Federal Tax Revenue
HCI_A	Human Capital Index for Agriculture
HCI_M	Human Capital Index for Manufacturing
HCI_O	Human Capital Index for Other Sectors
I	Total Investment
IFE_F	Index of Fiscal Effort in Excise Duties
IFI_F	Index of Fiscal Effort in Income Tax
IFM_F	Index of Fiscal Effort in Import Taxes
IFS_F	Index of Fiscal Effort in Sales Taxes
I_M	Investment in Manufacturing
IMV_P	Index of Provincial Effort in Motor Vehicles Tax
IMP	Total Import
$INET_L$	Index of Local Fiscal Effort in Export Tax
$INOCT_L$	Index of Local Fiscal Effort in Octroi
$INOT_L$	Index of Local Fiscal Effort in Other Taxes
INT	Interest Rate
$INTDD_F$	Interest on Domestic Debt
$INTED_P$	Interest on External Debt
I_O	Private Investment in Other Sectors
IOT_P	Index of Provincial Effort in Other Taxes
I_P	Total Private Investment
IPT_P	Index of Provincial Effort in Property Tax
ISD_P	Index of Provincial Effort in Stamp Duty
ITR_F	Federal revenues from Income Tax
K_M	Capital Stock in Manufacturing
L_A	Labour in Agriculture
L_M	Labour in Manufacturing
L_{OT}	Labour in Other Services
M	Money Supply
MR_F	Miscelleneous Federal Revenues

MTR_F	Federal Revenues from Import Taxes
MVT_P	Motor Vehicles Tax
NFI	Net Factor Income from Abroad
NRR_F	Federal Net Revenue Receipts
OCT_L	Octroi
OT_L	Local Taxes Others
OT_P	Provincial Taxes Others
ORE_F	Other Federal Recurring Expenditure
PHI	Public Health Index
PI	Price Index (Implicit GDP Deflator)
PI_{IMP}	Price Index of Imports
PI_M	Price Index of Manufacturing Goods
PT	Property Tax
RE	Total Recurring Expenditure
RED_P	Provincial Revenue from Education
$REED_L$	Local Recurring Expenditure on Education
$REED_P$	Provincial Recurring Expenditure on Education
RE_F	Total Recurring Expenditure Federal
REH_L	Local Recurring Expenditure on Health
REH_P	Provincial Recurring Expenditure on
$REIR_P$	Provincial Recurring Expenditure on Irrigation
RE_L	Total Local Recurring Expenditure
$REOT_L$	Local Recurring Expenditure on Other Services
$REOT_P$	Provincial Recurring Expenditure on Other Sectors
REP_F	Repayment of External Debt
$REPH_L$	Local Recurring Expenditure on Public Health
$REPH_P$	Provincial Recurring Expenditure on Public Health
RES_P	Provincial Social Recurring Expenditure
RH_P	Provincial Revenue from Health
RG	Resource Gap
RIR_P	Provincial Revenue from Irrigation
RM	Remittances
RNT_F	Federal Non Tax Revenue
ROT_L	Local Revenue from Other Non-Taxes
ROT_P	Provincial Revenue from Other Non-Taxes
RPA_F	Federal Receipts from Public Enterprise and Autonomous Corporation
RPH_P	Provincial Revenue from Public Health
RPOP	Rural Population
RSD	Provincial Revenue Surplus or Deficit
SAB_F	Surplus from Autonomous Bodies
SD_P	Stamp Duties
SH	Share of Provinces in National ADP
STR_F	Federal Revenues from Sales Tax
$SURO_F$	Revenue Transfer of Surcharges and Royalties to Provinces

T	Number of Tractors
TNT_L	Total Local Non-Taxes
TNT_P	Total Provincial Non-Taxes
TT_L	Total Local Taxes
TT_P	Total Provincial Taxes
WPI_X	World Export Price Index
X	Total Exports
Y	Gross Domestic Product
Y_A	Value Added in Agriculture
Y_M	Value Added in Manufacturing
Y_N	Gross National Product
Y_{NA}	Non-Agricultural GDP
Y_S	Value Added in Other Service Sectors

SPECIFICATION OF THE INTEGRATED REVENUE AND EXPENDITURE PLANNING MODEL FOR THE SOCIAL SECTORS

A. MACRO PRODUCTION BLOCK

Gross Domestic Product

1. $Y = Y_A + Y_M + Y_S$

Value Added in Agriculture

2. $Y_A = f(L_A, \overline{HCI_A}, \overline{PHI}, \overline{A}, \overline{T})$

Value Added Manufacturing

3. $Y_M = f(K_M, L_M, \overline{HCI_M}, \overline{PHI})$

Value Added in Service

4. $Y_S = f(Y_A + Y_M, I, \overline{RM}, RE, \overline{HCI_S}, \overline{PHI})$

Gross Domestic Product (Non-Agricultural)

5. $Y_{NA} = Y - Y_A$

Gross National Product

6. $Y_N = Y + \overline{NFI}$

B. MACRO INPUT DEMAND BLOCK

Capital Input Demand in the Manufacturing Sector

7. $K_M = (1 - \delta)*K_{M-1} + I_M$

Labour Input Demand in the Manufacturing Sector

8. $L_M = f(Y_M, K_M)$

Labour Input Demand in the Agriculture Sector

9. $L_A = f(Y_A, \overline{RPOP})$

C. MACRO EXPENDITURE BLOCK

10. Private Consumption Expenditure

$C_P = f(Y_N, C_{P-1}, \overline{INT}, \overline{RM})$

Public Consumption Expenditure (Recurring Expenditure)

11. $RE = RE_F + RE_P + RE_L$

Total Private Investment

12. $I_P = f(\triangle Y, \overline{INT}, I_{P-1}, [DE_F + DE_P], \overline{RM})$

Private Investment in Manufacturing

13. $I_M = f(\triangle Y_M, \overline{INT}, I_{M-1}, DE, \overline{RM})$

Private Investment in Other Sectors

14. $I_O = I_P - I_M$

Total Development Expenditure

15. $DE = DE_F + DE_P$

Total Investment

16. $I = I_P + DE$

Total Consumption

17. $C = C_P + RE$

Resource Gap

18. $RG = C + I - Y$

D. FEDERAL REVENUE BLOCK

Discretionary Change in Import Duties

19. $DCM_F = \overline{DCM_F}$

Discretionary Change in Sales Tax

20. $DCS_F = \overline{DCS_F}$

Discretionary Change in Excise Duty

21. $DCS_F = \overline{DCS_F}$

Discretionary Change in Income Tax

22. $DCI_F = \overline{DCI_F}$

Revenue from Import Duties

23. $MTR_F = f(IMP, \overline{DCM_F}, \overline{IFM_F})$

Revenue from Sales Tax

24. $STR_F = f(IMP, M, \overline{DCS_F}, \overline{IFS_F})$

Revenue from Excise Duties

25. $ETR_F = f(Y_M, Y_S, \overline{DCE_F}, \overline{IFE_F})$

Revenue from Income Tax

26. $STR_F = f(Y_{NA}, \overline{DCI_F}, \overline{IFI_F})$

Non-Tax Revenue

27. $RNT_F = \overline{RNT_F}$

Miscellaneous Revenues

28. $MR_F = \overline{MR_F}$

Receipts from Public Administration

29. $RPA_F = f(RPA_{F-1}, Y)$

Divisible Pool Transfers from Federal Taxes

30. $DPTX_F = f(ITR_F, STR_F, ETR_F)$

Total Divisible Pool Transfers

31. $DPT_F = DPTX_F + \overline{SURO_F}$

Net Revenue Receipts

32. $NRR_F = MTR_F + STR_F + ETR_F + ITR_F + \overline{RNT_F} + \overline{MR_F} + RPA_F - DPT_F$

Self Financing by Autonomous Corporations

33. $SAB_F = \overline{SAB_F}$

E. FEDERAL EXPENDITURE BLOCK

Total Recurring Expenditure

34. $RE_F = \overline{DEF_F} + INTDD_F + INTED_F + \overline{GP_F} + ORE_F$

Interest on Domestic Debt

35. $INTDD_F = f(DDEBT_F, \overline{INT})$

Interest on Foreign Debt

36. $INTED_F = f(EDEBT_F,)$

Other Recurring Expenditure

37. $ORE_F = f(NRR_F, ORE_{F-1})$

Development Expenditure

38. $DE_F = f(DE_{F-1}, \overline{GFB_F}, NRR_F)$

Repayment of External Debt

39. $REP_F = f(EDEBT)$

F. FEDERAL BUDGET DEFICIT BLOCK

Outstanding External Debt

40. $EDEBT_F = EDEBT_{F-1} + \overline{GFB_F} - REP_F$

Outstanding Internal Debt

41. $DDEBT_F = DDEBT_{F-1} + BDEF_F - \overline{GFB_F} + REP_F$

Budget Deficit

42. $BDEF_F = DE_F + RE_F - NRR_F - \overline{SAB_F}$

G. PROVINCIAL REVENUE BLOCK

Revenue from Stamp Duties

43. $SD_P = f(Y, \overline{DESSD_P}, \overline{ISD_P})$

Revenue from Motor Vehicle Tax

44. $MVT_p = f(Y, \overline{DESMV_p}, \overline{IMV_p})$

Revenue from Property Tax

45. $PT_p = f(Y, \overline{DESPT_p}, \overline{IPT_p})$

Revenue from Other Taxes

46. $OT_p = f(Y, \overline{DESOT_p}, \overline{IOT_p})$

Total Tax Revenues

47. $TT_p = SD_p + MVT_p + 0.15\ PT_p + OT_p$

User Charges on Education

48. $RED_p = CRE_p * \overline{RRED_p}$

User Charges in Health

49. $RH_p = CRH_p * \overline{REH_p}$

User Charges in Public Health

50. $RPH_p = CRPH_p * \overline{REPH_p}$

User Charges in Irrigation

51. $RIR_p = CRIR_p * \overline{REIR_p}$

Other User Charges

52. $ROT_p = CROT_p * \overline{REOT_p}$

Total Non-Tax Revenues

53. $TNT_p = RED_p + RH_p + RPH_p + RIR_p + ROT_p$

Gross Revenue Receipts

54. $GRR_p = TT_p + TNT_p + DPT_F + \overline{GP_p}$

Development Transfers

55. $DETF_p = \overline{DES_p} + SH * [DE_F - \overline{DES_p}]$

G. PROVINCIAL EXPENDITURE BLOCK

Debt Servicing by Provincial Governments

56. $DS_p = f(DS_{p.1}, DETF_{p.1})$

Total Recurring Expenditure

57. $RE_p = RRED_p + REH_p + REPH_p + REIR_p + REOT_p + DS_p$

Development Expenditure on Social Services

58. $DES_p = \overline{DEED_p} + \overline{DEH_p} + \overline{DEPH_p} + \overline{DEOSS_p}$

Development Expenditure on Irrigation

59. $DEIR_p = f(DETF_p - \overline{DES_p}, RSD_p, DEIR_{p.1})$

Development Transfers to Local Governments

60. $GR_p = \overline{GR_p}$

Development Expenditure on Other Sectors

61. $DEOT_p = f(DETF_p - \overline{DES_p}, RSD_p, DEOT_{p.1})$

Total Development Expenditure

62. $DE_p = \overline{DES_p} + DEIR_p + DEOT_p + \overline{GR_p}$

H. PROVINCIAL BUDGET DEFICIT BLOCK

Revenue Surplus or Deficit

63. $RSD_P = GRR_P - RE_P$

Budget Deficit

64. $BDEF_P = -RSD_P + DE_P - DETF_P$

I. LOCAL REVENUE BLOCK

Revenue from Octroi

65. $OCT_L = f(C_P, IMP, \overline{DESOCT_L}, \overline{INOCT_L})$

Revenue from Export Tax

66. $ET_L = f(Y_M, Y_A, \overline{DESET_L}, \overline{INET_L})$

Revenue from Other Taxes

67. $OT_L = f(Y, \overline{DESOT_L}, \overline{INOT_L})$

Total Tax Revenues

68. $TT_L = OCT_L + ET_L + 0.85\ PT_L + OT_L$

Non-Tax Revenues

69. $TNT_L = CRNT_L * RE_L$

Gross Revenue Receipts

70. $GRR_L = TT_L + TNT_L$

J. LOCAL EXPENDITURE BLOCK

Total Recurring Expenditure

71. $RE_L = \overline{REED_L} + \overline{REH_L} + \overline{REPH_L} + \overline{REOT_L}$

Total Develoopment Expenditure

72. $DE_L = GRR_L + GR_P - RE_L$ (such that $GRR_L > RE_L$)

K. TRADE BLOCK

Import Demand Function

73. $IMP = f(\overline{PI_{IMP}}, Y, IMP_{-1})$

Export Supply Function

74. $X = f(\overline{WPI_X}, Y_A, Y_M)$

Current Account Balance

75. $CG = PI_M * IMP - \overline{WPI_X} * X - \overline{RM}*PI$

L. MONETARY BLOCK

Change in Money Supply

76. $\triangle M = (BDEF_F + BDEF_P)*PI + CG + \gamma (PI*Y)$

Price Equation

77. $PI = f(PI_{IMP}, \overline{(M/Y)}_{-1}, PI_{-1})$

APPENDIX 2

LIST OF VARIABLES FOR THE SOCIAL SECTOR OUTPUT MODEL

5POP	=	Number of children aged 0 to 5 years
BEDS	=	Number of Basic Health Units constructed in each year to meet Target
$BEDS^T$	=	Target number of BEDSs required to achieve coverage
$BEDS^E$	=	Existing Stock of BEDSs
BHU	=	Number of Basic Health Units constructed in each year to meet Target
BHU^T	=	Target number of BHUs required to achieve coverage
BHU^E	=	Existing Stock of BHUs
$CCOMP^F$	=	Number of female students completing college or vocational education successfully
$CCOMP^M$	=	Number of male students completing college or vocational education successfully
CT^F	=	Teachers per female college
$DEST^{BEDS}$	=	Development Expenditure for providing one additional bed for hospital care
$DEST^{BHU}$	=	Development Expenditure for constructing the BHUs to achieve Target
$DEST_{CF}$	=	Development Expenditure for constructing the female colleges to achieve Target
$DEST_H$	=	Total Development Expenditure on the Health Sector to meet Targets
$DEST_{PH}$	=	Total Development Expenditure on the Public Health Sector to meet Targets
$DEST_{PHC}$	=	Total Development Expenditure on the Preventive Health Care Sector to meet Targets
$DEST_{PF}$	=	Development Expenditure for constructing the female primary schools to achieve Target

$DEST_{ME}$ = Development Expenditure for meeting the targets for doctors, nurses and paramedics

$DEST_{PW}$ = Development Expenditure for meeting the targets in population welfare

$DEST_{rs}$ = Development Expenditure on rural sanitation for achieving Target

$DEST_{rws}$ = Development Expenditure on rural water supply for achieving Target

$DEST_{SF}$ = Development Expenditure for constructing the female secondary schools to achieve Target

$DEST_{U}$ = Development Expenditure on University Education

$DEST_{us}$ = Development Expenditure on urban sanitation for achieving Target

$DEST_{uws}$ = Development Expenditure on urban water supply for achieving Target

DOCT = Number of Doctors

ELF_{NA} = Labour Force Employed in Non-Agricultural Sectors

ENR^{PF1} = Number of female children enrolled in class 1

ENR^{PF2} = Number of female children enrolled in class 2

ENR^{PF3} = Number of female children enrolled in class 3

ENR^{PF4} = Number of female children enrolled in class 4

ENR^{PF5} = Number of female children enrolled in class 5

ENR^{SF6} = Number of female children enrolled in class 6 of female secondary schools

ENR^{SF12} = Number of female children enrolled in classes 7 to 12

ENRU = Number of students enrolled in universities

FC = Number of female colleges

FC* = Number of female colleges needed to meet target enrollment

$FENR^{1Y}$ = Number of females enrolled in first year of degree or vocational education in college

$FENRS^{1}$ = Number of female children enrolled per school in class 1

$FENRS^{6}$ = Number of female children enrolled in class 6 per female secondary school

$FENRC^{1Y}$ = Enrollment in the first year of degree or vocational education per female college

FENRU = Number of female students enrolled in universities

FLR_{t-i} = Lagged Female Literacy Ratio

FPENRR = Female Primary Enrollment Rate

FPOP	=	Female Population of child bearing age
$FPOP^C$	=	Population of females of college going age
$FPOP^S$	=	Population of females of secondary school going age
$FPOP^P$	=	Population of females of primary school going age
FPS	=	Number of female primary school
FPS^*	=	Number of female primary schools required to meet enrollment target for primary education
FSENRR	=	Female Secondary Enrollment Rate
FSS	=	Number of female secondary schools
FSS^*	=	Number of female secondary schools required to meet enrollment target for secondary education
$GRRATE_{rs}$	=	Growth Rate required to achieve Access to Rural Sanitation Supply Target
$GRRATE_{us}$	=	Growth Rate required to achieve Access to Urban Sewerage Target
$GRRATE_{rws}$	=	Growth Rate required to achieve Access to Rural Water Supply Target
$GRRATE_{uws}$	=	Growth Rate required to achieve Access to Urban Water Supply Target
IMM	=	Level of immunisation achieved
IMR	=	Target Infant Mortality Rate
MCH	=	Number of Maternity & Child Health Centres constructed in each year to meet Target
MCH^T	=	Target number of MCHs required to achieve coverage
MCH^E	=	Existing Stock of MCHs
MENRU	=	Number of male students enrolled in universities
MW	=	Average Wage of Managerial Workers in Manufacturing Industry
MWR	=	Average Wage Rate of Unskilled Labourer in Manufacturing Industry
MWR_{ill}	=	Wage Rate in Manufacturing Industry of an illiterate female child
N	=	Number of Years between base year and Target year
NURS	=	Number of Nurses

OUT^{FC}	=	Number of female children dropping out from college without completing college or vocational education
OUT^{PF1}	=	Number of female children dropping out from school after completing class 1
OUT^{PF2}	=	Number of female children dropping out from school after completing class 2
OUT^{PF3}	=	Number of female children dropping out from school after completing class 3
OUT^{PF4}	=	Number of female children dropping out from school after completing class 4
OUT^{PF5}	=	Number of female children dropping out from school after completing class 5
OUT^{SF12}	=	Number of female children dropping out from school after completing class 12
OUT^{F1Y}	=	Number of female children dropping out from college after completing first year of degree or vocational college
PGR	=	Population Growth Rate
PMED	=	Number of Paramedics
POP	=	Population
POP^{PF1}	=	Population of female children aged 5
RLFS	=	Rural Labour Force
$RPCOV_{rws}$	=	Rural population with access to Rural Water Supply
$RPCOV_{rs}$	=	Rural population with access to Rural Sanitation
TGT	=	Target
$THROW_{PW}$	=	Throwforward balance of approved development costs of population welfare programme
$THROW_{U}$	=	Throwforward balance of universities' approved development costs
TS^{PF1}	=	Number of Teachers for class 1 per female primary school
TS^{SF6}	=	Number of Teachers for class 6 per female secondary school
UC^{BEDS}	=	Cost of providing one additional bed for hospital care
UC^{BHU}	=	Cost of constructing one BHU
UC^{C}	=	Cost of constructing one college
UC^{MCH}	=	Cost of constructing one MCH

UC^P	=	Cost of constructing one primary school
UC_{rs}	=	Per capita cost of providing sanitation in rural areas
UC_{rws}	=	Per capita cost of providing safe drinking water in rural areas
UC^S	=	Cost of constructing one secondary school
UC_{us}	=	Per capita cost of providing sewerage in urban areas
UC_{uws}	=	Per capita cost of providing safe drinking water in urban areas
$UCOMP_t$	=	
$UPCOV_{uws}$	=	Urban population with access to water supply
$UPCOV_{us}$	=	Urban population with access to sewerage
UT	=	Number of teachers in universities
α_{BEDS}	=	Share of expenditure incurred in the first year in constructing a BEDS
α_{BHU}	=	Share of expenditure incurred in the first year in constructing a BHU
α_{CF}	=	Share of expenditure incurred in the first year in constructing a female college
α_{MCH}	=	Share of expenditure incurred in the first year in constructing a MCH
α_{ped}	=	Share of private sector in provision of educational facilities
α_{PF}	=	Share of expenditure incurred in the first year in constructing a female primary school
α_{SF}	=	Share of expenditure incurred in the first year in constructing a female secondary school
$ß_{BEDS}$	=	Share of expenditure incurred in the second year in constructing a BEDS
$ß_{BHU}$	=	Share of expenditure incurred in the second year in constructing a BHU
$ß_{CF}$	=	Share of expenditure incurred in the second year in constructing a female college
$ß_{MCH}$	=	Share of expenditure incurred in the second year in constructing a MCH
$ß_{PF}$	=	Share of expenditure incurred in the second year in constructing a female primary school
$ß_{SF}$	=	Share of expenditure incurred in the second year in constructing a female secondary school

σ_{BEDS}	=	Share of expenditure incurred in the third year in constructing a BEDS
σ_{BHU}	=	Share of expenditure incurred in the third year in constructing a BHU
σ_{CF}	=	Share of expenditure incurred in the third year in constructing a female college
σ_{MCH}	=	Share of expenditure incurred in the third year in constructing a MCH
σ_{SF}	=	Share of expenditure incurred in the third year in constructing a female secondary school
δ_{1F}	=	Share of female children contnuing with education after completing class 1
δ_{2F}	=	Share of female children contnuing with education after completing class 2
δ_{3F}	=	Share of female children contnuing with education after completing class 3
δ_{4F}	=	Share of female children contnuing with education after completing class 4
δ_{5F}	=	Proportion of female children contnuing with education after completing class 5
δ_{6F}	=	Proportion of female children contnuing with education after completing class 6
δ_{12F}	=	Proportion of female students dropping out after completing high school
δ_{F1Y}	=	Proportion of female students dropping out after completing first year of degree or vocational college
δ_{u}	=	Proportion of students completing university education successfully
$\triangle_{fc}$	=	Proportion of females graduating from degree or vocational colleges
$\triangle_{u}$	=	Proportion of universities' approved development costs to be incurred in future years
$\triangle_{pw}$	=	Proportion of approved development costs for population welfare projects to be incurred in future years

ESTIMATION OF TARGET DRIVEN EXPENDITURES

EDUCATION

FEMALE PRIMARY EDUCATION

$$FENRS_t^1 = \alpha_0 + \alpha_1 TS_{t-1}^{PF1} + \alpha_2 POP_{t-1}^{PF1} + \alpha_3 FLR_{t-i} + \alpha_4 MWR_{iii} + \alpha_5 Y_A/RLFS$$

$$ENR_t^{PF1} = FENRS_t^1 * FPS_t$$

$$FPS_t = FPS^{\gamma_1}$$

$$ENR_t^{PF2} = \delta_{1F}\, ENR_{t-1}^{PF1}$$

$$OUT_t^{PF1} = ENR_t^{PF2} - ENR_{t-1}^{PF1}$$

$$ENR_t^{PF3} = \delta_{2F}\, ENR_{t-1}^{PF2}$$

$$OUT_t^{PF2} = ENR_t^{PF3} - ENR_{t-1}^{PF2}$$

$$ENR_t^{PF4} = \delta_{3F}\, ENR_{t-1}^{PF3}$$

$$OUT_t^{PF3} = ENR_t^{PF4} - ENR_{t-1}^{PF3}$$

$$ENR_t^{PF5} = \delta_{4F}\, ENR_{t-1}^{PF4}$$

$$OUT_t^{PF4} = ENR_t^{PF5} - ENR_{t-1}^{PF4}$$

$$ENR_t^{PF} = ENR_t^{PF1} + ENR_t^{PF2} + ENR_t^{PF3} + ENR_t^{PF4} + ENR_t^{PF5}$$

$$DEST_{PF} = \alpha_{PF}\, UC^P\, FPS_{t+2} + ß_{PF}\, UC^P\, FPS_{t+1}$$

$$FPENRR_t = (\Sigma\, ENR_t^{PFi}) / FPOP_t^P \qquad \text{such that } FPENRR_t < TGT$$

MALE PRIMARY EDUCATION

similar equations for males

FEMALE SECONDARY EDUCATION

$$FENRS_t^6 = \alpha_0 + \alpha_1\, TS_{t-1}^{SF6} + \alpha_2\, \delta_5\, ENR_{t-1}^{PF5} + \alpha_3\, FLR_{t-i} + \alpha_4 MWR$$

$$ENR_t^{SF6} = FENRS_t^6 * FSS_t$$

$$FSS_t = FSS^{\gamma_1}$$

$$OUT_t^{PF5} = ENR_t^{PF6} - ENR_{t-1}^{PF5}$$

$$ENR_t^{SF12} = \delta_{6F}\, ENR_{t-1}^{SF6}$$

$$DEST_{SF} = \alpha_{SF}\, UC^S\, FSS_{t+3} + ß_{SF}\, UC^S\, FSS_{t+2} + \sigma_{SF}\, UC^S\, FSS_{t+1}$$

$$FSENRR_t = (\Sigma\, ENR_t^{SFi}) / FPOP_t^S \qquad \text{such that } FSENRR_t < TGT$$

MALE SECONDARY EDUCATION

similar equations for males

COLLEGE EDUCATION FEMALE

$FENRC_t^{1Y} = \alpha_0 + \alpha_1 ENR_{t-1}^{SF12} + \alpha_2 CT^F + \alpha_3 FLR_{t-1} + \alpha_4 MW$

$FENR_t^{1Y} = FENRC_t^{1Y} * FC_t$

$FC_t = FC^3$

$OUT_t^{SF12} = \delta_{12F}\ ENR_{t-1}^{SF12}$

$OUT_t^{F1Y} = \delta_{F1Y}\ FENR_{t-1}^{1Y}$

$CCOMP_t^F = \triangle_{fc}(FENR_t^{-11Y} - OUT_{t-1}^{F1Y})$

$DEST_{CF} = \alpha_{CF}\ UC^C\ FC_{t+3} + ß_{CF}\ UC^C\ FC_{t+2} + \sigma_{CF}\ UC^C\ FC_{t+1}$

$(FENR_t^{1Y} + CCOMP_t^F) \quad < \text{ or } = \quad FPOP_t^C$

COLLEGE EDUCATION MALE

similar education for males

UNIVERSITY EDUCATION

$FENRU_t = \alpha_0 + \alpha_1 CCOMP_{t-1}^F + \alpha_2 (Y_{NA}/ELF_{NA})_{t-1} + \alpha_3 (UT/ENRU)_{t-1}$

$MENRU_t = \alpha_0 + \alpha_1 CCOMP_{t-1}^M + \alpha_2 (Y_{NA}/ELF_{NA})_{t-1} + \alpha_3 (UT/ENRU)_{t-1}$

$ENRU_t = FENRU_t + MENRU_t$

$UCOMP_t = \delta_u\ ENRU_t$

$DEST_{Ut} = DEST_{Ut-1} + \triangle_u THROW_U$

ESTIMATED COSTS OF MEETING EDUCATION SECTOR TARGETS

$DEST_{EDt} = DEST_{PPt} + DEST_{SPt} + DEST_{CPt} + DEST_{PMt} + DEST_{SMt} + DEST_{CMt} + DEST_{Ut}$

$DEED_{Pt} = DEST_{EDt} - \alpha_{ped}\ DEST_{EDt} - DEED_{Lt} - DEST_{Ut}$

$REED_{Pt} = f(REED_{Pt-1}, DEED_{Pt-1})$

PUBLIC HEALTH

RURAL WATER SUPPLY

$RPCOV_{rwst} = GRATE_{rws} * RPCOV_{rwst-1}$

$DEST_{rwst} = (RPCOV_{rwst+1} - RPCOV_{rwst})\ UC_{rws}$

URBAN WATER SUPPLY

$UPCOV_{uwst} = GRATE_{uws} * UPCOV_{uwst-1}$

$DEST_{uwst} = (UPCOV_{uwst+1} - UPCOV_{uws})\ UC_{uws}$

RURAL SANITATION

$RPCOV_{rst} = GRATE_{rs} * RPCOV_{rst-1}$

$DEST_{rst} = (RPCOV_{rst+1} - RPCOV_{rst})\ UC_{rs}$

URBAN SEWERAGE

$UPCOV_{ust} = GRATE_{us} * UPCOV_{ust-1}$

$DEST_{ust} = (UPCOV_{ust+1} - UPCOV_{ust}) UC_{us}$

ESTIMATED COSTS OF MEETING PUBLIC HEALTH SECTOR TARGETS

$DEST_{PHt} = DEST_{rwst} + DEST_{rst} + DEST_{uwst} + DEST_{ust}$

$DEPH_{Pt} = DEST_{PHt} - DEPH_{Lt}$

$REPH_{Pt} = f(REPH_{Pt-1}, DEPH_{Pt-1})$

HEALTH

PRIMARY HEALTH CARE

$BHU_t = (BHU^T - BHU^E) / N$

$DEST_t^{BHU} = \alpha_{BHU} UC_{BHU} BHU_{t+1} + ß_{BHU} UC_{BHU} BHU_{t+2} + \sigma_{BHU} UC_{BHU} BHU_{t+3}$

$MCH_t = (MCH^T - MCH^E) / N$

$DEST_t^{MCH} = \alpha_{MCH} UC_{MCH} MCH_{t+3} + ß_{MCH} UC_{MCH} MCH_{t+2} + \sigma_{MCH} UC_{MCH} MCH_{t+1}$

SECONDARY HEALTH CARE

$BEDS_t = (BEDS^T - BEDS^E) / N$

$DEST_t^{BEDS} = \alpha_{BEDS} UC_{BEDS} BEDS_{t+3} + ß_{BEDS} UC_{BEDS} BEDS_{t+2} + \sigma_{BEDS} UC_{BEDS} BEDS_{t+1}$

MEDICAL EDUCATION

$DOCT_t = f(BEDS_{t+i}, BHU_{t-i}, MCH_{t-i})$

$NURS_t = f(DOCT_t, BEDS_{t-i}, BHU_{t-i}, MCH_{t-i})$

$PMED_t = f(DOCT_t, BEDS_{t-i}, BHU_{t-i}, MCH_{t-i}, PMED_{t-1})$

$DEST_{MEt} = f(DEST_{MEt-1}, DOCT_{t+i}, NURS_{t+i}, PMED_{t+i})$

PREVENTIVE HEALTH CARE

$DEST_{PHCt} = f(IMR_{t+n}, DEST_{PHCt-1}, FPOP_t, 5POP_t)$

ESTIMATED COSTS OF MEETING HEALTH SECTOR TARGETS

$DEST_{Ht} = DEST_{BHUt} + DEST_{MCHt} + DEST_{BEDSt} + DEST_{MEt} + DEST_{PHCt}$

$DEH_{Pt} = DEST_{Ht} - DEH_{Lt}$

$REH_{Pt} = f(REH_{Pt-1}, DEH_{Pt-1})$

POPULATION WELFARE

$PGR = f(FLR, LR, MCH/FPOP, DOCT/POP, NURS/POP, PMED/POP, DEST_{PWt-i}, IMR, IMM)$

$DEST_{PWt} = f(PGR, DEST_{PWt-1}, \triangle_{pw}THROW_{PW})$

$DEPW_{Pt} = DEST_{PWt} - DEPH_{Pt}$

$REPW_{Pt} = f(REPH_{Pt-1}, DEPW_{Pt-1})$

TOTAL PROVINCIAL GOVERNMENT EXPENDITURE ON SOCIAL SECTORS

$DES_{Pt} = DEED_{Pt} + DEH_{Pt} + DEPH_{Pt} + DEPW_{Pt}$

$RES_{Pt} = REED_{Pt} + REH_{Pt} + REPH_{Pt} + REPW_{Pt}$

IRRIGATION AND OTHER SECTORS

ESTIMATED COSTS OF IRRIGATION AND OTHER SECTORS

$REIR_{Pt} = f(REIR_{Pt-1}, DEIR_{Pt-1})$

$REOT_{Pt} = f(REOT_{Pt-1}, DEOT_{Pt-1})$

APPENDIX 3

CONSTRUCTION OF HUMAN CAPITAL INDEX FOR MANUFACTURING SECTOR (HCI_M)

NUMBER OF WORKERS BY LEVEL OF EDUCATION	WEIGHTS BASED ON RELATIVE WAGES
ILLITERATE (I)	
Professional (PR)	
$L_I * P(L_M \cup L_{PR}) * P(L_{PR} \cup L_I) = L_{M,I,PR}$	$W_{M,I,PR}/W_{M,I,PR}$
Managerial (MG)	
$L_I * P(L_M \cup L_{MG}) * P(L_{MG} \cup L_I) = L_{M,I,MG}$	$W_{M,I,MG}/W_{M,I,PR}$
Clerical (C)	
$L_I * P(L_M \cup L_C) * P(L_C \cup L_I) = L_{M,I,C}$	$W_{M,I,C}/W_{M,I,PR}$
Sales (S)	
$L_I * P(L_M \cup L_S) * P(L_S \cup L_I) = L_{M,I,S}$	$W_{M,I,S}/W_{M,I,PR}$
Service (SV)	
$L_I * P(L_M \cup L_{SV}) * P(L_{SV} \cup L_I) = L_{M,I,SV}$	$W_{M,I,SV}/W_{M,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_I * P(L_M \cup L_{AA}) * P(L_{AA} \cup L_I) = L_{M,I,AA}$	$W_{M,I,AA}/W_{M,I,PR}$
Production (PR)	
$L_I * P(L_M \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{M,P,PD}$	$W_{M,I,PD}/W_{M,I,PR}$
Other (O)	
$L_I * P(L_M \cup L_O) * P(L_O \cup L_I) = L_{M,I,O}$	$W_{M,I,O}/W_{M,I,PR}$
PRIMARY (P)	
Professional (PR)	
$L_P * P(L_M \cup L_{PR}) * P(L_{PR} \cup L_P) = L_{M,P,PR}$	$W_{M,I,PR}/W_{M,I,PR}$
Managerial (MG)	
$L_P * P(L_M \cup L_{MG}) * P(L_{MG} \cup L_P) = L_{M,P,MG}$	$W_{M,I,MG}/W_{M,I,PR}$
Clerical (C)	
$L_P * P(L_M \cup L_C) * P(L_C \cup L_P) = L_{M,P,C}$	$W_{M,I,C}/W_{M,I,PR}$
Sales (S)	
$L_P * P(L_M \cup L_S) * P(L_S \cup L_P) = L_{M,P,S}$	$W_{M,I,S}/W_{M,I,PR}$
Service (SV)	
$L_P * P(L_M \cup L_{SV}) * P(L_{SV} \cup L_P) = L_{M,P,SV}$	$W_{M,I,SV}/W_{M,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_P * P(L_M \cup L_{AA}) * P(L_{AA} \cup L_P) = L_{M,P,AA}$	$W_{M,I,AA}/W_{M,I,PR}$

Production (PR)

$L_P * P(L_M \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{M,P,PD}$ $W_{M,I,PD}/W_{M,I,PR}$

Other (O)

$L_P * P(L_M \cup L_O) * P(L_O \cup L_P) = L_{M,P,O}$ $W_{M,I,O}/W_{M,I,PR}$

SECONDARY (S)

Professional (PR)

$L_S * P(L_M \cup L_{PR}) * P(L_{PR} \cup L_S) = L_{M,S,PR}$ $W_{M,I,PR}/W_{M,I,PR}$

Managerial (MG)

$L_S * P(L_M \cup L_{MG}) * P(L_{MG} \cup L_S) = L_{M,S,MG}$ $W_{M,I,MG}/W_{M,I,PR}$

Clerical (C)

$L_S * P(L_M \cup L_C) * P(L_C \cup L_S) = L_{M,S,C}$ $W_{M,I,C}/W_{M,I,PR}$

Sales (S)

$L_S * P(L_M \cup L_S) * P(L_S \cup L_S) = L_{M,S,S}$ $W_{M,I,S}/W_{M,I,PR}$

Service (SV)

$L_S * P(L_M \cup L_{SV}) * P(L_{SV} \cup L_S) = L_{M,S,SV}$ $W_{M,I,SV}/W_{M,I,PR}$

Agriculture/Animal/Forestry (AA)

$L_S * P(L_M \cup L_{AA}) * P(L_{AA} \cup L_S) = L_{M,S,AA}$ $W_{M,I,AA}/W_{M,I,PR}$

Production (PD)

$L_S * P(L_M \cup L_{PD}) * P(L_{PD} \cup L_S) = L_{M,S,PD}$ $W_{M,I,PD}/W_{M,I,PR}$

Other (O)

$L_S * P(L_M \cup L_O) * P(L_O \cup L_S) = L_{M,S,O}$ $W_{M,I,O}/W_{M,I,PR}$

COLLEGE (CG)

Professional (PR)

$L_{CG} * P(L_M \cup L_{PR}) * P(L_{PR} \cup L_{CG}) = L_{M,CG,PR}$ $W_{M,I,PR}/W_{M,I,PR}$

Managerial (MG)

$L_{CG} * P(L_M \cup L_{MG}) * P(L_{MG} \cup L_{CG}) = L_{M,CG,MG}$ $W_{M,I,MG}/W_{M,I,PR}$

Clerical (C)

$L_{CG} * P(L_M \cup L_C) * P(L_C \cup L_{CG}) = L_{M,CG,C}$ $W_{M,I,C}/W_{M,I,PR}$

Sales (S)

$L_{CG} * P(L_M \cup L_S) * P(L_S \cup L_{CG}) = L_{M,CG,S}$ $W_{M,I,S}/W_{M,I,PR}$

Service (SV)

$L_{CG} * P(L_M \cup L_{SV}) * P(L_{SV} \cup L_{CG}) = L_{M,CG,SV}$ $W_{M,I,SV}/W_{M,I,PR}$

Agriculture/Animal/Forestry (AA)

$L_{CG} * P(L_M \cup L_{AA}) * P(L_{AA} \cup L_{CG}) = L_{M,CG,AA}$ $W_{M,I,AA}/W_{M,I,PR}$

Production (PD)

$L_{CG} * P(L_M \cup L_{PD}) * P(L_{PD} \cup L_{CG}) = L_{M,CG,PD}$ $W_{M,I,AD}/W_{M,I,PR}$

Other (O)

$$L_{CG} * P(L_M \cup L_O) * P(L_O \cup L_{CG}) = L_{M,CG,O} \qquad W_{M,I,O}/W_{M,I,PR}$$

$$HCI_{Mt} = \frac{(\sum_i^4 \sum_j^8 L_{M,i,j,t} * (W_{Mj}/W_{M,PR})) * 100}{\sum_i \sum_j L_{M,i,j,o}} * (W_{Mj}/W_{M,PR})$$

Where

i = level of education

j = professional occupation

t = 1,...n

CONSTRUCTION OF HUMAN CAPITAL INDEX FOR AGRICULTURE SECTOR (HCI_A)

NUMBER OF WORKERS BY LEVEL OF EDUCATION	WEIGHTS BASED ON RELATIVE WAGES
ILLITERATE (I)	
Professional (PR)	
$L_I * P(L_A \cup L_{PR}) * P(L_{PR} \cup L_I) = L_{A,I,PR}$	$W_{A,I,PR}/W_{A,I,PR}$
Managerial (MG)	
$L_I * P(L_A \cup L_{MG}) * P(L_{MG} \cup L_I) = L_{A,I,MG}$	$W_{A,I,MG}/W_{A,I,PR}$
Clerical (C)	
$L_I * P(L_A \cup L_C) * P(L_C \cup L_I) = L_{A,I,C}$	$W_{A,I,C}/W_{A,I,PR}$
Sales (S)	
$L_I * P(L_A \cup L_S) * P(L_S \cup L_I) = L_{A,I,S}$	$W_{A,I,S}/W_{A,I,PR}$
Service (SV)	
$L_I * P(L_A \cup L_{SV}) * P(L_{SV} \cup L_I) = L_{A,I,SV}$	$W_{A,I,SV}/W_{A,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_I * P(L_A \cup L_{AA}) * P(L_{AA} \cup L_I) = L_{A,I,AA}$	$W_{A,I,AA}/W_{A,I,PR}$
Production (PR)	
$L_I * P(L_A \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{A,P,PD}$	$W_{A,I,PD}/W_{A,I,PR}$
Other (O)	
$L_I * P(L_A \cup L_O) * P(L_O \cup L_I) = L_{A,I,O}$	$W_{A,I,O}/W_{A,I,PR}$
PRIMARY (P)	
Professional (PR)	
$L_P * P(L_A \cup L_{PR}) * P(L_{PR} \cup L_P) = L_{A,P,PR}$	$W_{A,I,PR}/W_{A,I,PR}$
Managerial (MG)	
$L_P * P(L_A \cup L_{MG}) * P(L_{MG} \cup L_P) = L_{A,P,MG}$	$W_{A,I,MG}/W_{A,I,PR}$
Clerical (C)	
$L_P * P(L_A \cup L_C) * P(L_C \cup L_P) = L_{A,P,C}$	$W_{A,I,C}/W_{A,I,PR}$
Sales (S)	
$L_P * P(L_A \cup L_S) * P(L_S \cup L_P) = L_{A,P,S}$	$W_{A,I,S}/W_{A,I,PR}$
Service (SV)	
$L_P * P(L_A \cup L_{SV}) * P(L_{SV} \cup L_P) = L_{A,P,SV}$	$W_{A,I,SV}/W_{A,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_P * P(L_A \cup L_{AA}) * P(L_{AA} \cup L_P) = L_{A,P,AA}$	$W_{A,I,AA}/W_{A,I,PR}$
Production (PR)	
$L_P * P(L_A \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{A,P,PD}$	$W_{A,I,PD}/W_{A,I,PR}$

Other (O)

$L_P * P(L_A \cup L_O) * P(L_O \cup L_P) = L_{A,P,O}$ $W_{A,I,O}/W_{A,I,PR}$

SECONDARY (S)

Professional (PR)

$L_S * P(L_A \cup L_{PR}) * P(L_{PR} \cup L_S) = L_{A,S,PR}$ $W_{A,I,PR}/W_{A,I,PR}$

Managerial (MG)

$L_S * P(L_A \cup L_{MG}) * P(L_{MG} \cup L_S) = L_{A,S,MG}$ $W_{A,I,MG}/W_{A,I,PR}$

Clerical (C)

$L_S * P(L_A \cup L_C) * P(L_C \cup L_S) = L_{A,S,C}$ $W_{A,I,C}/W_{A,I,PR}$

Sales (S)

$L_S * P(L_A \cup L_S) * P(L_S \cup L_S) = L_{A,S,S}$ $W_{A,I,S}/W_{A,I,PR}$

Service (SV)

$L_S * P(L_A \cup L_{SV}) * P(L_{SV} \cup L_S) = L_{A,S,SV}$ $W_{A,I,SV}/W_{A,I,PR}$

Agriculture/Animal/Forestry (AA)

$L_S * P(L_A \cup L_{AA}) * P(L_{AA} \cup L_S) = L_{A,S,AA}$ $W_{A,I,AA}/W_{A,I,PR}$

Production (PD)

$L_S * P(L_A \cup L_{PD}) * P(L_{PD} \cup L_S) = L_{A,S,PD}$ $W_{A,I,PD}/W_{A,I,PR}$

Other (O)

$L_S * P(L_A \cup L_O) * P(L_O \cup L_S) = L_{A,S,O}$ $W_{A,I,O}/W_{A,I,PR}$

COLLEGE (CG)

Professional (PR)

$L_{CG} * P(L_A \cup L_{PR}) * P(L_{PR} \cup L_{CG}) = L_{A,CG,PR}$ $W_{A,I,PR}/W_{A,I,PR}$

Managerial (MG)

$L_{CG} * P(L_A \cup L_{MG}) * P(L_{MG} \cup L_{CG}) = L_{A,CG,MG}$ $W_{A,I,MG}/W_{A,I,PR}$

Clerical (C)

$L_{CG} * P(L_A \cup L_C) * P(L_C \cup L_{CG}) = L_{A,CG,C}$ $W_{A,I,C}/W_{A,I,PR}$

Sales (S)

$L_{CG} * P(L_A \cup L_S) * P(L_S \cup L_{CG}) = L_{A,CG,S}$ $W_{A,I,S}/W_{A,I,PR}$

Service (SV)

$L_{CG} * P(L_A \cup L_{SV}) * P(L_{SV} \cup L_{CG}) = L_{A,CG,SV}$ $W_{A,I,SV}/W_{A,I,PR}$

Agriculture/Animal/Forestry (AA)

$L_{CG} * P(L_A \cup L_{AA}) * P(L_{AA} \cup L_{CG}) = L_{A,CG,AA}$ $W_{A,I,AA}/W_{A,I,PR}$

Production (PD)

$L_{CG} * P(L_A \cup L_{PD}) * P(L_{PD} \cup L_{CG}) = L_{A,CG,PD}$ $W_{A,I,AD}/W_{A,I,PR}$

Other (O)

$L_{CG} * P(L_A \cup L_O) * P(L_O \cup L_{CG}) = L_{A,CG,O}$ $W_{A,I,O}/W_{A,I,PR}$

$$HCI_{At} = \frac{(\sum_{i}^{4}\sum_{j}^{8} L_{A,i,j,t} * (W_{Aj}/W_{A,PR})) * 100}{\sum_{i}\sum_{j} L_{A,i,j,o}} * (W_{Aj}/W_{A,PR})$$

Where

i	=	level of education
j	=	professional occupation
t	=	1,...n

CONSTRUCTION OF HUMAN CAPITAL INDEX FOR OTHER SERVICES SECTOR (HCI_O)

NUMBER OF WORKERS BY LEVEL OF EDUCATION	WEIGHTS BASED ON RELATIVE WAGES
ILLITERATE (I)	
Professional (PR)	
$L_I * P(L_{OT} \cup L_{PR}) * P(L_{PR} \cup L_I) = L_{OT,I,PR}$	$W_{OT,I,PR}/W_{OT,I,PR}$
Managerial (MG)	
$L_I * P(L_{OT} \cup L_{MG}) * P(L_{MG} \cup L_I) = L_{OT,I,MG}$	$W_{OT,I,MG}/W_{OT,I,PR}$
Clerical (C)	
$L_I * P(L_{OT} \cup L_C) * P(L_C \cup L_I) = L_{OT,I,C}$	$W_{OT,I,C}/W_{OT,I,PR}$
Sales (S)	
$L_I * P(L_{OT} \cup L_S) * P(L_S \cup L_I) = L_{OT,I,S}$	$W_{OT,I,S}/W_{OT,I,PR}$
Service (SV)	
$L_I * P(L_{OT} \cup L_{SV}) * P(L_{SV} \cup L_I) = L_{OT,I,SV}$	$W_{OT,I,SV}/W_{OT,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_I * P(L_{OT} \cup L_{AA}) * P(L_{AA} \cup L_I) = L_{OT,I,AA}$	$W_{OT,I,AA}/W_{OT,I,PR}$
Production (PR)	
$L_I * P(L_{OT} \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{OT,P,PD}$	$W_{OT,I,PD}/W_{OT,I,PR}$
Other (O)	
$L_I * P(L_{OT} \cup L_O) * P(L_O \cup L_I) = L_{OT,I,O}$	$W_{OT,I,O}/W_{OT,I,PR}$
PRIMARY (P)	
Professional (PR)	
$L_P * P(L_{OT} \cup L_{PR}) * P(L_{PR} \cup L_P) = L_{OT,P,PR}$	$W_{OT,I,PR}/W_{OT,I,PR}$
Managerial (MG)	
$L_P * P(L_{OT} \cup L_{MG}) * P(L_{MG} \cup L_P) = L_{OT,P,MG}$	$W_{OT,I,MG}/W_{OT,I,PR}$
Clerical (C)	
$L_P * P(L_{OT} \cup L_C) * P(L_C \cup L_P) = L_{OT,P,C}$	$W_{OT,I,C}/W_{OT,I,PR}$
Sales (S)	
$L_P * P(L_{OT} \cup L_S) * P(L_S \cup L_P) = L_{OT,P,S}$	$W_{OT,I,S}/W_{OT,I,PR}$
Service (SV)	
$L_P * P(L_{OT} \cup L_{SV}) * P(L_{SV} \cup L_P) = L_{OT,P,SV}$	$W_{OT,I,SV}/W_{OT,I,PR}$
Agriculture/Animal/Forestry (AA)	
$L_P * P(L_{OT} \cup L_{AA}) * P(L_{AA} \cup L_P) = L_{OT,P,AA}$	$W_{OT,I,AA}/W_{OT,I,PR}$
Production (PR)	
$L_P * P(L_{OT} \cup L_{PD}) * P(L_{PD} \cup L_P) = L_{OT,P,PD}$	$W_{OT,I,PD}/W_{OT,I,PR}$

Other (O)

$L_P * P(L_{OT} \cup L_O) * P(L_O \cup L_P) = L_{OT,P,O}$ $W_{OT,LO}/W_{OT,LPR}$

SECONDARY (S)

Professional (PR)

$L_S * P(L_{OT} \cup L_{PR}) * P(L_{PR} \cup L_S) = L_{OT,S,PR}$ $W_{OT,LPR}/W_{OT,LPR}$

Managerial (MG)

$L_S * P(L_{OT} \cup L_{MG}) * P(L_{MG} \cup L_S) = L_{OT,S,MG}$ $W_{OT,LMG}/W_{OT,LPR}$

Clerical (C)

$L_S * P(L_{OT} \cup L_C) * P(L_C \cup L_S) = L_{OT,S,C}$ $W_{OT,LC}/W_{OT,LPR}$

Sales (S)

$L_S * P(L_{OT} \cup L_S) * P(L_S \cup L_S) = L_{OT,S,S}$ $W_{OT,LS}/W_{OT,LPR}$

Service (SV)

$L_S * P(L_{OT} \cup L_{SV}) * P(L_{SV} \cup L_S) = L_{OT,S,SV}$ $W_{OT,LSV}/W_{OT,LPR}$

Agriculture/Animal/Forestry (AA)

$L_S * P(L_{OT} \cup L_{AA}) * P(L_{AA} \cup L_S) = L_{OT,S,AA}$ $W_{OT,LAA}/W_{OT,LPR}$

Production (PD)

$L_S * P(L_{OT} \cup L_{PD}) * P(L_{PD} \cup L_S) = L_{OT,S,PD}$ $W_{OT,LPD}/W_{OT,LPR}$

Other (O)

$L_S * P(L_{OT} \cup L_O) * P(L_O \cup L_S) = L_{OT,S,O}$ $W_{OT,LO}/W_{OT,LPR}$

COLLEGE (CG)

Professional (PR)

$L_{CG} * P(L_{OT} \cup L_{PR}) * P(L_{PR} \cup L_{CG}) = L_{OT,CG,PR}$ $W_{OT,LPR}/W_{OT,LPR}$

Managerial (MG)

$L_{CG} * P(L_{OT} \cup L_{MG}) * P(L_{MG} \cup L_{CG}) = L_{OT,CG,MG}$ $W_{OT,LMG}/W_{OT,LPR}$

Clerical (C)

$L_{CG} * P(L_{OT} \cup L_C) * P(L_C \cup L_{CG}) = L_{OT,CG,C}$ $W_{OT,LC}/W_{OT,LPR}$

Sales (S)

$L_{CG} * P(L_{OT} \cup L_S) * P(L_S \cup L_{CG}) = L_{OT,CG,S}$ $W_{OT,LS}/W_{OT,LPR}$

Service (SV)

$L_{CG} * P(L_{OT} \cup L_{SV}) * P(L_{SV} \cup L_{CG}) = L_{OT,CG,SV}$ $W_{OT,LSV}/W_{OT,LPR}$

Agriculture/Animal/Forestry (AA)

$L_{CG} * P(L_{OT} \cup L_{AA}) * P(L_{AA} \cup L_{CG}) = L_{OT,CG,AA}$ $W_{OT,LAA}/W_{OT,LPR}$

Production (PD)

$L_{CG} * P(L_{OT} \cup L_{PD}) * P(L_{PD} \cup L_{CG}) = L_{OT,CG,PD}$ $W_{OT,LAD}/W_{OT,LPR}$

Other (O)

$L_{CG} * P(L_{OT} \cup L_O) * P(L_O \cup L_{CG}) = L_{OT,CG,O}$ $W_{OT,LO}/W_{OT,LPR}$

$$HCI_{OTt} = \frac{(\sum_{i}^{4}\sum_{j}^{8} L_{OT,i,j,t} * (W_{OTj}/W_{OT,PR})) * 100}{\sum_{i}\sum_{j} L_{OT,i,j,o}} * (W_{OTj}/W_{OT,PR})$$

Where

i	=	level of education
j	=	professional occupation
t	=	1,...n

CONSTRUCTION OF PUBLIC HEALTH INDEX (PHI)

The Composite Public Health Index (PHI) will be constructed on the basis of a two step procedure. In Step 1, the individual public health indicators, as given in Table 1 will be converted into index based on a given base year. Using the factor weights derived from principle component analysis (PCI) technique, the required PHI will be constructed. Individual health indicators chosen to design PHI are given below:

HEALTH INPUTS

1. Hospitals
2. Dispensaries
3. Basic Health Units and Sub Health Centres
4. Maternity & Child Health Centres
5. Rural Health Centres
6. T.B. Centres
7. Total Beds
8. Doctors
9. Dentists
10. Nurses
11. Mid-wives
12. Paramedics
13. Lady Health Visitors
14. Rural Water Supply
15. Urban Water Supply
16. Calories per day
17. Protein per day

HEALTH RELATED OUTPUT

18. Crude Birth Rates
19. Crude Death Rates
20. Infant Mortality Rates