A Simple Inter-Industry Model of Pakistan, with an Application to Pakistan’s Sixth Five-Year Plan

SULEIMAN I. COHEN, IVO C. HAVINGA and MOHAMMAD SALEEM*

I. INTRODUCTION

The macro-econometric model of Pakistan’s economy by Naqvi et al. [3] is the first completed work in a renewed effort to model significant economic and social activities and issues in Pakistan. One of the current modelling efforts in which the authors are participating aims at combining elements from the macro-econometric model, inter-industry relations, factor market relations, and social accounting frameworks. This effort is now made possible by the compilation of the relevant statistics relating to an input-output table and the social accounting matrix.¹

The present paper reports on one of the primary building blocks in the above-mentioned modelling efforts, namely, the inter-industry model, in combination with certain features of a macro-econometric model. In spite of the substantial advances made in the evolvement of the input-output system towards economy-wide general equilibrium models, the traditional input-output model has remained among the most commonly used tools at the official planning level in developing countries and will probably continue for some more time. Notwithstanding the extension which is under way, the traditional input-output model can provide a rigorous text for hypothesizing the development of the economy in the past and future, a supplementary check on the feasibility of medium-term development plans, and a tool for commodity balances and investment planning.

The traditional input-output model presented here is characterized by incorporation of certain modifications in factor use so as to reflect the functioning of mixed economies in a more realistic way. While the next section specifies the model, the other sections discuss its estimation and employ it for tracing past development

*The authors are respectively a member of the Faculty of Economics at the Centre for Development Planning, Erasmus University, Rotterdam (Holland), a visiting fellow at the Pakistan Institute of Development Economics in the framework of the Netherlands Development Corporation and a staff economist at the Pakistan Institute of Development Economics, Islamabad. The authors like to acknowledge the computational assistance of Mr Khurshid and Mr Ishfaq Masood, the statistical assistance of Mr Mohammad Ali and Mr Tariq Mahmood, and the typing assistance of Mr Ghulam Raza.

¹The preliminary version of the Social Accounting Matrix 1979-80 for Pakistan is available at the Pakistan Institute of Development Economics.
and checking on the feasibility of growth targets of the Sixth Plan [4]. It is noted that past publicised efforts which did similar exercises for the five-year development plans of Pakistan are limited to Khan [2] and Tims [6].

II. SPECIFICATION

Although the present model—which has been applied elsewhere by Cohen [1]—shares general characteristics with traditional input-output models, it is rendered more useful by the incorporation of certain modifications in factor use. In particular, investment plays two roles: as a final demand item which can be predicted just like consumption through a behavioural relationship, and as a factor of production which increases the capacity for production through a technical relationship. The model includes both relationships. The adjustment between demand for and supply of investment takes place through fluctuations in capacity utilization. The rationale for fluctuations in idle capacity as a mechanism of adjustment to variations in the components of final demand and factor use is well developed in the economic literature. The model allows incorporation of different adjustment mechanisms as well.

Furthermore, the explicit distinction between private investment and public investment permits a differentiated treatment of each source and a more realistic representation in a mixed economy.

The model’s application to Pakistan involves eight equations. It gives solution to, among others, the value added in twelve sectors, but the number of sectors will be extended in future work. The model is formulated for periods of one year. Unless otherwise specified, all variables refer to year t, and are in constant prices of 1959-60. Equations and notations of the model appear in Table 1.

Equation 1 is the sectoral balance. It balances the supply of the good i (the sum of sectoral production and imports) with its demand (the sum of intermediate sectoral deliveries, private and public consumption, private and public investment and exports).

Equation 2 defines the gross value added by sector i as the gross domestic output of the sector i less the sectoral intermediate inputs and indirect taxes less subsidies.

Equation 3 sums the value added by the sectors, to give the gross domestic product at factor costs.

Equation 4 makes private consumption dependent on the gross domestic product at factor costs and the remittances from abroad. The present specification of the private-consumption function was selected from several alternative statistical trials, see Section III.

Table 1

The Basic Model

Equations

\[ PRD_i + m_i \ IM = \sum_{j=1}^{12} a_{ij} PRD_j + c_i^1 \ COP + c_i^2 \ COG + b_i \ INP + b_i \ ING + b_i \ INC + e_i \ EXP \]

\[ PIB_i = (1 - \sum_{j=1}^{12} a_{ij} - d_i) PRD_i \]

\[ GDP = \sum_i PIB_i \]

\[ COP = Z^0 + Z^1 \ GDP + Z^2 \ REM \]

\[ INP = \nu^0 + \nu^1 \ INP_{-1} + \nu^2 \ GDP + \nu^3 \ OIL \]

\[ INV = INP + ING \]

\[ \sum_{i=1}^{12} k_i PIB_i = \sum_{i=1}^{12} k_i PIB_{i-1} + INV_{-1} + CAP \]

\[ DEF = \ IM - EXP \]

Variables

CAP = Change in capacity utilization
COG = Public consumption, exogenous
COP = Private consumption
DEF = Trade deficit
EXP = Total exports, exogenous
GDP = Total gross value added at factor costs
IMP = Total imports, exogenous
INC = Change in stocks, exogenous
ING = Public gross capital formation, exogenous
INP = Private gross capital formation
INV = Total gross capital formation
PIB = Gross value added at factor costs of sector i
PRD = Gross production of sector i
Coefficients

\[ a_i \] = Input-output coefficients.
\[ b_i^1, b_i^2 \] = Proportion of sector \( i \) in total private and public investment, respectively.
\[ b_i^3 \] = Proportion of sector \( i \) in total change in stocks.
\[ c_i^1, c_i^2 \] = Proportion of sector \( i \) in total private and public consumption, respectively.
\[ d_j \] = Indirect taxes less subsidies per unit of production of sector \( j \).
\[ e_i \] = Proportion of sector \( i \) in total exports and imports, respectively.
\[ k_i \] = Incremental capital-output ratio of sector \( i \).
\[ v^2, v^3 \] = Parameters of the private investment function.
\[ z^2, z^3 \] = Parameters of the private consumption function.

Equation 5 formulates a function for the behavior of private investment. Generally speaking, the profit rate is one of the main determinants of private investment. Empirically, private investment is found to be related to profits (approximated by employer's income or total income), capital stock, the rate of interest, liquid reserves; and in the more open economies: foreign commitments or foreign capital inflow. A number of alternative statistical traits — see Section III — were made before the present form of equation 5 was considered the most applicable. In this equation private investment is dependent on lagged private investment, gross domestic product and a dummy for oil price increase.

Equation 6 depicts total investment as the sum of private and public investments.

Equation 7: Balance of capacity. This equation specifies that the total production capacity required to produce the gross product of all sectors in year \( t \) (obtained by multiplying incremental capital output rates by sector by gross product by sector) is equal to the realized total production capacity plus investment made a year earlier. To allow for the hypothesis that the required capacity may differ from the realized capacity, a slack variable is introduced for changes in capacity utilization, \( \text{CAP} \). Positive values of \( \text{CAP} \) mean an overutilization, while negative values stand for underutilization. As was stated earlier, the value of \( \text{CAP} \) should be subject to lower and upper restrictions since, in this context, the accumulated values of \( \text{CAP} \) cannot remain highly positive or negative for long.

Equation 8: Balance of payments. This equation states the equality of total exports (\( \text{EXP} \)) plus net foreign capital inflow (\( \text{DEF} \)) to total imports (\( \text{IMP} \)). Positive values of \( \text{DEF} \) stand for net foreign capital inflow and negative values for the outflow. Just as in the previous equation, the value of \( \text{DEF} \) should be subject to lower

and upper restrictions since, in this context too, the accumulated values of \( \text{DEF} \) cannot remain highly positive or highly negative for long.

There are two categories of known variables: (i) lagged variables, and (ii) variables under government control such as public consumption (\( \text{COG} \)) and public investment (\( \text{ING} \)), and exports (\( \text{EXP} \)) and imports (\( \text{IMP} \)) (and thus the net foreign capital inflow \( \text{DEF} \)). The remaining variables, among which is included the change in capacity utilization (\( \text{CAP} \)), are unknown. Because of the endogenous adjustments in capacity utilization, this model is reduced to a framework that can be described as demand-determined, static and open-ended.

In the case where the constraint on \( \text{CAP} \) is violated, and hence \( \text{CAP} \) fixed \textit{a priori}, the adjustment has to be sought in endogenizing appropriate parameters in the area of consumption and investment. As a result, such a framework can be described to be both demand- and supply-determined, dynamic and open-ended. Model-wise, the postulated adjustment in the area of consumption and investment can be shifted to the area of exports and imports. Thus situations are synonymous with those occurring in the well-known two-gap models.

The solutions obtained for the sectoral production should satisfy the restriction that \( \text{CAP} \) can fluctuate only within a very small margin. In particular, positive values of \( \text{CAP} \) would mean an overutilization of normal productive capacity which cannot be warranted for long. Production ought to be limited by the available productive capacity. A hard test for the model would be, therefore, to check on the validity of the results regarding capacity utilization. Once proved realistic, one may proceed to the use of the model for policy-making. As will be demonstrated in a later section, solutions of the model for the 1978–1983 period are validated regarding capacity utilization and other variables.

Solving equations 1 to 8 gives a reduced-form equation for the sectoral gross valued added and capacity utilization in terms of the exogenous variables as follows:

\[ PIB_i = f_9 (\text{COG, ING, EXP, IMP}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (9) \]

\[ \text{CAP} = f_{10} (\text{COG, ING, EXP, IMP, PIB}_{i-1}, \text{INV}_{t-1}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10) \]

Equation 9 is an interesting equation for policy analysis. It makes possible an appraisal of the combined effects of public expenditure on consumption and investment. Often a change in public consumption (\( \text{COG} \)) requires that public investment increases too. For example, government may expend on consumption and investment in the relationship \( \Delta \text{COG}: k \Delta \text{COG} \), so that what should be appraised is the impact of \((1 + k) \Delta \text{COG}\). Equation 9 captures the direct round of impact of such an

\[ \text{2} \text{The endogenizing of imports is one of the next steps in the evaluation of the present model.} \]
increase in government expenditure on the gross domestic product as well as the indirect round of impacts of the latter on private consumption and private investment (through equations 4 and 5), and, in turn, the impact of this additional final demand on the gross domestic product. Usually, traditional input-output models give a somewhat different appraisal.3

III. ESTIMATION

Owing to the nature of the inter-industry model, it is considered necessary to vary certain parameter estimates of the model in the application of the model to various periods, viz. the input-output coefficients and the foreign-trade coefficients. This section comments on the estimation of these and other coefficients.

First, the input-output coefficients \( (a_{ij}) \) are derived from the 1979-80 input-output flow matrix expressed at constant prices of 1959-60. It is assumed that these estimated coefficients hold for the period from 1978-79 to 1982-83. The input-output flow matrix of 1979-80 was compiled from the “Revised PIDE Input-Output Table 1975-76” by Saleem et al. [5] by aggregating 118 sectors into 12 sectors and subsequently updating the aggregated input-output flow matrix of 1975-76 by applying the RAS method to make it consistent with the 1979-80 data given in the *Pakistan Economic Survey 1982-83*.

Given the intention to compare the projections of the model with the targets and objectives set in the Six Five Year Plan (1983–88), the input-output flow matrix for 1982-83 was constructed at constant prices of 1959-60. This matrix is obtained by updating the aggregated input-output flow matrix for 1975-76 by applying appropriately the RAS method to make the matrix consistent with the 1982-83 data reported in the *Pakistan Economic Survey 1982-83*. The resulting input-output coefficients for 1982-83 are assumed to hold for the period from 1981-82 to 1987-88. Secondly, the coefficients of exports and imports by origin of sectors of production (i.e. \( e_i \) and \( m_i \)) show rapid changes over time. These sectoral coefficients are calculated anew for the input-output flow matrices of 1979-80 and 1982-83 from the *Pakistan Economic Survey 1982-83*, the *Monthly Statistical Bulletin* and the *Annual Report of the State Bank*. The foreign trade coefficients of the input-output flow matrices of 1979-80 and 1982-83 are assumed to hold respectively for the 1978-79 – 1982-83 and 1981-82 – 1987-88 periods.

3 In open, static, traditional input-output models the effect of a public stimulus on private investment and the impact thereof on the value added are not considered, while in the closed dynamic form, total investment is determined through its role as a factor of production and not as partly public and partly privately determined final demand items. As a result, in the closed dynamic form, once total investment is determined, an increase in public investment would have to be simply compensated by a decrease in private investment, and, moreover, without any additional feedbacks, which is an absurd result in view of the validity of equation 19.

For the sake of convenience was shall refer in Section IV to Model I when presenting the solutions of the model based, among others, on the coefficients derived from input-output flow matrix of 1979-80 and to Model II when the solutions of the model are based, among others, on the coefficients derived from the input-output flow matrix of 1982-83. All other estimates of remaining coefficients discussed below are kept constant for the whole 1978–1988 period.

Coefficients which distribute final demand by sector (i.e. \( b^1_i, b^2_i, b^3_i, c^1_i, c^2_i \)) as well as proportions of indirect taxes less subsidies (\( d_i \)) are calculated from the input-output flow matrix of 1975-76.

The incremental capital-output ratios \( (k_i) \) are calculated by dividing the accumulated investment of sector \( i \) for the 1977-78 – 1981-82 period by the change in the gross values added by sector \( i \) from the 1978-79 – 1982-83 period. The accumulated investment and the change in the gross value added are both expressed at constant prices of 1959-60 on the basis of the data of the *Pakistan Economic Survey 1982-83*.

The private consumption and private investment functions are estimated by OLS on the basis of data for the period from 1959-60 to 1982-83. Several alternatives were tried before a final solution was made, as shown in Table 2.

Regarding the consumption function, several functions were tested which incorporate alternatively the gross domestic product at factor cost (GDP), remittances from abroad (REM), net factor income from abroad (NFI), and two dummy variables. One dummy was taken up to account for the recession period (REC: 1969-70 to 1976-77 and 1980-81 onwards) and another dummy to allow for the period of high oil prices (OIL: 1973-74 to 1980-81).

All the specifications estimated are characterized by a high coefficient of determination. However, equation 11 is rejected because of the negative sign of the constant term and the subsequently high propensity to consume. Inclusion of either NFI or REM as a second explaining variable improves the performance of the equation, giving more significant results with REM than with NFI. Inclusion of dummy variables appears to overlap the period of high remittances and/or net factor income from abroad, and, therefore, disturbs the estimates. Among the alternatives, equation 12 seemed to demonstrate the best overall results, therefore.

The investment function was tested alternatively as a function of the gross domestic product (GDP), public investment (ING), remittances from abroad (REM),
Table 2 — (Continued)

<table>
<thead>
<tr>
<th>Eq.</th>
<th>Dependent No. Variables</th>
<th>Independent Variables</th>
<th>$R^2$</th>
<th>DW</th>
</tr>
</thead>
</table>
| 19   | INP                     | 864.60 + 0.497 INP$_{-1}$ + 0.026 GDP
   |                         | (3.520)               | (4.237) | (2.553) |
|      |                         | -0.202 ING
   |                         | (1.577)               | (2.240) |   |
| 20   | INP                     | 678.28 + 0.550 INP$_{-1}$
   |                         | (3.003)               | (4.724)         |
|      |                         | + 0.012 GDP
   |                         | (2.277)               | (3.129) |   |

net factor income from abroad (NFI), trade deficit (DEF), and lagged private investment (INP$_{-1}$). Also, three dummies were incorporated, one for the recession period (REC), another for the period of high oil prices (OIL) and also one for the period of nationalizations (1973-74 to 1975-76). Only INP$_{-1}$ GDP, ING and OIL demonstrate in general significant estimates for their corresponding parameters.

Equation 17 indicates the independent variable with the highest explanatory value for the variation in INP: lagged private investment ($R^2 = 428$). Adding GDP and ING hardly increases the explained variation in INP, although the corresponding estimated parameters are significant at conventional levels. (See equation 18.) The introduction of the dummy OIL increases the explained variation up to 74.2 percent, but equation 19 demonstrates insignificant t-values (in parenthesis) at the 5-percent level for ING. The specification 20 is selected because it demonstrates the highest obtainable coefficient of determination, stable parameter estimates, absence of autocorrelation and significant t-values for the estimated parameters.

IV. RESULTS

In spite of the limited scope of the current specification of the inter-industry model, it gives a workable representation of past developments.

The validity of the model can be tested from a comparison of solved and observed values. For Model I, the degree of reliability can be gathered from a comparison between the solutions and observed values of 1979-80 to 1982-83. For Model II, the observed values for the years 1981-82 and 1982-83 can be compared with solutions. Table 3 presents the ratios of the observed to the solved values.

First the validity of Model I is discussed according to Columns 1 to 5 in Table 3. The comparison shows that the predicted values correspond with the observed values for the period from 1978-79 to 1981-82 and less for the year 1982-83. For the years from 1978-79 to 1981-82 the ratio observed to solved values for the GDP shows a gap of 4-percent but for the year 1982-83 the overestimation becomes...
Table 3

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheat and Rice</td>
<td>0.98</td>
<td>0.94</td>
<td>0.94</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Other Agriculture</td>
<td>1.00</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>Mining and Quarrying</td>
<td>1.01</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Large-scale Manufacturing</td>
<td>1.01</td>
<td>1.03</td>
<td>1.03</td>
<td>1.03</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Ownership of Dwellings</td>
<td>1.00</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>Electricity and Gas</td>
<td>1.01</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
<td>1.04</td>
</tr>
<tr>
<td></td>
<td>Wholesale and Retail</td>
<td>1.01</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Transport and Communication</td>
<td>1.00</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>Govt. &amp; Other Services</td>
<td>1.00</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>GDP (Factor Cost)</td>
<td>1.00</td>
<td>1.06</td>
<td>1.06</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>Private Consumption</td>
<td>1.00</td>
<td>1.06</td>
<td>1.06</td>
<td>1.06</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>Total Investment</td>
<td>1.00</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
</tbody>
</table>

Table 4

Annual Compound Growth Rates (ACGRs) of Selected Solutions of the Model and the Sixth Five Year Plan (at constant prices of 1959-60)

<table>
<thead>
<tr>
<th>Sectors</th>
<th>ACGR Model (percent)</th>
<th>ACGR Sixth Plan (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Private Consumption</td>
<td>6.0</td>
<td>5.1</td>
</tr>
<tr>
<td>2. Private Investment</td>
<td>4.9</td>
<td>17.4</td>
</tr>
<tr>
<td>3. Total Investment</td>
<td>7.3</td>
<td>12.1</td>
</tr>
<tr>
<td>4. Gross Domestic Product</td>
<td>6.3</td>
<td>6.5</td>
</tr>
</tbody>
</table>

9-percent. For the values added by sectors, the model generates generally valid solutions over the period from 1978-79 to 1981-82. However, again for 1982-83 the values added in several sectors are seriously overestimated.

The comparison between solved and observed values of private consumption and private investment leads to the same conclusion that the model is generally validated for the period from 1978-79 to 1981-82 but with overestimates for the year 1982-83.

Predictions of Model II for the two years for which it is possible shows the opposite. Solutions on the basis of the technical coefficients and foreign-trade coefficients of the input-output table of 1982-83 indicate generally underestimations for many variables in 1981-82 while solutions are validated for 1982-83.

An additional check on the validity of the model for the period from 1977-78 to 1987-88 is to analyse the rate of change of capacity utilization. This rate of change in capacity utilization is calculated by dividing \( CAP \) by the total productive capacity (approximated by \( k_{GDP} + INV \)). The validity of the system as a whole requires that the value of this rate be either positively or negatively small and that its accumulation over the years should show a tendency to cancel out, unless there is evidence for structural change in capacity utilization. The obtained rates of the change in capacity utilization tend to be small and to decline over the years from 1977-78 to 1987-88 (viz: 0.968, -0.026, 0.021, 0.062, 0.094, 0.020, 0.020, 0.020, 0.020, 0.020).

The final part of this section deals with the consistency check on annual compound growth rates (ACGRs) of several targets set in the Sixth Plan by comparison with the ACGRs of the endogenous variables in the model. This simulation is based on Model II which should be more valid for the latter years. Tables 4 and 5 illustrate the ACGRs respectively for private consumption, private investment, total.
Table 5
Comparison of Annual Compound Growth Rates (ACGRs) of Sectoral Gross Values Added from the Model and the Sixth Five Year Plan (at constant prices of 1959-60)

<table>
<thead>
<tr>
<th>Sectors</th>
<th>ACGR Model (percent)</th>
<th>ACGR Sixth Plan (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agriculture</td>
<td>6.1</td>
<td>4.9</td>
</tr>
<tr>
<td>2. Mining and Quarrying</td>
<td>7.8</td>
<td>7.5</td>
</tr>
<tr>
<td>3. Manufacturing</td>
<td>6.2</td>
<td>9.3</td>
</tr>
<tr>
<td>4. Electricity</td>
<td>6.3</td>
<td>9.0</td>
</tr>
<tr>
<td>5. Other Sectors</td>
<td>6.3</td>
<td>6.4</td>
</tr>
<tr>
<td>6. G.D.P. (at factor cost)</td>
<td>6.3</td>
<td>6.5</td>
</tr>
</tbody>
</table>

investment and gross domestic product and for several gross values added for which ACGRs are reported in the Plan. Tables 6 and 7 give the disaggregated solutions by sector for the Plan period.

When comparing the average ACGRs of the model solutions with the ACGRs set in the Sixth Five Year Plan, it becomes apparent that the model gives a slightly lower growth for gross domestic product (6.3 percent versus 6.5 percent). The model predicts higher growth of private consumption (6.0 percent versus 5.1 percent), and a lower growth for private investment (4.9 percent versus 17.4 percent) vis-a-vis the plan targets. As a result, total investment in the present model would grow by 7.3 percent annually as compared with 12.1 percent annually in the Plan.

When comparing the growth targets of the Plan’s sectoral values added with the model, it is observed that the ACGRs of Mining and Quarrying (7.5 percent versus 7.8 percent) and Other Sectors (6.4 percent versus 6.3 percent) are almost equal. However, the ACGR of Agriculture solved by the model indicates an overestimation (6.1 percent versus 4.9 percent) while the sectors of Large- and Small-scale Manufacturing and Electricity demonstrate underestimation (respectively 6.4 percent versus 10.0 percent, 5.9 percent versus 7.3 percent and 6.3 percent versus 9.0 percent) all in relation to the targets of the Plan. Of course, the inter-industry model in its present form lacks realism in its treatment of the specifics of individual sectors, particularly, agriculture.

V. CONCLUSIONS

This paper reported on a simple inter-industry sub-model which forms a part of a large modelling framework encompassing elements of factor markets and social
Table 7

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and Quarrying</td>
<td>2.30</td>
<td>3.05</td>
<td>3.38</td>
<td>3.53</td>
<td>3.88</td>
<td>4.12</td>
<td>4.45</td>
</tr>
<tr>
<td>Large-scale Manufacturing</td>
<td>2.521</td>
<td>2.908</td>
<td>3.097</td>
<td>3.287</td>
<td>3.494</td>
<td>3.654</td>
<td>3.872</td>
</tr>
<tr>
<td>Construction</td>
<td>2.539</td>
<td>2.908</td>
<td>3.097</td>
<td>3.287</td>
<td>3.494</td>
<td>3.654</td>
<td>3.872</td>
</tr>
<tr>
<td>Ownership of Dwellings</td>
<td>2.539</td>
<td>2.908</td>
<td>3.097</td>
<td>3.287</td>
<td>3.494</td>
<td>3.654</td>
<td>3.872</td>
</tr>
<tr>
<td>Wholesale and Retail</td>
<td>2.539</td>
<td>2.908</td>
<td>3.097</td>
<td>3.287</td>
<td>3.494</td>
<td>3.654</td>
<td>3.872</td>
</tr>
<tr>
<td>Building and Communication</td>
<td>2.539</td>
<td>2.908</td>
<td>3.097</td>
<td>3.287</td>
<td>3.494</td>
<td>3.654</td>
<td>3.872</td>
</tr>
<tr>
<td>Services</td>
<td>4.05</td>
<td>4.88</td>
<td>5.52</td>
<td>6.608</td>
<td>7.869</td>
<td>9.077</td>
<td>10.289</td>
</tr>
<tr>
<td>Government Services and Other</td>
<td>4.05</td>
<td>4.88</td>
<td>5.52</td>
<td>6.608</td>
<td>7.869</td>
<td>9.077</td>
<td>10.289</td>
</tr>
<tr>
<td>Services</td>
<td>4.05</td>
<td>4.88</td>
<td>5.52</td>
<td>6.608</td>
<td>7.869</td>
<td>9.077</td>
<td>10.289</td>
</tr>
<tr>
<td>Services</td>
<td>4.05</td>
<td>4.88</td>
<td>5.52</td>
<td>6.608</td>
<td>7.869</td>
<td>9.077</td>
<td>10.289</td>
</tr>
<tr>
<td>Services</td>
<td>4.05</td>
<td>4.88</td>
<td>5.52</td>
<td>6.608</td>
<td>7.869</td>
<td>9.077</td>
<td>10.289</td>
</tr>
</tbody>
</table>

accounting. The presented model falls in the class of traditional input-output models, although it incorporates certain modifications regarding the demand for and supply of investment goods, and fluctuations in capacity utilization.

In spite of the simplicity of the traditional input-output model, it provides a consistency framework which can be helpful in tracing past developments and a supplementary tool for evaluating the feasibility of Plan targets.

After the validation of the presented model for the period from 1977-78 to 1982-83, the model has been used to simulate the aggregate targets of the Sixth Plan. The model gives a growth of the GDP which corresponds closely to that of the Plan. The model gives higher consumption which is compensated by lower investment. At the sectoral level, as can be expected, the largest discrepancies between the model solutions and plan targets are in the agricultural sector.

Irrespective of the extensions to the model, which are under way, it will be important to explore the difference between the model and the Plan in the judgements over consumption and investment levels in the future. Generally speaking, in their natural tendencies to push future growth, plans are known to be over-optimistic regarding private investment and reserved regarding private consumption.

**REFERENCES**


Comments on

“A Simple Inter-Industry Model of Pakistan,
with an Application to Pakistan’s
Sixth Five-Year Plan”

The inter-industry model by Cohen, Havinga and Saleem is aimed at a check of inter-sectoral consistency within the macro-economic targets set in Pakistan’s Sixth Five-Year Plan covering the period from July 1983 to June 1988. It may be interesting to note that whereas the technical underpinnings of Pakistan’s Third Five-Year Plan (1965–70) had been provided by Wouter Tim’s well-known inter-industry model, and the Fourth Five-Year Plan (1970–75) projections were based on a technique using a simple Leontief-type input-output framework, neither Pakistan’s Fifth Plan (1978–83) nor the current Sixth Plan (1983–88) made use of any such formal model. On the other hand, the two latter plans were formulated within the national accounting framework as is currently practised in this country.

So, this is after a lapse of some fifteen years that an attempt at applying a formal model (though a little late as the Sixth Plan is already in its second year of implementation) has been made, and it is positively encouraging. Needless to say that an exercise of this nature is useful in checking the inter-sectoral consistency of the Plan which can help to highlight any policy readjustments that may still be needed and may be possible for incorporation as far as possible.

Specifically, the authors have tried to analyse how far the targets of final demand components and sectoral values added contained in the Sixth Plan document are internally consistent and how they compare with those derived through the application of the input-output model.

For this purpose, the model distinguishes between two categories of exogenous variables: (i) those which are lagged and pre-determined, and (ii) those which are under control of the government; for instance, public consumption, public investment, exports and imports.

Summary results of the exercise of the paper under discussion are as under:

(i) Whereas private investment is targeted to grow at higher than 17 percent in the official Sixth Plan Document, the model projects it at no more than 4.9 percent. Hence a wide difference between the two sources.

(ii) Total investment requirement in the official Plan document is to grow at slightly above 12 percent corresponding with 6.5 percent GDP growth target as against just over 7.3 percent for a 6.3 percent growth in GDP according to the Model results.

(iii) Sectoral target in manufacturing is fixed at higher than 9 percent in the official Plan document compared with 6.2 percent in the Model, whereas the target in agriculture in the Model exercise is closer to the official target.

(iv) Significantly, private consumption targets are quite close in the revised version of the model.

Any discussion of the results of the exercise as highlighted above must take into account the working of the application of input-output technique vis-à-vis that of the internal structure of the official macro-economic framework.

Working of the input-output model as used for the exercise under discussion is rather simple in the manner of a typical application of a conventional Leontief-type model, it treats certain variables as exogenous whose values, once fixed, are used to determine the values of other unknown variables endogenously. The model is demand-oriented. Since both exports and imports are exogenously determined, the model remains open-ended.

Comments are offered on two fundamental aspects of the paper under discussion as under. My first comment pertains to those variables which are selected exogenously. The second comment relates to the way of building up the 1982-83 inter-industry flow matrix which is used as a basis for projections of the year-to-year macro-sectoral economic magnitudes of the Sixth Five-Year Plan.

Choice of Exogenous Variables

As mentioned earlier, the authors have selected such variables as public consumption, public investment, imports and exports exogenously. It is believed that a comparison of the projected values of the macro magnitudes with those contained in the official Plan document would have been more meaningful if the methodology behind the formulation of the official Plan had been kept in view. Adequate attention to this aspect does not seem to have been paid. Basically, the Plan document is the outcome of a massive coordination effort among different parts of the government at the federal, provincial and local levels. Since the intention is not to go into detail of the coordination exercise, for the purpose in hand, attention is focused on certain fundamental components of the basic economic framework of the official Plan and their interlinkages as under:

(a) Projection of GDP by major economic sectors;
(b) Private investment and public investment;
(c) Exports; and
(d) Imports.
Projections under (a) above reflect the impact of government policy package aimed at

(i) augmenting the supply of irrigation water and area under cultivation;
(ii) improving modern inputs of major crops quantitatively as well as qualitatively with adequate availability of agricultural credit, with a view to bringing about improvement in yield; and
(iii) special emphasis on the development of rain-fed (barani) areas which had been neglected in the past.

Crop-wise production targets, together with those for other sub-sectors in the official Plan, were thus fixed with reference to the various policies mentioned above. These targets had then been translated into the corresponding targets in terms of the value added which together provided the combined sectoral agricultural target.

In the case of manufacturing, its two main sub-sectors were treated separately: the large-scale and the small-scale manufacturing. Target growth in small-scale manufacturing is purely notional based on some sample survey results in the mid-Seventies, whereas the sectoral target in large-scale manufacturing is based on detailed studies of

(a) the existing industrial capacity together with the possible commissioning of new industries projected to be installed in keeping with the industrial investment programme in the public sector; and
(b) the size of industrial investment schedule for the Sixth Plan. It may be pointed out that both the public and private sector programmes referred to above do take into account, although informally, the direct requirement of individual industries and, to some extent, also the ‘indirect’ requirement of individual industries covered under the total investment programme.

Targets for other sectors in the official Plan reflect

(a) resource allocation provided within the overall public sector programme in line with the physical targets assigned to sectors like mining and quarrying, electricity and gas generation, railways and other transport;
(b) budgetary provision made as in the case of “Public Administration and Defence” sector; and
(c) recent past trends as reflected in the growth target of the remaining sectors.

In view of the above, the inter-industry and capital-output relationships implicit in the basic structure of the official plan are most likely to differ substantially from the past. Any comparative exercise of the type under discussion must, therefore, take into account these structural deviations which might have resulted from such factor as outlined in the preceding paragraphs.

Against this background of extremely intricate and complex developments which affected the making of the official Plan, perhaps a more meaningful consistency exercise could have been undertaken by using the input-output technique as under:

(i) The usual categories of consumption, investment and exports should be adopted as exogenously determined and brought close to official targets.
(ii) Sectoral growth in agriculture should also have been treated exogenously and closer to official target.
(iii) Technical input coefficients \((a_{ij})\) should also be adjusted to reflect the spirit of the Private Sector Investment Schedule released officially for the Sixth Plan period.
(iv) Once the exogenously determined variables are fixed, GDP and sectoral targets (with the exception of agriculture) and import requirements should be endogenized.

An exercise on the lines suggested above would be a fair basis for a check on the consistency of the official Plan exercise.

Construction of Basic Input-Output Tables

The authors have used the updated version of the basic 1975-76 input-output table constructed by the PIDE. One simply admires the efforts of the authors in making all possible adjustments to bring the flow matrices up to date. However, snags remain owing to factors some of which have been referred to in the preceding paragraphs.

It is, therefore, suggested that before a comparative exercise of the type under discussion is attempted, a proper basic input-output table must cover the following major elements:

(a) Cost structure of major producing sectors based on statistical information for a period as close to the starting year of the Sixth Plan as possible. In this respect, it may be pointed out that the task of constructing such a table may be facilitated if the number of sectors in the input-output table is made dependent on the availability of information. Perhaps a few large aggregated sectors, each reflecting a cost structure closest to the situation in the early Eighties as far as possible, would make the task much easier.
Changes in the industrial structure envisaged in the official Plan through the Industrial Investment Schedule covering the entire Plan period must be duly taken care of in the construction of basic matrices.

Sectoral classification should be carefully made so that critically important sectors are clearly identified and brought under proper focus.

To conclude, I express my deep appreciation for the tremendous efforts of the authors for advancing the input-output work for the economy of Pakistan.

Joint Chief Economist, Planning and Development Division, Government of Pakistan, Islamabad

Dr Ghulam Rasul

---

Energy Policy: An Optimal Allocation Approach

TARIQ RIAZ*

INTRODUCTION

Any system of ideas which underlies economic policy recommendations needs to be made explicit so that its doctrinal premise may be examined and debated. Section 1 of this paper, therefore, explicitly states the philosophical underpinning of this study. Section 2 presents the central energy problem in a general mathematical form whereas the solution of the specific energy problem for the Pakistani economy is presented in Section 3, in which policy guidelines for obtaining the desired solution have also been discussed. Finally, Section 4 briefly presents our concluding remarks.

1. GUIDING SOCIAL IDEAS

To me, as to the generations of classical, neoclassical and new neoclassical economists, individual freedom is the highest and the most fundamental human value. It implies the right to make and act on one’s own decisions without interfering with others’ freedom. Hence I prefer a society which co-ordinates the economic and non-economic activities of its members through voluntary means such as markets or consensus.

The framework of the free market is derived from and supplements the ideal of individual freedom. This freedom of the market-place ensures an efficient allocation and maximum production for the society. Each man looking for his own economic benefits serves the economic benefits of the whole society and, on the basis of general utility, it leads to maximum happiness and minimum pain or cost of production. Like others, I do however, recognize the need for some government intervention, especially in the case of Pigovian externalities and technical

---

*The author is a member of the faculty of the Department of Economics, New York State University College, Fredonia, N.Y. (USA).
1This concern for “virtue itself hath need of limits” opens the way for constraints on human actions, which one imposes in the form of laws, customs, and religious and moral codes.
2Almost two hundred years ago Adam Smith included the construction and maintenance of large public works, national defence and administration of justice as the three main duties of a sovereign. See Smith [3].