Chapter 2

INTER-INDUSTRY TRANSACTIONS FOR
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The inter-industry model for Gujarat was initially formulated for the year 1964-65, that being the latest year for which detailed information on input use pattern for the organised industrial sector was available. The need was, however, felt to update the 1964-65 model, particularly for projection analysis. Updating procedures for input-output analysis invariably have to rely on broad economic magnitudes, for, the Census of industries is usually available only after a considerable time lag. The Annual Survey of Industries, that provides the main basis for input-output research in India when published is already out of date by 8 to 9 years. Other alternative of resorting to survey methods is resource intensive and

1/ Appendix A gives details about the data sources and approaches adopted in estimating the inter-industrial flows for 1964-65.

2/ A publication by the Government of India, Central Statistical Organization, (Industrial Statistics Wing, Cabinet Secretariat) covers on a census basis those factories registered under the factories Act of 1948, employing 50 or more workers if using power, and 100 or more workers if not using power. Even towards the end of 1975, 1966 was the latest year for which the Annual Survey of Industries was available.
in any case beyond the capacity of an individual researcher. Fortunately for Gujarat we had available to us survey research on urban unregistered small scale units for a later period, i.e., 1969-70. That to a large extent determined the choice of the period for updating the 1964-65 model. We first indicate the main features of 1964-65 model; two prominent approaches of updating an obsolete input-output model are then discussed and in that light procedures adopted in updating the model are outlined.

**Input-Output Model for 1964-65**

The 1964-65 inter-industry model for Gujarat had tried to arrange the available data base in a coherent fashion. The main sources of data for industrial

3/ Even organisations like the Planning Commission in India adopt simple techniques of updating rather than undertaking any elaborate data base studies for the purpose. For example the Fifth Plan Model bases itself on the technology matrix for the year 1965-66. The 1965-66 model is first updated to 1970-71 using available information on output levels, investments, imports and public consumption consistent with national income data. The updated model of 1970-71 is then recast to fit with various sectoral output figures and final demand for the base year 1973-74 as well as with the national income estimates. See Government of India, Planning Commission, Perspective Planning Division, *A Technical Note on the Approach to the Fifth Five Year Plan of India, 1973*, p.2.


sectors were Annual Survey of Industries for the Census units, N.S.S. report for the sample units and Directorate of Industries publications for unregistered small scale units. For non-industrial sectors, namely, agriculture and allied, construction, and mining, recourse was made to unpublished documents on state incomes accounts from the Gujarat's Bureau of Economics and Statistics. The sector scheme, apart from broadly satisfying the usual criteria of aggregation, intended to highlight the strengths of the regional economy. Inter-industry flows were worked at 1964-65 producers' prices. As far as possible, non-competitive imports were separated and were considered exogenous to the inter-industry matrix. Interregional trade estimates, as incorporated, were based on a separate study that had carefully collated the available published and unpublished information about Gujarat's trade with the rest of the world. The small scale industry activities (registered small scale and unregistered small scale) were integrated into the model in a manner that permitted variations on account of aggregate labour, capital, and materials consumed by the size of the enterprise.

The model was initially cast into 21 sectors but for projection purposes we had to aggregate it into a 19

sector model. The aggregation was primarily necessitated because of the nature of the estimates that could be made for consumption and interregional trade for Gujarat. The projections based on the 19 sector model were incorporated in the Perspective Plan of Gujarat. The 24 sector model, however, has been used for updating the technology matrix, particularly for organised industrial activities.

Methods of Updating an Obsolete Input Output Models

Many non-survey methods of updating an input-output model have been resorted to. Approaches broadly fall into two classes. One set of studies attempt to improve the predictive ability of a base year model, which is somewhat obsolete, without updating the technology matrix. In the second set of studies the technology matrix is in fact altered for projection purposes. Theil-Tilanus method is a prominent member of the former class and the later class of studies are embodied mainly in the RAS or biproportional method as developed by Stone and his colleagues. We shall


briefly mention these two approaches and then describe the methods adopted in updating the Gujarat Model.

**Theil - Tiller Method:** The method known as "Statistical Correction Method" (SCM) is quite simple. Let us say that technology matrix \( (A_t) \) for the \( t \)th year is available, and sectoral output and final demand levels through income accounts for a later year \( (t + q) \) are known. The method gives a correction factor using the base year model \( (A_t) \) to predict output levels for a future year \( (t + s) \) by the use of sector-wise information on output and final demand requirements for an intermediate year \( (t + q) \), where \( s > q \). The algebraic formulation is as follows:

For the base year, \( t \), we have the basic input-output equations given by

\[
X_t = (I-A_t)^{-1} f_t \quad \ldots \ldots 2.1
\]

where \( I \) is the unit matrix, \( A \) is the input coefficient matrix, \( f \) is the final demand vector, \( X \) is the total output vector, and suffix \( t \) denotes the time.

Since by definition intermediate demands and final demands together account for total supplies, we have

\[
X_t = f_t + U_t \quad \ldots \ldots 2.2
\]

where \( U_t \) is the vector of intermediate demands. Substituting 2.2 in 2.1 we get

\[
U_t = \left[ (1-A_t)^{-1} - I \right] f_t \quad \ldots \ldots 2.3
\]
Intermediate demands for the period $t+q$, as $f_{t+q}$ is already known, are derived from

$$U_{t+q} = \left[(I-A_t)^{-1} - I\right] f_{t+q} \quad \ldots \quad 2.4$$

Now suppose $U^*_{t+q}$ is the vector of actual intermediate demands; the statistical correction factor, SCM, is given by

$$(SCM, q) = \frac{U_{t+q}}{U^*_{t+q}}$$

The corrected intermediate demands can now be estimated for the year $t+s$ by multiplying the SCM factor to predictions based on the base model, as shown below:

$$U_{t+s} = \left[(I-A_t)^{-1} - I\right] f_{t+s} \cdot U_{t+q} \div U^*_{t+q} \quad \ldots \quad 2.5$$

Given the exogenous determination of final demands for $t+s$, the output levels for the period $t+s$ can be easily derived. It is shown that corrected predictions based on the base year model ($A_t$) are almost as good as uncorrected predictions based on the input-output table of the correction year ($t+q$).

Though the method is quite simple and operational with the minimal information it is not suitable for our
needs. First, the method does not change the technology matrix and as such nothing can be said about the inter-sectoral relations for the intermediate year \( t+q \). As seen from Chapter III, the study of inter-sectoral relations is an important aspect of our study. Second, the use of minimal information is also not an advantage in our case. As shown later the updated 1964-65 model incorporates in certain respects information base which is a distinct improvement over the 1964-65 information base. We therefore turn to second class of updating procedures.

RAI or Proportional Method: Stone and his associates have developed a method of altering the technology matrix with the information base almost similar to Theil-Tilanus method. The following are supposed to be given: (i) input-output technology matrix for an initial year \( A_0 \), (ii) totals of commodities for a later year \( Y_{t+q} \), and (iii) marginal totals of intermediate outputs \( U_{t+q} \) and intermediate inputs \( V_{t+q} \) for the same later year. The method

\[ \text{10/ Various methods, without resorting to survey methods, are in fact possible for introducing changes in the input-output coefficients. For a review of methods, see: A. Ghosh, H. Sarkar and D. Chakraborty, "A Review of Models for the Correction of Input-Output Forecasts with Special Reference to ECARE Region," Armour, Vol. V, 1975 (in press). Most of these methods, however, base themselves on rather demanding data base, i.e., assume either the availability of more than one input-output model or fairly exact information on income accounts over time. These data needs are rather difficult to meet for regional analysis.} \]
is based upon the assumption that factors affecting the input coefficients such as output variations (size effect), changes in techniques of production and relative prices are captured by the uniform and proportional application of 'substitution' and 'fabrication effect', where the 'substitution effect', $r_j$, is measured by the extent to which commodity 'j' is substituted for or replaced by other commodities as intermediate input and the 'fabrication effect', $s_k$, connotes the extent to which commodity 'k' absorbs a greater or smaller ratio of intermediate to primary inputs in its fabrication. It is apparent that the substitution effect operates across rows and the fabrication effect across columns of a flow matrix. The algebraic formulation, attempts to find out the values of $r$ and $s$ multipliers from the following relationships:

$$A_{t+q} = \hat{A}_t \hat{A}_q$$

Where the symbol $\hat{\cdot}$ placed over a vector connotes the diagonal matrix, off-diagonal elements being zeros.

Defining $W$ as the matrix of inter-industry flows we have

$$W_{t+q} = A_{t+q} \hat{W}_{t+q}$$

and

$$\hat{W}_{t+q} = W_{t+q} \hat{W}_{t+q}$$

$$= \hat{r} (A_t \hat{A}_q) s$$
Where $i$ is the unit vector and $\prime$ is used for the transpose. Equations 2.8 and 2.9 can be solved for getting the values of $r$ and $s$ multipliers.

It has been shown that solution always exists and is unique and convergent. The updated matrix also maintains the basic similarity with the base matrix; zero elements of the original matrix are preserved and non-negativity conditions satisfied.

The RAS method because of its elegant mathematical properties has aroused considerable interest. Performance of RAS method as tested with the Belgian and more recently with the U.K. data has been encouraging. Belgian tests showed that RAS method resulted in a considerable improvement over the "naive" method, (where no changes in input coefficients were allowed). Similarly, U.K. tests showed that the application of RAS led to a substantial reduction in the "mean projection error". It would,


however, be erroneous to conclude from these tests that
the mathematical elegance of the method could be a
perfect substitute for information. Tests on Belgian,
U.K. and even at regional level, on the contrary,
suggest that injection of exogenous information could
contribute a great deal in enhancing the RAS performance.
This is mainly because of the fact that the assumptions
of uniform and proportional application of 'r' and 's'
multipliers are rather rigid. The authors of RAS methods
are themselves apprehensive about 'r' multipliers. To
quote:

"This treatment of r's as constant along the rows
is equivalent to assuming that the rate of substitu-
tion of one input for another is the same in all
branches of production. What happens in reality
is that in some cases a given input may be put to a
special use and thus not be subject to the normal
substitution effect. For instance, as a rule coal
is used as fuel, but in coke production it is a raw
material; consequently if there is a tendency
throughout the system to replace it by other fuels,
such as oil this tendency will not affect its
coefficient in coal production, a fact which was
very clearly brought out in the Belgian test when
comparing the estimated coefficients for coal with
the observed data."

It may be mentioned that the tendency on the part of
different customers of a producing industry to move diffe-
rently from the average suggested by the supplying industry
may be more general rather than confined merely to fuel
supplying industries. A particular industry may increase
its inter-industry supplies in aggregate, but customers of

15/ On cit., p. 31.
this industry may vary in sharing this change, not only in rate but in direction as well. Vaccara while studying the changes in input-output coefficients in the United States between 1947 to 1958 found that only in 34 out of 58 industries the coefficients changed in the same direction as the average for the majority and \textit{not all} of their, individual consuming industries. The correlation co-efficient of average percentage change in direct coefficients with the percentage of an industry's customers showing coefficient changes in the same direction as the average virtually turned out to be zero.\textsuperscript{16} Vaccara laments these findings: "This seemingly unpatterned behaviour of changes between 1947 and 1958 in the various individual input coefficients is indeed disconcerting. One would have hoped to observe more regularity in the pattern of change. How much easier would be the task of updating and projecting if the average pattern for an industry was characteristic of all the customers of an industry?"\textsuperscript{17} Belgium tests also showed that in many cases 's' multipliers acted more as devices to correct the errors arising from the rigidity of the 'r' multipliers than as the measures of fabrication effect.\textsuperscript{18} It appears that 'r' or

\begin{flushright}
\textbf{17/} \textit{Ibid.}, p. 254.
\textbf{18/} \textit{On, cit.}, p. 31.
\end{flushright}
row multipliers, apart from serving to obtain a consistent solution, given the marginal constraints, serve very little purpose.

Let us now turn to the fabrication effect. The fabrication effect ('s' multipliers) measures the extent to which the outputs of industry have come to absorb a greater ratio of materials, fuels and other current inputs to value added in their production. Given the overall tendency, or the value of the multiplier, it is assumed that the change is shared uniformly and proportionately. It may be interesting to find out how far this assumption conforms to observed reality. Carter's Study is perhaps the most celebrated in this field. Carter finds that for the United States, over a period 1939 to 1961, although the total amount of indirectness remains fairly stable, yet there are significant shifts in patterns of industrialisation. "Most sectors increase their dependence on the general sectors - producers of services, communications, energy, transportation and trade .... Increased requirements for general inputs are counterbalanced by decreases in other sets of coefficients. The relative contributions of material producers decline over the board."19/ Thus it

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is possible that overall changes across the columns may conceal an asymmetric behaviour of different inputs. Corroborative evidence is also provided by the Finland study. It was noticed that, whereas no factors were discovered that could influence the different input in a general and uniform fashion, various factors affected different inputs with varying intensities. "Mechanization of the production process was the factor most affecting the input-output coefficients. It affected primary and electric energy inputs most, but it also influenced the coefficients of raw materials inputs. Relative prices had stronger effects on material inputs than on inputs related to the use of machines."

We may mention that somewhat elaborate discussion of RAS method, as outlined above, is not intended as a critical review. Perhaps, given minimal information, RAS may be the most feasible alternative. However, certain important implications relating to updating an input-output model follow from this discussion. First, information has to be valued more than the technique. Leecumber puts it rather well: "To ignore information and

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21/ Ibid., p. 357.
rely on mechanical methods may lead to some elegant econometrics, but it will also lead to some very bad projections. Second, even given the minimal information constraint, introduction of uniform 'substitution effect' may lead to serious pitfalls. Third, 'fabrication effect' might be less prone to errors, if the column of input flows could be decomposed into meaningful categories, like fuel and non-fuel inputs, and changes therein studied separately. We may now indicate the procedures adopted in updating Gujarat 1964-65 model to 1969-70 base.

Updating the Technology Matrix:

While updating the 1964-65 model attempt has been made to make full use of the available information. For land based and non-industrial activities, viz., agriculture, mining, and construction, fresh estimates have been made following the methods used in the 1964-65 exercise. However unlike the 1964-65 model, petroleum and petroleum products sector has been treated endogenously in the updated flow matrix.

The unregistered urban small scale component of industrial activities has been estimated from the information.


23/ Appendix A.
Van der Veen estimates for 1969-70 the inter-industrial activities as well as output levels for urban unregistered small scale units. In order to use 1964-65 input-output model for Gujarat he, however, had to deflate the inter-scale flows as estimated for 1969-70 to 1964-65 prices. Price deflators separately estimated for registered and unregistered sub-system were uniformly applied across each row. This procedure, though necessary at that stage, implied as if the input structure was insensitive to relative price changes and the industrial structure was invariant over 1964-65 - 1969-70 period. The updating of Gujarat model to 1969-70 base has made it possible to incorporate the original estimates of Van der Veen and thereby avoid any errors that the deflation process might have introduced.

A brief outline of Van der Veen's work may be given here. Van der Veen first modifies and aggregates the 24 x 24 matrix of Gujarat 64-65 model into 16 x 16 matrix

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24/ Ibid.

25/ Ibid., Chapter 6, Table 9 gives in a 33x12 matrix form, flows to unrestricted small scale sub-system form itself, registered industrial activities, non-industrial activities and non-competitive imports for 1969-70 at purchasers' prices. Appendix VII, Table 21 gives a matrix of margins. From these two sources flows to the unregistered small scale can be worked out at 1969-70 producers' prices.
to make it correspond better with the industries of urban unregistered sub-sector. The $16 \times 16$ matrix is then made to pertain 12 registered industrial sectors bordered by 4 non-industrial sectors by eliminating the flows and output levels relevant to unregistered industrial sub-sector. This matrix is then augmented into a $28 \times 28$ matrix on the basis of survey research. Where $24 \times 24$ matrix showing inter-scale flows is bordered by 4 non-industrial sectors. The $28 \times 28$ matrix is better appreciated as a partitioned matrix into four square sub-matrices of equal size: $\frac{A}{B} \mid \frac{C}{D}$. Where sub-matrix $A$ shows the flows between unregistered small-scale sub-sector and sub-matrix $D$ shows flows between registered industrial activities, sub-matrix $B$ shows flows from unregistered to registered industrial activities and flows in reverse direction are shown by sub-matrix $C$.

It may be stressed again that sub-matrices $A$, $B$ and $C$ are incorporated into Gujarat's updated model using the field research of Van der Veen. Similarly flows from non-industrial sectors and other flows (rows 25 to 31, Table II.1) to unregistered small scale sub-sector are also based on Van der Veen's field research. We have, however, separated mining and salt sector into two sectors.

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* The large sized tables are given in the Statistical Appendix to Chapter 2. Roman letters are used to distinguish the appendix tables from the text tables.
The fact that Gujarat 1969-70 input-output model incorporates a technology that is specific to unregistered small scale deserves to be underscored. It is felt that in this respect Gujarat model is an improvement over the national models as well as the regional models. As seen from Table III.1 there are wide differences in the input use pattern between registered and urban unregistered sub-sectors. A dramatic instance of these differences is provided by textiles manufacturing (col.5 and col. 17, Table III.1) "an der Veen suggests that these difference arise" largely due to strikingly different kinds of products in the registered and in the urban unregistered industrial sub-sectors."26/ It may be mentioned that this phenomenon is not unique for Gujarat. Similar pattern has also been observed for Japan and other countries.27/

26/ Ibid., pp. 87-89.

27/ Itag Satoru and Takefusa Nakamura, "Role of Business in Japanese Inter-Industry Relations, 1951-1955," Bulletin of the Oxford University Institute of Economics and Statistics, August 1969, Vol. 26, pp. 217-223. An earlier study by R. Kamiya and T. Uchida on labour requirements by size of establishment in Japan also highlighted the need for studying inter-industry relations by size of establishment. To quote, "...as far as Japanese economy is concerned, there is need to define sectors of input-output analysis not only on the basis of major products but also on that of the size of the individual units of production, particularly in those applications of input-output technique which deal with employment and income generation." 28/ "The Labour Coefficient and the Size of Establishment in Two Japanese Industries," in T. Barna (ed.), Structural Interdependence and Economic Development, London: Macmillan & Co. Ltd., 1963, p. 274. The studies in contd...
Sub-matrix D pertaining to flows between registered industrial sub-sector, and also flows from non-industrial sectors to matrix D have been estimated by using information on certain aggregate categories. For organised industries covered under the Factories Act of 1948, census and sample units, we could get information at four digit level from the Bureau of Economics and Statistics, Gujarat. This information was available for certain broad economic magnitudes like, fuel, other materials, value added, total output, number of persons employed, wages, working capital for the year 1969-70. This information was aggregated separately for sample and census sectors according to the sector scheme for Gujarat 69-70 model. The sample-sector values were appropriately enhanced using the multipliers as could be inferred from the sample frame. At the next stage the sector-wise sub-totals for fuel inputs, material inputs, value added, total output for sample and census categories of industrial activities were combined. Control totals for fuels and other materials were disaggregated separately using the proportions of 1964-65 actual flows for materials.

India also show variations in factors intensities over the size of establishment. These studies, however, are not able to capture the extent to which changes in product composition explain variations in factor uses. For a survey of Indian literature in this respect, see K.K. Subrahmanian and S.P. Kashyap, "Small Scale Industry: A trend Report," in A Survey of Research in Economics, Vol. V. Industry, Sponsored by the Indian Council of Social Science Research, (New Delhi: Allied Publishers, 1975), pp. 75-112.
consumed and fuel used for each of the sectors. Flows into registered industrial activities, thus imbibe a uniform fabrication effect but separately for fuel and non-fuel inputs. Table 2.1 gives a comparative picture of sectorwise fuel and material coefficients between 1964-65 and 1969-70. It would be seen that overtime not only the rate of change differs between fuel and non-fuel coefficients but in 7 out of 12 sectors even the direction of change is different. Thus the introduction of fabrication effect separately for fuel and non-fuel inputs has obviously imparted some advantage. It should be stated here that in the earlier Gujarat's model also flows into the sample sector were derived through a more or less similar procedure.28/ Thus census sector is the only part of the updated model, where we have been handicapped because of information constraint as compared to 1964-65 model.

While updating this type of model, the question of price adjustment becomes important. It may be mentioned here that sub-matrices A, B and C, that represent flows of non-industrial sectors to unregistered small scale sectors and the technology relevant for non-industrial sectors, are all estimated at 1969-70 prices. The column

28/ Appendix-A, section on Integration of Small Scale Sector.
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sectors</th>
<th>Fuel per unit of output</th>
<th>Materials per unit of output</th>
<th>Fuel per unit of output</th>
<th>Materials per unit of output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk food &amp; malted food</td>
<td>0.0144</td>
<td>0.93062</td>
<td>0.01669 (+)</td>
<td>0.90492 (-)</td>
</tr>
<tr>
<td>2</td>
<td>Grain and oil milling</td>
<td>0.01031</td>
<td>0.92875</td>
<td>0.01230 (+)</td>
<td>0.92231 (-)</td>
</tr>
<tr>
<td>3</td>
<td>Other food and agro-based</td>
<td>0.00605</td>
<td>0.84337</td>
<td>0.01154 (+)</td>
<td>0.83789 (-)</td>
</tr>
<tr>
<td>4</td>
<td>Art silk and rayon fibres</td>
<td>0.03962</td>
<td>0.66967</td>
<td>0.02827 (-)</td>
<td>0.74645 (+)</td>
</tr>
<tr>
<td>5</td>
<td>Textiles</td>
<td>0.06144</td>
<td>0.61239</td>
<td>0.05921 (-)</td>
<td>0.62151 (+)</td>
</tr>
<tr>
<td>6</td>
<td>Wood, paper, leather and rubber</td>
<td>0.04434</td>
<td>0.57806</td>
<td>0.06398 (+)</td>
<td>0.64609 (+)</td>
</tr>
<tr>
<td>7</td>
<td>Chemicals</td>
<td>0.06636</td>
<td>0.55575</td>
<td>0.08123 (+)</td>
<td>0.54927 (-)</td>
</tr>
<tr>
<td>8</td>
<td>Non-metallic minerals products</td>
<td>0.20296</td>
<td>0.43796</td>
<td>0.21783 (+)</td>
<td>0.45340 (+)</td>
</tr>
<tr>
<td>9</td>
<td>Basic metals and metal products</td>
<td>0.03063</td>
<td>0.69757</td>
<td>0.03287 (+)</td>
<td>0.74855 (+)</td>
</tr>
<tr>
<td>10</td>
<td>Machinery</td>
<td>0.02473</td>
<td>0.57554</td>
<td>0.02117 (-)</td>
<td>0.66477 (+)</td>
</tr>
<tr>
<td>11</td>
<td>Transport-equipment</td>
<td>0.03949</td>
<td>0.54629</td>
<td>0.05083 (+)</td>
<td>0.61663 (+)</td>
</tr>
<tr>
<td>12</td>
<td>Misc. Products</td>
<td>0.00928</td>
<td>0.53837</td>
<td>0.01666 (+)</td>
<td>0.70592 (+)</td>
</tr>
</tbody>
</table>

* Symbols in parentheses indicate the direction of change.

control totals for registered industrial activities are also at 1969-70 prices. However, while introducing fabrication effect for fuel and non-fuel inputs we have not made allowance for relative price variations. This is because computation of price deflators appropriate for each cell of inter-sectoral flows is an extremely difficult task. Moreover, some authors believe that there are "sound reasons to expect temporal stability of inter-industry coefficients when expressed in current prices because input prices changes may well encourage proportional changes in output prices." This point of view is, however, controverted by other experts who feel that price changes play an important role in changing the technical coefficients. In any case the limitation of data availability has forced us to adopt this procedure for updating.

We have not made any allowance for substitution effect. This is justified in view of limitations imposed by the substitution effect (as discussed earlier) and also in view of the fact that commodity-wise estimates of total intermediate demands are difficult to compute from income accounting information. As a matter of fact input-


30/ See, Osmo Forsell, op. cit.
output models in India, at the national level and at
the regional level have invariably resorted to one degree of
freedom to balance commodity flows across rows.

The outcome of our labours is reflected in Table II.1. Table II.1 captures inter-sectoral flows into a $30 \times 30$
matrix. First 12 sectors pertain to unregistered urban
small scale industries and next 12 sectors to registered
industrial sector. These 24 sectors are bordered by 6
other sectors.

Completing the 1968-70 Model with respect to Final
Demand Requirements

Although the $30 \times 30$ matrix, can be gainfully
employed for studying inter-sectoral relations (Chapter 3),
unfortunately, however, its $30 \times 30$ order cannot be retained
for completing the model with respect to final demand
requirements. This is primarily because with the present
state of information base the estimation of commodity-
wise final requirement for public and private consumption,
and imports and exports, as seen from Appendix-A and also
from the account that follows, is possible only through
a series of approximations and at times with the help of
simplifying assumptions. To estimate the extent to which
different final demand requirements are met by establish-
ments differentiated by size is almost an impossible task.
Therefore, to achieve commodities balances across rows
of the input-output model we have to sacrifice details
by size of producing units. The complete model thus could
only be worked out only for 16 sectors.\textsuperscript{31} The first 24 sectors of Table II.1 were first reduced into 12 sectors by combining each of the sectors in unregistered industrial sub-sector to its counterpart in registered industrial sub-sector and further into 10 sectors, as information about trade and consumption requirements for equipment and textiles sectors did not permit disaggregated incorporation of these sectors. The complete

\textsuperscript{31} Whether aggregation of a detailed input-output model leads to greater stability or not is uncertain. Aggregation, to the extent it entails merging of sectors producing close substitutes, lends stability to input coefficients. A counter tendency occurs when sectors with different input coefficients are combined, unless the relative weights or internal composition of component commodities of a sector remain stable over time. In the ultimate analysis it is an empirical question. Sevaldson's work on Norway's economy is of interest here. See, Per Sevaldson, "The Stability of Input Output Coefficients," in Carter and Fredy (eds.) Applications of Input Output Analysis, op. cit., pp. 207-237. Sevaldson after having studied Norway's input-output accounts for the period 1949-60, reaches the conclusion that, "... as we move from the 79 sector table to the 14 sector table, there is drastic reduction in the standard deviations about the average coefficient, and for most of the coefficient classes there are further reductions as we move on from 14 to 5 sectors." p. 236. This does not mean that on this count an aggregated model is to be preferred over a disaggregative one. "A reasonable interpretation is that we should expect greater precision in the estimates of aggregate production levels - even when derived from a model with an aggregated input-output table - than in the estimates of detailed production levels, estimated from a model with a detailed input-output table. But we should expect to get even more accurate estimates of aggregate production levels when they are taken as sums of detailed production levels, estimated from a model with a detailed input output table." Ibid., p. 212.
model (Table II.2) has 10 sectors pertaining to industrial activities and six other sectors. These sectors are as follows: Agriculture and allied industries; Milk food and malted food; Grain and oil milling; Other food and agro-based industries; Salt; Textiles; Chemicals; Non-metallic mineral products; Basic metals and metal products; Equipment; Wood, paper, leather and rubber; Miscellaneous products; Mining; Construction; Electric light and power; Petroleum and petroleum products.

It may be mentioned that the commodity composition of sectors of 64-65 and 69-70 Gujarat models is comparable. The dimensions, however, differ because of aggregation and endogeneous treatment of petroleum sector.32/ Estimates for final requirements for Gujarat's 69-70 input-output model namely Government consumption, private consumption, trade and investment are based on fresh estimates, arrived at through similar procedures as adopted in the 64-65 model. Like the earlier model no allowance has been made for stock changes. These and any errors of estimates are likely to become parts of consumption or investment, which are obtained as residual demands.

32/ Referring to Appendix A, Table A.1, no change has been made for sectors No. 1, 2, 3, 4, 6, 8, 17, 23, 29 over two models; sectors 5 and 7; 9 and 10; 11, 12, and 13; 14 and 15; 16, 21 and 22; 18, 19, and 20 are aggregated into one sector each. It may be mentioned that even 64-65 model had to be reduced to 19 sectors for projection analysis.
in most cases of commodity balances. We may briefly spell-out the estimation procedures.

**Government Consumption:** Estimation of disaggregated commodity expenditure incurred by the State Government for 1969-70 is based on the assumption that the ratio of commodity expenditure to total expenditure and also the pattern of commodity expenditure are invariant as compared to 1964-65. The commodity expenditure patterns for urban and rural local bodies are however based on the field research. This is unlike the 1964-65 model where no account was made for such expenditures. In this respect Gujarat 69-70 model scores over the earlier model.

Commodity expenditures of the state government, urban and local bodies have been aggregated for each sector and subsequently converted into producers' prices. The estimates are shown in Table 2.2.

**Private Consumption:** Consumption estimates by commodity groups for the year 1969-70 have been taken

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33/ Atul Sarma as a part of his research on *Sectoral Impact of the Public Bodies Expenditure in Gujarat*, has estimated on a sample basis, covering 16 out of 55 urban local bodies, the disaggregated commodity expenditure of urban local bodies. The level of disaggregation of Sarma's study corresponds quite well with our inter-industry model. For estimating the commodity expenditure pattern of rural local bodies we had to assume that their commodity consumption pattern would be similar to smaller urban spatial units.
<table>
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<th>Sr. No.</th>
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<th>Urban Local bodies</th>
<th>Rural Local bodies</th>
<th>Total at purchasers' price</th>
<th>Purchasers' price to producers' price ratio</th>
<th>Total producers' price</th>
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<td>-</td>
<td>-</td>
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* These are 'model' ratios. See Appendix A, Table A.4.
from the studies on Gujarat's consumption pattern.

C.V.S.R. Murthy and N.G. Shah, "Household Consumption," Chapter III in Gujarat Economy in 2001 A.D.: A Study in Perspective, Sardar Patel Institute of Economic and Social Research, Ahmedabad, 1975 (mimeo); by the same authors, "Changes in the Levels of Living and the Pattern of Income Distribution in Gujarat," Key Paper, Gujarat Economic Conference, Pulsar, 1975. While detailed estimation procedures are given in the works mentioned above, a brief outline of their methods of deriving commodity expenditures for Gujarat may be given here. Total aggregate Consumer expenditure in Gujarat 1969-70, is estimated by studying macro-relations of the State Economy (see Chapter II, Gujarat Economy in 2001 A.D., op.cit.). Total consumption expenditure is disaggregated in rural and urban areas by using projected rural and urban populations in 1969-70 and the ratio of rural and urban differential in per capita expenditure. The ratio of rural and urban differential is derived from 25th round of the N.S.S. for 1970-71. At the next stage aggregate expenditures, separately for rural urban areas, are distributed into fourteen total expenditure classes using lognormal parameters as estimated from N.S.S. data on consumption for 1968-69. Finally, commodity-wise per capita annual expenditures, separately for rural and urban areas, are estimated adopting proportions approach. These proportions are worked on the basis of 25th round of the N.S.S. For example per-capita total expenditure on i-th commodity in rural areas, $e_{ir}$, is given by:

$$e_{ir} = \frac{C_r W_i}{P_r}$$

where $C_r$ is the total aggregate expenditure in rural areas, $W_i$ is the proportion of expenditure in an i-th commodity in rural areas, and $P_r$ is the projected population in the rural areas.
Some adjustments, however, had to be made in the consumption vector estimated at purchasers' prices so as to make it correspond for our model, where sectoral consumptions at producers' prices appears as a residual category in most cases. The process of correspondence involves two stages; first, correspondence is established between commodity composition of estimated consumption vector and sector scheme of the inter-industry model, and second, having established this correspondence the conversion of estimated consumption vector into producers' prices, or estimation of implicit purchasers' to producers' price ratios. At the first stage, commodity requirements of the estimated consumption vector for some commodities (mainly miscellaneous goods, durable, and fuel) were disaggregated into sectoral demands of input-output model by using the proportion at the national level.35/ At the

35/ Government of India, op. cit. It may be mentioned that even at the national level the problem of making N.S.S. data to correspond to the commodity classification of an input-output model is quite acute. Following statement may be considered: "Thus on the basis of utilising all possible sources of information, it has been possible for us to broadly convert N.S.S. product classification into input-output model classification even though there may be an element of error margin which is likely to vary from commodity to commodity. In the present stage of knowledge exact correspondence between the N.S.S. commodities and their input-output sectoral classification cannot be obtained. It is, however, important for further analysis and refinement, that efforts should be made to make the consumption classification for the expenditure surveys and the classification used in the input-output model to be more exact than at present." Ibid., p. 3. A regional model builder, with much less resources at his command, can not but share these sentiments.
second stage it was assumed that trade and transport margins explained the differences between consumption requirements derived from the input-output model (as residual) and the estimated commodity-wise consumption requirements. The purchasers' to producers' price ratios for commodity-wise consumption requirements were thus derived. In most cases this approach gave us realistic estimates in the sense that implicit ratios between purchasers' and producers' prices were comparable to the ones estimated for inter-industry flows. It may be mentioned that these estimates, like the ones obtained in 1964-65 model were somewhat on a higher side. However, in case of two sectors, namely, textiles and petroleum products, this approach lacked realism. Therefore, we had to readjust trade flows for these two commodities for obtaining the commodity balances.

36/ Appendix A, Section 5.3.3, Table A.10.

37/ Textile consumption appeared to be underestimate as compared to all India level. Even an assumption of purchasers' to producers' ratio being unity left with substantial unaccounted surplus. Therefore the exports estimates for Gujarat had to be enhanced. Similarly, a realistic consumption estimates for petroleum and petroleum products could only be retained by altering imports into the regional economy.
It may be mentioned that consumption demand being a residual category, the correspondence procedures are not as much required for the base year as for the projection exercises. To make it usable in the input-output framework the projected consumption vector for the terminal year is likely to present similar problems, as noticed in the base year. The advantage of developing the correspondence procedure for the base year is that these procedures could be assumed to be invariant for the terminal year. Thus, we have assumed that the proportions used for disaggregation and the implicit producers' to purchasers' price ratios to be invariant for projection purposes (Chapter 4). This assumption, of course, has been mainly motivated because of data constraints.

Imports and Exports: Estimation of imports and exports for a regional economy is an important task in the construction of regional input-output models. This is because a regional economy is likely to be more dependent on trade than the national economy. The study of inter-space linkages, therefore, becomes almost as important as the study of inter-industry linkages. Important though the interregional flows are, data constraints have often compelled the researchers to wish away these flows. Most of the attempts at regional input-output analysis have treated trade as a residual category.\(^{38}\) Exports are

\(^{38}\) For example, P.T. Moore, "Regional Reaction Paths," American Economic Review, May 1955, pp. 137-148. Most attempts at regional input-output models in India have also treated trade as a residual vector. For example input-output models for Maharashtra, Bihar and Haryana.
incorporated as a device to show disposal of net surplus for a commodity and similarly imports are shown to overcome net deficits. No cross-haulage is permitted in such cases. Since that regional model relates to space economy, rather than a point economy, and also the level of commodity aggregation for these model is invariably high, this approach of residual trade vector is quite unrealistic.\textsuperscript{39/}

Interregional flows for Gujarat's 1964-65 model, as has been indicated earlier, were based on a study that had carefully analysed published and unpublished data on Gujarat's trade with the rest of the world.\textsuperscript{40/} The trade estimates for the updated model are also based on a separate study where, following Jyoti's methodology, trade flows are generated for later years including 1969-70.\textsuperscript{41/}


\textsuperscript{40/} Jyoti Thakker, \textit{op. cit.}

\textsuperscript{41/} K. Vijayan, \textit{A Study of Trade Flows for Gujarat, 1966-67 - 1969-70}, Sardar Patel Institute of Economic and Social Research, 1975 (Mimeo). Although the general approach of the studies by Jyoti and Vijayan is similar, but information on prices as available to Vijayan is not as detailed as was available in the earlier study by Jyoti. This is primarily because the Costing Trade Statistics that used to publish information on both quantities and values of traded commodities ceased doing so after 1964-65. To overcome this difficulty, Vijayan first estimates commodity flows in quantities, these flows are then converted into 1964-65 prices by the use information on prices from Jyoti's unpublished work sheets. Flows at 1964-65 prices are subsequently converted into current prices through commodity-wise price relatives, separately for imports into Gujarat and Exports from Gujarat.
It may, however, be mentioned that data base for inter-
regional flows is scanty. Jyoti sums up the state of 
affairs in this way: "Estimates of interregional trade 
at a disaggregated level ... are thus obtained after 
making number of assumption at different stages of the 
analysis. The quantitative magnitudes are therefore 
more in the nature of approximations to the pattern and 
levels of trade." This continues to remain valid even 
after a lapse of five years.

As indicated earlier while incorporating trade 
flows, as estimated in Vijayan's study, we had to make 
adjustments, in two of the sectors. The non-competitive 
imports, as in the earlier model are identified and are 
shown as a row vector outside the transactions matrix 
(rows 31 and 31 in Table II.1 and row II in Table II.2).

Table 2.3 gives estimates of details of commodity flows 
constituting non-competitive imports into each of the 
sectors of 1969-70 inter-industry model. It may be 
mentioned that non-competitive imports have been identi-

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\[2\] On citation, p. 154.

\[3\] Non-competitive imports into unregistered industrial 
activities and non-manufacturing sector are based on 
actual estimates. Whereas these imports to 
registered manufacturing are the outcome of appli-
cation of the 'fabrication effect.'
<table>
<thead>
<tr>
<th>Sectors</th>
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<tr>
<td>Milk food</td>
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<tr>
<td>Grain &amp; oil milling</td>
</tr>
<tr>
<td>Other food &amp; agribased</td>
</tr>
<tr>
<td>Art silk &amp; manmade fi</td>
</tr>
<tr>
<td>Textiles</td>
</tr>
<tr>
<td>Wood, paper, leather &amp;</td>
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<tr>
<td>Chemicals</td>
</tr>
<tr>
<td>Non metallic mineral</td>
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<tr>
<td>Basic metals &amp; meta</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Transport Equipment</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>
fled only for inter-industry use. Exports and competitive imports are shown as column vectors. (Col. 20 and Col. 21 in Table II.2).

Concluding Remarks:

We have indicated in this chapter the procedures adopted in updating the 1964-65 input-output model for Gujarat to 1969-70 base. While a detailed view of inter-sectoral relations is given in the next chapter, we may briefly recapitulate the data base for 1960-70 model. The data base for estimating flows into non-industrial activities is quite similar to the 1964-65 model. However, the incorporation of survey based flows for unregistered urban small scale units and endogenous treatment of petroleum and petroleum products constitute an important improvements over the 1964-65 model. It may be mentioned that flows into registered industrial activities imbibe a uniform 'fabrication effect', separately for fuel and non-fuel inputs, but no allowance is made for 'substitution effect.' On balance the technology structure as estimated by us is unlikely to deviate much from the one that could have been estimated without the recourse of certain assumptions (particularly the fabrication effect for the census sector). Estimates for final demand requirements for 1969-70 model are also based on fresh information. Here again, the incorporation of expenditure pattern of urban and rural local bodies constitutes an advance over the earlier model.
STATISTICAL APPENDIX TO

Chapter 2
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<th>No.</th>
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<th>4</th>
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<th>6</th>
<th>7</th>
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<th>10</th>
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<tr>
<td>3</td>
<td>Grain &amp; oil milling</td>
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*No complete data for 1954.*
### Table 31.3

Inter-Industry Flow and Pattern of Final Demand for Guyana's Economy: 1948-70 Producer's Prices

(Us. in cc)

<table>
<thead>
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<th>Sector</th>
<th>Agriculture and Allied</th>
<th>Mining and Quarrying</th>
<th>Other</th>
<th>Textile and Clothing</th>
<th>Other Manufacturing</th>
<th>Food and Tobacco Products</th>
<th>Chemicals and Allied Products</th>
<th>Total</th>
<th>Financial Institutions</th>
<th>Government</th>
<th>Other Non-Ministerial Government</th>
<th>Net Output</th>
<th>Total Intermediate Inputs</th>
<th>Goods Output</th>
<th>Other Goods and Services</th>
<th>Goods Output Excluding Goods Output Included in Total Intermediate Inputs</th>
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Note: The table provides an overview of the inter-industry flows and the pattern of final demand in Guyana's economy for the period 1948-70, focusing on producer's prices in U.S. dollars. The table categorizes industries into various sectors, detailing the value of outputs and inputs across different economic activities.

(For detailed analysis, please refer to the original document for comprehensive insights.)

(For industrial, services, import transport charges, consumer goods, etc.)