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# Some Methodological Problems of the Treatment of Imports and Consumption in Multisectoral Models of Planning and Growth

by

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The author is a Research Director at the Pakistan Institute of Development Economics. Most of the numerical estimates were done in close collaboration with Dr.Arthur MacEwan, now Assistant Professor at Harvard, as part of a programme to develop basic data for multisectoral model-building. Physical distance and subsequent divergence of interest prevented closer collaboration on the present topics. The two notes have been in existence for sometime in somewhat different versions in typescript and mimeographed forms. More recent data are now available with respect to some assumptions of the numerical measurements. But since the estimates are mainly illustrative of some methodological questions which appear to be of interest, no attempt has been made to update the numbers. Computational assistance was provided by Mr. Aslam Khan.

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# Part I

## Treatment of Imports in Multisectoral Models

# TREATMENT OF IMPORTS IN MULTISECTORAL MODELS

## 1. Competitive and complimentary imports

One of the difficult problems in the formulation of the multisectoral models of planning or growth is the specification of import requirements. One can distinguish between two extreme assumptions. The first is to treat all imports as negative final demand. This amounts to the assumption that all imports are competitive with domestic production. In a consistency model the actual levels of such imports are determined outside the system (e.g., according to some criteria of comparative advantage, some notion of what demand is likely to be and so on), while in a programming model an optimum distribution is obtained as a result of the maximizing process.

Another extreme way of treating imports is to assume that they are all complementary to (i.e., non-competitive with) domestic production and determine them endogenously through fixed coefficients (or some other kind of function) relating such imports to the output levels of the using sectors. Such fixed coefficients are usually based on the values obtaining in the recent past, but sometimes

appropriately adjusted to reflect the desirable pattern of import substitution. Again such adjustment has to be made exogenously on the basis of the knowledge about comparative advantage and other feasibility conditions.

It is obvious that as methods of projecting the demand for imports by types both the assumptions are subject to quite serious limitations. The first method assumes unlimited freedom of choice which does not exist in reality. The second method leaves no choice in the area of import substitution except what is built in by the adjustment of the fixed coefficients. In reality quite a bit of choice would exist particularly over a five or ten year period although absolute freedom of choice would usually not be available.

By now the recognition of this fact has made the classification of imports into complementary and competitive a standard procedure in formulating the multisectoral models. The complementary 1/ imports indicate the floor demand for foreign exchange which is determined endogenously. The uncommitted foreign exchange left over after the satisfaction of the complementary import needs is distributed among the

1/ We use this synonymously with the more usual term non-competitive.

competitive imports. In a consistency model the distribution of uncommitted foreign exchange among sectors must again be done exogenously e.g., as percentages of total, according to some given criteria of allocation. In an optimizing model however such allocation is usually determined endogenously by the model as a result of the optimizing process. While in a multisectoral consistency model there is nothing that provides endogenously a desirable pattern of foreign exchange allocation or import substitution, a multisectoral optimizing model can be made to provide these things as endogenous solutions. Thus the 'best' allocation of foreign exchange or the 'optimum' guidelines for import substitutions are obtained as solutions of the optimizing exercises. This makes the specification of imports separately as competitive and complementary a particularly attractive feature for the optimizing exercises.

## 2. The definition and the determination of the complementary imports

Complementary imports are defined to be the import of those goods for which no domestic capacities exist. From this definition it would be quite straightforward to classify imports as complementary and competitive for any given

historical period. Again given a sufficiently detailed sector classification, it would be simple to specify the functional relationship that would determine their levels: the complementary import sectors would have no domestic production, but the demand for their products will be determined in the same way as for any domestic sector -- through fixed input coefficients of the Leontief type.

There are two kinds of considerations which make such an approach to the identification and determination of complementary imports useless to a planner. First, a planner is not concerned with any historical period but with future. It is the job of a planner to allocate available resources to create new capacities. Such additions to capacities would alter the criterion of complementarity radically over time. Thus what a planner wants are the measures for incremental or ex-ante (and not average or ex-post) complementarities. In the early years of independence most manufactured imports into Pakistan were complementary in the sense that there were no domestic capacities for their production. But it would be senseless to treat them as complementary in formulating plans because that would permit no creation of capacities in these sectors within the country.

Secondly, the sector classification that a multi-sectoral model builder will work with will usually not be as detailed as to permit the treatment of each complementary import as a separate sector. Usually each type of complementary import would be classifiable in one of the inevitably aggregated domestic producing sectors. Thus one would need to distinguish between the total demand for i-th input and the complementary import demand for the i-th kind where i is an aggregate sector. A method has therefore to be found for such distinction.

How should one go about in identifying the incremental complementarities in imports of the products classifiable under each aggregate sector? One can identify two broad classes of complementarities arising out of two different sets of circumstances. One class of complementarities derives from the fact that a particular kind of import classified under a domestic producing sector either is technologically impossible to produce domestically or its potential cost of production is known to be very much more than for the aggregate domestic sector. Such imports will be identifiable and their destinations (i.e., users) will be known. Frequently such products would be use-specific and the pattern of their distribution among users would be

dissimilar to the pattern of the distribution of the products of the aggregate sector under which they have been classified. Examples are:[2] (a) superior quality cotton imports into Pakistan which cannot be produced domestically due to technological considerations and is used up entirely by the cotton textiles sector while domestic cotton delivers also to other sectors; (b) superior quality tobacco imports (a product classified under all other agriculture) which again is technologically difficult to produce and is used up entirely by cigarette manufacturing while all other agriculture delivers also to many other sectors. We give to this type of imports the title of use-specific complementary imports.

A second kind of complementarity derives from the consideration that although there are no technological or other considerations militating against the substitution by domestic production of any single kind of the imported goods classifiable under any given aggregate sector, it would be quite impossible to substitute all such imported goods by

2/ In these examples and elsewhere in the paper the sector classification to which references are made is the same as used for other multisectoral work at the Institute. See, Khan, A.R. and A. MacEwan, Regional Current Input-Output Tables for East and West Pakistan Economies [4].

domestic production within the next five or ten years because there will be limitations on the pace at which a technique can be efficiently absorbed. Machinery imports into Pakistan is an example. It would perhaps be possible to substitute almost entirely by domestic production the import of any single kind of machines, say textile equipment or milling equipment for example, over the Fourth Plan period. But it would be impossible to substitute entirely the import of all kinds of machineries. It would be arbitrary and misleading to select a few of these machines as complementary. All we know is that the import substitution of the sector as a whole cannot be driven faster than a given rate. Note that such limits on complementary imports must be set with clear reference to a given planning period. We give to this class of imports the name of the non-use-specific complementarity.

Note that the second kind of complementarity is simply a limitation on the rate of expansion of domestic production of the corresponding sector. It seems to us that such limits on self sufficiency can better be expressed as minimum import ratio rather than as maximum absolute production. The latter is necessarily arbitrary whereas the former may be based on a ranking of the sub-sectors according to the ease with which

they can be replaced by domestic production, making a decision on a borderline upto which import replacement should be driven during a given plan period and looking into the base-year share of the total use of the remaining sub-sectors.

The essential distinction between the two types of complementary imports is that in the former case we know who the users of these imports will be in future while in the latter case we do not know who the users will be. All we know in the second case is that the domestic use of a particular sector's products must consist of a certain minimum proportion of imports.

## 3. Specification of the demand for complementary imports in multisectoral models

By far the more popular assumption about the demand for complementary imports is that they are determined for each sector in terms of given proportions of the sectoral domestic outputs (Johansen /3/, Chakravarty and Lefeber /1/ and Eckaus and Parikh /2/ for example):

$$(1) \quad M_i = m_i X_i$$

The other method is to specify the complementary imports as proportions of the activity levels of the using sectors involving the estimation of the full complementary imports coefficients matrix:

$$(2)\quad M_i = \sum_j m_{ij}X_j + m_{ic}C_i + m_{ik}I_i$$

where for the i-th sector's products

$M_i$ = Complementary imports

$X_i$ = Output

$C_i$ = Final consumption

$I_i$ = Investment

and $m_i$, $m_{ij}$, $m_{ic}$ and $m_{ik}$ are fixed coefficients.

The difference between the two assumptions can easily be demonstrated by substituting the usual input-output balance equation

$$(3)\quad X_i = \sum_j a_{ij}X_j + C_i + I_i$$

into (1) to get

$$(4)\quad M_i = \sum_j m_i a_{ij}X_j + m_i C_i + m_i I_i.$$

The two sets of assumptions would be identical if

$$m_{ij} = m_i a_{ij} \quad \text{or} \quad m_{ij}/a_{ij} = m_i \quad \text{for all } j.$$

In other words, if the complementary imports were not in any way use-specific but the degree of complementarity between i-th import and i-th domestically produced goods were the same for all the using sectors, then the two methods would give exactly equivalent results. In the circumstances discussed above, the degree of complementarity would frequently vary between using sectors so that the two methods would give quite different results.

It is obvious that we should employ the first method to determine the non-use-specific complementary imports and the second method to determine the use-specific complementary imports. Using any one method indiscriminately for all complementary imports would be misleading. If the use-specific complementarity is specified as a fixed proportion of the domestic output of the corresponding aggregate producing sector then in a consistency model, for example, the demand for such imports would be artificially inflated if growth is concentrated in those sectors which are big users of domestically produced inputs of the given sector but not of the imported inputs classified under the sector. In an optimizing exercise, all the sectors not using these imported inputs will be discriminated against relative to the sectors using these inputs because foreign exchange is a scarc

factor. Again if in the case of the non-use-specific complementarity we arbitrarily select a number of using sectors (perhaps on the basis of the base-year pattern) and assume fixed $m_{ij}$s for them then the optimizing process would discriminate against these sectors.

Thus the proper way of treating imports is a three-way classification: (a) use-specific complementary imports should be expressed as fixed proportions of the activity levels of the users; (b) non-use-specific complementary imports should be expressed as fixed proportions of the sectoral domestic outputs; and (c) competitive imports will use up the remainder, i.e., the uncommitted amount of the foreign exchange after the demand for both types of complementary imports are satisfied.

## 4. Estimating incremental coefficients for complementary imports

It is reasonable to estimate the use-specific complementarity on the basis of the recent data. It is a reasonable assumption that such coefficients would be more or less stable over time like the current input coefficients of the Leontief type. We estimate these coefficients for the year 1962/63 and derive the incremental coefficients for the

Fourth Plan only after very minor adjustments for the changing shares for the large and small-scale parts of each sector.

It is however impossible to estimate the non-use-specific complementarity on the basis of past historical data. According to our definition, ex post almost all imports are complementary. What we want are ex-ante constraints on the rates of import replacement in certain sectors. Let us discuss in a little greater detail the nature of these constraints. For many of the aggregate sectors there exist substantial economies-of-scale with respect to the dozens of individual products aggregated together. Outstanding examples are machineries, transport equipment and the sectors related to the capital goods. Thus it will be unwise to create a little domestic capacity for each of the individual products although there are no obvious technological or economic barrier to the domestic production of any single product. The level of production that optimizes economies-of-scale and maximizes the effects of such factors as learning by doing will usually be so great for each individual product that efficient import substitution in all will not be feasible. It would be sensible to specialise in a number of these products while depending on

imports for the rest. Which ones should be made and which ones should be bought must be decided after a careful analysis of lots of considerations. Not all such considerations can be incorporated in the usual kind of multisectoral models which necessarily work with somewhat aggregate sectors. But as stated above, an arbitrary selection of a number of individual products as complementary imports and relating their demand to the activity levels of their users will introduce unnecessary bias against such users.

Domestic production limits arising out of the above factors must, however, be shown in some way and in the absence of detailed information about the possibilities of economies-of-scale, the pace of learning by doing and so on, we have to make crude approximations. We do this by postulating a fixed relation between incremental shares of imports and domestic production in total supply. The incremental coefficients themselves are estimated on an analysis of what can be done during the given time period and are based heavily on the trends projected in the perspective plan. They are set considerably below the base-year average levels. This means that the larger the demand for the aggregate sectors' products in future, the greater would be the average proportion supplied domestically. Tying the average rate of

import substitution in this way to the level of demand seems to be a better way of specifying limits on domestic production than postulating absolute limits to production independent of the level of demand. Since in the ultimate analysis the coefficients representing such constraints are arbitrary, they may be a useful element in the sensitivity analysis of the planning model.

Below we outline the details of the method adopted for the identification and the quantification of the two types of complementary imports for each of the two regions of Pakistan. It should however be made clear that the lack of detailed information has made it impossible for us to employ the above classification to the fullest extent. There must be many more use-specific complementary imports than we have shown below. For example, there must be a number of chemicals which are use-specific and technologically impossible or difficult (i.e., costly) to produce domestically. For lack of detailed information and technical knowledge we cannot classify them as such. Although the distinction between the two types of complementarity is analytically important, in practice we can derive only limited benefit from this distinction because of the paucity of knowledge.

4.1. Coefficients of use-specific complementary imports

Tables 1A and 1B show the details involved in identifying and quantifying the use-specific complementary imports into each region both from abroad and from the other region for the year 1962/63. We assume that in general such imports are used up by the large-scale industries. Allocation to small-scale industries have been made only when there is a balance after satisfying total requirement by large-scale manufacturing. Tables 2A and 2B show the average coefficients of such imports into large-scale and small-scale users of given types. We think it reasonable to assume the incremental coefficients would be the same as average. Thus for the aggregate using sector we can estimate the incremental coefficient by taking a weighted average of the large and the small scale coefficients, weights being proportional to the incremental shares of each technique.

4.2. Coefficients of non-use-specific complementary imports for the Fourth Plan

We have outlined above the kind of considerations that necessitate the introduction of such coefficients. They are best viewed as constraints on the rate of import replacement by domestic production. We have also indicated the essentially

arbitrary nature of the estimated values of such coefficients.

The sectors for which it is particularly important to specify these constraints are the investment goods and the related industries. These are basic metals, metal products, machineries and transport equipment. The procedure we follow is described below.

We project domestic production and imports of the metal product, machinery and transport equipment sectors for 1969/70 -- the base-year of the Fourth Plan -- by applying 8 per cent growth rate in output per year (10 per cent being the growth rate postulated by the perspective plan for investment goods) and 6 per cent growth rate in imports per year (same as the perspective plan growth rate for investment goods imports) to the values of outputs and imports in the 1962/63 input-output table. Applying to these bench mark figures for 1969/70 the perspective plan growth rates (10 per cent for production and 6 per cent for imports) we obtain what might be termed "the perspective plan estimates" of the incremental shares of imports and domestic production. The "perspective plan assumptions" about import shares during the Fourth Plan certainly do not indicate the

floor share for each sector. They probably indicate what the perspective plan according to its calculations find desirable. "Technological limits" of the type we discuss above must be somewhat lower. We assume that the floor import shares are 2/3 of what have been implicitly postulated in the perspective plan. As already stated, the arbitrariness in the quantification of the constraints makes these coefficients important variables in any sensitivity analysis.

For basic metal we use the Third Plan estimates for the 1969/70 bench mark production and imports of steel and estimate their increases over the Fourth Plan by using the growth rates for production and imports of investment goods as postulated in the perspective plan. Again we take as floor ratio for the Fourth Plan the 2/3 of this import ratio. This is 0.38. We however have to adjust for a peculiar feature of the basic metals sector. This sector is vertically integrated so that both raw materials (e.g., crude metals like iron ore) and finished products (e.g., steel) are classified under this sector. The special feature is that the entire amount of raw materials have to be imported. Denote for this sector,

$M$ = Total imports

$M'$ = Import of final products

$M''$ = Import of raw materials

$M'' = aX = mX$ (a is the Leontief input-coefficient)

$M' = b(M'+X)$ (i.e., b is the ratio of complementary product import to total supply of the finished product)

$$= \left[\frac{b}{1-b}\right] X$$

$$M = M' + M'' = \left[ m + \frac{b}{(1-b)} \right] X$$

Our b = .38 and m=a=.4 approximately (from the input-output table) so that the complementary import coefficient is approximately 1. Note that crude metal imports are use-specific, but, since they are entirely on the diagonal, it does not matter if we treat it as non-use-specific. Also note that this method would have to be applied in a few other possible cases, e.g., if a petroleum industry is started in East Pakistan and in case of tea in West Pakistan.

What about the non-use-specific complementary imports of these kinds from the other region? One may argue that each region would still be heavily dependent on foreign import so that it is reasonable to assume that they would not supply to each other in these products. But again, the efficiency in the import substitution programme would probably require some amount of regional specialization and trade in the individual products classified under each sector. We however do not quantify these at this stage. Such quantification

will have to be done entirely arbitrarily.

We also define the non-use-specific complementarity for the imports of other chemicals ($\frac{1}{2}$ the average 1962/63 ratio) and transport and services n.e.s. (equal to base-year ratios).

## References

1. Chakravarty, S. and Louis Lefeber, "An Optimizing Planning Model", Economic Weekly, Annual Number February 1965.

2. Eckans, R.S. and K.S. Parikh, Planning for Growth: Multisectoral, Intertemporal Models Applied to India, Cambridge, Mass. 1968.

3. Johansen, Leif, Multisectoral Study of Economic Growth, Amsterdam 1960.

4. Khan, Azizur Rahman and Arthur MacEwan, Regional Current Input-Output Tables for the East and West Pakistan Economies, Pakistan Institute of Development Economics Research Report No.63.

TABLE 1A

A DESCRIPTION OF THE USE-SPECIFIC COMPLEMENTARY IMPORTS INTO EAST PAKISTAN 1962/63

| Sector under which imports are classifiable | | Types and quantities of imported goods | Using sector/activity |
|---|---|---|---|
| | | FROM ABROAD | |
| 04 | Cotton | All Cotton imports | Large-scale Cotton textiles |
| 05 | Tea | All imported tea | Final Consumption |
| 06 | All Other Agriculture | (a)Fish, Fruits, Vegetables, Coffee, Cocoa, Spices | (a)Final Consumption |
| | | (b)Wood | (b)Large-scale Wood, Cork & Furniture |
| 11 | Cotton Textiles | 80% of all textile yarn & thread | Large-scale Cotton textiles |
| 13 | Other Textiles | (a)20% of all textile yarn & thread | (a)Other textiles |
| | | (b)Special textile fabrics etc. | (b)Final Consumption |
| 14 | Paper & Printing | (a)50% of Pulp & Waste 80% of complementary paper import which in turn is assumed to be 50% of paper import | (a)Paper & Printing |
| | | (b)Books, magazines etc. 20% of complementary paper import | (b)Final Consumption |

TABLE 1A (Contd.)

A DESCRIPTION OF THE USE-SPECIFIC COMPLEMENTARY IMPORTS INTO EAST PAKISTAN 1962/63

| Sector under which imports are classifiable | | Types and quantities of imported goods | Using sector/activity |
|---|---|---|---|
| | | FROM ABROAD | |
| 16 | Rubber & Rubber Products | (a)All Crude rubber<br>(b)Tyres and Tubes | (a)Rubber & Rubber Products<br>(b)Transport |
| 24 | Wood Cork & Furniture | Wood, Cork manufactures | Large scale and small scale Wood, Cork and Furniture |
| | | FROM WEST PAKISTAN | |
| 04 | Cotton- | Cotton | Large-scale and small scale cotton textiles |
| 06 | All Other Agriculture | (a)50% of the Tobacco used in cigarette making<br>(b)Fruits, Vegetables & Spices | (a)Cigarettes<br>(b)Final Consumption |
| 13 | Other Textiles | Woollen textiles (assumed to be 80% of imported other textiles from West Pakistan | Final Consumption |
| 14 | Paper and Printing | Books, Printed Matter | Final Consumption |

TABLE 1B

A DESCRIPTION OF THE USE-SPECIFIC COMPLEMENTARY IMPORTS INTO WEST PAKISTAN 1962/63

| Sector under which imports are classified | | Types of imported goods | Using sector/activity |
|---|---|---|---|
| | | FROM ABROAD | |
| 04 | Cotton | Special-quality cotton (approximately 1% of cotton used by the cotton textile sector) | Large-scale cotton textiles |
| 05 | Tea | All imported tea | Final consumption |
| 06 | All other agriculture | a)Special-quality tobacco<br>b)Cocoa butter, spices<br>c)Raw silk, special-quality wool, flax yarn<br>d)Board pulp<br>e)Plants for use in medicine<br>f)Plants for use in perfume<br>g)Special-quality wood<br>h)Spices, cocoa, coffee, other special foods | a)Tobacco products<br>b)Other food<br>c)Other textiles<br>d)Paper (paper-board)<br>e)Other chemicals<br>f)Wood, etc.<br>g)Final consumption |
| 09 | Tobacco products | Special-quality cigars and cigarettes | Final consumption |
| 11 | Cotton textiles | Special-quality thread and material | Cotton textiles, other textiles, leather and miscellaneous manufacturing |
| 13 | Other textiles | Primarily partly-finished wool fibres of special quality | Cotton textiles, other textiles |
| 14 | Paper and printing | Foreign books and periodicals | Final consumption |

TABLE 1B (Contd.)

A DESCRIPTION OF THE USE-SPECIFIC COMPLEMENTARY IMPORTS INTO WEST PAKISTAN 1962/63

| Sector under which imports are classified | | Types of imported goods | Using sector/activity |
|---|---|---|---|
| | | FROM ABROAD | |
| 15 | Leather | a)Special-quality leather<br>b)Shoes | Leather products<br>Final consumption |
| 16 | Rubber | a)All crude rubber<br>b)Tyres (85% of imports) | a)Rubber<br>b)Transport services |
| | | FROM EAST PAKISTAN | |
| 05 | Tea | All tea imported from East Pakistan | Tea processing and final consumption |
| 06 | All other agriculture | Betal leaves, fruits, vegetables, spices | Final consumption |
| 14 | Paper and printing | Books and periodicals | Final consumption |
| 15 | Leather | a)Shoe leather<br>b)1/4 of regional import of finished leather goods | a)Leather products<br>b)Final consumption |
| 18 | Chemicals | Matches | Final consumption |

TABLE 2A

USE-SPECIFIC COMPLEMENTARY IMPORTS INTO EAST PAKISTAN 1962-63

Flows are in million rupees at purchasers prices. Coefficients are shown in parentheses below the flows

| Supplying Sectors | Large Scale Manufacturing Sectors | | | | | | Small Scale & Cottage Manuf. Sectors | | | Private Consumption |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cigarettes 9 | Cotton Textiles 11 | Other Textiles 13 | Paper 14 | Rubber Products 16 | Wood, Cork, Furniture 24 | Cotton Textiles 11 | Wood, Cork, Furniture 24 | Transport 31 | |
| FROM ABROAD | | | | | | | | | | |
| 04 | | 14.6 (.0660) | | | | | | | | |
| 05 | | | | | | | | | | 2.5 (.0001) |
| 06 | | | | | | 1.6 (.0870) | | 8.0 (.0718) | | 15.7 (.0009) |
| 11 | | 10.6 (.0479) | | | | | | | | |
| 13 | | | 2.7 (.0641) | | | | | | | 3.1 (.0002) |
| 14 | | | | 14.9 (.1200) | | | | | | 4.8 (.0003) |
| 16 | | | | | 2.3 (.2500) | | | | 13.0 (.0130) | 4.0 (.0002) |

TABLE 2A (Contd.)

USE-SPECIFIC COMPLEMENTARY IMPORTS INTO EAST PAKISTAN 1962-65

Flows are in million rupees at purchasers prices. Coefficients are shown in parentheses below the flows

| Supplying Sectors | Large-Scale Manufacturing Sectors | | | | | | Small-Scale & Cottage Manuf. Sectors | | Transport | Private Consumption |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cigarettes 9 | Cotton Textiles 11 | Other Textiles 13 | Paper 14 | Rubber Prod 16 | Wood, Cork, Furniture 24 | Cotton Textiles 11 | Wood, Cork, Furniture 24 | 31 | |
| 24 | | | | | | 2.0 (.1087) | | 0.5 (.0045) | | |
| FROM WEST PAKISTAN | | | | | | | | | | |
| 04 | | 62.3 (.2818) | | | | | 34.7 (.0369) | | | |
| 06 | 13.8 (.1424) | | | | | | | | | 13.6 (.0008) |
| 13 | | | | | | | | | | 4.7 (.0003) |
| 14 | | | | | | | | | | 2.2 (.0001) |

NOTE: Coefficients are obtained by dividing the flows by the outputs of the using sectors.

TABLE 2B

USE-SPECIFIC COMPLEMENTARY IMPORTS INTO WEST PAKISTAN

(LARGE SCALE)

| | 05-Tea | 09-Tobacco | 10-Other Food | 11-Cotton Textiles | 13-Other Textiles | 14-Paper | 15-Leather | 16-Rubber | 18-Chemicals | 24-Wood etc. | 28-Miscellaneous Manuf. | 31-Transport | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FROM ABROAD | | | | | | | | | | | | | |
| 04 | | | | 5.0 (.00301) | | | | | | | | | |
| 05 | | | | | | | | | | | | | 1.2 (.00006) |
| 06 | | 23.9 (.08072) | .3 (.00201) | | 2.7 (.00880) | 4.1 (.02664) | | | .4 (.00102) | 1.3 (.09559) | .3 (.00224) | | 21.6 (.00116) |
| 09 | | | | | | | | | | | | | 2.8 (.00015) |
| 11 | | | | 2.2 (.00132) | 1.7 (.00554) | | .2 (.00180) | | | | .2 (.00149) | | |
| 13 | | | | 3.0 (.00180) | 21.0 (.06845) | | | | | | | | |
| 14 | | | | | | | | | | | | | 12.5 (.00067) |
| 15 | | | | | | | .1 (.00090) | | | | | | 1.5 (.00008) |

TABLE 2B (Contd.)

USE-SPECIFIC COMPLEMENTARY IMPORTS INTO WEST PAKISTAN

(LARGE SCALE)

| | 05-Tea | 09-Tobacco | 10-Other Food | 11-Cotton Textiles | 13-Other Textiles | 14-Paper | 15-Leather | 16-Rubber | 18-Chemicals | 24-Wood etc. | 28-Miscellaneous Manuf. | 31-Transport | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | | | | | | | 4.9 (.19919) | | | | 50.0 (.14599) | |
| **FROM EAST PAKISTAN** | | | | | | | | | | | | | |
| 05 | 85.5 (.79387) | | | | | | | | | | | | 136.5 (.00732) |
| 06 | | | | | | | | | | | | | 75.0 (.00402) |
| 14 | | | | | | | | | | | | | .2 (.00001) |
| 15 | | | | | | | 3.8 (.03411) | | | | | | 7.7 (.00041) |
| 18 | | | | | | | | | | | | | 39.5 (.00212) |

TABLE 2C

Use-Specific Non-Competitive Imports of Paper into West Pakistan

These imports can be supplied from East Pakistan or From Abroad

| Large-Scale Sector to which Delivered | | Quantity | Coefficient** |
|---|---|---|---|
| 05 | Tea | 2.6 | .02424 |
| 09 | Tobacco Products | 8.3 | .02803 |
| 10 | Other Food | 3.7 | .02477 |
| 11 | Cotton Textiles | 1.0 | .00060 |
| 13 | Other Textiles | .5 | .00163 |
| 14 | Paper and Printing | 23.2 | .15335 |
| 15 | Leather Products | .1 | .00090 |
| 16 | Rubber Products | .11 | .00406 |
| 18 | Other Chemicals | .4 | .00102 |
| 19 | Cement | 4.0 | .02228 |
| 21 | Metal Products | .9 | .00363 |
| 28 | Miscellaneous Manuf. | 6.0 | .04478 |
| 31 | Transport | 9.7 | .00537 |
| 32 | Trade | .5 | .00018 |
| 34 | Government | 4.0 | .00270 |
| 35 | Services n.e.s. | 5.0 | .00255 |
| | Consumption* | 37.8 | .00203 |
| | Total: | 107.8 | |

* Does not include non-competitive import of printed matter.
** Quantity divided by output of the using large-scale sector

TABLE 3

NON USE-SPECIFIC COMPLEMENTARY IMPORTS

Incremental Coefficients for the Fourth Five-Year Plan Period

The following are to be entered as diagonal elements in the complementary import coefficients matrix. Each entry is the ratio $\Delta M_i \div \Delta X_i$ at purchasers price.

A. INTO EAST PAKISTAN

| | From Abroad | From West Pakistan |
|---|---|---|
| Chemicals | .200 | .065 |
| Basic Metals | 1.000 | - |
| Metal Products | .070 | - |
| Machinery | .665 | - |
| Transport Equipment | .365 | - |
| Transport | .030 | - |
| Services, n.e.s. | .005 | - |

B. INTO WEST PAKISTAN

| | From Abroad |
|---|---|
| Chemicals | .200 |
| Basic Metals | 1.000 |
| Metal Products | .100 |
| Machinery | .665 |
| Transport Equipment | .500 |
| Petroleum Products | .500 |
| Transport | .024 |
| Services, n.e.s. | .002 |

# Part II

## Predicting Consumption Proportions for Multisectoral Planning Models

### Some Problems and Illustrations

# PREDICTING CONSUMPTION PROPORTIONS FOR MULTISECTORAL PLANNING MODELS

## SOME PROBLEMS AND ILLUSTRATIONS

### 1. Introduction

Consumption is what it is all about. The ultimate purpose of planning should be the provision of consumption to private individual. Private consumption however is a composite commodity. In a multisectoral analysis it is necessary to break down the demand for aggregate consumption into demand for individual consumption goods.

In those models which specify aggregate consumption demand as an exogenous target, the actual demands for individual consumption goods can be shown. In the models which determine aggregate consumption endogenously it is only possible to express the demands for individual consumption goods as proportions (or more general functions) of total consumption demand. In each case we have to use a comprehensive set of so-called Engel functions, the functions which represent the relationship between the demand for individual consumption goods and aggregate consumption demand.

Section 2 discusses some problems of predicting consumption proportions for use in multisectoral planning exercises. In section 3 we derive a nearly comprehensive set of Engel functions on the basis of cross section data

separately for urban and rural areas of each of the two regions of Pakistan. It is well known that sets of Engel Functions have already been estimated for Pakistan or parts thereof. The reason we cannot use the available estimates are: (a) they do not correspond to the sector classification we want (see below); (b) we do not have such estimates for all four consumption groups we specify; (c) there seems to be some advantage in estimating all the sets of functions from the same and most recent set of data. We use the estimated Engel relations to derive marginal consumption proportions for the Fourth Five-Year Plan period.

## 2. Problems of predicting consumption proportions for future

For a fixed consumption target model there is no problem in the specification of consumption demand on a multisectoral basis. The Engel functions can be applied to the target consumption to obtain consumption demand for individual products.

If consumption is endogenous, as it is in all those optimizing models which maximize some function of aggregate consumption, then it is not possible to specify actual demand for each kind of consumption goods. What is possible and

must be done is to relate the consumption of each good as some function of total consumption. This means the use of the Engel functions themselves in the planning exercise. In order to be able to utilize the computational methods of linear programming, it is necessary that the Engel curves be linear. We, however, argue below that the linear Engel functions should usually be rejected as implausible.

What we must now do is to make linear approximations to our non-linear Engel curves and in order to do that we again have to have some knowledge about the likely level of aggregate consumption.

In most models of optimizing variety the assumption is made that

$$C_i = c_i E$$

(where $C_i$ is consumption expenditure on i, E is total consumption expenditure, $c_i$ is a fixed coefficient) and that

$$\sum_i c_i = 1$$ */

In doing so either linear and homogeneous Engel functions are assumed or linear approximations are made to non-linear

*/ See Chakravarty and Lefeber [1], Eckaus and Parikh [2] and Manne and Weisskopf [6] for example.

functions which necessarily involves the assumption of some value for the unknown aggregate consumption expenditure. We reject the first alternative as being an unrealistic description of the determination of consumption demand for individual products (see arguments below in 3.3). We are therefore left with the second alternative in which the closeness of the linear approximation depends on how well we are able to predict the level of aggregate consumption.

The problem is particularly complicated in view of the consideration that in an optimizing model the level of the objective function, aggregate consumption, depends partly on how the linear approximation is made. If we overstate (understate) the $c_i$ s for those sectors the consumptions of which are difficult to provide in terms of scarce resources, then the level of endogenous aggregate consumption would be smaller (larger) than if those $c_i$ s were smaller (larger). Since the $c_i$ s for food products are a diminishing function of the level of aggregate consumption, we shall be understating (overstating) the $c_i$ s for food products if we overestimate (underestimate) the unknown aggregate consumption level. If it is also true, as it seems to be held widely to be true, that the unit cost in terms of capital and foreign exchange is less for these sectors than for others, then the

result of initially overestimating (underestimating) the unknown aggregate consumption would be to generate endogenously a level of aggregate consumption which would be smaller (greater) than otherwise.

One way to get around the problem would be the method of trial and error which is necessarily expensive in terms of time. The other way would be not to require rigid adherence to the Engel functions. Strict adherence to the Engel curve makes a model very rigid and unrealistic. Engel curves trace the path of demand when income and consumption change and nothing happens to relative prices. If relative prices change then demands would deviate from the rigid paths indicated by the Engel relations. Strict adherence to Engel curves would express a complete preference for the base-year relative prices. There of course is nothing sacrosanct about base-year relative prices. Ensuring their continued prevalence in future would preclude the desirable process of the relative cheapening of those goods whose consumption can be provided relatively easily. If on the other hand we insist on following the Engel curve rigidly, then the fact that one commodity, however unimportant, is in limited supply or is very expensive to provide, would hold down total consumption because the consumers are supposed to demand all commodities

in fixed proportions to total consumption.

Strict adherence to Engel curves would allow no freedom for aggregate consumption and would usually hold the latter down. Complete neglect of Engel curves would provide too much freedom to consumption which does not exist in reality and would allow it to go up while making its composition absurd. The best way seems to be the middle one of generally adhering to the Engel functions but allowing a little freedom to consumption pattern to deviate slightly to either side. If the linear approximations to the Engel functions give a set of $c_i$ then the appropriate way to define the constraints on consumption may be the following:

$$(1 - \gamma_i)\, c_i E \leqslant C_i \leqslant (1 + \gamma_i)\, c_i E$$

where $\gamma_i$ can be anything between say .05 and .10. In general we should use very low $\gamma_i$ for those products whose demands are price-inelastic so that the effects on relative prices are not so violent. It should be intuitively clear that once we provide some freedom of this sort to the pattern of consumption we can afford to be somewhat less accurate in initially estimating aggregate consumption for use to make linear approximations to the Engel curves.

## 3. Estimating the Engel functions and predicting consumption proportions for the Fourth Plan

With the above words of caution, we would embark on the estimation of the consumption proportions for the Fourth Plan period without appearing to suggest that they be adhered to rigidly for the plan exercises. Our first task is to estimate the Engel curves. We next derive the $c_i$ s on the assumption of some target aggregate consumption. The tentative nature of the target consumption particularly requires the allowance of some movement around the consumption proportion derived from the Engel curves.

### 3.1. Data and sectors for the estimation of the Engel functions

The present study is a part of the general study on the data requirement and statistical basis for multisectoral regional planning. We therefore try to conform as closely as we can to the 35-sector classification adopted in the foregoing studies on the current input-output relationships [4] and capital-output ratios [5]. This sector classification is shown in table 1.

We use the data provided by the Quarterly Surveys of Current Economic Conditions (QSCEC) for the year 1963/64 [7]. It shows per capita household expenditure on total consumption and consumption of various goods and services. Although the information is provided for quite detailed classification of such goods and services, they are not adequate for the straightforward adoption of our sector classification in the estimation of Engel relations.

For the seven of our sectors (paper, rubber products, other chemicals, machinery, transport equipment, wood cork and furniture and miscellaneous manufactures) we have no separate information on consumption expenditures. But these sectors taken together account for a very small proportion of total consumption expenditure, less than 5 per cent in East and just over 5 per cent in West according to our 1962/63 input-output tables [4]. For the projection of consumption demand for these sectors' products we have to depend on other sources of information.

We also have the problem of comparability of the sectors in table 1 and the consumption groups in QSCEC. In three cases we have to combine two of our sectors to correspond to the QSCEC commodity groups: their "Other Food" seems to correspond to our all other Agriculture and

All Other Food Processing; their clothing corresponds to our Cotton and Other Textiles; and their Fuel and lighting probably corresponds to our Coal and Petroleum and Electricity and Gas. Our Services n.e.s. is assumed to correspond to Education and Recreation, Personal care, Domestic Help and 50 per cent of Medical Expenses (the other 50 per cent going to medicines etc.) shown in QSCEC. Finally our Leather Products include only footwear from QSCEC. This is not quite right; leather products consist also of non-footwear items while footwear may not always be of leather. We hope the two would approximately cancel each other.

Note that trade service is not shown to be consumed directly, because the estimates are all at purchasers' price and hence assumed to include trade and transport margins on the consumption goods. Since we consider only personal consumption, we also exclude the consumption of Government Services which are socially consumed.

The QSCEC provides information on monthly average aggregate consumption expenditure and monthly average expenditure on each group of consumption goods for eleven income groups. In a number of cases, we however aggregate the two highest income groups to eliminate certain obviously

peculiar features. In a few other cases we leave out of consideration certain extreme observations.

3.2. The four consumption groups

One of the standard assumptions underlying the use of the consumption functions of the Engel type for predictive purposes is that the group for which such functions are estimated must be homogeneous in the sense that either consumption behaviour must be roughly similar for all members of the group or if there exist dissimilarities between sub-groups within the group, then the weight of each sub-group must remain unchanged in the aggregate consumption of the group as a whole over time. As is well known and can easily be verified, the patterns of personal consumption differ widely between the two regions of Pakistan and between urban and rural areas within each region. There must be other sources of difference between consumption patterns, but the above are the overwhelmingly important sources of such difference. Moreover the regional shares of expenditure are unlikely to remain stable over time(as the objective of parity is gradually realized). Similarly the share of urban expenditure in total national expenditure must go up with the advance in the rate of urbanization.

The above considerations have led us to estimate four different sets of Engel functions for the following expenditure groups:

(a) Urban East Pakistan

(b) Rural East Pakistan

(c) Urban West Pakistan

(d) Rural West Pakistan

and to make projection separately for each expenditure group. Aggregate regional projections are obtained as weighted averages of urban and rural projections.

3.3. The form of Engel functions

The simplest of the Engel curves is the linear one of the form

$$C_i = a + b\,E\,.$$

The difficulty with this type of functions is that they assume that the marginal consumption proportion $(dC_i/dE)$ is constant irrespective of the level of consumption and that expenditure elasticity of demand gradually approaches 1 as consumption expenditure becomes very large. These assumptions are inadmissible for most consumption goods. In general for most necessaries (notably food items) the

marginal consumption proportion should decline with the increase in the level of consumption (which is satisfied by a semi-logarithmic Engel function* of the form $C_i = a + b \log E$) while for most non-necessary goods and services a reasonable assumption is that marginal consumption proportion bears a constant relation to average consumption proportion or, in other words, that expenditure elasticity of demand is constant (which is satisfied by a double-logarithmic function of the type $\log C_i = a + b \log E$).

For food items we use the semi-logarithmic relation of the form**

$$C_i = a_i + b_i \log E$$

which gives the marginal consumption proportion as a declining function of the level of expenditure

$$\frac{dC_i}{dE} = b_i/E$$

and expenditure elasticity of demand as a declining

*/Other forms of Engel functions also have this property and we are not claiming any superiority of this form over others except possible computational advantage.

**/ Throughout this paper $C_i$ and E are monthly per capita figures.

function of the level of consumption of i

$$\eta_i = \frac{dC_i}{dE} \cdot \frac{E}{C_i} = b_i/E \quad \frac{E}{C_i} = b_i/C_i.$$

It would be preferable to use a function for food items which would specify an absolute level of satiety since it is unrealistic to assume that expenditure on food items can be increased without limit. But for the purpose of prediction for only moderately large increase in expenditure over not too long a period this should not matter much because the level of satiety for an average consumer is unlikely to be reached soon.

For other goods and services we postulate a double logarithmic Engel function of the type

$$\log C_i = a_i + b_i \log E$$

which gives the marginal consumption proportion as proportional to average consumption proportion

$$\frac{dC_i}{dE} = b_i \quad \frac{C_i}{E}$$

and a constant expenditure elasticity of demand

$$\eta_i = \frac{dC_i}{dE} \quad \frac{E}{C_i} = b_i .$$

Such a relation is clearly more realistic than the simple linear relation in so far as it allows the marginal consumption proportion to vary.

It would of course be desirable to test the hypothesis that the above functions are the best forms to use. We do something in this direction by fitting alternative forms (particularly the linear form) of Engel functions to the QSCEC data. In no case do the alternative forms provide a significantly better fit although in a number of cases the fit is insignificantly improved by the use of the linear form.*/

3.4. The results

The results of the fitted Engel functions are shown for East and West Pakistan in tables 2 and 3. It is easily noticed that the patterns of consumption vary widely among the four groups of consumers. In the following section we make a detailed analysis of the comparison of expenditure elasticities among these groups.

It may be noted that the fit is invariably good for the rural areas in both the regions, the coefficient of variation being seldom less than 0.8 and frequently more than 0.9.

*/ Linear form gives significantly better fit in one or two cases of consumption goods which we cannot use in our sector classification scheme.

Only exception seems to be the demand for fuel in rural East which does not vary at all with the level of total expenditure. The fit for urban areas is also similarly good with some very important exceptions -- the coefficients of determination are rather low for rice and wheat in urban East and for wheat in urban West. It is difficult to explain this phenomenon except by reference to the greater heterogeneity of the sample of consumers in urban areas.

It should be pointed out that wheat is an "inferior good" for the consumers in rural East Pakistan. This should not surprise any body. Similar result has been obtained by Nurul Islam [3]. It represents the strong preference for rural East Pakistan consumers for rice the consumption of which is not substituted by wheat unless poverty forces it. One of the odd things about the fitted Engel curves is that for West Pakistan urban expenditure elasticity for wheat is greater than rural expenditure elasticity. But urban elasticity also has much greater variance than rural.

3.5. Predicting aggregate consumption

In order to estimate the marginal consumption proportions ($dC_i/dE$), i.e., the slopes of the lines which

approximate the Engel functions at the relevant range, we have to know the levels of aggregate personal consumption for each of the four groups at the beginning and end of the relevant time period. In this sub-section we briefly discuss the methodology of estimating aggregate personal consumption in 1969/70, the base-year for the Fourth Plan, and in 1974/75, the terminal-year of the Third Plan.

We start with 1964/65 regional income figures at 1959/60 prices from the Third Five-Year Plan (TFYP, [9]) and convert them into 1964/65 prices. For this purpose we estimate CSO's implicit national income deflator by comparing current & constant price estimates and obtain regional deflators after comparing the CSO regional wholesale price indices. The sources of CSO statistics are the Statistical Yearbook (CSOYB) for 1965 and 1966 [8]. We assume that during the Third Plan period the two regions are going to grow at about the same rate, 35 per cent over the period. At the moment this seems to be the most optimistic assumption about regional rates of growth and regional balance.* We assume for the Fourth Plan a 44 per cent growth in East

* This and a few other numerical assumptions would appear to be outdated and inaccurate by now. Since the computations are mainly illustrative, we do not think it is imperative to incorporate the latest available information which itself is rather tentative.

Pakistan and 40 per cent growth in West Pakistan, which are close to the perspective plan assumptions. We also maintain that the perspective plan assumption of attaining 13.6 per cent saving rate in 1969/70 and 16.9 per cent in 1974/75 will hold for each region (TEYP [9] p.19).

We use the assumption II of the population projections made at the Pakistan Institute of Development Economics in [10]. Urban and rural populations are estimated on the assumption that the elasticity of urban population with respect to total population will be about 2 -- somewhat higher than the elasticity during the period 1951 - 1961.

Public consumption was separated out by using roughly the ratios in 1962/63 input-output tables [4].

Urban/rural per-capita consumption disparity is assumed to be 1.5 in East (as compared to 1.49 in 1963/64 QSCEC) and 1.3 in West (as compared to 1.27 in 1963/64 QSCEC). We finally arrive at the following per-capita monthly personal consumption expenditure figures (Rs.):

| | East | | West | |
|---|---|---|---|---|
| | Urban | Rural | Urban | Rural |
| 1969/70 | 37.6 | 25.1 | 38.4 | 29.5 |
| 1974/75 | 42.4 | 28.3 | 43.1 | 33.1 |

The reason we obtain the monthly figures is that the Engel curves are fitted to monthly data.

### 3.6. Marginal consumption proportions and expenditure elasticities during the Fourth Plan

The marginal consumption proportions (MCP) for the food items are defined as

$$dC_i/dE = b_i/E$$

and for non-food items as

$$\frac{dC_i}{dE} = b_i \quad \frac{C_i}{E} = b_i \quad \text{antilog } \frac{(a_i + b_i \log E)}{E} .$$

By inserting the appropriate values of E (monthly consumption expenditure) we obtain for each commodity group and for each expenditure group an estimate of MCP for the base-year and the terminal year of the Fourth Plan. The MCP for the Fourth Plan period is defined to be the average of the base and terminal year MCPs. The overall MCP for a region is the weighted average of the MCPs of the urban and rural areas, the weights being the incremental expenditure shares of urban and rural areas over the Fourth Plan period. The MCPs for urban and rural areas and their weighted average for East and West Pakistan for the Fourth Plan period are shown in tables 4 and 5.

We have said above that the residual sectors (paper, rubber products, other chemicals, machinery, transport

equipment, wood cork and furniture and miscellaneous manufactures) have very small average consumption proportions, together only 4.16 per cent in East and 5.35 per cent in West according to 1962/63 input-output tables [4]. These sectors have high expenditure elasticities according to the available Indian and Pakistani evidences. Even if we put such elasticity between 1962/63 and the Fourth Plan period at 1.5 the MCP for these sectors together should be .062 in East and .080 in West.

But our residual categories have higher MCPs in both the regions. This must mean the QSCEC commodity classification and our sector classification shown in table 1 are not quite comparable. In using these for the Fourth Plan we should therefore allocate the remainder of the residual MCPs to sectors which appear to have low MCPs in tables 4 and 5. The important among these sectors probably are: coal, petroleum, electricity, gas and leather products in both the regions and transport in West Pakistan.

The expenditure elasticities of demand for each of the four groups of consumers are shown in tables 6 and 7. For food items such elasticities decline with the level of consumption and we show their values for the base and

terminal years of the Fourth Plan. For non-food items the elasticities are constant.

It is interesting to compare the patterns of regional consumption at the margin. East's consumption at the margin is only slightly more agriculture-intensive than West's. But intra agricultural composition of consumption varies widely between the regions. Nearly half of East's consumption of agricultural goods and nearly a quarter of its aggregate consumption at the margin consists of one staple grain -- rice. West's agricultural consumption is much more diversified with rice and wheat together accounting for only about a fifth and "other food" (livestock products, other grains, pulses, vegetables, fruits etc.) accounting for nearly three-quarters. These have implications for the grain self-sufficiency programmes. While in East Pakistan rice production has to be driven reasonably fast even after the attainment of self-sufficiency West's self-sufficiency in wheat is very much an once for all problem. In fact, its demand is going to rise very slowly indeed and, unless exports become possible, a glut is extremely likely.

West's MCPs are higher than East's for most manufactured goods, transport and housing. But it is interesting

to note that although East's average share for services is smaller than West's (see 1962/63 input-output tables [4]), its marginal share for services is very much higher than West's.

## References


1. Chakravarty, S. and Louis Lefeber, "An Optimising Planning Model", The Economic Weekly, Annual Number 1965.

2. Eckaus, R.S. and Kirit Parikh, Planning for Growth, M.I.T. Press (Forthcoming).

3. Islam, Nurul, Studies in Consumer Behaviour, Vol.I and II.

4. Khan, Azizur Rahman and Arthur MacEwan, Regional Current Input-Output Tables for the East and West Pakistan Economies 1962/63. Pakistan Institute of Development Economics, Research Report No. 63.

5. _____, "A Multisectoral Analysis of Capital Requirements For Development Planning in Pakistan", The Pakistan Development Review, Winter 1967.

6. Manne, Alan and Tom E. Weisskopf, A Dynamic Multisectoral Programming Model for India, Paper submitted at the 4th International Conference on Input-Output Techniques, Geneva 1968.

7. Pakistan, Central Statistical Office, Quarterly Survey of Current Economic Conditions 1963/64.

8. _____, Statistical Yearbook, 1965 and 1966.

9. Pakistan, Planning Commission, The Third Five-Year Plan.

10. Pakistan Institute of Development Economics, Population Projections For Pakistan, 1960-2000.

Table 1

Sector Classification For Multisectoral Planning

01 Rice Growing and Processing
02 Wheat Growing and Processing
03 Jute Growing and Baling
04 Cotton Growing and Ginning
05 Tea Growing and Processing
06 All other Agriculture, Forestry and Fishery
07 Sugar Refining and Gur Making
08 Edible Oils
09 Cigarettes, Bidi and Other Tobacco Products
10 Other Food and Drink
11 Cotton Textiles
12 Jute Textiles
13 Other Textiles
14 Paper and Printing
15 Leather and Leather Products
16 Rubber and Rubber Products
17 Fertilizer
18 Other Chemicals
19 Cement, Concrete and Bricks
20 Basic Metals
21 Metal Products
22 Machinery
23 Transport Equipment
24 Wood, Cork and Furniture
25 Construction of Residential Houses
26 Construction of Non-Residential Buildings
27 All Other Construction
28 Miscellaneous Manufacture
29 Coal and Petroleum Products
30 Electricity and Gas
31 Transport
32 Trade
33 Ownership of Dwellings
34 Government
35 Services, n.e.s.

Table 2

The Engel Functions: East Pakistan

| Types of functions and Commodity Group | Rural $a_i$ | Rural $b_i$ | Rural $R^2$ | Urban $a_i$ | Urban $b_i$ | Urban $R^2$ |
|---|---|---|---|---|---|---|
| Semilogarithmic functions | | | | | | |
| Rice | - 9.371 | 5.778 | 0.984 | 4.017 | 0.984 | 0.425 |
| Wheat | 1.686 | -0.422 | 0.355 | 0.613 | 0.071 | 0.252 |
| Tea | - 0.581 | 0.288 | 0.694 | -1.216 | 0.445 | 0.970 |
| Sugar | - 0.565 | 0.199 | 0.704 | -1.481 | 0.523 | 0.999 |
| Edible Oils | - 1.180 | 0.578 | 0.983 | -1.338 | 0.635 | 0.977 |
| Cigarettes etc. | - 2.502 | 1.059 | 0.870 | -3.549 | 1.411 | 0.972 |
| All other agri: & All other food: (Other food) | -10.332 | 4.736 | 0.990 | -18.213 | 7.279 | 0.990 |
| All other agri: & All other food: (Baked products) | - 0.999 | -0.356 | 0.800 | -1.940 | 0.658 | 0.967 |
| Double logarithmic functions | | | | | | |
| Textiles: Cotton & Other | - 3.048 | 1.057 | 0.934 | -3.279 | 1.143 | 0.966 |
| Leather Products | -13.364 | 3.409 | 0.920 | -7.370 | 1.665 | 0.908 |
| Metal Products | - 7.087 | 1.584 | 0.748 | -7.846 | 1.760 | 0.928 |
| Fuel & lighting: gas, electricity, coal and Petroleum | 0.470 | 0.005 | 0.000 | -0.688 | 0.430 | 0.876 |
| Transport | -10.464 | 2.797 | 0.947 | -11.843 | 3.213 | 0.791 |
| Housing | - 1.549 | 0.692 | 0.935 | -2.938 | 1.225 | 0.966 |
| Services, n.e.s. (Education & Recreation) | -17.066 | 4.972 | 0.963 | -11.756 | 3.290 | 0.862 |
| (Personal care) | - 3.683 | 0.959 | 0.778 | -4.163 | 1.210 | 0.954 |
| (Medical Exp.) | -6.714 | 1.880 | 0.758 | -5.820 | 1.607 | 0.904 |
| (Domestic help) | -19.768 | 5.745 | 0.977 | -14.823 | 3.802 | 0.918 |

Table 3

The Engel Functions: West Pakistan

| Types of functions & Commodity Groups | | Rural $a_i$ | Rural $b_i$ | Rural $R^2$ | Urban $a_i$ | Urban $b_i$ | Urban $R^2$ |
|---|---|---|---|---|---|---|---|
| **Semi** logarithmic functions | | | | | | | |
| Rice | | -3.368 | 1.287 | 0.724 | - 3.547 | 1.316 | 0.957 |
| Wheat | | 0.832 | 1.609 | 0.779 | - 0.633 | 1.640 | 0.300 |
| Tea | | - 0.683 | 0.288 | 0.910 | - 1.316 | 0.517 | 0.926 |
| Sugar | | - 1.399 | 0.486 | 0.844 | - 3.087 | 1.164 | 0.985 |
| Edible Oils | | 0.219 | 0.002 | 0.000 | - 0.301 | 0.399 | 0.784 |
| Cigarette etc. | | - 0.940 | 0.476 | 0.846 | - 2.997 | 1.135 | 0.812 |
| All other agri. & All other food | Other food | -19.711 | 8.100 | 0.988 | -34.320 | 12.260 | 0.962 |
| | Baked products | - | - | - | - 1.631 | 0.553 | 0.868 |
| Double logarithmic functions | | | | | | | |
| Textiles: Cotton & other | | - 2.291 | 0.921 | 0.967 | - 3.516 | 1.252 | 0.978 |
| Leather product | | - 2.813 | 0.675 | 0.961 | - 3.410 | 0.833 | 0.922 |
| Metal products | | - 6.671 | 1.550 | 0.931 | - 8.304 | 1.828 | 0.956 |
| Fuel & Lighting: | gas, electricity, coal & petroleum | - 0.725 | 0.347 | 0.812 | - 1.001 | 0.502 | 0.951 |
| Transport | | - 6.741 | 1.870 | 0.960 | - 5.726 | 1.569 | 0.936 |
| Housing | | - 4.398 | 1.375 | 0.911 | - 2.862 | 1.148 | 0.944 |
| Services n.e.s. | Education & recreation | -11.888 | 3.003 | 0.838 | - 7.759 | 2.209 | 0.908 |
| | Personal care | - 2.143 | 0.635 | 0.963 | - 2.474 | 0.846 | 0.966 |
| | Medical Exp. | - 5.439 | 1.429 | 0.897 | - 4.501 | 1.232 | 0.796 |
| | Domestic help | -16.619 | 4.164 | 0.946 | -15.376 | 3.755 | 0.931 |

Table 4

Marginal Consumption Proportions During the Fourth Plan:East Pakistan

| | Urban | Rural | Weighted Average |
|---|---|---|---|
| Rice | .025 | .217 | .191 |
| Wheat | .002 | - .016 | - .014 |
| Tea | .011 | .008 | .008 |
| All other Agri: & (Baked) Prod:) All other Food (Other) (Food ) | .200 | .192 | .193 |
| Sugar | .013 | .008 | .009 |
| Edible Oils | .016 | .022 | .021 |
| Cigarettes etc. | .036 | .040 | .039 |
| Textiles (Cotton & Other) | .073 | .060 | .062 |
| Leather & Products | .013 | .016 | .016 |
| Metal Products | .012 | .009 | .009 |
| Coal,Petrol,Electricity and Gas | .024 | - | .003 |
| Transport | .082 | .030 | .037 |
| Housing | .149 | .054 | .067 |
| Services,n.e.s. | .228 | .223 | .224 |
| Residual | .116 | .137 | .135 |

Incremental share of urban expenditure during Fourth Plan = .134

Table 5

Marginal Consumption Proportions During the Fourth Plan:West Pakistan

| | Urban | Rural | Weighted Average |
|---|---|---|---|
| Rice | .033 | .042 | .037 |
| Wheat | .041 | .052 | .046 |
| Tea | .013 | .010 | ,012 |
| All other agri: and Food | .316 | .260 | .289 |
| Sugar | .029 | .016 | .023 |
| Edible Oil | .010 | .000 | .005 |
| Cigarettes etc. | .028 | .015 | .022 |
| Textiles | .095 | .072 | .084 |
| Leather | .015 | .014 | .015 |
| Metal Products | .010 | .013 | .011 |
| Coal,Petrol,Electricity and Gas | .029 | .018 | .024 |
| Transport | .043 | .044 | .043 |
| Housing | .114 | .062 | .089 |
| Services,n.e.s. | .164 | .072 | .120 |
| Residual | .060 | .310 | .180 |

Incremental share of urban expenditure during Fourth Plan = .522

Table 6

Expenditure Elasticities: East Pakistan

| Commodity Group | Rural 1969/70 | Rural 1974/75 | Urban 1969/70 | Urban 1974/75 |
|---|---|---|---|---|
| Rice | 0.625 | 0.581 | 0.130 | 0.128 |
| Wheat | -1.294 | -1.535 | 0.082 | 0.081 |
| Tea | 2.337 | 1.825 | 1.118 | 0.985 |
| Sugar | 2.618 | 1.990 | 1.257 | 1.092 |
| Edible Oils | 0.846 | 0.769 | 0.658 | 0.609 |
| Cigarettes etc. | 1.162 | 1.020 | 0.899 | 0.811 |
| All other agri. & All other food (Other food | 0.960 | 0.861 | 0.889 | 0.803 |
| All other food (Baked Products | 2.405 | 1.864 | 1.472 | 1.251 |
| Textiles: Cotton & Other | 1.057 | | 1.143 | |
| Leather Products | 3.409 | | 1.665 | |
| Metal Products | 1.584 | | 1.760 | |
| Fuel & lighting (gas, electricity, coal, and petroleum) | 0.005 | | 0.430 | |
| Transport | 2.797 | | 3.213 | |
| Housing | 0.692 | | 1.225 | |
| Services, n.e.s. (Education, recreation | 4.972 | | 3.290 | |
| (Personal care | 0.959 | | 1.210 | |
| (Medical Exp. | 1.880 | | 1.607 | |
| (Domestic help | 5.745 | | 3.802 | |