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A Note on the Semi-Input-Output Method

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Introduction

The appraisal of investment projects may well be regarded as the most crucial part of a planning procedure. This paper deals with one of the techniques proposed for the appraisal of investment projects, the semi-input-output method, which in one of the most promising approaches to the problem o appraisal. In order to understand the nature of the problem we should make clear from the outset that the problem can be divided into two separate questions.

The first question is the determination of the criteria for evaluation. This is in principle an exercise in cost-benefit analysis. Cost elements are all scarce factors. In the case of Pakistan this would include capital, foreign exchange and skilled labour. The benefits to be taken into account can be derived from the targets set by the Planning Commission in the formulation of the Third Five Year Plan [4 p. 39].

The second question to be tackled is the determination of the impact of a project. It is here that semi-input-output comes in the picture. The first question is completely separated from the second. Therefore, we can illustrate the technique of the semi-input-output method with whatever criterion we choose. In what follows we will use the capital-coefficient as the criterion to be used. This is done, not because we are of the opinion

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that capital is the only scarce factor and the increase of G.N. P. the only target, but in order to be able to concentrate fully on the technique of the semi-input-output method.

I. The Semi-input-output method [1/]

As stated in the introduction we shall assume that capital is the only scarce factor of production, although this is in disagreement with reality. The only reason for doing so is to facilitate the description of the method. This is permissible in this case since the use of the semi-input-output method is not dependent on the criteria to be applied, as was explained in the introduction. Assuming that capital is the only scarce factor, implies that preference should be given to those industries whose capital-coefficients on the basis of value added are low. However, due to the interdependence of the economy, as shown in input-output-tables, the direct capital-coefficient is not a sufficient basis for the appraisal of investment projects, as we also have to take into account the necessary increases of production in other sectors of the economy.

The crucial question is what part of the indirect effects is inevitable. The main purpose of the semi-input-output method is to find the answer to this crucial point. Many authors, especially those familiar with input-output analysis, assume that an increase of production in one sector necessarily leads to production increases in all other sectors of the economy. Therefore, in their opinion the relevant capital-coefficient is the weighted average capital-coefficient for all sectors, the weights being the increases in value added per sector. This way of reasoning is perfectly acceptable as far as it goes. However, it does not go very far. This system is only acceptable in the case of a closed

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1/ This section draws heavily on Tinbergen's ideas, which can be found in a number of articles and unpublished papers, e.g. [7, 8, 9].

economy. As soon as we allow for imports and exports we have the choice between domestic production and imports.

Since almost all countries take part in international trade it does not make sense to assume that an increase of production in one sector necessitates an increase of production in all other sectors of the economy. In order to find out which production increases are really inevitable we should distinguish between the so-called "national" industries and the so-called "international" industries. National industries are defined as those industries whose products cannot be transported internationally due to physical difficulties. Examples of such industries are construction, inland transport and most of the service industries. The criterion is not water-tight. Electric-energy for instance is for most countries a national industry, but for small countries, like Luxembourg, it may well be an international industry. For all practical cases, however, it is not difficult to distinguish between national and international sectors in a particular country.

An increase of production in one sector does not necessarily involve the increase of production in the other international sectors, as the input requirements of international sectors can be met from imports. "National" products however have, by definition, to be produced domestically. Therefore, the inter-industry deliveries from the national sectors should be taken into account.

In other words, the problem to be solved is to find the additional capacity needed in the "national" industries for a given increase in one of the "international" industries.

As an example let us assume that there are 20 sectors, of which sectors 1-15 are international and 16-20 are national industries. We indicate the increases in production in comparison to some initial situation by v, the increases in final demand by

f and those in national income by y.

The v, f and y carry an index indicating the sector to which they refer. The technical coefficients are shown by $a_{i.j}$. We further assume that inter-industry deliveries satisfy the usual input-output assumptions and that all prices are constant and equal to one.

These assumptions are brought out by the following system of equations:

Input-Output equations

$$v_1 = f_1 + a_{1,1} v_1 + a_{1,2} v_2 + a_{1,3} v_3 + \text{------} + a_{1,20} v_{20}$$
$$v_2 = f_2 + a_{2,1} v_1 + a_{2,2} v_2 + a_{2,3} v_3 + \text{----} + a_{2,20} v_{20}$$

- -

- -

$$v_{20} = f_{20} + a_{20,1} v_1 + a_{20,2} v_2 + a_{20,3} v_3 + \text{- - - - - - - - -} + a_{20,20} v_{20}$$

Income equations

$$y_1 = (1 - a_{1,1} - a_{2,1} - a_{3,1} \text{- - - - - - - - - - - - -} a_{20,1}) v_1$$
$$y_2 = (1 - a_{1,2} - a_{2,2} - a_{3,2} \text{- - - - - - - - - - - - -} a_{20,2}) v_2$$

etc.

Our problem is now: given an increase in production in one of the sectors what must be the total increase in the production of the national industries. As an example we choose

$$v_1 = \overline{v}_1 \; ; \; v_2 = v_3 \text{- - - - - - - - - - - - - - - - - -} = v_{15} = 0$$

meaning that production capacity is added in industry No. 1 only. The unknowns are the five v's of the national industries v_{16} --v_{20}. The necessary increase in production of sector 16 is equal to the deliveries to sector 1 plus the deliveries to all national sectors. The same is true for all other national sectors. In equations:

$$v_{16} = a_{16,1} \overline{v}_1 + a_{16,16} v_{16} + a_{16,17} v_{17} + \text{- - - - - -} + a_{16,20} v_{20}$$

- -

$$v_{20} = a_{20,1} \overline{v}_1 + a_{20,16} + a_{20,17} v_{17} + \text{- - - - - - - -} + a_{20,20} v_{20}$$

As we have five unknowns and five equations we can solve the equations for v_{16} --, v_{20}. For their solution only a portion of the matrix of technical coefficients is needed, which means that the solution is considerably simpler than the solution of the traditional input-output model.

The income equations enable us to find the income created in the national industries. We now can calculate the total capital coefficient:

$$R_t = \frac{r_1 y_1 + r_{16} y_{16} + - - - - - - - - + r_{20} y_{20}}{y_1 + - - - - - + y_{20}}$$

in which

R_t = the total capital coefficient.

r = direct capital coefficient. The indexes refer to sectors.

As an illustration of the semi-input-output method an exercise was made with Pakistani data. It should be stressed that what follows is just an illustration. No conclusions should be drawn from the results as the data concerning input-output relations are not particularly fitted for the application of semi-input-output. Moreover, as not enough data concerning capital coefficients for the Pakistani economy were available the author had to rely partly upon estimates for India.[1/] Therefore, these coefficients may not be relevant to the Pakistani economy.

The input-output table used is a modified version of the table given in [5]. This modified table is reproduced in Table I. Table II gives the matrix of technical coefficients. The direct capital coefficients are given in Table III.

Only sectors 19 and 20 are national industries. Looking at

1/ In an appendix to this paper we shall mention the qualifications which make the input-output table and the capital coefficients suited for the application of the semi-input-output method.

the direct capital coefficients only, section 16, having the lowest capital coefficient, seems most attractive for investment.

However, as explained above, the relevant capital coefficient is the capital coefficient of the "bunch", meaning the increase of production in sector 16 as well as the necessary increases in the sectors 19 and 20.

From Table II we know that in order to increase y_{16} by 100 we have to increase v_{16} by 568.8. We can now determine the necessary increases of production in sector 19 and 20. The relevant equations are:

$$v_{19} = a_{19,16}\,\bar{v}_{16} + a_{19,19}\,v_{19} + a_{19,20}\,v_{20}$$
$$v_{20} = a_{20,16}\,\bar{v}_{16} + a_{20,19}\,v_{19} + a_{20,20}\,v_{20}$$

Substituting 568.8 for $\bar{v}_{16}$ and inserting the values of the a's as given in Table II we get:

$$v_{19} = .00368 \times 568.8 + .07817\,v_{19} + .00080\,v_{20}$$
$$v_{20} = .45629 \times 568.8 + .10441\,v_{19} + .06894\,v_{20}$$

Solving these equations for v_{19} and v_{20} we get:

$$v_{19} = 2.51154$$
$$v_{20} = 277.54200$$

Looking back to Table II we see that

$$y_{19} = .59255\,v_{19} \quad \text{or} \quad y_{19} = 1.48821$$

and that

$$y_{20} = .83371\,v_{20} \quad \text{or} \quad y_{20} = 231.38954$$

Therefore, the total capital coefficient =

$$\frac{y_7\,r_7 + y_{19}\,r_{19} + y_{20}\,r_{20}}{y_2 + y_{19} + y_{20}} =$$

$$\frac{70 + 9.18226 + 925.55816}{100 + 1.48821 + 231.38954} = 3.02.$$

This same exercise is then repeated for all international sectors. The total capital coefficients obtained are given in Table IV.

It will be noted that in most sectors the total coefficients are higher than the direct coefficients. In two sectors, however, they are lower. This illustrates that the total capital coefficient can be either higher or lower than the direct coefficient.

Table V gives the ranking of direct as well as total capital coefficients, which gives a clear picture of the changes in attractiveness of sectors after taking the necessary increases of production in the national sectors into account.

II. The use of semi-input-output for planning purposes

So far, the semi-input-output method has been proposed only for the evaluation of investment projects. The method can in our opinion also be used in the process of drawing up a development plan. An example of this will be given in this section.

As a rule the drawing up of a development plan starts with a simple aggregate model. In its simplest version there is only one target: an increase of national income by a certain amount and only one instrument namely investment. The necessary amount of investment can be found by multiplying the planned increase of national income by the over-all capital coefficient. This necessary volume of investments should be equal to the estimated availability of funds for investment purposes. If this is not the case we have to revise the income target. This stage of planning we call the macro stage.

The next stage in the planning procedure is the sector-stage. It is at this moment that the semi-input-output method comes into the picture. What we have to do is to divide the investment funds in an optimal way over the sectors of the economy.

At this stage the following data should be available:

1. the input-output relations
2. sectoral capital coefficients
3. sectoral income elasticities of consumption
4. for each sector the necessary investment to be produced in national sectors (e.g. construction) per unit of output
5. the maximum volume of production per sector (to be absorbed domestically or abroad)

The planning procedure involved can be illustrated by the following example, using a 20 sector input-output table. Let us assume that the sectors 1-15 are "international" sectors, that the sectors 16-19 are "national" sectors producing both intermediate and consumption goods and that sector 20 is a "national" sector producing investment goods only (construction). Let us further assume that the "international" sectors 14 and 15 produce investment goods only. Defining:

y as the increase in national income

y_i as the increase of income in sector i

v_i as the increase of production volume in sector i

c_i as the increase of consumption of goods produced in sector i

J_i as the amount of capital goods originating from sector i which is necessary to sustain the increase of production

J_i^{-1} as the amount of capital goods originating from sector i in the preceding period

j_i as the increase of supply of capital goods originating in sector i

f_i as the increase of supply for final use of commodity i

e_i as the increase of exports (or decrease of imports) of commodity i

a_{ij} as the technical coefficient

j_{ij} as the coefficient indicating the amount of investment goods originating in sector i necessary to sustain a given increase of production in sector j,

we get the following equations:

A. Input-output equations:

$$v_1 = f_1 + a_{1,1}\, v_1 + a_{1,2}\, v_2 + a_{1,3}\, v_3 + \dots + a_{1,20}\, v_{20}$$

$$v_2 = f_2 + a_{2,1}\, v_1 + a_{2,2}\, v_2 + a_{2,3}\, v_3 + \dots + a_{2,20}\, v_{20}$$

$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

$$v_{20} = f_{20} + a_{20,1}\, v_1 + a_{20,2}\, v_2 + a_{20,3}\, v_3 + \dots + a_{20,20}\, v_{20}$$

B. Income equations

$$y_1 = (1 - a_{1,1} - a_{2,1} - a_{3,1} - \dots - a_{20,1})\, v_1$$

$$y_2 = (1 - a_{1,2} - a_{2,2} - a_{3,2} - \dots - a_{20,2})\, v_2$$

etc.

C. Consumption equations

$$c_1 = \alpha_1 + \beta_1$$

$$c_2 = \alpha_2 + \beta_2$$

etc.

D. Investment equations

$$J_{14} = j_{14,1}\, v_1 + j_{14,2}\, v_2 + \dots + j_{14,20}\, v_{20}$$

$$J_{15} = j_{15,1}\, v_1 + j_{15,2}\, v_2 + \dots + j_{15,20}\, v_{20}$$

$$J_{20} = j_{20,1}\, v_1 + j_{20,2}\, v_2 + \dots + j_{20,20}\, v_{20}$$

$$j_{14} = J_{14} - J_{14}^{-1}$$

$$j_{15} = J_{15} - J_{15}^{-1}$$

$$j_{20} = J_{20} - J_{20}^{-1}$$

E. Definitial equations

$$f_1 = c_1 + e_1$$

$$f_2 = c_2 + e_2$$

$$f_{13} = c_{13} + e_{13}$$

$$f_{14} = j_{14} + e_{14}$$

$$f_{15} = j_{15} + e_{15}$$

$$v_{16} = c_{16} + j \sum_{1}^{20} a_{16_j} v_j$$

$$v_{19} = c_{19} + j \sum_{1}^{20} a_{19_j} v_j$$

$$v_{20} = j_{20}$$

F. Boundary conditions

$$v_1 \leqslant f_1 + j \sum_{1}^{20} a_{1,j} v_j$$

$$v_{13} \leqslant f_{13} + j \sum_{1}^{20} a_{13,j} v_j$$

$$v_{14} \leqslant f_{14}$$

$$v_{15} \leqslant f_{15}$$

y and e_1 to e_{15} are detetermined outside the model.

With these equations and boundary conditions we can now obtain the optimal development plan.

First we look at the national sectors 16 to 19. The increases of consumption of the products of these sectors have to be produced domestically.

In equations:

I

$$v_{16} = c_{16}\, y + a_{16,16}\, v_{16} + a_{16,17}\, v_{17} + a_{16,18}\, v_{18} + a_{16,19}\, v_{19}$$

$$v_{17} = c_{17}\, y + a_{17,16}\, v_{16} + a_{17,17}\, v_{17} + a_{17,18}\, v_{18} + a_{17,19}\, v_{19}$$

$$v_{18} = c_{18}\, y + a_{18,16}\, v_{16} + a_{18,17}\, v_{17} + a_{18,18}\, v_{18} + a_{18,19}\, v_{19}$$

$$v_{19} = c_{19}\, y + a_{19,16}\, v_{16} + a_{19,17}\, v_{17} + a_{19,18}\, v_{18} + a_{19,19}\, v_{19}$$

As we have 4 equations with 4 unknowns we can solve for $v_{16}, \text{------} v_{19}$. With the aid of equations B we can find the income created in sectors 16,----19. Multiplying these income increases with the capital coefficients we get the total investments necessary to realize c_{16} up to c_{19}. The national sector 20 need not be taken into consideration at this stage. This sector only produces investment goods. Therefore, it is not at all certain that its capacity should be increased. This we only can find out at a later stage. Once we know that this sector should increase its capacity we,of course, should take this into account as well.

The next step is to increase the production of that international sector which has the highest rank (or the lowest total capital coefficient). Let this be sector 7. We know that the maximum value of $v_7 = f_7 + j \sum_1^{20} a_{7,j}\, v_j$. The f_7 does not cause difficulties as its value is determined by equations E. The interindustry deliveries however, are more difficult to deal with. As we do not know as yet by how much production will be increased in sectors j we cannot determine the value of $j \sum_1^{20} a_{7,j}\, v_j$. Therefore, we have to determine this value in several steps.

The production increases of national sectors as determined in the first step require inputs from sector 7. As the v's of the first step are known we can calculate how much input from sector 7 is required for that. Let us call this p_7. We further know that in order to produce v_7 additional production is needed in the national sectors. Therefore, in order to get the provisional maximum of v_7 we also have to include the deliveries of commodity 7 necessary to increase the production volume of the national sectors.

In equations:

II

$$v_7 = f_7 + p_7 + a_{7,7}\, v_7 + a_{7,16}\, v_{16} + a_{7,17}\, v_{17} + a_{7,18}\, v_{18} + a_{7,19}\, v_{19}$$

$$v_{16} = a_{16,7}\, v_7 + a_{16,16}\, v_{16} + a_{16,17}\, v_{17} + a_{16,18}\, v_{18} + a_{16,19}\, v_{19}$$

- -

$$v_{19} = a_{19,7}\, v_7 + a_{19,16}\, v_{16} + a_{19,17}\, v_{17} + a_{19,18}\, v_{18} + a_{19,19}\, v_{19}$$

We now have five equations with five unknowns. In the same way as in step I we can determine the income created and investment needed.

The third step is to increase the production of the sector with rank 2 to the maximum. Let this be section 1. The procedure is essentially the same as in step II. There are, however, 2 differences.

1. We have to allow for the interindustry demand for products of sector 1 in step I as well as in step II.

2. In this third step additional demand for the products of sector 7 will be created. As sector 7 has a higher rank than sector 1 we should include this increased demand in the solution of the third step.

In equations:

III

$$v_1 = f_1 + p_1 + a_{1,1}\, v_1 + a_{1,16}\, v_{16} + a_{1,17}\, v_{17} + a_{1,18}\, v_{18} + a_{1,19}\, v_{19} + a_{1,7}\, v_7$$

$$v_{16} = a_{16,1}\, v_1 + a_{16,16}\, v_{16} + a_{16,17}\, v_{17} + a_{16,18}\, v_{18} + a_{16,19}\, v_{19} + a_{1,7}\, v_7$$

- -

$$v_{19} = a_{19,1}\, v_1 + a_{19,16}\, v_{16} + a_{19,17}\, v_{17} + a_{19,18}\, v_{18} + a_{19,19} v_{19} + a_{19,7}\, v_7$$

$$v_7 = a_{7,1}\, v_1 + a_{7,7}\, v_7 + a_{7,16}\, v_{16} + a_{7,17} + a_{7,18}\, v_{18} + a_{7,19}\, v_{19}$$

The y's and the investments are found in the same way as before.

In successive steps the same procedure is carried out, until the target is reached and/or the available volume of investment is used up. If the income target is reached before the investment restriction is reached, our target should be increased.

If the investment restriction is reached first, our target was too high. In both cases the targets should be revised and the exercise should be repeated until the target and the investment restriction are reached simultaneously.

By adding up the v's created in the successive steps we find the total increases of production per sector. Subtracting from the f's and c's we get the increases in export per sector (of course, this may be negative).

III. Semi-input-output and the Balance of Payments

The semi-input-output method states explicitly that a production increase in one sector need not lead to an increase of production in the other international sectors, as the required inputs from these sectors for the expansion of production can be imported. Now, if these inputs are really imported, would this not lead to a foreign exchange deficit? The answer to this in the author's opinion is no, a project is neutral as far as the balance of payments is concerned. As an example let us assume that we want to increase the gross production of sector 3 from Table I by Rs.1000. In order to make this increase possible we, at any rate, have to increase the production volume of the sectors 19 and 20. Applying semi-input-output we obtain the necessary increases of v_{19} and v_{20}:

$$v_{19} = .00260 \times 1000 + .07817\, v_{19} + .00080\, v_{20}$$

$$v_{20} = .26615 \times 1000 + .10441\, v_{19} + .06394\, v_{20}$$

Solving for v_{19} and v_{20} we get:

$v_{19} = 3.06753$

$v_{20} = 284.67046$

The import requirements are:

for sector 3 : $\sum_{1}^{18} j\ a_{j,3}\ v_3 - a_{3,3}\ v_3 = 454.99$

for sector 19: $\sum_{1}^{19} j\ a_{j,19}\ v_{19} - a_{3,19}\ v_{19} = .62$

for sector 20: $\sum_{1}^{18} j\ a_{j,20}\ v_{20} - a_{3,20}\ v_{20} = 21.52$

Adding these we get as total import requirements 477.13. The total availability of products of sector 3 for final demand increases with

$$1000 - \left[a_{3,3}\ v_3 + a_{3,19}\ v_{19} + a_{3,20}\ v_{20}\right] = 966.60$$

Calculating the increases in value added in the sectors 3, 19 and 20 we find

$y_3 = 161.87;\ y_{19} = 1.82;\ y_{20} = 237.33$

or a total increase in national income of 401.02.

Therefore as long as the increase of national expenditure does not exceed the increase of national income the increase of domestic final demand cannot be more than 401.02. This means that a market has to be found for at least 565.58 [1/] worth of comodity 3. This means that this amount has to be exported, or what has the same effect, should be used for import substitution.

Therefore, as long as the necessary additional export or import substitution can be realized, the project has no influence on the balance of payments. The crucial question is, of course,

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1/ If table I were based on factor costs instead of on purchaser prices the total import requirements plus the total increase of national income would be equal to the increased availability of products for final demand. In our example the total availability is greater than the sum of import requirements and additional income. This difference is due to the existence of indirect taxes.

whether this export or import substitution is feasible. This does not create a problem in our analysis as the value of e in our model gives us the upper limit of export (or import substitution) possibilities.

The fact that in our system projects have no balance of payments effect implies, of course, that an existing balance of payments deficit cannot be remedied by our system. As many developing countries have a severe balance of payments problem this might at first sight be considered a disadvantage of the semi-input-output method. It should be realized, however, that the basic reason for a balance of payments deficit lies in the inequality of investment and savings, or, to put it in other words, in the inequality of national expenditure and national income. In fact, ex post the trade gap is equal to the savings gap [10]. Therefore, the correct way to tackle the balance of payments problem is by influencing savings and investment 4/.

4/ This should not be misunderstood. The author does not want to say that the investments should be lowered. In fact, he believes that a balance of payments deficit is unavoidable in the years of "take off", and should be met with foreign assistance.

Table

MODIFIED INPUT OUTPUT TABLE , 1963/64

(Rs. Million)

		01	02	03	04
01	Agriculture, Forestry, fishery	1,335.76	.99	1,143.77	253.48
02	Mining and quarrying	.45	-	14.32	12.94
03	Food, beverages, tobacco	108.42	-	116.85	7.30
04	Textiles, clothing, footwear	4.32	-	14.92	231.62
05	Wood, cork, furniture	-	-	9.84	-
06	Pulp, papers, printing	-	-	37.04	21.17
07	Leather and leather goods	-	-	-	14.35
08	Rubber & rubber manufactures	-	-	-	8.77
09	Chemicals	175.40	1.40	14.93	43.83
10	Coal and petroleum derivatives	35.00	-	17.23	36.56
11	Non-metallic mineral products	-	-	6.44	-
12	Basic metal industries	-	-	4.54	13.48
13	Metal goods	-	-	24.47	.09
14	Non-electrical machinery	20.80	1.06	3.01	22.33
15	Electrical goods	-	-	-	-
16	Transport equipment	-	-	-	-
17	Miscellaneous industries	-	-	328.60	573.99
18	Small scale industries	62.70	1		
19	Electricity	40.00	3.14	9.24	45.69
20	All other services	948.73	22.40	947.13	608.51
I	Total inter-industry demand (domestic)	2,731.58	28.99	2,692.33	1,894.11
II	Indirect taxes on Imports	1.52	.51	55.38	29.09
III	Indirect taxes minus subsidies	23.00	-	234.85	258.40
IV	Gross value added	20,298.00	165.00	576.04	905.65
V	Gross value of products	23,054.10	194.50	3,558.60	3,087.25

	05	06	07	08
01	3.99	15.49	42.20	12.26
02	.03	5.28	.41	.36
03	-	.51	1.98	-
04	-	.24	.09	.50
05	.18	4.46	-	-
06	.12	55.97	.25	-
07	-	-	.22	-
08	-	-	-	.26
09	.38	16.38	7.95	3.03
10	.04	12.77	.65	.43
11	-	-	-	-
12	.46	.58	-	-
13	.74	-	-	2.52
14	-	2.99	-	-
15	-	-	-	-
16	-	-	-	-
17	-	-	-	-
18				.7
19	.16	1.90	.23	1.17
20	41.55	116.51	40.99	27.58
I	47.65	233.08	94.97	48.11
II	.76	11.61	2.28	1.65
III	1.56	19.10	.32	3.26
IV	13.15	132.15	19.19	22.68
V	63.12	395.94	116.76	75.70

	09	10	11	12	13	14
01	53.19	-	.43	.40	1.06	.25
02	20.39	81.05	38.53	1.64	1.79	.65
03	38.69	-	.03	-	.10	-
04	8.00	-	18.86	-	-	-
05	3.13	-	.85	1.16	3.18	.47
06	11.05	-	-	-	-	-
07	-	-	-	-	-	.43
08	-	-	-	-	-	-
09	38.49	4.36	2.93	2.41	3.98	..71
10	14.02	7.92	5.63	8.21	3.35	2.40
11	14.79	-	8.78	.57	1.25	-
12	13.03	2.21	5.28	181.51	116.84	55.86
13	-	-	-	10.29	6.90	.94
14	-	-	.66	1.30	-	12.73
15	-	-	-	-	-	.04
16	-	-	-	-	-	-
17	-	-	-	-		
18	-	-	-	-	-	-
19	24.37	4.01	6.26	5.83	1.09	1.12
20	188.55	124.86	52.31	120.33	228.63	57.35
	427.70	224.41	140.55	333.65	368.17	132.95
	14.74	14.64	2.98	16.35	6.94	7.84
	22.44	240.00	51.65	4.80	8.29	-
	234.00	108.82	159.20	178.55	145.44	82.22
	698.88	587.87	354.38	533.35	528.84	223.01

	15	16	17	18	19	20
01	.07	3.03	1,670.79	9,370.00	-	32.00
02	.19	1.70	8.79	5.72	59.51	63.63
03	-	-	0.13	82.90	-	25.53
04	.36	-	9.35	30.75	-	1.64
05	1.78	.34	2.99	.04	-	62.25
06	-	-	1.00	-	-	59.12
07	-	-	-	-	-	-
08	-	3.91	.64	19.41	-	22.63
09	2.62	1.56	30.20	55.00	.12	137.30
10	.94	11.75	10.31	22.51	17.42	81.32
11	1.81	-	.11	.98	-	411.16
12	30.73	28.25	12.85	13.35	-	208.22
13	-	60.50	.49	13.54	1.77	276.41
14	4.04	24.48	4.35	3.45	.55	38.77
15	26.92	6.31	-	-	2.01	67.49
16	-	242.12	-	-	-	27.74
17			35.52	303.62	-	.03
18	-	-		837.74		303.02
19	1.24	4.58	5.50	25.00	31.58	15.64
20	35.30	567.67	364.55	1,013.86	42.18	1,264.37
	106.00	956.20	2,157.57	11,797.87	155.14	3,098.27
	14.02	67.22	10.88	79.66	9.46	168.93
	15.13	1.97	11.33	- 60.00	-	- 15.00
	95.74	218.72	206.22	1,580.46	239.38	16,305.69
	230.89	1,244.11	2,386.00	13,397.99	403.98	19,557.89

	Total Intermediate Sales I	Consumption II	Investment III	Exports	Total Final Demand II&III&IV A
01	13,939.16	9,467.37	-	317.43	9,784.80
02	317.38	-	-	5.94	5.94
03	382.44	3,403.40	-	27.00	3,430.40
04	320.65	2,186.43	-	629.26	2,815.69
05	90.67	20.84	8.83	.25	29.92
06	185.72	270.66	-	3.50	274.16
07	15.00	76.52	-	27.00	103.52
08	55.62	69.48	10.00	1.39	80.87
09	542.98	508.56	-	34.34	542.90
10	288.46	513.64	-	4.80	518.44
11	445.89	33.54	-	1.68	35.22
12	687.19	45.47	409.18	.20	454.85
13	398.66	257.17	55.99	7.32	320.48
14	140.52	24.81	877.80	8.80	911.41
15	102.77	104.48	237.89	4.65	347.79
16	269.86	607.52	795.99	4.94	1,408.45
17	1,241.76	152.28	4.87	1,018.80	1,175.95
18	1,203.46	12,173.48	-	23.54	12,197.02
19	227.75	176.23	-	-	176.23
20	6,813.36	8,590.19	4,425.20	460.06	13,475.45
	27,669.30	38,682.07	6,825.75	2,580.90	48,088.72
	516.46	370.00	204.25	-	574.25
	821.10	-	-	94.00	94.00
	41,686.30	-	-	-	-
	70,693.16	39,052.07	7,030.00	2,674.90	48,756.97

TABLE I

	Total Requirements II + A	Imports	Gross value and sales
01	23,723.96	669.86	23,054.10
02	323.32	128.82	194.50
03	3,812.84	254.24	3,558.60
04	3,136.34	49.09	3,087.25
05	120.59	57.47	63.12
06	459.88	63.94	395.94
07	118.52	1.76	116.76
08	136.49	60.79	75.70
09	1,085.88	387.00	698.88
10	806.90	219.03	587.87
11	481.11	126.73	354.38
12	1,142.04	608.69	533.35
13	719.14	190.30	528.84
14	1,051.93	828.92	223.01
15	449.79	218.90	230.89
16	1,678.31	434.20	1,244.11
17	2,417.71	31.71	2,386.00
18	13,400.48	2.49	13,397.99
19	403.98	-	403.98
20	20,288.81	730.92	19,557.89
	75,758.02	5,064.86	70,693.16
	1,090.71	-	1,090.71
	915.10	-	915.71
	41,686.30	-	41,686.30
	1,19,450.13	-	1,19,450.13

Sources: [5, Appendix A]

TABLE II

MATRIX OF TECHNICAL COEFFICIENTS

01	Agriculture, forestry, fishery
02	Mining and quarrying
03	Food, beverages, tobacco
04	Textile, clothing, footwear
05	Wood, cork, furniture
06	Pulp, papers, printing
07	Leather and leather goods
08	Rubber and rubber goods
09	Chemicals
10	Coal and petroleum derivatives
11	Non-metallic mineral products
12	Basic metals
13	Metal goods
14	Non-electrical machinery
15	Electrical goods
16	Transport equipment
17	Miscellaneous
18	Small scale industries
19	Electricity, gas, water
20	All other services
	Total inter-industry
	Indirect taxes on import
	Indirect taxes minus subsidies
	Gross value added
	Gross value of products

TABLE II

MATRIX OF TECHNICAL COEFFICIENTS

	01	02	03	04	05	06
01	5,794	.509	32.141	8.208	6.321	3.912
02	.002	-	.402	.418	.048	1.334
03	.470	-	3.284	.236	-	.129
04	.019	-	.419	7.502	-	.061
05	-	-	.276	-	.285	1.126
06	-	-	1.041	.683	.190	14.136
07	-	-	-	.463	-	-
08	-	-	-	.282	-	-
09	.756	.720	.420	1.419	.602	4.137
10	.152	-	.484	1.182	.063	3.225
11	-	-	.181	-	-	-
12	-	-	.128	.434	.729	.146
13	-	-	.688	-	1.172	-
14	.090	.545	.085	.722	-	.755
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	9.234	18.590	-	-
18	.272	-	-	-	-	-
19	.174	1.614	.260	1.477	.253	.480
20	4.115	11.517	26.615	19.710	65.827	29.426
	11.844	14.905	75.658	61.326	75.490	58.867
	.007	.262	1.556	.939	1.204	2.932
	.100	-	6.600	8.370	2.471	4.824
	88.045	84.833	16.187	29.334	20.833	33.376
	100.000	100.000	100.000	100.000	100.000	100.000

TABLE II (Contd)

	07	08	09	10	11	12	13
01	36.143	16.195	7.611	-	.121	.075	.200
02	.351	.476	2.918	13.787	10.873	.307	.338
03	1.696	-	5.536	-	.008	-	.019
04	.077	.661	1.145	-	5.322	-	-
05	-	-	.448	-	.240	.217	.601
06	.214	-	1.581	-	-	-	-
07	.188	-	-	-	-	-	-
08	-	.343	-	-	-	-	-
09	6.809	4.003	5.507	.742	.827	.452	.753
10	.557	.568	2.006	1.347	1.589	1.539	.633
11	-	-	2.116	-	2.478	.107	.236
12	-	-	1.864	.376	1.490	34.032	22.094
13	-	3.329	-	-	-	1.929	1.305
14	-	-	-	-	1.860	.244	-
15	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-
19	.197	1.546	3.487	.682	1.766	1.093	.206
20	35.106	36.433	26.979	21.239	14.761	22.561	43.232
	81.338	63.554	61.198	38.173	39.661	62.556	69.617
	1.953	2.180	2.109	2.490	.841	3.066	1.312
	.274	4.306	3.211	40.825	14.575	.900	1.568
	16.435	29.960	33.482	18.511	44.924	33.477	27.502
	100.000	100.000	100.000	100.000	100.000	100.000	100.000

Table II (Contd)

	14	15	16	17	18	19	20
01	.112	.030	.244	70.025	69.936	-	.164
02	.291	.082	.137	.368	.043	14.731	.325
03	-	-	-	.005	.619	-	.131
04	-	.156	-	.392	.230	-	.008
05	.211	.771	.027	.125	-	-	.318
06	-	-	-	.042	-	-	.302
07	.193	-	-	-	-	-	-
08	-	-	.314	.027	.145	-	.116
09	.318	1.135	.125	1.266	.411	.030	.686
10	1.076	.407	.944	.432	.168	4.312	.416
11	-	.784	-	.005	.007	-	2.102
12	25.048	13.309	2.271	.539	.100	-	1.024
13	.422	-	4.863	.021	.101	.438	1.413
14	5.708	1.750	1.968	.182	.026	.135	.198
15	.018	11.659	.507	-	-	.498	.345
16	-	-	19.461	-	-	-	.142
17	-	-	-	1.489	2.266	-	-
18	-	-	-	-	6.253	-	-
19	.502	.537	.368	.231	.186	7.317	.080
20	25.716	15.289	45.629	15.279	7.567	10.441	6.394
	59.615	45.909	76.858	90.428	88.058	38.403	14.164
	3.516	6.072	5.403	.456	.595	2.342	.864
	-	6.553	.158	.475	- .448	-	.077
	36.868	41.466	17.580	8.643	11.796	59.255	83.371
	100.000	100.000	100.000	100.000	100.000	100.000	100.000

TABLE III

Direct capital coefficients used in the example

01	Agriculture, forestry, fishing	1.75	1)
02	Mining, quarrying	1.57	3)
03	Food, beverage, tobacco industry	1.85	4)
04	Textiles, clothing, footwear industry	2.11	4)
05	Wood and cork, furniture industry	1.31	4)
06	Pulp and paper, printing and publishing	1.00	5)
07	Leather and leather manufactures	1.40	4)
08	Rubber and rubber manufactures	1.37	4)
09	Chemical industries	2.42	4)
10	Coal and petroleum derivatives	2.13	4)
11	Non metallic mineral products	1.29	4)
12	Basic metal industries	5.71	4)
13	Metal goods industries	7.50	4)
14	Non electrical machinery	2.65	4)
15	Electrical goods manufacturing	1.80	4)
16	Transport equipment	.70	2)
17	Miscellaneous industries	2.30	1)
18	Small scale industries	.84	3)
19	Electricity, gas water	6.17	2)
20	All other services	4.00	2)

Sources: 1) [1]

2) [6]

3) [3]

4) [2] This study gives capital coefficients per unit of output. For our purpose we transformed these in capital coefficients per unit of value added.

5) Our estimate.

TABLE IV

Total Capital Coefficients

01	Agriculture, forestry, fishing	1.85
02	Mining, quarrying	1.88
03	Food, beverage, tobacco industry	3.14
04	Textiles, clothing, footwear industry	4.11
05	Wood and cork, furniture industry	3.30
06	Pulp and paper, printing and publishing	2.34
07	Leather and leather manufactures	3.11
08	Rubber and rubber manufactures	2.80
09	Chemical industries	3.19
10	Coal and petroleum derivatives	6.08
11	Non-metallic mineral products	1.99
12	Basic metal industries	5.08
13	Metal goods industries	5.46
14	Non-electrical machinery	3.18
15	Electrical goods manufacturing	2.66
16	Transport equipment	3.02
17	Miscellaneous industries	3.36
18	Small scale industries	2.02

TABLE V

Ranking of Capital Coefficients

16	Transport equipment	1	8
18	Small scale industries	2	4
06	Pulp and paper, printing and publ.	3	5
11	Non-metallic mineral products	4	3
05	Wood and cork, furniture industries	5	13
08	Rubber and rubber manufactures	6	7
07	Leather and leather manufactures	7	9
02	Mining, quarrying	8	2
01	Agriculture	9	1
15	Electrical goods manufacturing	10	6
03	Food, beverages, tobacco industry	11	10
04	Textiles, clothing, footwear industry	12	15
10	Coal and petroleum derivatives	13	18
17	Miscellaneous industries	14	14
09	Chemical industries	15	12
14	Non-electrical machinery	16	11
12	Basic metal industries	17	16
13	Metal goods industries	18	17

Appendix

Qualifications which make the input-output table suited for the application of semi-input-output.

1. The input-output table should be on the basis of factor cost, rather than on the basis of purchaser prices.
2. The sectors should be homogenous.
3. Import should be treated as competitive.
4. The table should be based on international prices, except in those cases where there is clear evidence that the world market prices do not reflect equilibrium prices.
5. The technical coefficients should be the marginal rather than the average coefficients.

Necessary qualifications of capital coefficients.

1. We need incremental capital coefficients on the basis of value added.
2. The capital coefficients should be relatively stable.
3. The capital coefficients should take into account the shadow price for foreign exchange. This means that the capital coefficients to be used is the one defined on page 10.

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