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SOME EXERCISES WITH THE NATIONAL ECONOMIC COUNCIL INPUT-OUTPUT TABLES

by

Gonzalo M. Jurado and José Encarnación, Jr.

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1. Introduction

The 1961 and 1965 input-output tables of the Philippine economy which are now available provide data on which some standard techniques of input-output analysis can be applied, e.g., to check the consistency of development targets, to describe structural change, to make predictions of the values of some economic variables, etc.[2/] At the same time, in yielding the bases for such analysis, the data permit the evaluation of the usefulness of the techniques employed, not to mention the evaluation of the reliability of the input-output tables themselves.

In this paper we employ the projection and RAS methods to analyze structural change in the Philippine economy between 1961 and 1965. We also attempt to estimate the input coefficients of the Philippine economy for 1969 and judge the dependability of the 1961 and 1965 input-output tables. Some knowledge about structural

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2/There are many excellent references on the various techniques of input-output analysis. For instance, see [1], [2], [11], and [12].

change in the Philippine economy in the past is obviously useful in that it can be used as a guide in the formulation of development strategy for the future. Also, findings on the reliability of data could lead to an improvement in the collection and classification of empirical facts.

2. The Data

The bases for the exercises which we want to carry out are the 1961 and 1965 input-output tables constructed by the National Economic Council[3] and the 1969 national income accounts. Here we note a few of the features of these data, reserving for a later section our observations about their general quality.

The 1961 and 1965 input-output tables have dimensions 50x50 and 51x51, respectively. They are expressed in current producers' prices; that is to say, each entry q_{ij} in the transactions table is a value entry equal to $p_i q'_{ij}$ where p_i is the current price of the output of industry i and q'_{ij} is the quantity of current output of industry i delivered to industry j.

$q_{ij} = p_i q'_{ij}$

[3] The compilation of input-output tables for the Philippine economy is done separately by the National Economic Council and the Bureau of Census and Statistics. Whatever are the implications of this duplication of effort, we have two versions each of the 1961 and the 1965 input-output relationships in the Philippine economy. Our decision to use NEC's rather than BCS's tables was dictated solely by the fact that NEC's tables may be more comparable with the other data which we would be using in this paper for projection purposes, namely, the national income accounts.

In each table the intermediate demand quadrant includes not just producing industries but also an "Unallocated Sector." The unallocated row serves as a supplier of all inputs whose exact sources could not be identified while the unallocated column serves as an absorber of all deliveries that could not be traced to specific end-users.

The final demand quadrant contains six sectors, namely, Private Consumption Expenditures, Government Consumption Expenditures, Gross Fixed Capital Formation, Change in Inventories, Exports, and (Less) Imports. As it is, all imports are classified as competitive and therefore do not enter the production system itself. This classification of course forecloses the possibility of measuring the extent of "import dependence" of various industries. We will discuss this point further below.

In the primary input quadrant, five sectors are reported: Wages and Salaries, Depreciation Allowances, Other Value Added, Indirect Taxes less Subsidies, and Statistical Discrepancy. Looking at the primary input coefficient matrix, we find that the coefficients of Wages and Salaries (except in Services) seem to be unusually low. So are those of Depreciation Allowances. In contrast the coefficients of Other Value Added seem to be rather large. One explanation for these rather unexpected magnitudes would perhaps lie in the manner the data are classified. In respect to labor, for instance, the basic data on wages and salaries were estimated directly from the production cost data of various industries, apparently not counting some minor industries not keeping such production cost data. At the same time, the depreciation allowance is reckoned strictly against the book value of the capital stock whereas other value added includes all operating profits, i.e., profits, interests, rental income and other residual elements. Finally, there is the row for Statistical Discrepancy. This row functions as an accounting balancing item.

To make the data suitable to the techniques which we wished to employ, we collapsed the transactions tables to smaller 7x7 tables in accordance with the NEC classification code, and eliminated the "Unallocated Sector" by prorating the unallocated row to all other rows and the unallocated column to all other columns except Government Consumption Expenditures (since the data for this sector would seem to be firmer than those for the other sectors). The resulting seven sectors are (1) Agriculture, Fishing and Forestry, (2) Mining, (3) Manufacturing, (4) Construction, (5) Transportation, Communication, Warehousing and Storage, and Utilities, (6) Commerce and (7) Services.

The next step was to express the two smaller tables in the same 1965 prices in order to make them comparable. Since each entry in the 1961 transactions table is $q_{ij}^{61} = p_i^{61} q'^{61}_{ij}$,

$(q_{ij}^{61} = p_i^{61} q_{ij}^{'61}) \, p_i^{65}/p_i^{61}$

$q_{ij}^{61} = p_i^{65} q_{ij}^{'61}$

q_{ij}

multiplying q_{ij}^{61} by a price inflator $p_i' = p_i^{65}/p_i^{61}$ $(i = 1....7)$ gives $p_i'q_{ij}^{61} = p_i^{65}q'_{ij}{}^{61}$. Applying the same procedure to the primary input table, multiplying the value of primary resource f used in industry j, q_{fj}^{61}, by a price inflator $p_f' = p_f^{65}/p_f^{61}$ $(f = 8....11)$ gives $p_f'q_{fj}^{61} = p_f^{65}q'_{fj}{}^{61}$. These inflators are reported in Appendix Table 1.

These price adjustments resulted in inequalities between column totals and row totals (i.e., between total inputs and total outputs) which were eliminated by making further adjustments in the column for Private Consumption Expenditures, adding to or subtracting from it depending on whether or not total outputs were less than or were greater than total inputs. This procedure automatically eliminated the "Statistical Discrepancy."

The resulting A and $(I-A)^{-1}$ matrices for each of the two tables are shown in Appendix Tables 2 to 4 and 6 to 8. In addition to the inter-industry tables, we also use national income accounts data showing Net Domestic Product in 1969 for each of the seven sectors. While these are not exactly the needed data, they provide the basis for computing such figures. The computation procedure will be discussed below.

3. The Projection Method

Here we employ the method of forward and backward projections to analyze structural change [12]. Let the vector q stand for total output, the matrix A for the square matrix of input coefficients, and the vector y for final demand or national income. Then the distribution of total output to intermediate and final demand may be described in the form

$$(1) \quad q = Aq + y$$

and the general solution can be stated as

$$(2) \quad q = (I-A)^{-1}y \equiv By$$

where B is the Leontief inverse. The general solution gives the total output q necessary to sustain a given level of final demand y.

From two input-output tables of two different years expressed in constant prices, one for a base year $t = 0$ and another for a previous year $t = -T$, we can carry out forward and backward projections. For a forward projection from $t = -T$ to $t = 0$, premultiply the vector of actual final demand for $t = 0$ with the inverse at $t = -T$, to arrive at an estimate of the corresponding total output, viz:

$$(3) \quad q^*(0) = B(-T)\ y(0)$$

where the asterisk (*) indicates an estimate. Then compare the estimated with the corresponding actual data for each industry:

(4) $\quad q^*_j(0) - q_j(0) \;=\; w_j(0)$

where $w_j(0)$ is the forward projection error for industry j.

For a backward projection from $t = 0$ to $t = -T$, the procedure is to compute

(5) $\quad q^*(-T) \;=\; B(0)\; y(-T)$

(6) $\quad q^*_j(-T) \;-\; q_j(-T) \;=\; w_j(-T)$

where $w_j(-T)$ is the backward projection error for industry j.

Normally we would expect non-zero projection errors for each of the two projections. These errors can be described as falling under four cases.

	Forward projection error	Backward projection error
Case I	-	+
Case II	+	-
Case III	-	-
Case IV	+	+

To interpret these errors it is necessary to examine their sources. Looking back at equation (3) we find that projection errors can arise only from two sources: from a change in the input-output relations and from a change in the pattern of final demand. More specifically,

(7) $\Delta(B) = B(0) - B(-T)$

(8) $w(0) = -\Delta B\ y(0)$

(9) $w(-T) = \Delta B\ y(-T)$

Given these sources of errors, the projection errors summarized in the four cases can be interpreted. Case I suggests that one growing industry became more interdependent with another growing industry, an indication of a mutually re-inforcing expansion of the two industries during the period. Case II implies that the industry is losing its interdependence with the rest of the economy, suffering a reduction in its sales to customers. Case III indicates that a growing industry is selling more to industries facing expanded markets for their products, and less to industries facing decreased demand for their products, a phenomenon even more desirable from a development viewpoint than that of Case I. Finally Case IV suggests that sales from this industry increased to end-users whose own products faced contracted markets and decreased to end-users whose own products confronted expanded markets. This last case implies bottlenecks and inconsistencies in the development of this industry and creates a situation even more undesirable than that of Case II from a development point of view.

Obviously a development program would prefer to have Cases I and III, which represent a successful and dynamic exploitation of inter-industry linkages. The appearance of Cases II and IV, on the other hand, would suggest a need to review development strategy with respect to the industries involved.

It is apparent that these cases of projection errors are more or less comparable with the concepts of forward linkage and backward linkage in standard input-output analysis. An industry i's forward linkage, it may be recalled, is simply its sales to other industries as a percentage of its total sales or, more precisely, $\Sigma_j q_{ij}/q_i$; whereas an industry j's backward linkage is simply its intermediate input purchases as a proportion of its total input purchases or, more exactly, $\Sigma_i q_{ij}/q_j$. Thus, Case I of projection errors suggests that the industry's forward linkage increased and/or the backward linkage of other industries with it increased. Conversely, Case II indicates that the industry's forward linkage decreased and/or the backward linkage of other industries with it decreased. Case III is nothing but a more dynamic version of Case I and Case IV is nothing but an even more undesirable version of Case II.

It is also clear that while in some instances a simple examination of an industry's forward linkage may be enough to confirm projection errors, in most cases a simultaneous scrutiny of other industries' backward linkage with it may be necessary. This is because while the forward linkage of an industry may have changed in a way as to deny projection errors, its linkage with particular growing or declining industries may have changed in the way implied by such projection errors.

Applying the projection techniques to the two tables yields results which are summarized in Table 1. Forward linkages computed separately, are also reported in the table to facilitate comparison.

Table 1. Projection errors

	Forward Projection[a]				Backward Projection				
	q*(1965)	q(1965)	w(1965)		q*(1961)	q(1961)	w(1961)		Change in forward linkage
	(1)	(2)	(3)	(4)=(3)/(2)	(5)	(6)	(7)	(8)=(7)/(6)	
1. Agriculture, etc.	6,629	6,885	-256	-3.71	6,115	6,047	68	1.12	1.239
2. Mining	458	407	51	12.63	266	305	-39	-12.82	.889
3. Manufacturing	11,350	11,317	33	.29	8,229	8,364	-135	-1.61	1.035
4. Construction	1,958	1,947	11	.55	1,351	1,356	-4	-.32	1.025
5. Transportation, etc.	1,687	1,725	-38	-2.26	1,087	1,066	22	2.07	.985
6. Commerce & Trade	7,382	7,193	189	2.62	4,181	4,318	-137	-3.17	.809
7. Services	5,080	5,306	-226	-4.25	2,720	2,568	152	5.91	.988

[a] Except for those in columns (4) and (8), figures are in million 1965 pesos.

The errors show that three industries, namely, (1) Agriculture, Fishing, & Forestry, (5) Transportation, Communications, Warehousing, Storage and Utilities, and (7) Services, fall under Case I; and four industries, i.e., (2) Mining and Quarrying, (3) Manufacturing, (4) Construction, and (6) Commerce, fall under Case II.

An inspection of the original disaggregated transactions tables shows that indeed Agriculture expanded its role as a supplier of products to the other industries. Its forward linkage increased by almost 24 per cent from 1961 to 1965. In the case of Transportation and Services, the transactions tables show that while their individual forward linkages declined during the period, their backward linkage to each other increased. Specifically, the input requirements of Services from Transportation went up from 1.13 per cent of its total inputs in 1961 to 1.75 per cent in 1965; and that of Transportation from Services increased from 3.38 per cent of its total inputs to 4.04 per cent in the same period. This interdependence possibly accounts for their mutual expansion.

For Manufacturing the projection errors imply that this industry has been losing ground as a supplier of inputs to the other industries. This phenomenon however is denied by the industry's forward linkage, which in fact went up by 3.5 per cent, and the backward linkages of expanding industries (Transportation and Services but not Agriculture) which increased and of declining industries which decreased. The explanation possibly lies in changes in the pattern of final demand.

This may in fact be the case, for if many manufacturing firms were import dependent [8], then the devaluation of 1962 could only have raised their production costs and output prices, consequently diminishing the attractiveness of their output to ultimate consumers. The same problem of interpretation arises with respect to construction. While the projection errors show that the industry declined from 1961 to 1965, the transactions tables show that its forward linkage increased by 2.5 per cent and the backward linkages of growing (declining) industries increased (decreased). As with Manufacturing, the explanation here possibly lies in changes in the pattern of final demand, although these are not obvious from an inspection of the coefficients.

Somewhat easier is the case of Mining and Quarrying. The projection errors show that this industry declined as an input supplier. This is confirmed by its total forward linkage which decreased by 11 per cent during the period. Finally, Commerce is shown to have declined as a supplier of inputs by the projection errors. It is also shown to have lost a portion of its market by its total forward linkage which decreased by about 19 per cent from 1961 to 1965.

4. The RAS Method

In addition to the projection method, we can employ the RAS method [10] to examine structural change. Changes in the input-output coefficients between two years can be interpreted as a combination of "substitution" and "fabrication" effects. Substitution effects refer to the replacement of one commodity by another in the input mix of the various industries (such as the displacement of coal by petroleum, of gas by electricity, etc.). On the other hand, fabrication effects refer to changes in the ratio of intermediate inputs to total inputs, i.e., to changes in the value added ratios.

These two effects can be systematically isolated under the simplifying assumption that they are uniform in the following sense:

$$(10) \qquad a_{ij}(T) = r_i a_{ij}(0) s_j \qquad\qquad (i,j = 1,\ldots,n)$$

or $(A(T) = R\,A(0)\,S$ for short, where R and S are diagonal matrices. The two time-periods considered are $t = 0$ and $t = T$.

When $A(T)$ and $A(0)$ are known, we can find estimates for the r_i and s_j by solving (10). Clearly, however, (10) can only hold approximately since in general, we have n^2 equations but only $2n$ unknowns in (10). Taking logarithms,

$$(11) \quad \log a_{ij}(T) = \log a_{ij}(0) + \log r_i + \log s_j$$

assuming that $a_{ij}(T)$ and $a_{ij}(0)$ are not zero. (When either is zero, we simply drop the corresponding expression in (11) and in what follows.)

A reasonable procedure (cf. [3]) to determine the r_i and s_j would be to minimize the sum of squared deviations

$$(12) \quad \sum_i \sum_j (\log a_{ij}(T) - \log a_{ij}(0) - \log r_i - \log s_j)^2$$

Setting to zero the partial derivatives of (12) with respect to r_i and s_j, we get

$$(13) \quad -2\sum_j (c_{ij} - \log r_i - \log s_j) = 0 \ (i = 1, \ldots, n)$$

$$(14) \quad -2\sum_i (c_{ij} - \log r_i - \log s_j) = 0 \ (j = 1, \ldots, n)$$

where $c_{ij} = \log a_{ij}(T) - \log a_{ij}(0)$. This gives us $2n$ equations in $2n$ unknowns. One of the equations is redundant since the r_i can be determined only up to a multiplicative scalar, for if r_i, s_j satisfy (10), so do λr_i, $(1/\lambda)s_j$. What is important for analysis is the relative pattern of values of the r_i (and of the s_j) among themselves, though we would expect that the mean of the r_i would be close to unity.

The possibilities for r_i and s_j are

$$(15) \quad r_i = 1, \ r_i > 1, \ r_i < 1$$

$$(16) \quad s_j = 1, \ s_j > 1, \ s_j < 1.$$

A substitution effect r_i equal to unity means that the output of the industry in question just kept its share of the market among the various industrial users between the two periods (abstracting from fabrication effects). A substitution effect greater (less) than unity means that the particular commodity came to greater (lesser) use in industrial production. Similarly, a fabrication effect s_j equal to unity suggests that the industry in question kept its input structure intact during the period, an indication of zero or little technological or institutional change (abstracting from substitution effects). A fabrication effect greater (less) than unity indicates that the share of intermediate inputs to total inputs increased (decreased) and, hence, the value added share decreased (increased). This phenomenon suggests a change biased in favor of (against) purchased raw materials and against (in favor of) employment of primary resources.

It is apparent that for industries i that the planning authorities wish to develop and hope would absorb more primary resources (provide more employment to labor, for instance) the desired values of the two effects are $r_i > 1$ and $s_i < 1$.

To explain the change in any input coefficient, however, it is important to remember that the two effects are acting on the coefficient simultaneously. It may be that the two effects are reinforcing, neutralizing, or even reversing each other so that examination of one or the other alone would not tell the whole story.

One will observe that the substitution and fabrication effects are more or less comparable with the various cases of projection errors and, like these various cases of projection errors themselves, are also comparable with changes in forward and backward linkage. Abstracting from fabrication effects, to say that an industry's substitution effect is greater (less) than unity is to say that its projection errors place it under Case I or III (Case II or IV), or that its forward linkage increased (decreased). Similarly, abstracting from substitution effects, to say that an industry's fabrication effect is greater (less) than unity is to suggest that its backward linkage increased (decreased). The fabrication effect has no direct counterpart in the projection method.

The results of applying the RAS method to the two input-output tables are summarized in Table 2. Changes in forward and backward linkages are also reported for purposes of comparison.

Table 2. Substitution (r) and fabrication (s) effects and changes in linkages between 1961 and 1965

	r	s	Changes in Forward linkage[a/]	Changes in Backward linkage[b/]
1. Agriculture, etc.	.500	.843	1.239	.721
2. Mining	1.369	1.732	.889	.835
3. Manufacturing	1.027	.730	1.035	1.109
4. Construction	.577	1.450	1.025	.870
5. Transportation, etc.	1.027	.632	.985	1.032
6. Commerce & Trade	1.186	1.450	.809	.735
7. Services	.667	.308	.988	1.585

a/ Defined as $(\sum_j q_{ij}{}^{65}/q_i{}^{65})/(\sum_j q_{ij}{}^{61}/q_i{}^{61})$, where q_{ij} means deliveries of industry i to industry j and q_i means output of industry i.

b/ Defined as $(\sum_i q_{ij}{}^{65}/q_j{}^{65})/(\sum_i q_{ij}{}^{61}/q_j{}^{61})$.

The substitution effects show that between 1961 and 1965 the outputs of (2) Mining, (3) Manufacturing, (5) Transportation, and (6) Commerce came to more widespread use in the various industries, whereas those of (1) Agriculture, (4) Construction, and (7) Services fell into industrial disuse relatively. The fabrication effects indicate that during the same four years, intermediate inputs as a proportion of total inputs declined in (1) Agriculture, (3) Manufacturing, (5) Transportation, and (7) Services, whereas they rose in (2) Mining, (4) Construction, and (6) Commerce.

When taken together, these two effects understandably have different impacts -- equal to $r_i s_j$ -- on the individual input coefficients. However, as should be expected, the average of these combined effects for each (industry) row is almost equal to the original substitution effect -- $(\sum_j r_i s_j)/7 \approx r_i$ -- and for each (industry) column is not too different from the original fabrication effect -- $(\sum_i r_i s_j)/7 \approx s_j$. (See Appendix Table 10.)

A comparison of the changes implied by these substitution and fabrication effects with the changes implied by the projection errors and the linkages is made in Table 3. As can be seen, the substitution effects, except those for Construction and Transportation, are the exact opposite of the findings in the projection exercise and, except for Manufacturing and Services, are the opposite of those implied by changes in forward linkage. For instance, the subsbiuttion effect shows that Agriculture lost (-) customers during the period contrary to the projection errors (+) and the change in the industry's forward linkage (+).

Table 3. Summary of changes in interindustry structure implied by various indicators, 1961-1965

	Change implied by projection error	Change implied by r	Change implied by s	Change in forward linkage	Change in backward linkage
1. Agriculture	+	-	-	+	-
2. Mining	-	+	+	-	-
3. Manufacturing	-	+	-	+	+
4. Construction	-	-	+	+	-
5. Transportation	+	+	-	-	+
6. Commerce	-	+	+	-	-
7. Services	+	-	-	-	+

It can also be seen that the fabrication effects, except that for Agriculture, are the opposite of those implied by changes in backward linkage.

This lack of consistency among the several indicators is rather puzzling but perhaps not unexpected, and we will not attempt to resolve it here. We note only that it creates problems one of which is that of determining the specific factor biases of technological or institutional change. Should one go by the fabrication effects or the changes in backward linkage? In the present instance there is no way of establishing the specific factor biases of the fabrication effects, or even of verifying them at all, since they are inconsistent with changes in backward linkage.

We may report here, however, factor biases of technological or institutional change as this change is reflected by backward linkage. From Table 4, it can be seen that the increase in the value added ratio of (1) Agriculture, (2) Mining, (4) Construction, and (6) Commerce was in favor of all the primary factors in Agriculture, Construction and Commerce, but was against labor in Mining. Moreover, the decrease in the value added ratio of (3) Manufacturing, (5) Transportation, and (7) Services was against all the factors in Manufacturing but was in favor of profits in Transportation and of the government in Services. Table 5 contains additional information on employment, to give an idea of the actual number of persons employed as implied roughly by the wage coefficients.

Table 4. Ratios of primary input coefficients $q_{fj}(1965)/q_{fj}(1961)$

	1	2	3	4	5	6	7
8. Wages	1.087	.894	.961	1.138	.968	1.181	.924
9. Depreciation	1.101	.925	.789	1.411	.907	1.757	.641
10. Other Value Added	1.090	1.676	.797	1.427	1.121	1.007	.828
11. Indirect Taxes less subsidies	(.079)	(2.413)	.883	.500	.702	.847	1.062
Total	1.069	1.127	.851	1.211	.980	1.080	.888

Table 5. Employment (in thousands) by sector, 1961 and 1965

	1	2	3	4	5	6	7	Total
A. Wage & Salary Workers								
1961	3,588	32	922	231	300	749	1,073	6,895
1965	3,815	24	1,005	295	355	928	1,414	7,836
1965/1961	1.06	.75	1.09	1.28	1.18	1.24	1.32	1.14
B. Total Employed Persons								
1961	5,512	27	1,028	227	300	873	1,128	9,095
1965	5,725	24	1,101	295	361	1,114	1,482	10,101
1965/1961	1.04	.89	1.07	1.30	1.20	1.28	1.31	1.11

Sources: Bureau of Census and Statistics, Philippine Statistical Survey of Households, No. 10 and No. 19.

A word should be added about the sizes of the substitution and fabrication effects. While we would expect the substitution effect to exceed unity for industries generating increased forward linkage, can we justify the value of 1.31 for Mining? On the fabrication effects, how much faith can one place on such small fabrication effects as .73 for Manufacturing, .63 for Transportation, and .31 for Services? It does not seem likely that any market expansion or input reduction can take place to the extent implied by these figures during a period as short as four years.

For planning purposes, it is plainly difficult to determine whether one should be guided by the results of the projection exercises or the substitution effects -- or even by the changes in forward linkage. The methods themselves offer no clue as to which of them is to be preferred. More useful perhaps would be the implications of the fabrication effects which have no direct counterpart in the projection method. But even these would have to be compared carefully with the changes in backward linkage. Some judgment based on expert knowledge of specific industries would have to be exercised.

5. Projection of Input Coefficients

If it is desired that estimates of future input coefficients $a_{ij}*(T)$ be made, one approach would be to use the estimated r_i and s_i and the base year $a_{ij}(0)$. However, since the magnitudes of the r_i and s_j seem rather "unreasonable," it may be misleading to use them. Moreover, to use them would be to make the assumption that the same substitution and fabrication effects that operated in the past would continue to operate without modification into the projection period. This assumption would of course be difficult to defend if the economy is in fact going through different structural changes.

Another method of estimating future coefficients (see [10]) avoids the above problem but creates new ones for us. Let u stand for the intermediate output vector, v for the intermediate input vector, q for the total output vector--all at time T--and A the coefficient matrix in the base year. We know that

$$(17) \qquad A^*q = u$$

$$(18) \qquad \hat{q}A^{*\prime}h = v$$

where A^* (the coefficient matrix at T) is to be estimated and h is the appropriate unit vector. $A^{*\prime}$ is the transpose of A^*, and $\hat{q}$ the diagonal matrix obtained from q.

A^* may be estimated from A in the following way. With A and q given, we calculate u_o:

(19) $$Aq = u_o$$

and therefore

(20) $$\hat{u}\hat{u}_o^{-1}Aq = u$$

where u is known. Comparing (17) and (20), we see that

(21) $$A^* = \hat{u}\hat{u}_o^{-1}A$$

satisfies the row conditions but not the column conditions (18). In order to satisfy the column conditions, we try (21) in the left hand side of (18) giving

(22) $$\hat{q}A'\hat{u}\hat{u}_o^{-1}h = v_o$$

so that

(23) $$\hat{q}\hat{v}\hat{v}_o^{-1}A'\hat{u}\hat{u}_o^{-1}h = v$$

satisfies the column conditions. The first-round estimate of A^* is thus

(24) $$A_1^* = \hat{u}\hat{u}_o^{-1}A\hat{v}\hat{v}_o^{-1}$$

which, however, in general does not satisfy the row conditions. A second round estimate is given by

(25) $$A_2^* = \hat{u}^2\hat{u}_o^{-1}\hat{u}_1^{-1}A\hat{v}^2\hat{v}_o^{-1}\hat{v}_1^{-1}$$

where (cf. (19))

(26) $u_1 = A_1^*q$

and (cf. (22))

(27) $v_1 = \hat{q}A_1^{*\prime}\hat{u}\hat{u}_1^{-1}h$

Iteration of this process, which is known to be convergent, gives the desired estimate of A^* which can be written in the form

(28) $A^* = R^*AS^*$

One problem with applying this procedure is that it requires a knowledge of the values of q, u and v which are not ordinarily given in the national income accounts. Another problem is that the estimated values of these variables predetermine the values of the coefficients that are to be estimated. At any rate it seemed worthwhile to experiment with this procedure.

In order to get figures for q, u, and v for 1969, we can calculate them from a manipulation of data from the 1969 national income accounts. Specifically, adding to net domestic product by sector an estimate of that sector's depreciation allowance and taxes net of subsidies, we get an approximation of gross domestic product by sector which in turn could serve as a basis for an approximation of the final demand vector y for 1969. We then assume that

$$u(1969) = b_1(b_3/b_2)\ u(1965)$$
$$v(1969) = b_1(b_4/b_2)\ v(1965)$$
$$q(1969) = u(1969) + y(1969)$$

where
$$b_1 = y(1969)/y(1965)$$
$$b_2 = y(1965)/y(1961)$$
$$b_3 = u(1965)/u(1961)$$
$$b_4 = v(1965)/v(1961).$$

These computed values of q, u, v, and y for 1969 are presented in Appendix Table 13. The estimated 1969 input coefficients and 1965-1969 substitution and fabrication effects are shown in Tables 6 and 7.

How reliable these estimates of the 1969 input coefficients are can be judged from the magnitudes of the substitution and fabrication effects. The largest substitution effect (3.09 for Agriculture) is about 12 times the smallest (0.26 for Construction), while the largest fabrication effect (2.16 for Transportation) is more than three times the smallest (0.66 for Agriculture). It is doubtful whether any industry can increase its market by more than 2 times or lose three-fourths of it in so short a period of time as four years. Neither is it credible that over the same period of time any industry can expand its input structure by more than 100 per cent. The net result of this is to say that the foregoing substitution and fabrication effects are not any better, indeed are worse, than the same effects estimated under section 4, and for that reason the estimates of the 1969 input coefficients are rather difficult to accept.

Table 6. Estimated Input Coefficients a_{ij} for 1969

	1	2	3	4	5	6	7
1. Agriculture, etc.	0.0698	0.0591	0.5693	0.0219	0.0363	0.0000	0.1970
2. Mining	0.0002	0.0183	0.0464	0.0636	0.0003	0.0005	0.0006
3. Manufacturing	0.0195	0.1241	0.0602	0.2823	0.2064	0.0193	0.0962
4. Construction	0.0000	0.0002	0.0000	0.0061	0.0005	0.0025	0.0003
5. Transportation, etc.	0.0019	0.0221	0.0090	0.0418	0.0782	0.0205	0.0194
6. Commerce & Trade	0.0052	0.0215	0.0154	0.0374	0.0423	0.0286	0.0276
7. Services	0.0024	0.0280	0.0096	0.0408	0.0512	0.0508	0.0621

Table 7. Substitution (r) and fabrication (s) effects

	r	s
1. Agriculture, etc.	3.087	0.656
2. Mining	2.687	1.314
3. Manufacturing	0.437	0.668
4. Construction	0.258	1.734
5. Transportation, etc.	0.537	2.162
6. Commerce & Trade	0.278	1.658
7. Services	0.587	1.069

6. Concluding Remarks

It is beyond the scope of the present paper to evaluate the usefulness of the analytical techniques used but it is quite apparent that applying the projection and RAS methods to Philippine input-output data for 1961 and 1965 does not yield much insight into structural change during that 4-year period. Indeed the methods yield results that appear contradictory.

We have already noted the poor results of the "forecasting" experiment in which the 1969 national income accounts and the 1965 input matrix were used to generate an estimate of the 1969 input matrix. Apparently gross domestic product by sector is an unreliable approximation to the final demand vector. Alternatively one could assume some simple relationship holding among the final demand vectors for 1961, 1965 and 1969. The difficulty with such a procedure, however, is that it in effect predetermines the values of the input coefficients to be estimated without even using such data for 1969 as are in fact already available. Moreover, it is not clear what assumptions would be reasonable in the present context, as the final demand vectors for 1961 and 1965 exhibit patterns of change that do not seem appropriate for linear extrapolations.

Table 8 gives the ratio of final demand in 1965 to that in 1961 for each of the seven sectors.

Table 8. $y_i(1965)/y_i(1961)$

1.	Agriculture	.944
2.	Mining	2.625
3.	Manufacturing	1.321
4.	Construction	1.434
5.	Transportation	1.641
6.	Commerce	1.850
7.	Services	2.073
	Total	1.453

While four industries (Manufacturing, Construction, Transportation and Commerce) grew at more or less the same rate as total final demand and therefore kept their proportional shares in that total roughly the same, three industries (Agriculture, Mining, and Services) declined or increased at rates out of proportion to the rest of the economy and suffered sharp changes in their relative shares in total final demand.

Other problems in the classification of data for the interindustry tables have already been noted in Section 2. The failure to separate competitive and non-competitive imports precluded analysis of import dependence of the various industries. It would have been more appropriate to distribute competitive imports as a separate column and to enter non-competitive imports as a separate row in the primary input sector.

The presence of an unallocated sector and a statistical discrepancy was yet another inconvenience. If the input-output tables were to be operationalized, these features had to be eliminated.

Any conclusions arrived at in the present study are as good only as the quality of the data on which they are based. It hardly needs mentioning that the deficiencies noted need to be removed in order to increase the usefulness of the input-output tables for planning or projection purposes. But more disturbing from an analytical viewpoint, however, is the lack of consistency in the results obtained by the different standard methods employed.

Appendix Table 1. Price Indices

	1965	1961	1965/1961
1. Agriculture, etc.	149.3	118.8	1.2567
2. Mining	120.5	82.0	1.4695
3. Manufacturing	147.5	126.0	1.1706
4. Construction	147.4	119.3	1.2355
5. Transportation, etc.	129.2	115.8	1.1157
6. Commerce & Trade	141.6	121.3	1.1674
7. Services	129.7	113.8	1.1397
9. Labor: (Wage Indices)			
1. Agriculture, etc.	767.5	632.5	1.2134
2. Mining	1124.0	1836.0	1.1569
3. Manufacturing	1896.0	1620.0	1.1704
4. Construction [a/]	1896.0	1620.0	1.1704
5. Transportation, etc.	2520.0	2184.0	1.1538
6. Commerce & Trade	2412.0	2304.0	1.0469
7. Services [b/]	2412.0	2304.0	1.0469
10. Depreciation	180.8	147.5	1.2258
11. Other value added [c/]	118.8	143.0	1.2037
12. Indirect Taxes less subsidies	118.8	143.0	1.2037

Source: Mahar Mangahas and Jose Encarnacion, Jr., "Production Sub-model of the Philippine Economy: 1950-1969" Discussion Paper No. 71-26. IEDR UP School of Economics. 1971

[a/] The index used here is that for Manufacturing.

[b/] The index used here is that for Commerce

[c/] The index used here is the GNP price deflator

[d/] The index used here is the GNP price deflator.

Appendix Table 2. Coefficients a_{ij} (1961) in 1965 prices

	1	2	3	4	5	6	7
1. Agriculture, etc.	.08229	.01086	.23783	.00490	.00015	.00001	.00618
2. Mining	.00019	.03670	.02750	.02305	.00010	-	.00002
3. Manufacturing	.07359	.26678	.20524	.41347	.20791	.03616	.08149
4. Construction	-	.00165	-	.00453	.00068	.01048	.00005
5. Transportation, etc.	.00856	.02124	.01646	.02970	.06995	.02923	.01133
6. Commerce & Trade	.03324	.06493	.07982	.08885	.07781	.09402	.03305
7. Services	.00077	.03262	.01119	.05324	.03379	.06142	.02851
Total	.19864	.43478	.57804	.61774	.39039	.23132	.16063

Appendix Table 3. Primary Input Coefficients (1961) in 1965 prices

	1	2	3	4	5	6	7
8. Labor	.37922	.25681	.10945	.21265	.28834	.24662	.56426
9. Depreciation	.03830	.07062	.03126	.01548	.08073	.02550	.02937
10. Other value added	.36985	.22402	.22359	.13138	.18147	.45645	.23928
11. Indirect taxes less subsidies	.01399	.01377	.05766	.02275	.05907	.04011	.00646
Total	.80136	.56522	.42196	.38226	.60961	.76868	.83937

Appendix Table 4. Inverse Coefficients $(I-A)^{-1}$ (1961) in 1965 prices

	1	2	3	4	5	6	7
1. Agriculture, etc.	1.11871	0.11228	0.34292	0.15678	0.08006	0.02064	0.0375
2. Mining	0.00343	1.04916	0.03781	0.04069	0.00893	0.00250	0.0034
3. Manufacturing	0.11174	0.38398	1.32073	0.58035	0.30647	0.07730	0.1177
4. Construction	0.00057	0.00301	0.00151	1.00640	0.00208	0.01181	0.0006
5. Transportation, etc.	0.01410	0.03620	0.03202	0.05091	1.08620	0.03805	0.0167
6. Commerce & Trade	0.05263	0.11832	0.13552	0.16563	0.12589	1.11864	0.0512
7. Services	0.00614	0.04864	0.02652	0.07557	0.04975	0.07368	1.0347

Appendix Table 5. Components of Demand (1961) in 1965 prices

i.	Private Consumption Expenditures	Government Consumption Expenditures	Gross Fixed Capital Formation	Change in Inventories	Exports	(Less) Imports	Total Final Demand	Total Demand
1.	3,098,552	1,137	-	30,973	618,202	(214,423)	3,534,441	6,047,445
2.	(71,745)	12,234	-	(1,358)	281,036	(188,723)	31,444	305,216
3.	5,707,954	160,123	1,171,855	175,588	506,758	(2,748,846)	4,973,432	8,364,272
4.	(56,166)	29,800	1,329,714	-	-	-	1,303,348	1,356,126
5.	511,355	29,182	32,812	-	26,297	-	599,646	1,065,735
6.	2,375,357	33,372	227,776	-	98,603	-	2,735,108	4,317,859
7.	2,037,360	976,650	-	-	-	(322)	2,013,688	2,568,557

Appendix Table 6. Coefficients a_{ij} (1965)

	1	2	3	4	5	6	7
1. Agriculture, etc.	0.0344	0.0145	0.2759	0.0041	0.0054	0.0	0.0308
2. Mining	0.0001	0.0052	0.0258	0.0136	0.0000	0.0001	0.0001
3. Manufacturing	0.0681	0.2160	0.2061	0.3722	0.2181	0.0267	0.1063
4. Construction	0.0	0.0006	0.0002	0.0137	0.0010	0.0058	0.0006
5. Transportation, etc.	0.0055	0.0313	0.0251	0.0159	0.0673	0.0230	0.0174
6. Commerce & Trade	0.0285	0.0588	0.0831	0.0774	0.0703	0.0620	0.0479
7. Services	0.0063	0.0364	0.0245	0.0401	0.0404	0.0522	0.0512
T o t a l	0.1433	0.3630	0.6410	0.5371	0.4028	0.1701	0.2546

Appendix Table 7. Primary Input Coefficients (1965)

	1	2	3	4	5	6	7
8. Labor	0.4123	0.2295	0.1052	0.2420	0.2790	0.2913	0.5214
9. Depreciation	0.0421	0.0653	0.0246	0.0218	0.0732	0.0448	0.0188
10. Other Value added	0.4032	0.3753	0.1781	0.1875	0.2033	0.4597	0.1981
11. Indirect taxes less subsidies	-0.0011	-0.0332	0.0509	0.0113	0.0414	0.0339	0.0068
T o t a l	0.8566	0.6369	0.3589	0.4628	0.5971	0.8298	0.7453

Appendix Table 8. Inverse Coefficients $(I-A)^{-1}$ (1965)

	1	2	3	4	5	6	7
1. Agriculture, etc.	1.06408	0.02485	0.37826	0.15384	0.09976	0.01865	0.07988
2. Mining	0.00270	1.00599	0.03433	0.02735	0.00846	0.00173	0.00433
3. Manufacturing	0.09751	0.02799	1.31571	0.51350	0.32023	0.05749	0.15980
4. Construction	0.00030	0.00117	0.00128	0.01500	0.00196	0.00648	0.00126
5. Transportation, etc.	0.01034	0.03737	0.04317	0.03781	1.08586	0.02967	0.02672
6. Commerce & Trade	0.04270	0.07151	0.13608	0.14204	0.11668	1.07788	0.07339
7. Services	0.01256	0.04507	0.04728	0.06772	0.06205	0.06263	1.06405

Appendix Table 9. Components of Demand (1965)

	Private Consumption Expenditures	Government Consumption Expenditures	Gross Fixed Capital Formation	Change in Inventories	Exports	(Less) Imports	Total Final Demand	Total Demand
1.	2,305,996	6,263	-	111,411	1,188,866	(274,445)	3,338,091	6,884,971
2.	1,496	6,337	-	3,736	353,062	(282,093)	82,538	406,811
3.	7,454,203	201,790	1,490,090	79,306	1,227,091	(3,882,904)	6,569,576	11,317,165
4.	4,646	39,342	1,825,475	-	-	-	1,869,463	1,947,130
5.	698,899	70,065	38,270	-	197,829	(21,285)	983,778	1,725,461
6.	3,608,799	138,172	693,998	-	687,978	(70,150)	5,058,797	7,193,453
7.	2,258,405	1,636,463	-	-	569,421	(290,801)	4,173,488	5,305,602

Appendix Table 10. Combined substitution and fabrication effects: $r_i s_j$

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	
	$r_i \backslash s_j$	.843	1.732	.730	1.450	.632	1.450	.308	$\left(\frac{\Sigma_j r_i s_j}{7}\right)$
Agriculture, etc.	.500	.422	.866	.365	.725	.316	.725	.154	.510
Mining	1.369	1.154	2.371	.999	1.985	.865	1.985	.422	1.397
Manufacturing	1.207	.866	1.779	.750	1.489	.649	1.489	.316	1.048
Construction	.577	.486	.999	.421	.837	.364	.837	.178	.539
Transportation, etc.	1.027	.866	1.779	.750	1.489	.649	1.489	.316	1.048
Commerce	1.186	1.000	2.054	.866	1.720	.750	1.720	.365	1.211
Services	.667	.562	1.155	.487	.967	.422	.967	.205	.681
$\left(\frac{\Sigma_i r_i s_j}{7}\right)$		.765	1.572	.663	1.316	.574	1.316	.279	

Appendix Table 11. Values of Selected Variables (1961) in 1965 prices

Sector	Intermediate Output u	Intermediate Input v	Final Demand y	Total Output q
Agriculture, etc.	2,513	1,201	3,534	6,047
Mining	274	133	31	305
Manufacturing	3,391	4,834	4,973	8,364
Construction	52	838	1,303	1,556
Transportation, etc.	466	416	599	1,065
Commerce & Trade	1,583	999	2,735	4,317
Services	555	413	2,013	2,568

Source: National Economic Council, The 1961 Interindustry (Input-Output) Accounts of the Philippines, Manila, n.d.

Appendix Table 12. Values of Selected Variables (1965) in current prices

	Intermediate Output u	Intermediate Input v	Final Demand y	Total Output q
1. Agriculture, etc.	3,547	987	3,338	6,884
2. Mining	324	148	82	406
3. Manufacturing	4,748	7,225	6,569	11,317
4. Construction	78	1,046	1,869	1,947
5. Transportation, etc.	742	695	983	1,725
6. Commerce & Trade	2,135	1,224	5,058	7,193
7. Services	1,132	1,351	4,173	5,305

Sources: National Economic Council, "The 1965 Interindustry (Input-Output) Accounts of the Philippines," The Statistical Reporter, Vol. XV, No. 3, July-September 1971.

Appendix Table 13. Values of Selected Variables (1969) in 1965 prices*

	Intermediate Output u	Intermediate Input v	Final Demand y	Total Output q
1. Agriculture, etc.	14,234	2,304	8,964	23,198
2. Mining	881	377	497	1,378
3. Manufacturing	4,429	7,253	5,782	16,211
4. Construction	37	427	876	913
5. Transportation, etc.	976	961	1,335	2,311
6. Commerce & Trade	1,270	661	4,126	5,396
7. Services	1,755	3,361	6,572	8,327

*Data calculated from 1969 national income accounts using the procedure described in the text.

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