

Some Implications of the BCS Input-Output Tables*

I. Introduction

Different input-output tables for the Philippine economy for 1961 and 1965 have been prepared by the National Economic Council (NEC) and by the Bureau of the Census and Statistics (BCS). The implications of the NEC tables on structural change in the economy have been analyzed by Jurado and Encarnacion in an earlier paper [2]. We will make a similar analysis of the BCS tables in this paper.

Moreover, the availability of the study utilizing the NEC tables allows us to make comparisons. On this basis, we can make firmer conclusions regarding structural change in the economy, or regarding the nature of the data on which we base our analysis.

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For purposes of testing the accuracy of the input-output tables, the methodology used by Sicat [7] in his evaluation of the 1961 input-output tables is used in the more aggregated versions of the 1965 input-output tables. In addition, the formal similarity of this test to the projection method we used for analyzing structural change is put to bear on the issue. It turns out that in doing so, a stricter test of the input-output tables is made available.

As distinguished from the previous exercise (Jurado and Encarnacion, [2]) we intend to go further in trying to evaluate the methods used in analyzing structural change in the economy. There is therefore an attempt in this paper to reconcile the seeming inconsistencies of various methods, namely, those of the projection method, the RAS method and the simpler comparison of forward linkages.

II. The Data

As mentioned earlier, this exercise will be based on the input-output tables for 1961 and 1965 prepared by the BCS. These tables were prepared using producer's prices, in which case transport and trade margins were allocated to the producing industry. As distinguished from the NEC tables, the BCS classified imports as non-competitive; thus, imports were entered as a separate row in the quadrant of primary inputs. To be consistent with this treatment, imports were not netted out from final demands.

Another important distinction between the BCS and NEC tables is that the latter have unallocated rows and columns, while the former do not. The BCS sought to trace sources of all inputs or users of all output. Moreover, both NEC tables are 50 x 50, except that for 1965 where another sector, Scrap forms the 51st industry. On the other hand, the 1961 BCS table is 29 x 29 while the 1965 table is 97 x 97.

For our purposes, both 1961 and 1965 tables are collapsed into a 7 x 7 order, following the sectoral classification in the national income accounts in defining these seven sectors. In addition, to remove price effects in our analysis,

both tables are expressed in constant 1965 prices. To do this, price inflators (reported in Appendix Table 1) were used to inflate 1961 figures to constant 1965 prices.

What we did in this connection was to multiply each entry along a row in the transactions table for 1961 by the price index of that sector for 1965 divided by the price index for 1961. For the entries in the primary inputs quadrant, relevant inflators were used. For imports, the implicit import price index was used. For Compensation of Employees, appropriate wage indices for the different sectors were used, i.e., for compensation of employees for the agricultural sector, the wage index for agriculture was used, and similarly for the other sectors (see Appendix Table 1). For Depreciation and Indirect Taxes less Subsidies, the GNP inflator was used in reducing these to constant 1965 prices.

We inflated profits differently to what was done in a previous exercise (Jurado and Encarnacion, [2]). Instead of using the GNP inflator for this income category, we used relevant sectoral price indices, i.e., for Agriculture, for example, we inflated profits generated in the agricultural sector by the price index of agricultural products. The rationale for this procedure is that, between the GNP

inflator and the sectoral inflator as proxies for the true profits inflator, the latter should be closer to the true value. A better procedure perhaps is to use the ratio of the sectoral price index and the GNP inflator. If this were done, however, the profits inflator will tend to be an overestimate for those sectors that used relatively more inputs that experienced the greater increase in prices between 1961 and 1965, and an underestimate for the opposite case. Hence, we applied the sectoral inflators as profits inflators in this exercise.

In the process of expressing the 1961 table in constant 1965 prices, some inconsistencies arose. Thus, row sums did not tally anymore with column sums: total sales did not equal total purchases. What we did in this case was to allocate the discrepancy along the primary inputs rows Depreciation, Profits, and Indirect Taxes less Subsidies proportionately.¹ The justification for this is that in most cases in the actual preparation of the tables, control totals for output were directly estimated, and the discrepancy

¹ Jurado and Encarnacion [2] removed similar inconsistencies by making Personal Consumption absorb the discrepancy. Odd results, like a negative entry for consumption of Mining output, turned out.

between this estimate and total inputs is absorbed by the profits row. It is natural therefore to do the same thing in reconciling the inconsistencies. We also made Depreciation and Indirect Taxes less Subsidies absorb part of the discrepancy because of the weakness of using the GNP inflator in adjusting the entries along these rows to 1965 prices.

The resulting 7 x 7 technology matrices and the supporting tables are reported as Appendix Tables 2-9.

III. The Projection Method

A method of analyzing structural change in the economy is provided by the so-called projection method (Usui, [9]). This method consists simply of making ex post backward and forward projections of required output given two input-output tables for an economy at two points in time and corresponding final demand vectors.

Let $y(0)$ be the vector of final demand at base year (0) and $y(-T)$ be the final demand vector $-T$ years earlier. Hence, given $A(0)$ and $A(-T)$, the matrices of input-output coefficients for the two years, output estimates can be made.

For backward projections of output, we use the following relations:

$$(1) \quad q^*(-T) = [I - A(0)]^{-1} y(-T)$$

where $q^*(-T)$ is used to designate the vector of output at time $-T$ on the basis of the structure of the economy at year (0).

The actual vector of output for year $(-T)$, $q(-t)$, is given by the following relation:

$$(2) \quad q(-T) = [I - A(-T)]^{-1} y(-T)$$

Had there been no structural change between year $-T$ and year 0, $q^*(-T)$ should equal $q(-T)$. Therefore, the difference $q^*(-T) - q(-T)$ should give an indication of structural change. This backward projection error is formalized by the following, where $w(-T)$ denotes backward projection error:

$$(3) \quad w(-T) = q^*(-T) - q(-T) = \{ [I-A(0)]^{-1} - [I-A(-T)]^{-1} \} y(-T) \\ = \Delta B y(-T)$$

where ΔB denotes the quantity inside braces.

In a similar fashion, forward projection errors can be estimated. Where $w(0)$ denotes the forward projection error, $q^*(0)$ and $q(0)$ the estimated and actual output vectors for year (0), and $y(0)$ the final demand vector for the base year,

$$(4) \quad w(0) = q^*(0) - q(0) = \{ [I-A(-T)]^{-1} - [I-A(0)]^{-1} \} y(0) \\ = -\Delta B y(0)$$

Note that if there is no change in the composition of final demand between year $(-T)$ and the base year, the following relationship must be satisfied:

$$(5) \quad y(0) = \alpha y(-T)$$

where α is a positive scalar equal to the ratio of final demand for the output of industry i in year 0 to final demand for the same output in year $(-T)$. Any sector i can be used in this connection, under the assumption that there is no change in the composition of final demand.

Under the assumption expressed by equation (5), the forward projection error can be calculated in terms of the backward projection error. Thus

$$\begin{aligned} (6) \quad w^*(0) &= -\Delta B y(0) = -\Delta B \alpha y(-T) \\ &= -\alpha \Delta B y(-T) = -\alpha w(-T) \end{aligned}$$

In words, the direction of the forward projection error if there had been no change in the structure of final demand will simply be the reverse of the backward projection error; its absolute magnitude will be greater than the magnitude of the backward projection error by as much as the proportionate change in final demand.

However, if the components of final demand do not change equally, it is possible ^{that} ~~to have~~ both backward and forward projection errors ~~to~~ have the same sign. Four possible cases can arise therefore:

	Backward Projection Error	Forward Projection Error
Case I	+	-
Case II	-	+
Case III	-	-
Case IV	+	+

The implication of each of these cases are discussed in Usui [9] and Jurado and Encarnacion [2].

Briefly, Case I indicates an industry which, between year (-T) and year (0) increased its degree of interdependence with other industries. This case is also manifested by an increase in the forward linkage of that industry. For Case II, the opposite thing happened. The industry concerned decreased its degree of interdependence with the rest of the economy. This decrease should also be reflected by a decline in that industry's forward linkage with the rest of the economy.

Note that in Case III a negative forward projection error indicates the same phenomenon as Case I, yet the backward projection error is itself negative. An industry exhibiting this characteristic is simply one whose linkage with an industry facing expanded final demand markets increased and whose linkage with contracting industries declined. Case IV

is just the opposite of Case III. Here, the industry's linkage with a growing industry declined while its linkage with a declining industry increased.

The conclusion is drawn that Case I is favorable to development. Case III is even more desirable in this regard. The reason is simply that in both cases interdependencies in the economy are exploited to the full.

Let us show more rigorously how we can make such a conclusion regarding Case III. We know that for Case III $w(-T) < 0$, $w(0) < 0$. If there had been no change in final demand composition, $w^*(0) > 0$. Based on equation (6),

$$\begin{aligned} (7) \quad w^*(0) &= -\alpha \Delta B y(-T) \\ &= -\Delta B \hat{\alpha} y(-T) \end{aligned}$$

where $\hat{\alpha}$ is a diagonal matrix whose elements are α , defined above. The vector $w(0)$ can be expressed in a manner similar to (7). If we let $\hat{\beta}$ be the diagonal matrix whose elements are equal to the actual ratios of the components of final demand in year (0) and year (-T), we have

$$(8) \quad y(0) = \hat{\beta} y(-T).$$

Therefore,

$$(9) \quad w(0) = -\Delta B \hat{\beta} y(-T)$$

Subtracting (9) from (7), we get

$$\begin{aligned} (10) \quad w^*(0) - w(0) &= -\Delta B \hat{\alpha} y(-T) + \Delta B \hat{\beta} y(-T) \\ &= -\Delta B [\hat{\alpha} - \hat{\beta}] y(-T) \\ &= \Delta B [\hat{\beta} - \hat{\alpha}] y(-T) \end{aligned}$$

For industry i falling under Case III, $w_i^*(0) - w_i(0) > 0$.

The row of ΔB corresponding to sector i has elements Δb_{ij} where $\Delta b_{ij} > 0$ if the degree of interdependence of i to j increased between the two time periods, and $\Delta b_{ij} < 0$ for the opposite case. Take $\alpha = h'y(0)/h'y(-T) \triangleq$ aggregate final demand at year (0) divided by aggregate demand at year $(-T)$, where h is the unit vector. Therefore, $\alpha_{jj} - \beta_{jj} < 0$ for that sector j for which the final demand for its output increased more than the average increase in final demand between the two years, and $\alpha_{kk} - \beta_{kk} > 0$ for sector k where growth in final demand for its output increased less than the average. Therefore, to satisfy the condition $w_i(-T) < 0$, $w_i(0) < 0$ and $w_i^*(0) - w_i(0) > 0$, to $\Delta b_{ij} > 0$ must correspond $(\alpha_{jj} - \beta_{jj}) < 0$ and vice versa for $\Delta b_{ij} < 0$. This is no more than saying that sector i increased its linkage with a growing

Table 1. Projection Errors

	Forward Projection Errors ^{a/} $\frac{q^*(1965)}{q(1965)} \frac{w(1965)}{w(1965)}$						Backward Projection Errors ^{a/} $\frac{q^*(1961)}{q(1961)} \frac{w(1961)}{w(1961)}$			Final Change in Demand in Forward Linkage $\frac{y_1(1965)}{y_1(1961)}$		
	(1)	(2)	(3)	(4)	(5) = (3)/(2)	(6) = [(4)-(3)] (3)	(7)	(8)	(9)	(9)/(8)	(12)	
1. Agriculture, etc.	4,967	8,363	-3,394	-3,573	-40.5	5.27	7,665	4,951	2,714	54.8	0.950545	3.1495853
2. Mining	501	518	-	23	- 3.2	238.17	316	334	- 17	-5.2	1.493740	1.1039886
3. Manufacturing	13,292	15,791	-2,498	-2,067	-15.8	-17.28	11,835	10,265	1,670	15.2	1.296160	1.7104399
4. Construction	2,247	2,117	130	113	6.1	-13.49	561	647	- 85	-13.2	4.107330	0.1842329
5. Transportation, etc.	3,078	3,881	-803	-819	-20.7	1.92	3,213	2,592	622	23.9	1.169029	2.5124838
6. Commerce & Trade	8,954	7,726	1,228	1,522	15.8	23.97	5,318	6,474	-1,156	-17.8	1.487450	0.7870438
7. Services	2,094	1,576	517	643	32.8	24.28	1,133	1,622	-488	-30.1	1.417120	0.5105738
											<u>1.417120</u>	<u>0.5105738</u>
											<u>1.316802</u>	

^{a/} Except for those in Column (5), (6), (10), (11) and (12), all figures are in million pesos.

industry and decreased its linkage with a declining industry.¹

Let us now apply the method to data on the Philippines. Table 1 shows backward and forward projection errors for the seven sectors. Sectors 1, 3 and 5 fell under Case I, while sectors 4, 6 and 7 fall under Case II. Only sector 2 (Mining) falls under Case III.

The Mining sector stands out as the most dynamic sector of them all, based on negative forward and backward projection errors. And we get confirmation of this from the technology matrices and the Leontief inverses. We find that the forward linkage of Mining to the sectors facing expanded markets (sector 4, Construction; 6, Commerce and 7, Services) increased. The input coefficient of Construction from Mining increased from 1.4 per cent to 4.1 per cent of total Construction output between 1961 and 1965. For the Service sector, the increase was from nil to some positive value. Mining also increased its purchases from itself, its input coefficient

¹ Note that on the basis of equation (3), the Δb_{ij} 's can all be negative for $w(-T)$ to be negative. But, on the basis of equation (4), this cannot be so, i.e., some Δb_{ij} 's must be negative, and some must be positive. As we define α ($\alpha - \beta_{jj}$)'s cannot all have the same sign. Therefore, the conclusion above will only be qualified for Δb_{ij} 's ≈ 0 and $(\alpha - \beta_{jj}) \approx 0$. Moreover, for large values of $w_i^*(0) - w_i(0)$, such qualifications lose significance. On the other hand, if $w_i^*(0) - w_i(0) > 0$ but $w_i(0) > 0$, then the qualification is stronger. In this case however, sector i still falls under Case II and not under Case III.

having gone up from 0.004315 to 0.006974. On the other hand, the coefficients to declining industries also declined. Mining to Manufacturing went down from 0.007499 to 0.003769, practically a halving from 1961 to 1965.

Perhaps a more conclusive indicator would be the Leontief inverse since the coefficients incorporate direct and indirect effects. Each unit of final demand for Mining output called forth 1.00795 units of Mining output in 1965 greater than the 1.00529 units called forth in 1961. For Construction, corresponding figures are 0.04354 units in 1965 as against 0.01511 in 1961; Commerce 0.00013 units in 1965 as against 0.00004 in 1961; and for Services, 0.00095 in 1965 versus 0.00051 in 1961. These are all the industries the demand for whose output increased more than the average between 1961 and 1965.

For the declining industries, the corresponding direct and indirect requirements from Mining per unit of final demand for their outputs are: Manufacturing: from 0.00869 in 1961 to 0.00477 in 1965. The 1965 coefficient is practically half that of 1961. Transportation: 0.00118 in 1965 to 0.00093 in 1965. Only for Agriculture is there an inconsistency, since the direct and indirect input requirements

from Mining per unit of Agriculture's final demand went up from 0.00071 in 1961 to 0.00088 in 1965.

On the whole, nevertheless, the implications of the projection errors we get for the Mining sector are fully borne out by direct checks of input-output coefficients and changes in the pattern of final demand. Note that Δb_{21} (Mining to Agriculture) is rather small compared to the other Δb_{2j} . Indeed the direct input-output coefficient from Mining to Agriculture shows a change from zero to 0003 units of Mining output per unit of Agriculture's output.

All the other sectors show normal projection errors, i.e., the signs of forward projection errors are the opposite of backward projection errors. Even this behavior should be explained. Such an explanation is required because we know that the composition of final demand changed between 1961 and 1965 and, therefore, where there is no longer a necessity for such reversal of signs.

The whole case can be explained by taking just one example, the case of Agriculture. Its forward projection error is negative compared to a positive backward projection error. Moreover, the actual projection error differs little

from the hypothetical figure for forward projection for such sector when final demand for all sectors increased at the same rate. For clarity in exposition, let us assume that $w_1^*(0) = w_1(0)$. Therefore, from equation (10),

$$(11) \quad \sum_j \Delta b_{1j} (\alpha - \beta_{jj}) y_j(-T) = 0$$

Equation (11) cannot be satisfied by either of the following:

- (a) for sectors j for which $\Delta b_{1j} > 0$, $\beta_{jj} > \alpha$, and
for sectors k for which $\Delta b_{1k} < 0$, $\beta_{kk} < \alpha$.
- (b) for sectors j for which $\Delta b_{1j} > 0$, $\beta_{jj} < \alpha$, and
for sectors k for which $\Delta b_{1k} < 0$, $\beta_{kk} > \alpha$.

In other words, equation (11) cannot be fulfilled if the linkage of sector 1 increases with such sectors facing expanded markets and decreases with such sectors facing contracting markets. If such were the noted changes, then sector 1 must fall under Case III and not Case I. Neither can the equality be fulfilled if Agriculture both increases its linkage with such sectors for which final demand markets are contracting, and decrease its linkage with sectors facing expanded markets. If such were the noted changes, Agriculture

must fall under Case IV and not under Case I where it really is.

What is required are compensatory changes. For positive Δb_{1j} 's, some β_{jj} 's should be greater than α and others should be smaller than α . Similarly, for negative Δb_{1k} 's, some β_{kk} 's should be greater than α and others should be less. Another possibility is actually more simple. All Δb_{1j} 's > 0 in a situation where demand for the output of the different sectors grow at different rates. There is no longer a constraint forcing at least one Δb_{1j} to be negative if the others are positive since the projection errors are of opposite signs anyway. The economics of this is straightforward: Agriculture simply increased its degree of interdependence with the rest of the economy, accounting for positive backward projection errors and negative forward projection errors.

We find that the simple case holds for the Agricultural sector. The Leontiff inverse shows an increase in all the coefficients along the Agriculture row [Table 9 Appendix].

What remains to be seen is whether or not the projection errors tally with computed changes in forward linkage. It should be noted first that a negative error in forward

projections indicates an increase in the sector's linkage with the other sectors as a whole. Thus, we expect the ratios of forward linkage in the later year to forward linkage in the earlier year to be greater than one for sectors with negative forward projection errors. This is fully borne out. Sectors 1, 2, 3, and 5 all have negative projection errors and these are also the sectors with forward linkage ratios greater than one. Moreover, the magnitude of projection errors tally with the magnitude of the forward linkage ratios. Agriculture, with the highest forward projection error of -40.5 per cent correspondingly has the highest forward linkage ratio of 3.15. Mining with only a -3.2 per cent error has a mere 1.14 forward linkage ratio. What could seem a little surprising is the Construction sector whose forward projection error is only 6.1 per cent but whose forward linkage declined to a little less than 20 per cent of its previous value. This may be accounted for mainly by the fact that the input of Construction from itself declined from 2.5 per cent of output in 1961 to 1.1 per cent in 1965, while the industry experienced the greatest increase in final demand of more than 400 per cent.

On the whole, nevertheless, the results of the projection

exercises tally very well with changes in forward linkage. There is actually no necessity that this should be so (see p.36 below), but from our results, we can simply say that either procedure indicates well enough structural changes that had taken place in the economy between 1961 and 1965.

Both procedures, for example, indicate Agriculture to be a dynamic sector. It falls under Case I, in our projection exercise, and it experienced the highest change in forward linkage, in the other method. [These are the characteristics of a dynamic industry, i.e., one that increases its interdependence with the rest of the economy.] However, even here, we get an indication that the two methods we have used so far need not turn in identical results. For example, the projection method shows Mining to be a very dynamic sector, falling as it does under Case III, while its change in forward linkage is only moderate. This is one thing we hope to clarify some more below.

IV. The RAS Method

The so-called RAS method is by now well-known from the works of Stone [8], Johansen [1], and Lecomber [3]. The method is used mainly to predict future input-output matrices since these are needed for long-term projections.

What is required by the method, using Stone's approach [8] is one input-output matrix for year 0, A_0 let us say, and vectors of total output q_t , total intermediate sales u_t , and total intermediate purchases v_t , for year t . The unknown is the input-output matrix, A_t for year t . It is postulated further that A_t satisfies the following relationship:

$$(12) \quad A_t = R A_0 S,$$

where R and S are diagonal matrices. The diagonal elements r_i and s_j of the matrices R and S act as row and column multipliers of A_0 .

On the basis of the vectors assumed to be known, we have

$$(13) \quad \sum_i a_{ij}^t q_j^t = \sum_i r_i a_{ij}^0 s_j q_j^t = v_j^t$$

$$(14) \quad \sum_j a_{ij}^t q_j^t = \sum_j r_i a_{ij}^0 s_j q_j^t = u_i^t$$

Equations (13) and (14) give a total of $2n$ equations to solve for $2n$ unknowns r_i, s_j ($i, j = 1, \dots, n$). Stone [8] suggests an iterative procedure for computing the r_i 's and the s_j 's. Knowing R and S , we have A_t (from equation (12)), an estimate of the input-output matrix for year t .

Johansen's approach is a little different, for it takes off from two input-output matrices A_0 and A_t for the two years 0 and t . Equation (12) is also postulated. However, since we know A_t , we can start with

$$(12) \quad A_t = R A_0 S,$$

which gives us directly n^2 equations for only $2n$ unknowns; the system is therefore inconsistent. For estimation purposes, however, Johansen suggests the following:

$$(15) \quad \text{Minimize } \sum_{ij} (a_{ij}^t - r_i a_{ij}^0 s_j)^2$$

$$(16) \quad \text{Minimize } \sum_{ij} (\log a_{ij}^t - \log (r_i a_{ij}^0 s_j))^2$$

Either way we get systems of equations that can be solved for the r_i 's and s_j 's in an iterative manner. System (16) was availed of in this exercise as there was already an experience with it in a previous exercise (Jurado and

Encarnacion, [2]).

The main purpose of this exercise, as already mentioned, is to be able to predict input-output coefficients for future years. If R and S are known, then for year 2_t from year 0 let us say,

$$(17) \quad a_{ij}^{2t} = r_i a_{ij}^t s_j = r_i^{2_0} a_{ij}^{2_0} s_j^{2_0}.$$

This holds true under the assumption that the multiplicative factors between years 0 and t continue unchanged between t and 2_t .

The significance of this assumption can be better appreciated if we give interpretations to r_i and s_j (Usui, [9]). Since r_i multiplies the coefficients along row i , it indicates a substitution effect. For example, $r_i > 1$ and $r_m < 1$, implies that using industries use more of the output of industry i as input than before, while they use less of the output of industry m , i.e., i goods were substituted for m goods. The s_j 's on the other hand are column multipliers. Hence, an $s_j > 1$ implies more of the inputs of industry j are produced inputs, and vice-versa for $s_j < 1$. There is thus a biased change against primary inputs for the former. The s_j 's therefore measure fabrication effects.

Table 2. Substitution and Fabrication Effects and
Changes in Linkage, 1961-1965

	r	s	Forward Linkage	Backward Linkage
1. Agriculture, etc.	0.577391	0.474276	3.1495853	0.7918293
2. Mining	1.369210	0.973936	1.1039886	0.8817518
3. Manufacturing	0.577391	0.410706	1.7104399	1.1372782
4. Construction	4.999998	0.355656	0.1842329	1.6205907
5. Transportation, etc.	0.577391	0.843394	2.5124838	1.6064917
6. Commerce & Trade	1.369210	0.266704	0.7870438	5.9786491
7. Services	2.108480	0.355656	0.5105738	2.4178830

When we use the values of r_i and s_j that we get on the basis of changes between any time interval for predicting coefficients for future years, we are thus assuming that the same technical changes, of substitution and fabrication, take place in future years for the same interval. The appropriateness of this assumption will certainly depend on a lot of things.¹ We are not concerned about this at the moment since along with our previous exercise using projection methods, we are more interested in the values of the r_i 's and s_j 's as indicators of structural change in the economy.

In Table 2 we have both the fabrication and substitution effects for the seven sectors of the economy, and also the changes in both forward and backward linkage. We may say from an examination of the r_i 's that Agriculture's output was used less as inputs by other industries

¹ For example, the a_{ij} 's may not be pure technological coefficients so that their values over time may be affected by changes in relative prices. In fact, more conflicting results arise in taking into account price effects. We expect, for example, that the substitution effect for sector i that experienced a relative increase in price should tend to be smaller than one. Unfortunately, this does not seem to be so. Mining, which experienced the greatest increase in price from 1961 to 1965 ($P_2^{1965}/P_2^{1961} = 1.4695$, Appendix Table 1) had a substitution effect of 1.369210 (Table 2), which means that, all other things being constant, users shifted to an input whose price rose more than the others! Of course all other things may have changed between 1961 and 1965. We expect that the effects of all these changes can be captured by the RAS method and the projection method.

between 1961 and 1965. The same thing can be said of Manufacturing and Transportation, etc. On the other hand, the outputs of the remaining sectors came into greater use, the more so for Construction because it experienced the highest substitution effect of almost 5.

Continuing this line of reasoning, we may also say that the structural change in the economy reflected by the results of the RAS method appears inconsistent with the structural change implied by the projection method. This can be seen by comparing the changes in forward linkage, which we have shown to tally well with the results of backward and forward projections, with the substitution effects. In this comparison, we get opposite results.

Where forward linkage of greater than one for Agriculture, Manufacturing, and Transportation, etc. imply substitution effects greater than one, on the contrary we get the opposite: substitution effects are much less than one. And where we expect substitution effects less than one on the basis of negative changes in forward linkage, as is true for Construction, Commerce, and Services, we get substitution effects greater than one. Only for the Mining sector do we find a consistency.

Now this is indeed an odd result, if the analysis were correct. On the basis of one method, we get a positive structural change, say, between 1961 and 1965 for the Philippine economy; and on the basis of another method, we get a negative result! The position still seems hopeless if we compare the fabrication effects and changes in backward linkage. All the fabrication effects are less than one, five of the seven even are less than 0.50. These figures could mean that the backward linkages of all the sectors must have gone down between 1961 and 1965. But unfortunately this is not so, in general. Only two sectors, Agriculture and Mining, experienced a fall in backward linkage. The rest all exhibited high positive changes, topped by Commerce with a change in backward linkage of almost 600 per cent.

While all these are disturbing, we cannot make such bold assertions as yet. All the implications that we can derive from an individual r_i or s_j are premised on ceteris paribus assumptions. For instance, a substitution effect of 0.577391 for Agriculture implies a negative change in forward linkage if no fabrication changes occur for all the other sectors using Agriculture's output as input. Thus, to be able to say whether or not the results of the R A S

exercise are inconsistent with those of the projection method, we should take into account the simultaneous effects of all the r_i 's and the s_j 's. This line of analysis is facilitated by Table 3 where the combined effects of substitution and fabrication on each of the input-output coefficients are reported.

Taking into account the joint effects of substitution and fabrication, we note the following results that stand out. For the sectors Agriculture, Manufacturing, and Transportation, etc., the total row multipliers are all less than one. This implies that input coefficients of all sectors from the identified industries all went down from 1961 to 1965. Therefore, the forward linkages of the three sectors should have gone down. As a matter of fact, Agriculture and Transportation displayed the highest increase in forward linkage (Table 2). In the case of the other sectors, mixed results are exhibited. For the rows of each of these sectors, some coefficient multipliers are greater than one, others are less. The implications of these as to whether forward linkages increased or not can be derived on the basis, for example, of whether the increasing coefficients corresponded to growing sectors, etc. We need

Table 3. Combined Substitution and Fabrication Effects: $r_i s_j$

	r_i	(1)	(2)	(3)	(4)	(5)	(6)	(7)	$\frac{\sum r_i s_j}{7}$
	s_j	0.474276	0.973936	0.410706	0.355656	0.843394	0.266704	0.355656	
1. Agriculture, etc.	0.577391	0.273843	0.562342	0.237138	0.205353	0.486968	0.153992	0.205353	0.303570
2. Mining & Quarrying	1.369210	0.649383	1.333523	0.562343	0.486968	1.154783	0.365174	0.486968	0.719877
3. Manufacturing	0.577391	0.273843	0.562342	0.237138	0.205353	0.486968	0.153992	0.205353	0.303570
4. Construction	4.999998	2.371379	4.869678	2.053529	1.778279	4.216968	1.333519	1.778279	2.628804
5. Transportation, etc.	0.577391	0.273843	0.562342	0.237138	0.205353	0.486968	0.153992	0.205353	0.303570
6. Commerce & Trade	1.369210	0.649383	1.333523	0.562343	0.486968	1.154783	0.365174	0.486968	0.719877
7. Services	2.108480	1.000002	2.053525	0.865965	0.749894	1.778279	0.562340	0.749894	1.108557
		0.784525	1.611039	0.679371	0.588310	1.395102	0.441169	0.588310	
	$\frac{\sum r_i s_j}{7}$								

not go into this because, undoubtedly, the inconsistencies in the case of Agriculture, Manufacturing and Transportation are sufficient to show that the results of the R A S exercise contradict those of the projection method.

This inconsistency may be accounted for by the large variation of input coefficients. Taking the Agricultural sector's row and column coefficient ratios between 1965 and 1961, for example, we have the following rough magnitudes.

(For this purpose, $c_{ij} = a_{ij}^{65}/a_{ij}^{61}$.)

$c_{11} = 7.0$	$c_{12} = .25$	$c_{13} = 2.50$
$c_{17} = 1.4$	$c_{41} = 1.4$	$c_{51} = 5.0$
$c_{31} = 1.1$	$c_{71} = .15$	

There are fantastically high positive and negative changes in coefficients between 1961 and 1965 which are smoothed out by the method of minimizing sum of squares. This means that for the cells ij where the 1965/1961 ratios are large, we should expect $r_i s_j$ to be smaller than the actual ratio, and vice-versa. Indeed, this turns out to be so. Of the 14 cells for which $r_i s_j > 1$ (Table 3), only 4 corresponded to coefficients for which the actual change was positive. The remaining 10 in reality corresponded to cells for which the

actual change was negative.

This smoothing out process must be the general rule for matrices in which some coefficients in a few cells change astronomically, for if the r_{ij} for such cells follow the trend of actual change for such cells, then more coefficients in other cells would diverge from the actual change of coefficients in such cells. Evidently, in this case, the sum of squares of deviations of actual coefficients from the estimated ones would tend to increase. In other words, Johansen's R A S method breaks a middle ground between having a few estimated coefficients with large deviations about their actual values and many more estimated coefficients with small or negligible deviations about their actual values, or having the firstly mentioned coefficients with moderate deviations about their actual values, and the many having relatively larger deviations about their actual values.

It is clear, however, that the results of the R A S exercise need not be consistent with that of the projection method since, precisely, backward and forward projection errors will be sensitive to coefficients having large changes. This sensitiveness may be due to changes in the composition

of final demand, which changes are totally neglected by Johansen's R A S method.

In conclusion we can put forward a hypothesis: that the R A S method is appropriate only for small positive or negative changes in input coefficients. In cases where wild swings in these coefficients take place, the method breaks down. We are not saying here that the changes in the input-output coefficients for the Philippines represent real changes. We will discuss this issue in the last section. Rather, the point is raised because it is not really impossible for a developing economy to have such an experience during the period where deliberate structural changes are attempted. In this case, a less sophisticated method like backward and forward projections will be more useful. Especially is this point valid when we put to bear the fact that changes in the structure of final demand also take place simultaneously with changes in input-output structure. The projection method is able to take this into account more explicitly than does the R A S method.

V. A Comparison of Structural Changes Implied by BCS and NEC I-O Tables

The projection and R A S exercises made on the NEC input-output tables (Jurado and Encarnacion, [2]) came out with inconsistent results similar to what we have come out with in our exercise using the BCS tables. But as we have explained in the previous section, there is not much trust that can be put on the R A S method. Thus, we will simply compare the results of the projection exercises. Table 4 summarizes the relevant data for purposes of comparison.

In terms of changes in forward linkage, we have both NEC and BCS tables implying the same direction of change for Agriculture, Manufacturing, Commerce and Trade, and Services. For Mining, Construction and Transportation, opposite changes are exhibited. The NEC tables imply a negative change in forward linkage for Mining, while the BCS shows a positive change for the same variable. This is an odd result, because for the same economy we have one study saying that Mining decreased its degree of interdependence with other industries, while a different study using the same conceptual tools tells the opposite. This is even more astounding if

we consider Construction. The BCS tells a story of this sector enormously reducing its degree of interdependence with the rest of the economy, while the NEC says it is not so.

Even for the sector where both NEC and BCS agree on the direction of change, they cannot quite agree on the magnitude of this change. The BCS shows Agriculture increasing its intermediate sales as a portion of its total output by more than 200 per cent while the NEC says that this increase is actually only just a little more than 20 per cent. Roughly the same story is told for Manufacturing, Commerce and Trade, and Services. The BCS rather goes to the extreme in showing greater changes than does the NEC, even when both agree as to the direction of change.

The same inconsistency between the two is also manifested by the projection exercises. In terms of the four cases of projection errors that can arise, we have these classifications for the different sectors:

	<u>NEC</u>	<u>BCS</u>
1. Agriculture	I	I
2. Mining	II	III
3. Manufacturing	II	I
4. Construction	II	II
5. Transportation, etc.	I	I
6. Commerce and Trade	II	II
7. Services	I	II

Table 4. Projection Errors, NEC and BCS.

	N E C ^{a/}						B C S					
	Change in						Change in					
	w(1961) (1)	w*(1965) (2)	w(1965) (3)	$\frac{[(2)-(3)]}{(3)}$ (4)	Forward $y_1(1961)$ Linkage $y_1(1961)$ (5)	$y_1(1961)$ (6)	w(1961) (1)	w*(1965) (2)	w(1965) (3)	$\frac{[(2)-(3)]}{(3)}$ (4)	Forward $y_1(1965)$ Linkage $y_1(1965)$ (5)	$y_1(1965)$ (6)
1. Agriculture, etc.	68	- 98.8	-256	-61.4	1.239	.944	2,714	-3,573	-3,394	5.27	3.149	0.950
2. Mining	-39	56.7	51	11.2	.889	2.625	-17	23	-16	238.17	1.104	1.494
3. Manufacturing	-135	196.2	33	494.5	1.035	1.321	1,569	-2,067	-2,458	-17.28	1.710	1.296
4. Construction	-4	5.8	11	-47.3	1.025	1.434	-85	112	130	-13.49	0.184	4.107
5. Transportation, etc.	22	-3.2	-38	-15.8	.985	1.641	621	-819	-803	1.92	2.512	1.168
6. Commerce & Trade	-137	199.1	189	5.3	.809	1.850	-1,156	1,522	1,228	23.97	0.787	1.487
7. Services	152	-220.9	-226	2.3	.988	2.073	-488	643	517	24.28	0.510	1.417
				Average		1.453						

^{a/} NEC figures are taken from Jurado, G. and Encarnacion, J., Jr., "Some Exercises With the National Economic Council Input-Output Tables," National Economic Council, Manila, November 1972, Table 1.

For Agriculture, Construction, Transportation and Commerce and Trade, BCS and NEC agree in their classification of industries. Both say that Agriculture and Transportation, etc. experienced change that led to other industries using more of their outputs as inputs. Both say the opposite thing for Construction and Commerce and Trade.

On the other hand, the BCS results show Mining not only increasing its linkage with other industries but also that it increased it with other sectors that had experienced expanding markets. NEC on the other hand shows the Mining sector to have lost its markets. Opposite results also arise for the case of Manufacturing and Services.

These contradictory results on structural changes for the same economy are quite disturbing. Of course both cannot be true, although one may still be correct.

A minor issue may be clarified at this point, however. In the projection exercise using NEC tables, a seeming inconsistency arose as between the results of this exercise and the changes in forward linkage. To take an example, we have Manufacturing showing a change in forward projection of 3.5 per cent (Table 4), while its positive

forward projection error points to a decrease in linkage.

The reconciliation of this seeming contradiction follows the approach we have developed in the third section of this paper.

Assuming no changes in the structure of final demand, a backward projection error of -135 million should show a forward projection error of 196.2 million (Table 4). But the actual forward projection error was only 33 million. Thus the changes in the structure of final demand must have led to this discrepancy, that is, $w_3^*(0) - w_3(0) > 0$. We have shown that if these were so, the relevant sector must have increased its interdependence with a growing industry and reduced it with other industries. To be sure, the qualification we have put forward (footnote 1 page 14 of the third section) should be considered, but it does not detract from the fact that the Manufacturing sector is on the way to being classified under Case III. Thus, if we are to resolve the contradiction, we can say that the Manufacturing sector increased its linkage with a growing industry and reduced it with a declining one and therefore, this led to an increase in this industry's forward linkage.

It is easy to verify this. We know that Mining,

Transportation, etc., Commerce and Trade, and Services increased their share of the market more than the average. Now is it true that there is at least one input coefficient for these sectors along the Manufacturing row that increased? The input coefficient for Services increased indeed from 0.08145 to 0.1063. For the declining industries, that for Agriculture declined from 0.07359 to 0.0681, and that for Construction from 0.41347 to 0.3772. Note that final demand for Services more than doubled while total demand increased by only a little more than 45 per cent. Add the fact that the absolute magnitude of final demand for Services output is one of the largest (19 per cent of total in 1965) and this explains why the forward linkage for Manufacturing increased, while its forward projection error was still positive.

Table 5. Actual and Estimated Outputs, 1961
(million)

	$Q*BCS'61^a/$ (1)	$QBCS'61^b/$ (2)	(3)=[(1)-(2)]/(2)
1. Agriculture, etc.	7,908	4,951	59.72
2. Mining	645	334	93.26
3. Manufacturing	13,133	10,265	27.93
4. Construction	545	647	-15.70
5. Transportation, etc.	3,722	6,474	-42.51
6. Commerce & Trade	4,419	2,592	70.51
7. Services	1,480	1,622	-8.71

$\frac{a}{Q*BCS'61}$ - estimate of total output using final demand vector of BCS 1961 I-0 & $(I-A)^{-1}$ of NEC 1961.

$\frac{b}{QBCS'61}$ - total output vector of BCS 1961 I-0 table.

VI. Comparison of NEC and BCS Tables

Sicat [7] has shown that the input-output tables for the Philippines prepared by the NEC and BCS in 1961 were so different they might as well have described two different economies. The basis of this conclusion is the fact that the two 1961 tables had widely different structural implications.

The differences can be seen in Table 5. The first column of sectoral outputs consists of estimates based on the NEC table for 1961 and actual vectors of final demand of the BCS table for the same year, i.e.,

$$(18) \quad Q_{BCS'61}^* = [I - A_{61}^{NEC}]^{-1} Y_{BCS'61}$$

where $Q_{BCS'61}^*$ is the estimated output vector, A_{61}^{NEC} is the input-output table of the NEC in 1961, and $Y_{BCS'61}$ is the BCS final demand vector of 1961. The second column of Table 5 consists of actual outputs as shown in the BCS tables. Such output vector, $Q_{BCS'61}$ is given by:

$$(19) \quad Q_{BCS'61} = [I - A_{61}^{BCS}]^{-1} Y_{BCS'61}$$

Thus, if the two tables are identical or nearly so (which must be expected because they describe the same economy at

Table 6. Actual and Estimated Outputs, 1965
(million)

	$Q*BCS'65^a/$ (1)	$QBCS'65^b/$ (2)	(3) = [(1)-(2)]/(2)
1. Agriculture, etc.	9,044	8,363	8.14
2. Mining	845	518	63.07
3. Manufacturing	17,056	15,791	8.01
4. Construction	2,105	2,117	-0.54
5. Transportation, etc.	3,638	3,881	-6.25
6. Commerce & Trade	7,172	7,726	-7.17
7. Services	2,425	1,576	53.82

$\underline{a}/Q*BCS'65$ - estimate of total demand using final demand vector of BCS (1965) & NEC (I-A)⁻¹.

$\underline{b}/QBCS'65$ - total demand vector of BCS 1965 I-0(transactions) table.