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FOREIGN ASSISTANCE IN MODELS OF THE PHILIPPINE ECONOMY

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# FOREIGN ASSISTANCE IN MODELS OF THE PHILIPPINE ECONOMY\*

By Mahar Mangahas

## Introduction

This paper is concerned with recent attempts to measure, by means of aggregative models, the contribution of foreign assistance to Philippine economic growth. Chenery and Strout (1965) have applied a relatively simple model to a group of 50 countries, and have concluded that in most less developed countries, significant per capita income growth will depend largely on the availability of external resources. However, ~~the~~ the model as applied by Chenery-Strout in the case of the Philippines indicate that this country may be an exception to this statement.

More recently Shibuya and Yamashita (1968) have presented post-war simultaneous models for the Philippines and six other Asian countries (Taiwan, India, South Korea, the state of Malaya, Pakistan and Thailand), with the immediate purpose of estimating the contribution of foreign assistance -- defined as imports less exports, or the external trade gap -- on economic growth. In the

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Philippine case, the model was estimated for the 1950-1964 data period, and then used to estimate the contribution of foreign assistance to economic growth both over the data period and over 1965-1970. The study's main conclusion was that the Philippine economy was heavily dependent on external trade assistance in the past and would likely remain so in the future.

The model used is examined here partly for its own sake, since simultaneous models for the Philippines are not plentiful, and such a model would deserve critical examination for possible general usefulness. This paper examines the unique behavioral assumptions and a stability property of the model. In particular it concludes that the Shibuya-Yamashita findings are in error due to misinterpretation of the model, and that a correct interpretation would imply that foreign assistance has not been a critical factor affecting Philippine economic growth.

A third model, published by the Institute of Asian Economic Affairs<sup>1</sup> (1968), is somewhat of a cross between Chenery-Strout and Shibuya-Yamashita. In this study, foreign assistance was defined as filling either an external trade gap or a savings-investment

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<sup>1</sup>Now the Institute of Developing Economies (Tokyo).

gap<sup>2</sup>, with -- following Chenery and Strout -- a separate model for each case. The models were estimated for the 1953-1963 data period, then used to forecast foreign assistance requirements in 1975. It was concluded that maintenance of the historical growth rate of GNP would require a substantial level of foreign assistance in 1975 in order to fill an expected gap of investment over savings; but no external trade gap was expected. This conclusion, however, rests heavily on the assumption of a state of general excess capacity in the economy.

#### The Old National Accounts Series: A Few Reminders

The recent major revision of the national income accounts by the National Economic Council was not yet available at the time the models were estimated. Shibuya and Yamashita used the old national income series for 1950-1964, as found in The Statistical Reporter, April issues.<sup>3</sup> The studies by IAEA and Chenery-Strout both used the U.N. Yearbooks of National Accounts Statistics. The usefulness of the old series for economic analysis has been treated by Levy (1964).

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<sup>2</sup>It should be carefully noted that the term "foreign assistance", in the literature and in this paper, is used in quite a broad sense, and not restricted to government-to-government grants for which no compensation is expected.

<sup>3</sup>The original unprocessed data are found in Yamashita (1967).

Sicat (1964) and others, and it seems relevant here to summarize certain of the criticisms raised (several of which were considered in the recent revision), since the studies do not point them out. All these qualifications may be kept in mind while viewing the numerical results. (These results need not reflect badly on the models themselves, since, if warranted, they may be reestimated using new data.)

GNP, or  $Y$  in the notation of this paper, is estimated by the sum of prior estimates of (a) national income at factor cost, (b) depreciation, and (c) indirect taxes less subsidies. Item (c) can be eliminated as more or less not subject to question. National income is obtained as the sum of value-added across sectors, and in each sector value-added is obtained as the difference between the value of gross output and non-factor operating expenses. Firstly, these sectoral gross output values are very rough; secondly, non-factor operating expenses are estimated by temporally fixed percentages of the gross output value; therefore sectoral value-added is estimated by a temporally fixed percentage of a rough estimate of the sectoral value of the gross output. Depreciation, on the other hand, was felt to be much underestimated, with one component (depreciation on construction) estimated each year by the same benchmark value, and another (depreciation on machinery and equipment)

estimated by a fixed percentage of the aggregate, over the preceding ten years, of the value of investment in machinery and equipment.<sup>4</sup> A user of the GNP series then available had to bear in mind Levy's remark regarding the estimate of national income:

" ... it may be stated with [confidence] that the methods and sources at present employed for national income estimation are not such as to guarantee estimates of even a [minimum] standard of reliability."<sup>5</sup>

Personal consumption, or  $C_p$ , was formerly estimated as the residual after subtracting from GNP the estimates of gross domestic investment, or  $I$ , government consumption expenditures, or  $C_g$ , and net foreign investment, or  $E - M$  (exports less imports). Its reliability then depended completely on that of the latter variables.

The variable  $I$  was probably much underestimated. The estimate of the value of construction was rather crude, and short on coverage. With respect to machinery and equipment, certain mark-up ratios, used to estimate purchaser values from producer value estimates, may have been seriously underestimated. Data on inventory changes in the agricultural sector are based on direct estimates; ~~the~~

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<sup>4</sup>This value too was felt to be much underestimated.

<sup>5</sup>Op. cit., p. 9.

mining, manufacturing and trade, they are estimated by fixed percentages of either gross production or value-added.

The estimate of government consumption expenditures,  $C_g$ , excludes armed forces expenditures for construction and durable equipment<sup>6</sup> and also certain national government expenditures. On the other hand it includes expenditures of the Bureau of Posts and Telecommunications, so that some cancelling of errors results.

The difference between imports and exports is critical to the objective of the models, namely to determine the influence of net foreign assistance on total and per capita GNP. The reported imports and exports have been underestimates to the extent that high tariffs and an overvalued exchange rate have encouraged smuggling both into and out of the country. In addition, the import data definitely exclude imports of the armed forces. Levy's conclusion, pertinent to the trade gap,  $L$ , was not too encouraging:

"... the balancing item in the Rest of World account, i.e., 'net lending abroad' must be regarded as of dubious accuracy. Seeing that this item measures the extent of capital export or import into the economy, this constitutes a serious gap in economic knowledge."<sup>7</sup>

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<sup>6</sup>These items are not included in the estimate of  $I$ .

<sup>7</sup>Op. cit., p. 35.

The Shibuya-Yamashita Model

The Philippine model consists of six behavioral equations and three identities. All variables are in million 1963 U.S. dollars, except for population, which is in thousands of persons. The time period is the calendar year. Three relations were estimated by two-stage least squares (2SLS), and three apparently by ordinary least squares (OLS), as indicated below.<sup>8</sup>

In the production function, GNP is simply linear in the capital stock and population (proxies for capital and labor services):

$$(1) \quad Y = a_0 + a_1 K + a_2 N$$

where Y is GNP, K is the gross capital stock, and N is the population. Estimation was by 2SLS, with  $K_{-1}$ ,  $N$  and  $t$  (anno domini less 1950) as predetermined variables, resulting in:

$$(1a) \quad Y = - 758.6 + 0.1556 K + 0.1123 N$$

(427.3) (0.0911) (0.0473)

$$\bar{R} = .996$$

$$DW = 1.007$$

$$s = 65.8^9$$

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<sup>8</sup>The regressions were rerun in single precision, using the data published in the Shibuya-Yamashita paper, with results substantially the same as those published.

<sup>9</sup>The estimates use the notations:  $\bar{R}$  = the square root of the coefficient of determination, corrected for degrees of freedom;  $DW$  = the Durbin - Watson statistic; and  $s$  = the standard error of estimate.

The authors obtained surprisingly high levels of  $\bar{R}$  for almost all equations, and serial correlation in a minority of cases (the production function being one of them)<sup>10</sup>

Private and government consumption expenditures are assumed linear in current GNP and in lagged consumption, equations (2) and (3) below. These functions are actually of minor importance within this model, since, as will be seen, their marginal propensities to spend play no part whatsoever in the determination of either current or future GNP:

$$(2) \quad C_p = b_0 + b_1 Y + b_2 C_{p-1} \quad \checkmark$$

$$(3) \quad C_g = c_0 + c_1 Y + c_2 C_{g-1} \quad \checkmark$$

These functions were presumably estimated by OLS (roughly

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<sup>10</sup>Data for  $K$  was obtained by taking a total incremental capital-output ratio of  $k = 2.58$  (cf. Chenery (1965), appendix Table A-2), estimating  $K_{1950} = k Y_{1950}$ , and  $K_j = K_{j-1} + I_j$  for  $j$  greater than 1950. The reciprocal of the total ICOR implied by (1) is  $a_1 + a_2$  ( $dN/dK$ );  $dN/dK$  may be estimated roughly at 1.9 for the period.

verified by recomputations), with results:

$$(2a) \quad C_P = 401.5 + 0.3199 Y + 0.4727 C_{P-1}$$

(144.5) (0.2384) (0.3284)

$$\bar{R} = .979 \quad DW = 2.253 \quad s = 95.1$$

$$(3a) \quad C_g = -1.6 + 0.0589 Y + 0.4402 C_{g-1}$$

(26.9) (0.0303) (0.2679)

$$\bar{R} = .977 \quad DW = 1.928 \quad s = 16.6$$

✓ Note that these two functions imply a marginal propensity to save of over 60%.

The investment and import demand functions, of major importance, both possess an interesting feature in that the net inflow of foreign capital, L, is made an explanatory factor:

$$(4) \quad I = d_0 + d_1 Y + d_2 L$$

MFI

$$(5) \quad M = m_0 + m_1 Y + m_2 L$$

✓ We have in  $d_2$  a most critical parameter, for thus far the only endogenous variable determining GNP is investment (since  $I = K - K_{-1}$ ). If  $d_2$  were zero, then GNP would be determined completely by the

production function, the investment function and the definition of K. Therefore a non-zero  $d_2$  is the critical means by which foreign resources are introduced into the model as one of the determinants of GNP. In addition, it will be seen later that  $m_2$  and  $d_2$  play an important role in determining the stability of the system.

④ - [ The authors do not present a theoretical basis for the inclusion of  $L$  in these functions, by which a priori expectations concerning the signs of the estimates of  $d_2$  and  $m_2$  would be obtained. (In the Chenery-Strout and IAEA models, foreign assistance is treated as a factor which fills the investment-saving gap or the foreign trade gap, whichever is more restricting to growth; but it is not made a determinant of either domestic investment or imports.)

[ If a country is struggling to support a fixed foreign exchange rate, then the following rationale may be offered. An increase in  $L$  would indicate increased pressure for the price of foreign exchange to increase, i.e., indicate an increased cheapness of imported goods relative to the case of foreign exchange rate equilibrium. Hence, and especially if this equilibrium is pictured as inevitable, added pressure would exist to increase imports of all commodities, investment goods included. Under this theory, the

signs of  $d_2$  and  $m_2$  would both be positive. These signs do not materialize in the case of the Philippines, but they do for almost all other countries for which estimates were made:

	<u><math>d_2</math></u>	<u><math>m_2</math></u>
Taiwan	.34	-.57
India	.26	.94
S. Korea	.39	1.06
Malaya	.60	.61
Pakistan	.28	.54
Philippines	-.26	-.25 //
Thailand	no estimate	.40

The estimates of the investment and import demand functions, from 2SLS, are:

$$(4a) \quad I = - 177.8 + 0.1822 Y - 0.2631 L^{11}$$

(75.6) (0.0194) (0.1901)

$$\bar{R} = .949$$

$$DW = 2.124$$

$$s = 44.9$$

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<sup>11</sup>In the published paper, the coefficient of  $L$  was given a positive sign, a typographical error discovered in recomputations. The error was verified by comparing published computed  $I$  - values for 1951-1964 with those computed from (4a).

$$(5a) \quad M = -188.7 + 0.2380 Y - 0.2461 L$$

$$(183.0) \quad (0.0470) \quad (0.4599)$$

$$\bar{R} = .841$$

$$DW = 1.957$$

$$s = 108.7$$

It may be noted that the estimates of  $d_2$  and  $m_2$ , both negative, have  $t$  - ratios of only 1.4 and 0.6 respectively. The nonconformity of the Philippine estimates with those of the other countries suggests that the coefficients of  $L$  in equations (4a) and (5a) might be handled with more hesitation than otherwise.

The model is completed by a simple trend function for exports, and the three definitional relations:

$$(6) \quad E = h_0 + h_1 t$$

$$(7) \quad K = K_{-1} + I$$

(8)

$$\boxed{L = M - E} \quad \text{external trade gap}$$

(9)

$$S = Y - C_p - C_g$$

Equation (6) is estimated by OLS:

(6a)

$$E = 163.8 + 48.35 t$$

$$(66.1) \quad (7.76)$$

$$\bar{R} = .863$$

$$DW = .774$$

$$s = 117.1$$

Equation (9) is not written  $Y = C_p + C_g + S$ , as originally stated, to emphasize the fact that savings is simply determined as a residual from GNP. In this model savings and the marginal propensity to save are quite immaterial from the viewpoint of the determination of either investment or GNP. [The model may be instructively divided into two blocks, the first block determining GNP through equations (1), (4), (5), (6), (7) and (8), and the second block using this level of GNP to determine  $C_p$ ,  $C_g$  and  $S$  through (2), (3) and (9). There is no feedback from the second block to the first.]

Table 1 contains the reduced-form coefficients of the estimated model. The critical coefficient, from the viewpoint of stability in the system, is that of  $K_{-1}$  in the equation for  $I$ , which is .021, i.e., current capital stock per se induces a positive level of investment in the succeeding period, and thus provides for its own indefinite growth, quite apart from the effects of the exogenous variables  $N$  and  $t$ . As a result, the interim multipliers for every endogenous variable<sup>12</sup> expand without limit. The said coefficient of  $K_{-1}$  may be obtained by combining (1), (4), (5), (6), and (8), arriving at

$$\frac{a_1 [d_1(1 - m_2) + d_2 m_1]}{(1 - a_1 d_1)(1 - m_2) - a_1 d_2 m_1}$$

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<sup>12</sup>Excepting  $E$ , of course, which in this model is affected solely by the time variable.

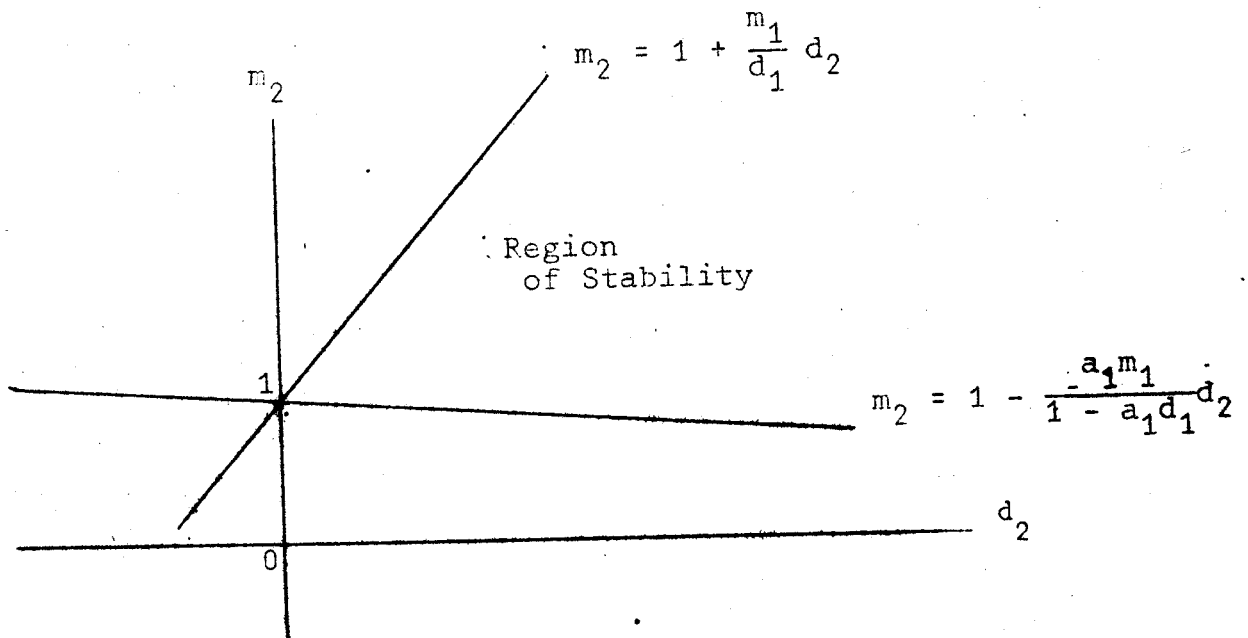
TABLE 1

REDUCED FORM COEFFICIENTS OF THE SHIBUYA-YAMASHITA ECONOMETRIC MODEL FOR THE PHILIPPINES

Endogenous Variables	Predetermined Variables					
	Const.	N	t	K <sub>-1</sub>	C <sub>p-1</sub>	C <sub>g-1</sub>
Y	-790.9	.1146	1.622	0.159	0	0
L	-434.0	.0219	-38.491	0.030	0	0
M	-270.2	.0219	9.859	0.030	0	0
E	163.8	0	48.350	0	0	0
I	-207.8	.0151	10.423	0.021	0	0
K	-207.8	.0151	10.423	1.021	0	0
C <sub>p</sub>	148.5	.0367	0.519	0.051	0.427	0
C <sub>g</sub>	- 48.2	.0067	0.096	0.009	0	0.440
S	-891.2	.0712	1.008	0.099	-0.427	-0.440

To determine the conditions under which this expression is negative instead, let us first assume that the production coefficient of capital ( $a_1$ ), the marginal propensity to invest ( $d_1$ ) and the marginal propensity to import ( $m_1$ ) are all positive fractions. Then the numerator is positive or negative depending respectively on whether  $m_2$  is less than or greater than  $1 + (m_1/d_1) d_2$ . And the denominator is positive or negative depending respectively on whether  $m_2$  is less than or greater than  $1 - (a_1 m_1 / (1 - a_1 d_a)) d_2$ . The values of  $m_2$  and  $d_2$  consistent with stability are then defined by the area indicated in Figure 1. Using the estimated values of  $a_1$ ,  $d_1$  and  $m_1$ , the upper boundary is defined by  $m_2 \leq 1 + 1.33 d_2$ , and the lower boundary is defined by  $m_2 = 1 - .04 d_2$ . As it turns out, neither the Philippine estimates nor the means of other-country estimates of  $m_2$  and  $d_2$  fall in the region of stability. This attaches a measure of inconvenience to the hypothesis that the external trade deficit is a direct determinant of investment and of imports.

The likely future contribution of foreign assistance to growth was then examined by considering (1) the implied growth in the trade gap, given an arbitrary GNP growth path for 1965-1970, and conversely (2) the implied GNP growth path, given arbitrary levels of the trade gap for 1965-1970. The first question was approached by combining



A Stability Region for the Shibuya-Yamashita Model

Figure 1

equations (5), (6) and (8) to get

$$(10) \quad L = \frac{m_0 - h_0}{1 - m_2} + \frac{m_1}{1 - m_2} Y^* - \frac{h_1}{1 - m_2} t$$

where  $Y^*$  is a predetermined level of GNP.<sup>13</sup>

Equation (10) must be carefully interpreted, however. It does not represent the amount of foreign assistance necessary to support  $Y^*$ , in the sense that adequate levels of inputs for  $Y^*$  will be employed<sup>14</sup>; it simply represents the trade gap that a GNP level of  $Y^*$  will induce. Note that the coefficient of  $Y^*$  is positive provided  $m_2$  is less than one (satisfied according to the estimates for all countries except South Korea), hence an increase in  $Y^*$  will increase the trade gap. Assuming the gap is financed from abroad, the effect on investment (allegedly a decrease,

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<sup>13</sup>The authors state (pp. 5-6) that  $L$  may also be obtained from the investment-saving gap, by combining equations (4), (9), (2) and (3) thus:

$$(10.1) \quad L = I - S = \frac{1}{1 - d_2} (d_0 - b_0 - c_0) + (1 + d_1 - b_1 - c_1)Y - b_2 C_{p-1} - c_2 C_{g-1}$$

This may be classified as belonging to Chenery-Strout's savings-limit phase (*infra*), whereas equation (10) would belong to the trade-limit phase. The authors' statement that the values of  $L$  from equations (10) and (10.1) are "expected to be theoretically equal" is certainly inaccurate from the *ex ante* view.

<sup>14</sup>Cf. Chenery-Strout (1965), p.19n., where it is clear that the concept of a "marginal import ratio" is concerned with input-requirements.

cet, par., according to the Philippine estimate for  $d_2$ ) is determined by combining (10) and the investment function (4), obtaining

$$(11) \quad I = \text{const.} + (d_1 + \frac{m_1}{1 - m_2} Y^*) - \frac{h_1 d_2}{1 - m_2} t$$

This generally will not be equal to the amount of investment necessary to provide the inputs for  $Y^*$ , which last may be obtained from manipulation of (1), giving

$$(12) \quad I = \text{const.} + \frac{1}{a} Y^* - \frac{a_2}{a_1} N - K_{-1}$$

It does not therefore seem appropriate to state that, by means of (10), "the required volume of foreign aid for accomplishing the target can be calculated".<sup>15</sup> A more appropriate relation can be obtained by introducing the necessary level of investment, from (12), in the investment demand function (4), and solving for the necessary level of  $L$ :

$$(13) \quad L = - \frac{a_0 + a_1 d_0}{a_1 d_2} + \frac{1 - a_1 d_1}{a_1 d_2} Y^* - \frac{1}{a_2} K_{-1} - \frac{a_2}{a_1 d_2} N$$

Thus we find that the necessary level of  $L$  depends also on the inherited capital stock and the population base. One would expect that less  $L$  would be needed if the levels of these input sources

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<sup>15</sup> Shibuya and Yamashita (1968), p.6.

were greater, and that more  $L$  would be needed if  $Y^*$  were greater i.e., one would have strong reasons to expect  $d_2$  to be positive,<sup>16</sup> and consequently to further doubt the negative Philippines estimate.

In general, when one drops an endogenous variable from a simultaneous model (and transforms it into an exogenous one, say), one drops an equation as well to keep the model determinate. By using (10), Shibuya and Yamashita have decided to drop the production function. On the other hand, equation (13) implies that the import demand function has been dropped instead, leaving imports to be determined simply by  $M = E + L$ . Equation (13) may be said to determine production requirements for foreign assistance, whereas (10) determines the trade supply of foreign assistance. Thus, in the complete model, GNP and the other endogenous variables may be said to be determined at levels consistent with the equality of the production requirements for and the trade supply of foreign assistance.<sup>17</sup>

To find the implications on GNP of an arbitrary level of foreign assistance  $L^*$ , the authors suggested either of two equations, the first of which amounts to equation (10) solved for  $Y$

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<sup>16</sup>The estimates of  $a_1$ ,  $a_2$ , and  $d_1$ , are all positive and less than one. These magnitudes and signs are as expected from parameters of a linear production function and from the marginal propensity to invest.

<sup>17</sup>The nature of the economic forces leading to this state would be another matter for question.

in terms of  $L^*$  (equation (1.14) in their text)<sup>18</sup> and the second of which amounts to equation (13) solved for  $Y$  in terms of  $L^*$  (equation (1.15) in their text). Using the same arguments as in the previous paragraph, the equations are not identical, and the latter is clearly more appropriate:

$$(14) \quad Y = \frac{a_0 + a_1 d_0}{1 - a_1 d_1} + \frac{a_1}{1 - a_1 d_1} K_{-1} + \frac{a_2}{1 - a_1 d_1} N + \frac{a_1 d_2}{1 - a_1 d_1} L^*$$

Again, for the marginal effect of foreign assistance on GNP to be positive, it is necessary for  $d_2$  to be positive.

Shibuya-Yamashita do present a computed positive relationship between  $Y^*$  and  $L$ , and between  $L^*$  and  $Y$ , deriving from equation (10) and its converse with  $Y$  expressed as a function of  $L^*$ . In the latter equation, the computed level of  $Y$  is that which is just sufficient to induce the trade supply level  $L^*$  (denote it  $Y_g$ ); whereas that (14) determines is that level of GNP which can be supported by the given level  $L^*$ , in the sense that sufficient levels of inputs will be employed.

Now turn to the marginal effect of a unit of foreign assistance on GNP, which effect, according to equation (14), is  $a_1 d_2 / (1 - a_1 d_1)$ . Following the several arguments above which dis-

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<sup>18</sup>This would be  $Y = - \frac{m_0 - h_0}{m_1} + \frac{1 - m_2}{m_1} L^* + \frac{h_1}{m_1} t$ .

count the possibility that  $d_2$  is negative (as the Philippine estimates says it is), let us fall back on the mean of the  $d_2$  - estimates for Taiwan, India, S. Korea, Malaya and Pakistan -- namely 0.37. Assume then that a marginal unit of  $L$  (one million dollars) induces \$370.000 worth of investment. This addition to the capital stock will then produce  $.156 (\$370.000) = \$ 58,000$  as an addition to GNP, given the estimate of  $a_1$  at .156. Given that the marginal propensity to invest,  $d_1$ , is .182, then investment will rise further by .182 (\$58,000), with subsequent effects on GNP and so on by the familiar multiplier process. In this case the multiplier is quite small,  $a_1$  and  $d_1$  being small fractions, and the total effect of one million dollars of foreign assistance on GNP, within the period, is only about \$60,000.

✓ In the Shibuya-Yamashita relation, i.e., equation (10), on the other hand, the marginal effect of a unit of foreign assistance on GNP is given by  $(1 - m_2)/m_1$ . If we accept the negative Philippine estimate for  $m_2$ , namely -.246, then this expression is estimated by  $(1 - (-.246))/.238$ , which is greater than 5.0, i.e., implying that a marginal \$1 million dollars of foreign assistance will raise GNP by more than \$5 million. If  $m_2$  is estimated instead by .71 (the mean of the estimates for India, S. Korea, Malaya, Pakistan and Thailand), then the expression reduces to  $.29/.248$ , still about twenty times greater than the corresponding estimate using equation (14).

In particular, GNP is not projected to vary significantly,<sup>19</sup> using equation (14) and the investment function, if  $L$  is assumed, alternatively,<sup>20</sup> (a) to be zero over 1965-1970, (b) to be constant at \$44.2 million<sup>21</sup> over 1965-1970; and (c) to grow by .5% annually over 1965-1970, with \$44.2 million as base in the beginning period less one. Furthermore, (d) if  $L$  is assumed to be zero over 1951-1964, the implied level of GNP is not significantly less than actual GNP for the same period. Figure 2 shows actual GNP,  $Y$  = GNP computed via equation (14), assuming zero foreign assistance and  $d_2 = .37$ , and  $Y_s$  = GNP computed by Shibuya and Yamashita, also assuming zero foreign assistance. It is seen that the level of GNP which zero-L is sufficient to produce is significantly greater than the level of GNP which is just sufficient to induce zero-L. Thus the Shibuya-

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<sup>19</sup>Using  $a_0 = -759$ ,  $a_1 = .156$ ,  $a_2 = .112$ ,  $d_0 = -178$ ,  $d_1 = .182$  and assuming  $d_2 = .37$ , equation (14) becomes approximately

$$Y = -810 + 0.16 K_{-1} + 0.115 N + 0.06 L^*$$

<sup>20</sup>Cases (a)-(d) here are identical to Shibuya and Yamashita's cases (3)-(6), pp.103-106. In case (b), they estimate (p.64) the (marginal) "productivity of aid" by

$$\frac{GNP_{70} - GNP_{65}}{L_{66} + L_{67} + L_{68} + L_{69} + L_{70}} = 4.53$$

By this measure, the "productivity of aid" is supposed to be greatest in the Philippines among all countries studied.

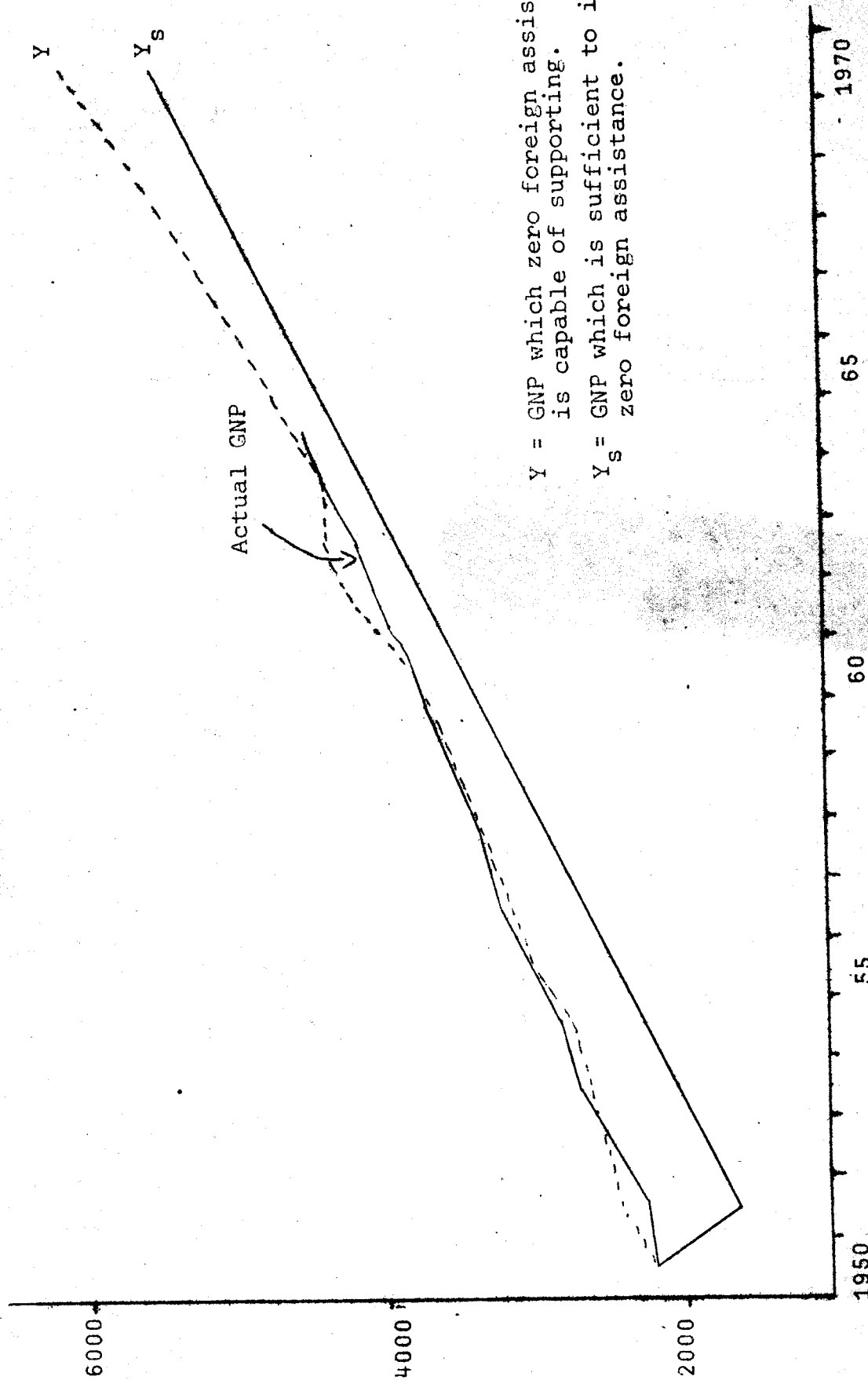
<sup>21</sup>This is the annual average for 1960-1964.

GNP

(million 1963  
US dollars)

Fig. 2

GNP Paths Under the Shibuya-Yamashita Model



$Y$  = GNP which zero foreign assistance  
is capable of supporting.

$Y_s$  = GNP which is sufficient to induce  
zero foreign assistance.

TABLE 2

THE SHIBUYA - YAMASHITA MODEL:  
ESTIMATES OF PHILIPPINE GNP GIVEN ZERO  
FOREIGN ASSISTANCE, 1951 - 1970  
In million 1963 U.S. dollars

	<u>Actual GNP</u>	<u>Y = GNP which zero foreign assistance is capable of supporting</u>	<u>Y<sub>s</sub> = GNP which is sufficient to induce zero foreign assistance</u>
1950	2,235		
1951	2,298	2,457	1,684
1952	2,510	2,547	
1953	2,758	2,650	
1954	2,847	2,758	
1955	3,060	3,022	
1956	3,276	3,166	2,700
1957	3,358	3,315	2,903
1958	3,499	3,472	3,106
1959	3,704	3,635	3,309
1960	3,805	3,808	3,512
1961	4,027	3,995	2,716
1962	4,166	4,191	3,918
1963	4,385	4,399	4,122
1964	4,550	4,618	4,325
1965		4,844	4,529
1966		5,080	4,732
1967		5,327	4,935
1968		5,585	5,138
1969		5,856	5,341
1970		6,138	5,544

NOTE: Actual GNP and Y<sub>s</sub> are from Shibuya-Yamashita (1968), pp. 44-45 and p. 106. For computation of Y, see text. The projections of Y and Y<sub>s</sub> over 1965 - 1970 take actual data for 1964 as given

Yamashita model itself, properly interpreted, leads to conclusions radically different from those drawn by the two authors. Although it was claimed (p.67), that the Philippines was characterized both by "high dependence on aid" and "high efficiency of aid", their model does not constitute evidence to this effect.

### Chenery and Strout's Model 1

Chenery-Strout (1965-1966) have presented a Harrod-Domar type model, in which production is determined by the interaction of investment and an incremental capital-output ratio,

$$k = \frac{I_{t-1}}{Y_t - Y_{t-1}} (?)$$

*should it not be*

$$= \frac{I_{t-1}}{Y_t - Y_{t-1}}$$

*because*

$$\Delta K_t = I_{t-1}$$

*right!*

Then the level of investment consistent with the target annual rate of growth,  $r$ , is

(15)

$$I_t = krY_t$$

This formulation implies of course that all non-capital inputs are in abundance, capital being the only scarce factor. Chenery-Strout assume that there may be instances in which a small supply of certain human skills, which are complementary to capital, would impose a maximum investment level less than that required by equation (15), specifically a level given by

(15.1)

$$I_t = I_0(1 + b)^t$$

*it all depends from what you start from*

*OF*

Chenery and Strout then postulate a maximum-savings function

$$(16) \quad S'_t = S_0 + a'(Y_t - Y_0) \quad .$$

where  $a'$  is the maximum marginal propensity to save, and a minimum-import function:

$$(17) \quad M'_t = M_0 + m'(Y_t - Y_0) \quad ,$$

where  $M'_t$  is the minimum level of imports needed to sustain  $Y_t$ , in an input - output sense, ( $m'$ ), being the minimum marginal import ratio. Exports are assumed simply to grow at a constant potential rate,

$$(18) \quad E_t = E_0(1 + g)^t \quad .$$

Note that relations (15)-(18) are forms containing very few parameters requiring estimation.

In the maximum-savings function,  $a'$  is intended to include not only the private marginal propensity to save but also the government's ability to increase total savings by taxation and other policies. The minimum-import relation, on the other hand, results "from the relatively inelastic demand for a large proportion of the manufactured goods currently imported -- particularly intermediate goods

and investment goods -- arising from the lack of domestic supply and their necessity in production."<sup>22</sup>

11- [In this theory, growth is limited by whichever is greater,  $I_t - S'_t$ , the ex ante minimum investment-savings gap, or  $M'_t - E_t$ , the ex ante minimum external trade gap.]  $I_t$  is given by (15) subject to the condition that the maximum indicated by (15.1) is not exceeded. If inadequate savings is the problem in any given year, then required foreign assistance is given by

(19) (\*)  $L_t = I_t - S'_t ;$  ✓

otherwise, it is given by

(20)  $L_t = M'_t - E_t$  ✓

Ex post, of course, we always have  $I_t - S_t \equiv M_t - E_t$ . Estimation of the extreme-value parameters  $b$ ,  $a'$ ,  $m'$  and  $g$  from ex post data is therefore an important problem.<sup>23</sup> In their preliminary study (1965), Chenery-Strout estimated  $b$  by the highest investment growth rate over a recent 5-year period; this turned out to be 7.8% p.a. over 1958-1962. They fit time trends

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<sup>22</sup>Chenery-Strout (1966), p.689.

<sup>23</sup>Cf. Fei and Ranis (1968), pp.909-10.

to 1957-1962 data, then used the computed changes in exports, savings, imports and GNP to estimate  $g$  at .046,  $a'$  at .26, and  $m'$  at .07. (Such estimates would appear not to represent the extreme values called for by the model.) Later (1966), they put  $a'$  and  $m'$  at greater extremes,<sup>24</sup> and presented the following estimates:

$$k = 2.78, a' = .30, m' = .01, g = .046, b = .078.$$

With these parameters and the 1962 (base year) data published<sup>25</sup> by Chenery-Strout, the model may be applied for any target growth rate to estimate the minimum value of external assistance needed to support the target level of GNP for a given year.<sup>26</sup> If  $r = .05$ , then the model gives for 1963 a minimum required ratio of external assistance to 1962 GNP of 1.1%. In this year the ex ante trade gap turns out to be about equal to the ex ante savings gap. In 1964, the ex ante trade gap is the larger, at 0.3% of 1962 GNP. And after 1964 the gaps would vanish and the target growth rate would be maintained solely by domestically generated capital formation. The total minimum external assistance over 1963 and 1964 comes to about \$53 million dollars of 1963 purchasing

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<sup>24</sup>The estimation procedure was not indicated.

<sup>25</sup>Chenery-Strout (1966), pp.706,731.

<sup>26</sup>Although Chenery-Strout disclaimed accuracy of their model if applied to any one country, the results may be interesting to students of the Philippping economy.

power. These results may account for the effusive statement: "The possibilities of securing rapid and sustained development by effective use of foreign assistance have been strikingly demonstrated in the past decade by such countries as Greece, Israel, Taiwan and the Philippines."<sup>27</sup>

✓ The most obvious note of caution is that the estimates of minimum required levels of assistance are likely to be rather distant from expected required levels of assistance, even if one accepts the basic model. Considering only 1962-1967 (corresponding to Chenery-Strout's forecast period), the data in Table 3 indicate: (1) a marginal propensity to save of  $.3$  out of GNP is only occasionally attainable; (2) a minimum marginal propensity to import of say  $.15$  is much more realistic than one of  $.01$ ; however, (3) the maximum sustainable exports growth rate would seem to be somewhat larger than 4.6% p.a.

### The IAEA Model

The main difference between the IAEA model and the two previous is the lack of a production relationship. A given level of GNP is implicitly viable so long as induced investment equals total (domestic and foreign) savings, in the savings-limit variation, or so long as the trade gap is met by a net inflow of foreign capital,

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<sup>27</sup>Chenery and Strout (1966), p.679..

Table 3. The Philippines: Net Borrowing from Abroad,  
Inventory and GNP, 1946 - 1967

	Exports E	Imports M	Net Borrowing from Abroad L = M - E		Gross Domestic Capital Formation I	Gross National Product Y
			L	E		
(In million pesos at 1955 prices)						
1946					291	2,951
1947	727	1,306	579		705	4,166
1948	1,049	1,283	234		935	4,928
1949	786	1,653	867		936	5,489
1950	767	830	63		841	5,967
1951	841	905	64		785	6,477
1952	979	923	56		767	7,001
1953	924	1,046	122		944	7,589
1954	1,030	1,110	80		999	8,226
1955	1,131	1,319	188		1,083	8,801
1956	1,175	1,134	41		1,203	9,437
1957	1,103	1,306	203		1,416	9,987
1958	1,055	1,130	75		1,412	10,365
1959	985	951	34		1,580	11,080
1960	1,167	1,043	124		1,407	11,229
1961	1,193	1,404	211		1,817	11,961
1962	1,186	1,969	783		1,902	12,696
1963	1,447	1,780	333		2,192	13,631
1964	1,582	2,155	573		2,439	13,970
1965	1,849	2,293	444		2,577	14,734
1966	2,319	2,415	96		2,662	15,618
1967	2,150	3,010	860		2,854	16,555

Source: OSCAS, NEC. Overall revision as of 30 August 1968.

Table 3. The Philippines: Net Borrowing from Abroad,  
Inventory and GNP, 1946 - 1967 (continued)

	Exports E	Imports M	Net Borrowing from Abroad L = M - E	Gross Domestic Capital Formation I	Gross National Production Y
				(Annual percentage changes)	
1947				142.3	41.2
1948	44.3	- 1.8	- 59.6	32.6	18.3
1949	- 25.1	28.8	270.5	0.1	11.4
1950	- 2.4	- 49.8	- 92.7	- 10.2	8.7
1951	9.6	9.0	1.6	- 6.7	8.5
1952	16.4	2.0	- 187.5	- 2.3	8.1
1953	- 5.6	13.3	317.9	23.1	8.4
1954	11.5	6.1	34.4	5.8	8.4
1955	9.8	18.8	135.0	8.4	7.0
1956	3.9	- 14.0	- 121.8	11.1	7.2
1957	- 6.1	15.2	595.1	17.7	5.8
1958	- 4.4	- 13.5	- 63.1	- 0.3	3.8
1959	- 6.6	- 15.8	- 145.3	11.9	6.9
1960	18.5	9.7	- 364.7	- 11.0	1.3
1961	2.2	34.6	270.2	29.1	6.5
1962	- 0.6	40.2	271.1	4.7	6.1
1963	22.0	- 9.6	- 57.5	15.2	7.4
1964	9.3	21.1	72.1	11.3	2.5
1965	16.9	6.4	- 22.5	5.7	5.5
1966	25.4	5.3	- 78.4	3.3	6.0
1967	- 7.3	24.6	795.8	7.2	6.0

Source: OSCAS, NEC. Overall revision as of 30 August 1968.

in the trade limit variation. The further implication is that the economy is generally characterized by excess capacity, in the most elementary Keynesian fashion, all inputs being abundant and readily employable at existing rates of compensation. On the other hand, the Chenery-Strout ICOR relationship presumes that capital is the scarce factor, and the Shibuya-Yamashita production function allows for separate contributions from capital and labor.

In their notation,  $I_p$  is private gross investment,  $I_g$  is government gross investment, and  $J$  is the increase in inventory. Units are in million 1962 U.S. dollars. The savings-limit variation of the model, as estimated for 1953 - 1963, consists of equations (23)-(29) following.

$$(23) \quad I_{pt} = -525.19 + 0.223 Y_t \\ (0.001)$$

$$R^2 = .900$$

$$(24) \quad I_{gt} = 12.69 + 0.017 Y_t \\ (0.000)$$

$$R^2 = .823$$

$$(25) \quad J_t = 108.28 - 0.031 Y_t + 0.212 (Y_t - Y_{t-1}) \\ (0.000) \quad (0.010)$$

$$R^2 = .695$$

$$(26) \quad S_t = - 559.14 + 0.205 Y_t \\ (0.001)$$

$$R^2 = .858$$

$$(27) \quad I_t = I_{pt} + I_{gt} + J_t$$

$$(28) \quad Y_t = Y_0 (1 + r)^t$$

$$(29) \quad L_t = I_t - S_t$$

It may be noted that the estimate of the marginal propensity to save is somewhat more reasonable here than in the Shibuya-Yamashita model. On the other hand, the implicit marginal propensity to invest out of current GNP is  $.223 + .017 + .212 - .031 = .422$ , which is rather large. No rationale is given for the curious form of the inventory-change function.

The trade-limit variation consists of (28) above and

$$(30) \quad M_t = 64.77 + 0.918 E_t \\ (0.003)$$

$$R^2 = .966$$

$$(31) \quad E_t = - 786.22 + 0.381 Y_t \\ (0.005)$$

$$R^2 = .770$$

(32)

$$L_t = M_t - \frac{F_t}{S_t}$$

The import function is another unexplained curiosity. The marginal propensity to import implied by (30) and (31) is about .35; compare Shibuya-Yamashita's .238.

The IAEA projections of foreign assistance requirements in 1975 are found in Table 4. They assume  $r = 5.6\%$ , the historical growth rate (1962 prices). They forecast a savings insufficiency of \$266 million, but no trade insufficiency. (This is a rather large gap in comparison to recent ex post levels of net foreign borrowing; see Table 3.) For comparison, the IAEA group also applied the Chenery-Strout model, using alternatively the Chenery-Strout parameter values and the IAEA parameter values, and obtained substantially the same conclusion arrived at earlier, namely that the Chenery-Strout model foresees neither a savings nor a trade insufficiency for the Philippines in the intermediate future.

? ww!  
Immediate ? NO → in the very distant future!

If the assumption of general excess capacity in the economy is invalid, then the IAEA model suffers from a fault very similar to that found in the Shibuya-Yamashita presentation, viz., the quantity  $(I - S)$  will represent a gap induced by the desired level of GNP, but the filling of this gap will not necessarily provide for the

Table 4

I.A.E.A. PROJECTIONS OF PHILIPPINE FOREIGN ASSISTANCE  
REQUIREMENTS, 1975  
In million 1962 U.S. dollars

	I.A.E.A. <u>model</u>	<u>Chenery-Strout model</u>	
		<u>Own parameters</u>	<u>I.A.E.A. parameters</u>
<u>y<sup>a/</sup></u>	8,073		
I	1,362		
S	1,096		
I - S	266	- 357	- 347
M	2,167		
E	2,290		
M - E	- 123	- 260	-1,446

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<sup>a/</sup> Assumed annual growth rate is 5.6%.

Source: I.A.E.A. (1968), pp.148 and 150.

employment of the inputs needed to produce this desired level of GNP. Some type of input-output relationship is needed to complete the theory.<sup>28</sup>

### Concluding Remarks

\*The issue of whether external assistance has been or is likely to be an important factor contributing to Philippine economic growth remains unsettled. Shibuya-Yamashita have made the most pessimistic observations; but their model is far from satisfactory. And it has been argued that even granting their model, the conclusions ought to have been rather different. ✓The Chenery-Strout one-factor model would indicate that the Philippines is or soon will be on the phase of "self-sustaining growth", in the sense that neither a savings limit nor a trade limit will operate as a constraint to growth. The model is however posed in terms of all manner of ex ante minima and maxima, such that its parameters are difficult to estimate. "Safe" extreme values of the parameters may be the source of the optimistic view which the model produces. The IAEA excess-capacity model is least satisfactory of all, implying that external assistance makes its contribution to growth solely by augmenting aggregate demand. This is the main reason for an unconvinced attitude towards the forecasts.

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<sup>28</sup>The IAEA group rejected the Chenery-Strout method of simply using an ICOR, on grounds of bad statistical fit. They apparently claim it an advantage that their investment function does not involve the problem of measuring the "troublesome" capital coefficient. Op. cit., p.145.

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