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EXPORT AS AN ADDITIONAL VARIABLE IN THE INCOME DETERMINING FUNCTION OF H-D TYPE GROWTH MODEL

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I. INTRODUCTION

THERE has been a great deal of strong criticism of the application of the Harrod-Domar (hereafter abbreviated as H-D) type growth model to the analysis of economic development of LDCs.[1]

There is good reason for such criticism in view of the weakness in the model as detailed in Section II. Admitting the fairness of the criticism, we still can not refrain from asking the following questions. Is the model really useless and harmful to development studies? If it is an ineffective tool in describing LDC economies, how can we improve it?

One defect in the earlier version of the H-D type growth model[2] was an apparent negative relation between exports and economic growth found in the derivative of the model.[3]

To overcome this defect the innovation of the two-gap approach of the model[4] was introduced and has gained remarkable popularity in its theoretical extension and application for the study of economic development.[5]

Are there any other ways in which it is possible to improve the H-D type growth model? To answer this question, it may be worthwhile to see what has been done so far in empirical studies on the relationship between exports and the economic growth of LDCs.

As a matter of fact, this is one of the most popular topic in the study of economic development, especially in the context of export instability and economic growth, either in the form of partial analysis or in the complete model analysis, some with theoretical reasoning and others with mainly empirical results. The findings in these earlier works on exports and economic growth, if any, should be considered in any study trying to improve the H-D type growth model.

The purpose of this article is to clarify the role of exports in economic growth

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1 For example, Myint [16, p. 478].

2 For the definition of the H-D type growth model in its simplest form, see Section II.

3 Ball [2, p. 617]. See also the discussion in Section II.

4 See Chenery et al. [3].

5 One example is Weisskopf [20].

within the framework of the H-D type growth model and to present an example of the revised version.

The second purpose is to identify the conditions separating the different long-term effects of exports on economic growth in the theoretical framework of a revised H-D type growth model.

The difference in economic structure, stages of development and the potential capacity of development in the variety of LDCs will certainly necessitate a different set of policies for development. Though the model in this study is too simple to meet fully the requests from LDCs, we intend to examine the effects of alternative policies on economic growth as the third purpose of this article.

In the next section the mathematical properties of the H-D type growth model will be reviewed and its insufficiency in describing the reality of the relations between exports and economic growth will be presented. Section III contains some of the earlier works on exports and economic growth surveyed and compiled in tabular form. Section IV, the main part of this article, illustrates the revision of the H-D type growth model in which the role of exports in economic growth is explicitly identified with its theoretical properties. In the final section implication of the results from the revised H-D type model in search of policy suggestions for economic development and a trial application of the model for four Southeast Asian countries will be discussed.

II. H-D TYPE GROWTH MODEL IN ITS SIMPLEST FORM

A. *Theoretical Properties*

We describe the simplest form of H-D type growth model[6] in the following five equations:

$$Y_t=\beta K_t, \tag{1}$$

$$C_t=\alpha Y_t, \tag{2}$$

$$M_t=\mu Y_t, \tag{3}$$

$$E_t=E(0)e^{rt}, \tag{4}$$

$$Y_t=C_t+\dot{K}_t+E_t-M_t. \tag{5}$$

Y_t: GDP, K_t: capital stock, C_t: consumption, M_t: import, E_t: export, $\dot{K}_t$: investment, α, β, μ: parameters, r: export growth rate, and $E(0)$: initial value of export.

From equations (1)–(5) we can obtain the following differential equation about K_t:

$$\dot{K}_t=\rho\beta K_t-E(0)e^{rt}, \tag{6}$$

where

$$\rho=(1-\alpha+\mu). \tag{7}$$

[6] Theoretical discussion on another modified version of the H-D type growth model appears elsewhere; see Fukuchi and Imagawa [7].

Dividing both sides of the equation (6) by K_t, the following equation (8) concerning the growth rate of capital stock will be obtained:

$$\frac{\dot{K}_t}{K_t}=\rho\beta-\frac{E(0)}{K_t}e^{\gamma t}. \tag{8}$$

If other things are equal, the relation between the growth rate of export (γ) and the growth rate of capital stock ($\dot{K}_t/K_t$) in equation (8) may appear to be negative, since

$$\partial(\dot{K}_t/K_t)/\partial\gamma<0. \tag{9}$$

Combining equations (1) and (8), we may conclude that the growth rate of GDP will be decreased by raising the growth rate of exports. This is the most unrealistic characteristic of this simple growth model which we found confusing when we tried to apply it in analysis of the economic development of LDCs.

For example, Ball [2, p. 617] states that "the [slightly modified H-D type growth] model serves to suggest that 'export biased' development based on consideration of comparative advantage may be open to a direct objection in terms of the effect on the rate of growth of income."[7]

However, we can not agree with him. It will be necessary to consider the long-term effect of exports on growth. To examine this effect, we will take the following procedure based on the solution of the differential equation about K_t (6).

First, we define the growth rate of GDP as:

$$R_Y=\dot{Y}_t/Y_t. \tag{10}$$

Definition of Self-Sustained Growth (SSG):

$$\lim_{t\to\infty}Y_t>0, \quad \lim_{t\to\infty}\dot{Y}_t>0. \tag{11}$$

Definition of Successful Export Drive (ED):

$$\lim_{t\to\infty}\partial R_Y/\partial\gamma>0. \tag{12}$$

In the context of the model (1)–(5),

(i) The solution of GDP is given by:

$$Y_t=\beta[K(0)+A]\,e^{\rho\beta t}-\beta Ae^{\gamma t}, \tag{13}$$

[7] Although Ball's model has a slightly different balance of payments equation as [2′] below shows, its main structure is the same as the typical H-D type growth model:

$$\Delta Y_t=\sigma It, \qquad [4]$$
$$C_t=(1-s)Y_t, \qquad [3]$$
$$\Delta M_t=m\Delta Y_t, \qquad [10]$$
$$-\Delta D_t=\Delta X_t-\Delta M_t, \qquad [2']$$
$$Y_t=C_t+I_t-\Delta D_t, \qquad [1']$$

where Δ: increment, σ: inverse of incremental capital output ratio. The negative relation between the increment in exports (ΔX) and the growth rate of GDP ($\Delta Y/Y$) can be found in the following equation [11] derived from the model above:

$$\frac{\Delta Y}{Y}=\frac{s\sigma}{1-\sigma m}-\frac{\Delta X}{Y}\frac{\sigma}{1-\sigma m}. \qquad [11]$$

where

$$A=\frac{E(0)}{(\gamma-\rho\beta)}, \tag{14}$$

with the initial value of $K(0)$ and $E(0)$.

(ii) The conditions for SSG are:

$$\rho\beta>\gamma, \quad K(0)+A>0. \tag{15}$$

(iii) The conditions for ED are:

$$\rho\beta>\gamma, \quad K(0)+A<0 \quad \text{or} \quad \rho\beta<\gamma. \tag{16}$$

Following is the proof of (i), (ii), and (iii) above.

(i) Solving the differential equation (6) we can obtain

$$K_t=\left[K(0)+\frac{E(0)}{(\gamma-\rho\beta)}\right]e^{\rho\beta t}-\frac{E(0)}{(\gamma-\rho\beta)}e^{\gamma t}. \tag{17}$$

Then, we can rewrite the equation (1) by the equation (17) into the form of equation (13) completing (i).

Being differentiated by time t, equation (13) becomes

$$\dot{Y}_t=\beta^2\rho[K(0)+A]e^{\rho\beta t}-\beta\gamma Ae^{\gamma t}. \tag{18}$$

(ii) The conditions for SSG can be confirmed by equations (10), (13), and (18).

(iii) The conditions for ED are the following:

Taking into consideration that (10) consists of (13) and (18) and differentiating (10) by γ,

$$\frac{Y^2}{\beta^2}\frac{\partial R_Y}{\partial\gamma}=A^2e^{2\gamma t}+[(\rho\beta-\gamma)A'X+(\rho\beta-\gamma)tAX \\ -(\rho\beta-\gamma)A'A-AX]e^{(\rho\beta+\gamma)t}, \tag{19}$$

where

$$X=K(0)+A. \tag{20}$$

If $\rho\beta>\gamma$ and $X<0$, the second term in the parenthesis of the right-hand side of the equation (19) will prevail as $t\to\infty$ and positive.

If $\rho\beta<\gamma$, the first term in the right-hand side of the equation (19) will prevail as $t\to\infty$ and always positive.

B *Implication of the Model*

As the condition for SSG shows, if the combination of parameters estimated for a certain country happens to be $\rho\beta<\gamma$, it means that the country can not achieve SSG as far as it remains in the economic structure described by the model.

Even if $\rho\beta>\gamma$, if $K(0)+A$, the combination of the initial condition of $K(0)$ and $E(0)$ with parameters, can not be positive, again the country can not enjoy SSG in the long run, since it fails to fill the necessary conditions.

Next, let us examine the conditions for guaranteeing the positive effect of exports on the growth rate of GDP. As long as condition (iii) can be satisfied, an increase in exports always has a positive effect on the growth rate of GDP.

So what has worried Ball does not always prevail. The long-term effect and the direction of exports on economic growth entirely depends on the size of parameters and initial conditions of the model.

However, comparison of the conditions for SSG (15) and that for a successful export drive (16) suggests that SSG can not be guaranteed in the long run if the country keeps following an export drive policy for its economic development.

This is apparently one of the most unrealistic properties of the model described above, which should be revised so that the model will be applicable for the analysis of LDCs' economic development and policy.

Before undertaking revision of the above model, it may be quite useful to see what were the findings in the empirical works on the relationship between exports and economic growth in general.

III. EARLIER WORKS ON EXPORTS AND ECONOMIC GROWTH

In this section we attempt to find empirical evidence supporting the hypothesis adopted in the revision of the H-D type growth model in the next section.

Thirteen years have passed since Massell et al. wrote in their small article that "although the theoretical reasoning for expecting a strong link between export and economic growth are well established, there have been few empirical studies of this relationship" [14, p. 208].

Now we can find an enormous number of empirical works on the subject, especially on export instability and economic growth as shown in the latest survey article by Lam [10].

In the study of export instability and economic growth, the common practice is cross-country analysis. First, exports as well as GDP from the data of the individual country are prepared in the form of an instability index or growth rate. Then the regression equation of the GDP variable explained by the export variable is estimated to see the effect of export instability on economic growth.

Though the importance of studying the impact of export instability on economic growth can not be ignored, we will focus our interest on the relation between the growth rate of exports and that of GDP appearing in the thirteen articles selected and summarized in tabular form in Table I. It may be most appropriate to study them in chronological order.

First, we will take MacBean [12] published in 1966. In his pioneering work investigating export instability and economic growth, the main tool is a cross-country analysis using the data from twenty-two LDCs. Among the variables explaining the rate of growth of GDP ($\dot{Y}$) in the equation the growth rate of total import capacity ($\dot{X}$) has a positive and significant effect on $\dot{Y}$.

In 1967, Emery [5], trying to offer empirical evidence that the rise in exports stimulates an increase in economic growth, also applied a cross-country analysis to the data of fifty LDCs and DCs. The result shows a positive and stable relationship between exports and economic growth.

In the study of sixteen overseas sterling countries in relation to exports and economic growth published in 1968, Maizels [13] calculated the regression equa-

TABLE I

SUMMARY OF EARLIER WORKS ON EXPORTS AND ECONOMIC GROWTH

Author [Source] year	Choice of Variables and Functional Form	Data Coverage
MacBean [12] 1966	$R_Y=f(\ ,+R^*_Z,\ )$ $R_Y=f(\ ,+R_Z,+X/Y,\ )$	Cross-sectional: 1950/51–1957/58, 22 LDCs.
Emery [5] 1967	$R_Y=f(\ +R^*_X)$	Cross-sectional: 1953–63, 50 LDCs & DCs.
Maizels [13] 1968	$Y=f(X^*)$ $R_Y=f(\ +R^*_X)$	Time Series: 1953–62, 4 DCs & 5 LDCs, separately. Cross-sectional: 16 OSCs.
Cohen [4] 1968	$\Delta Y/Y=f(\ ,+\Delta X/Y,\ )$	Cross-sectional: 1955–60, 27 LDCs; 1960–65, 41 LDCs.
Kenen et al. [9] 1972	$R_Y=f(\ ,+A,\ )$ $R_Y=f(\ ,+A^*,\ )$ $R_Y=f(\ ,+A^*,\ )$	Cross-sectional: 1950–66, 30 LDCs. 1956–67, 30 LDCs. 1956–67, 50 LDCs.
Massell et al. [14] 1972	$\Delta Y=f(\ ,+\Delta X^*,\ )$	Cross-sectional: 1955–66, 11 Latin American States.
Glezakos [8] 1972	$R_y=f(\ ,+R^*_X,\ )$	Cross-sectional: 1950–66, 18 DCs & 50 LDCs, separately.
Voivodas [19] 1974	$R_Y=f(\ ,-X/Y,\ )$ $R_Y=f(\ ,+\Delta X/Y^*,\ )$	Cross-sectional: 1956–68, 31 LDCs & 6 PPDCs.
Lim [11] 1976	$R_Y=f(\ ,-X/Y,\ )$ $R_Y=f(\ ,+\Delta X/Y,\ )$ $R_Y=f(\ ,-X/Y,\ )$ $R_Y=f(\ ,-\Delta X/Y,\ )$	Cross-sectional: 1956–68, 29 LDCs & 6 PPDCs. 1956–73, 29 LDCs & 6 PPDCs.
Rangarajan et al. [17] 1976	$+\frac{\partial Y}{\partial X}$: Multiplier	Separate country model: 2 DCs & 11 LDCs.
Michaely [15] 1977	Coefficient of rank correlation $R_y \pm R_{(X/Y)}$	1950–73, +: 23 LDCs above U.S. $300. −: 18 LDCs U.S. $300 or less.
Balassa [1] 1978	$R_Y=f(K/Y^*,\ F/Y^*,\ R^*_L,\ +R^*_X)$	Cross-sectional: 1960–66, 1966–73, 10 middle income LDCs.
Tyler [18] 1981	$R_Y=f(R^*_K,\ R^*_L,\ +R^*_X)$	Cross-sectional: 1960–66, 41 middle income LDCs (37 non-oil middle income LDCs).

Notes: 1. A: trend term of export, Δ: increment, F: current account balance, K: capital, L: labor force, OSC: overseas sterling countries, PP: primary producing, R: growth rate, X: export, Y: GDP, y: per capita GDP, Z: import capacity.

2. +: Coefficient has positive sign.
−: Coefficient has negative sign.
*: Statistically significant at the 0.05 level.

tion of GDP on the volume of exports using the time series data of each country. All but India have a positive and statistically meaningful coefficient.

In the same year, Cohen [4], examining the relative effects of exports and foreign capital on the economic growth of LDCs, presented a cross-country analysis of two kinds; one from the data on foreign trade and GNP of twenty-seven LDCs for the late 1950s, which has a better result than the other from the data of forty-one LDCs for the first half of the sixties.

The purpose of the analysis by Kenen et al. [9] published in 1972 was to reexamine MacBean's claim that there is no systematic relationship between instability in exports and economic growth. However, the trend term of export included in his regression equation of GDP has a positive and stable effect.

The study by Massell et al. [14] in 1972 which more or less along the lines of the study by Cohen [4], was based on the regression equation with variables in the form of first difference estimated by pooling data from the sample of eleven Latin American countries for twelve years. Again, exports were shown to have a positive and significant effect on GNP.

Glezakos [8] examining the effect of export instability on economic growth presented a cross-country analysis of eighteen DCs and fifty LDCs separately. In the equation, growth rate of export proceeds explaining the growth rate of real per capita income has a positive and stable effect.

Interested in the effects of export instability on the import of capital goods, Viovodas [19] presented in 1974 his cross-country analysis based on the data from thirty-one LDCs and six primary producing DCs. The changes in export receipts are positively and significantly related to the growth rate of GDP, for which an equation has been obtained as a reduced form of the model with an explicit H-D framework.

In his article published in 1976, Lim [11] summarizes four main earlier works, i.e., MacBean [12], Kenen et al. [9], Glezakos [8], and Voivodas [19] and presents his own trial of regression analysis, which has a similar specification to that by Voivodas, using data from a sample of twenty-nine LDCs and six primary producing DCs, though the result is somewhat different from what has been done by Voivodas.

Rangarajan et al. made their study public in 1976 with the aim of proving that "the impact of exports on economic growth varies from country to country" [17, p. 368]. The model, specifies so that exports would have the usual Keynesian-type multiplier effect, is estimated for eleven LDCs and two DCs, supporting the conclusion that "the effect has to be examined for each country separately" [17, p. 372].

The important finding by Michaely in 1977 was that "growth is affected by export performance only once countries achieve some minimum level of development" [15, p. 52]. The difference in the correlation between changes of per capita GNP and that of ratio of exports to GNP calculated for separate groups of twenty-three countries (above U.S.$300 of per capita income) and of eighteen countries (U.S.$300 or less) supports his conclusion.

What Balassa [1] did in 1978 is most relevant to our study in the next section.

Here, in order to explain GNP growth rate, domestic and foreign investment and labor as explanatory variables with exports are used. The reasoning is that "the inclusion of export in a production-type relationship is warranted on the grounds that exports tend to raise total factor productivity."[8] The regression from the pooled data of ten countries indicates that adding the export variable in the equation raises the coefficient of determination significantly and all the parameters are positive and stable.

[8] Balassa [1, p. 185]. He also explains that this attempt was first introduced by C. Michalopoulos and K. Jay in AID Discussion Paper No. 28 (Agency for International Development, Washington, D.C.) in 1973, though the present author could not locate the article. However, the same attempt was presented two years earlier in 1971 with theoretical discussion by Fukuchi [6]. Being much inspired by his finding, the present author has attempted to develop the role of exports within the framework of the H-D type growth model. As the theoretical background supporting our analysis, it is most appropriate to present his process of reasoning [6, pp. 253–54]. He begins with the following simple H-D type growth model where the notation of symbols are the same as ours except for k, capital output ratio.

$$kY_t=K_t, \quad [1]$$
$$Y_t=C_t+I_t+E_t-M_t, \quad [2]$$
$$C_t=\alpha Y_t, \quad [3]$$
$$M_t=\mu Y_t, \quad [4]$$
$$E_t=E(0)e^{rt}, \quad [5]$$
$$\dot{K}_t=I_t. \quad [6]$$

Equations (1)–(4) yield

$$I_t=\frac{(1-\alpha+\mu)}{k}K_t-E_t. \quad [7]$$

In the absence of sectoral data, k in the above model seems to be postulated as the weighted sum of sectoral capital output ratios implicitly assuming the following relations between sectoral production for C_t, I_t, and E_t and sectoral capital stock (K_c, K_i, K_e) with sectoral capital output ratio (k_c, k_i, k_e).

$$k_cC_t=K_{ct}, \quad [8]$$
$$k_iI_t=K_{it}, \quad [9]$$
$$k_eE_t=K_{et}, \quad [10]$$
$$K_t=K_{ct}+K_{it}+K_{et}. \quad [11]$$

Then, equations [1], [3], [4] and [8]–[11] yield

$$I_t=\frac{1}{k_i}\left(1-\alpha\frac{k_c}{k}\right)K_t-\frac{k_e}{k_i}E_t. \quad [12]$$

Equating [7] and [12], k can be defined as a combination of sectoral capital output ratios shown by [13]:

$$k=k_c\alpha+k_i(1-\alpha+\mu)+(k_e-k_i)E_t/Y_t. \quad [13]$$

Finally, from [1] and [13] one can show equation [14], the following:

$$Y_t=\frac{1}{k_c\alpha+k_i(1-\alpha+\mu)}K_t+\frac{k_i-k_e}{k_c\alpha+k_i(1-\alpha+\mu)}E_t. \quad [14]$$

It is most appropriate to assume $k_i>k_e$, especially for LDCs, then, the coefficient of E_t in the equation [14] should be positive. He concludes that if the assumption on aggregate k above is accepted, the equation [14] implies that exports should be incorporated explicitly in the income determining function of a macro model.

Tyler [18] following what Balassa [1] had done, though the country coverage is much wider than Balassa's, presented his cross-country analysis in 1981. He claimed a result demonstrating a strong cross-country association between export performance and GNP growth.[9]

IV. REVISION OF H-D TYPE GROWTH MODEL

We are now aware that the positive and stable effect of exports on economic growth has been clearly demonstrated in the most of the earlier works on exports and economic growth surveyed in the previous section.

Although Balassa [1, pp. 185–86] and Tyler [18, pp. 126–27] have not presented fully their theoretical reasoning on the inclusion of exports as one of the additional variables in the Cobb-Douglas type production function, these earlier works strongly suggest that exports should play a direct role in determining the level of GDP in the macro growth model, which has been supported by Fukuchi [6].

We specify the positive effect of exports on GDP in the following way and call it the revised model.

$$Y_t=\beta K_t+\eta E_t\,, \tag{21}$$

$$C_t=\alpha Y_t\,, \tag{2}$$

$$M_t=\mu Y_t\,, \tag{3}$$

$$E_t=E(0)e^{rt}\,, \tag{4}$$

$$Y_t=C_t+\dot{K}_t+E_t-M_t\,. \tag{5}$$

The equation (21) can be regarded as a sort of reduced form including both a supply factor and the external demand factor of export. One caution should be given that the equation can not be called a production function since exports can not be regarded as a production factor. Here, η is the additional parameter assumed positive ($\eta>0$), which we may temporarily term the propensity to induce production. Following the same procedure in Section II, we can obtain the following differential equation about K_t.

$$\dot{K}_t=\rho\beta K_t+(\rho\eta-1)E(0)e^{rt}\,, \tag{22}$$

where again

$$\rho=(1-\alpha+\mu)\,. \tag{7}$$

In the context of the model (21), (2)–(5),

(i) The solution of GDP is given by:

[9] Tyler [18, p. 129]. After completing his paper, the present author discovered an additional paper on exports and economic growth, an article by G. Feder entitled "On Exports and Economic Growth" (*Journal of Development Economics*, Vol. 12, Nos. 1/2 [February/April 1983]) which requires some comment. Following a practice used in the studies of Balassa [1] or Tyler [18], Feder analyzes the sources of growth for a group of semi-industrialized LDCs in the framework of two sectors of exports and non-exports. His main finding is that marginal factor productivities are higher in the export sector.

$$Y_t=\beta[K(0)-A]\,e^{\rho\beta t}+[\beta A+\eta E(0)]\,e^{\gamma t}\,, \tag{23}$$

$$A=\frac{(\rho\eta-1)}{(\gamma-\rho\beta)}E(0)\,, \tag{24}$$

with initial value of $K(0)$ and $E(0)$.

(ii) The conditions for SSG are:

$$\rho\beta>\gamma\,,\quad K(0)-A>0\quad\text{or}\quad\rho\beta<\gamma\,,\quad\eta\gamma>\beta\,. \tag{25}$$

(iii) The conditions for ED are,

$$\rho\beta>\gamma\,,\quad\eta\gamma<\beta\quad\text{and}\quad K(0)-A>0\quad\text{or}\quad\rho\beta<\gamma\,. \tag{26}$$

Here, we put additional definitions of the following:

Definition of Successful Internal Drive (ID):

$$\lim_{t\to\infty}\partial R_Y/\partial\alpha<0\,. \tag{27}$$

Definition of Successful Import Substitution (MS):

$$\lim_{t\to\infty}\partial R_Y/\partial\mu<0\,. \tag{28}$$

(iv) The conditions for ID are:

$$\rho\beta>\gamma\quad\text{or}\quad\rho\beta<\gamma\,,\quad K(0)-A>0\quad\text{and}\quad\eta\gamma<\beta\quad\text{or}\quad\rho\beta<\gamma\,,\quad K(0)-A<0\quad\text{and}\quad\eta\gamma>\beta\,. \tag{29}$$

(v) The conditions for MS are:

$$\rho\beta<\gamma\,,\quad K(0)-A>0\quad\text{and}\quad\eta\gamma>\beta\,. \tag{30}$$

Following is the proof of (i)–(v) above.

(i) By solving the differential equation (22), we can obtain

$$K_t=\left[K(0)-\frac{(\rho\eta-1)}{(\gamma-\rho\beta)}E(0)\right]e^{\rho\beta t}+\frac{(\rho\eta-1)}{(\gamma-\rho\beta)}E(0)e^{\gamma t}\,. \tag{31}$$

Then we can rewrite equation (21) by equation (31) into equation (23) completing (i).

Being differentiated by time t, the equation (23) becomes

$$\dot{Y}_t=\rho\beta^2[K(0)-A]\,e^{\rho\beta t}+\gamma[\beta A+\eta E(0)]\,e^{\gamma t}\,. \tag{32}$$

(ii) The proof of the conditions for SSG can be confirmed from the equations (10), (23), and (32).

(iii) The proof of the conditions for ED is the following:

$$Y^2\frac{\partial R_Y}{\partial\gamma}=Z^2e^{2\gamma t}+[\beta XZ+\beta^2(\gamma-\rho\beta)A'X+\beta(\gamma-\rho\beta)tXZ+\beta(\gamma-\rho\beta)A'Z]\,e^{(\rho\beta+\gamma)t}\,, \tag{33}$$

where

$$X=[K(0)-A]\,,\quad Z=[\beta A+\eta E(0)]\,. \tag{34}$$

If $\rho\beta>\gamma$, the third term in the parenthesis of the right-hand side of the equation (33) will prevail as $t\to\infty$. Then to keep it positive, we need the following conditions:

TABLE II

TYPE OF ECONOMIES ACCORDING TO THE PARAMETERS AND INITIAL CONDITIONS

Combinations of Parameters and Initial Conditions				SSG	ED	ID	MS	Type
$\rho\beta>\gamma$	$\eta\gamma>\beta$	$\rho\eta>1$	$K(0)-A>0$	○	×	○	×	A
	$\eta\gamma<\beta$	$\rho\eta>1$	$K(0)-A>0$	○	○	○	×	B
		$\rho\eta<1$	$K(0)-A>0$	○	○	○	×	C
			$K(0)-A<0$	×	×	○	×	D
$\rho\beta<\gamma$	$\eta\gamma>\beta$	$\rho\eta>1$	$K(0)-A>0$	○	○	×	○	E
			$K(0)-A<0$	○	○	○	×	F
		$\rho\eta<1$	$K(0)-A>0$	○	○	×	○	G
	$\eta\gamma<\beta$	$\rho\eta<1$	$K(0)-A>0$	×	○	○	×	H

$K(0)-A>0$ and $\eta\gamma-\beta<0$.

If $\rho\beta<\gamma$, the first term of the equation (33) will prevail as $t\to\infty$ and will always be positive.

(iv) To prove the conditions for ID, first we differentiate (10) by α and reach the following equation (35):

$$Y^2\frac{\partial R_Y}{\partial\alpha}=-\beta^3X^2e^{2\rho\beta t}+[\beta^2(\gamma-\rho\beta)tXZ-\beta^2(\gamma-\rho\beta)A'X -\beta^2XZ-\beta(\gamma-\rho\beta)A'Z]\,e^{(\rho\beta+\gamma)t}. \tag{35}$$

If $\rho\beta>\gamma$, the first term of the right-hand side of the equation (35) prevails as $t\to\infty$ and is always negative satisfying the definition (27).

If $\rho\beta<\gamma$, the first term in the parenthesis of the right-hand side of the equation (35) prevails as $t\to\infty$ and to keep it negative, we need the following conditions:

$K(0)-A>0$ and $\eta\gamma<\beta$ or $K(0)-A<0$ and $\eta\gamma>\beta$.

(v) The proof of the conditions for MS is the following:

$$Y^2\frac{\partial R_Y}{\partial\mu}=\beta^3X^2e^{2\rho\beta t}+[\beta^2(\gamma-\rho\beta)A'X+\beta(\gamma-\rho\beta)A'Z +\beta^2XZ-\beta^2(\gamma-\rho\beta)tXZ]\,e^{(\rho\beta+\gamma)t}. \tag{36}$$

If $\rho\beta>\gamma$, the first term of the right-hand side of the equation (36) prevails as $t\to\infty$ and is always positive, which means it can not satisfy the definition (28).

If $\rho\beta<\gamma$, the last term in the parenthesis of the right-hand side of the equation (36) prevails as $t\to\infty$ and to keep it negative, $K(0)-A>0$ and $\eta\gamma>\beta$ are necessary conditions.

The discussion extended above is summarized in Table II. The table produces eight different types of economic structure from type A to H according to the relative size of parameters and initial conditions combined.

Needless to say, this classification is derived from the model specified by

equations (21), (2)–(5). If the model specification is different, a different table will naturally come out. In this sense, our results are always conditional.

In the following section, alternative policies to achieve SSG as well as to alter the type of economies based on the results from the revised model and a trial application of the model for four Southeast Asian countries will be discussed.

V. POLICY IMPLICATION

A. *Alternative Policies to Achieve SSG*

As Table II shows, if we assume the economic structure expressed in the models (21), (2)–(5), we can present various policy suggestions to achieve their development target according to the type of economy.

First we assume the target in the economic development of the country is to reach the path of SSG. In this model we have three alternative policies to accomplish the target, namely, export drive policy (ED), internal drive policy (ID) and import substitution policy (MS). Roughly speaking, those which belong to types A, B, C, and D may be termed the countries pursuing an inward-looking policy, while those countries classified as types E, F, G, and H as countries carrying on an outward-looking policy according to the dominant parameter which distinguishes one group from the other.

Let us examine the alternative policies suitable to each type of economy.

The country in type A can achieve SSG only by internal drive policy (ID), while the countries in types B, C, and F can realize the target by export drive policy (ED) and/or by internal drive policy (ID), whereas the country in types E and G can accomplish their SSG target by export drive policy (ED) and/or by import substitution policy (MS). On the other hand, countries belonging to types D and H fail to achieve SSG as long as they stay in their current economic structure. The policy recommended to them is to change the type of their economy into other than types D or H.

B. *Alternative Policies to Change the Type of Economy*

How is it possible for these countries to change their type of economy and enjoy SSG?

We can not change $K(0)$ and $E(0)$, the initial condition of K_t and E_t. We may say that the difference between types C and D, and types E and F are mainly in the difference in their initial conditions, although the notable change in the value of combined parameters may cause the change from type C (type E) to type D (type F) or the other way round. On the other hand, the dissimilarity of type C (type E) to other types, say, to type B (type G) comes from the difference in the comparative size of its combined parameters.

Here, four parameters of α, β, μ, and η and one growth rate (γ) and their various combinations ($\rho\beta$: internal rate of growth, $\eta\gamma$: trade effect weighted by external rate of growth, and $\rho\eta$: cross effect of internal and external factors)

will serve as the tools to achieve desirable structural changes in each country. The direction of these parameter changes should be defined in advance:

$$\dot{\alpha}<0, \quad \dot{\beta}>0, \quad \dot{\mu}<0, \quad \dot{\eta}>0, \quad \text{and} \quad \dot{\gamma}>0. \tag{37}$$

Since α and μ are components of ρ ($\rho=1-\alpha+\mu$), it is not easy to decide the direction of change in ρ. We add the following conditions:

$$\dot{\rho}\geqq 0, \quad \text{if} \quad \dot{\alpha}\leqq\dot{\mu}\leqq 0 \quad \text{and} \quad \dot{\rho}<0, \quad \text{if} \quad 0>\dot{\alpha}>\dot{\mu}. \tag{38}$$

Following are examples in altering the type of economy: The country belonging to type D will succeed in changing its economic structure into type B by raising the value of ρ and/or η so that the condition $\rho\eta>1$ which distinguishes type B from type D can be satisfied. In the case of countries in type H, they have three alternative policy measures, i.e., η, γ, and β. They can change their type of economies into type G by increasing the value of η and/or γ to satisfy the condition $\eta\gamma>\beta$ which distinguishes type G from type H. Some other examples of drastic changes in economic structure can be demonstrated by the following cases; type A to and from type E, or type H to type C. In these cases, the combination of parameters will be altered so that $\rho\beta>\gamma$ turns out to be $\rho\beta<\gamma$ or vice versa.

C. *Application of the Model*

To see the applicability of the model, we present in Table III the empirical result distinguishing the type of economy of four Southeast Asian countries calculated for three different data periods of 1961–69, 1970–79 and 1961–79, together with their estimated parameters and figures.

The first observation from the result is that for all countries the internal rate of growth ($\rho\beta$) is always greater than the external rate of growth (γ) in every data period.

The second finding drawn from the comparison of their economic structure is that the incremental output capital ratio (β) is always higher than the trade effect weighted by the external rate of growth ($\eta\gamma$).

If we stick to these two common characteristics, it may be suggested that Indonesia, Malaysia, the Philippines, and Thailand are more or less the same broad category of economic classification, although we can point out differences in their economic structure as described in the next paragraph.

The third point to be mentioned is that these four ocuntries can be classified into two groups; in the cases of data periods of 1961–79 and 1970–79, type B for Indonesia and Malaysia, and type C for the Philippines and Thailand, while in the 1960s according to the difference in their initial conditions ($K(0)-A$), type C for Indonesia and Thailand and type D for Malaysia and the Philippines.

Fourthly, we can find notable changes in the economic structure of Indonesia, Malaysia and the Philippines in the 1970s from the structure of the sixties. Cross effect of internal and external factors may be one of the dominant factors in bringing about their structural change. On the other hand, the Thai economy appears to remain unchanged, judging from the type of economy classified. During

TABLE III

ESTIMATED PARAMETERS, FIGURES, AND TYPE: CASE OF FOUR SOUTHEAST ASIAN COUNTRIES

Country	Data Period	β (t)	η (t)	R^2 DW	α (t)	R^2 DW	μ (t)	R^2 DW	γ	$E(0)$	ρ	$K(0)-A$	$\rho\beta$	$\eta\gamma$	$\rho\eta$	Type
Indonesia	1961–69	0.5268	2.2030	0.9629	0.6612	0.9141	0.1010	0.7174	0.036	1,080	0.4398	6,652	0.2317	0.0793	0.9689	C
		(4.62)	(7.81)	2.32	(9.28)	2.20	(2.62)	1.01								
	1970–79	0.3728	1.4719	0.9906	0.7309	0.9992	0.4698	0.9817	0.089	1,800	0.7389	9,293	0.2755	0.1310	1.0876	B
		(7.03)	(5.00)	0.98	(30.97)	1.60	(21.96)	1.61								
	1961–79	0.2963	2.0314	0.9950	0.7146	0.9988	0.3675	0.9508	0.096	1,080	0.6529	10,438	0.1935	0.1950	1.3263	B
		(7.90)	(14.22)	1.31	(29.16)	0.70	(18.70)	0.43								
Malaysia	1961–69	0.4771	0.2386	0.9980	0.5713	0.9732	0.1752	0.9143	0.056	5,975	0.6039	–503	0.2881	0.0134	0.1441	D
		(16.99)	(2.05)	3.08	(17.05)	1.13	(9.29)	2.96								
	1970–79	0.1007	1.2597	0.9596	0.7245	0.9659	0.5978	0.7448	0.044	9,887	0.8733	60,557	0.0879	0.0554	1.1001	B
		(2.16)	(4.10)	1.60	(16.01)	1.35	(5.22)	1.92								
	1961–79	0.1310	1.3436	0.9704	0.6287	0.9839	0.4114	0.8303	0.045	5,975	0.7827	26,893	0.1025	0.0605	1.0516	B
		(2.40)	(3.94)	1.01	(33.09)	0.96	(9.44)	1.22								
Philippines	1961–69	0.3794	0.1360	0.9964	0.7468	0.9029	0.3625	0.7621	0.050	12,761	0.6157	–10,669	0.2336	0.0068	0.0837	D
		(19.17)	(1.20)	2.62	(8.42)	2.23	(5.36)	2.20								
	1970–79	0.5058	0.7552	0.9807	0.6138	0.9938	0.2469	0.9055	0.073	17,270	0.6331	86,794	0.3202	0.0551	0.4781	C
		(5.09)	(1.30)	1.23	(38.10)	1.33	(9.34)	1.69								
	1961–79	0.5744	0.6909	0.9663	0.7069	0.9750	0.1724	0.7974	0.058	12,761	0.4655	12,986	0.2674	0.0401	0.3216	C
		(5.68)	(1.30)	0.86	(26.50)	1.44	(8.24)	1.08								
Thailand	1961–69	0.4996	0.4948	0.9922	0.6295	0.9992	0.3949	0.9872	0.046	30,858	0.7654	214,630	0.3824	0.0228	0.3787	C
		(18.02)	(1.42)	1.95	(33.98)	2.62	(24.84)	1.65								
	1970–79	0.4115	0.4834	0.9972	0.7777	0.9984	0.3036	0.8753	0.089	44,269	0.5259	239,779	0.2164	0.0430	0.2542	C
		(11.93)	(2.30)	2.12	(55.66)	3.27	(8.01)	1.30								
	1961–79	0.4279	0.3310	0.9956	0.7585	0.9974	0.2997	0.9588	0.063	30,858	0.5412	121,377	0.2316	0.0209	0.1791	C
		(19.19)	(1.64)	1.06	(56.48)	0.94	(20.50)	1.06								

Source: Data by national currency unit at 1975 price from U.N., ESCAP, *Statistical Yearbook of Asia and Pacific, 1981* (Bangkok, 1983).

Notes: 1. Figures in parentheses are t ratio.
2. Constant terms omitted.
3. R^2 is adjusted for degree of freedom.

the period of the sixties and seventies the country has remained as type C, however, this is not a correct description of the economy. We should say rather that Thailand has surely achieved some structural change in her economy during the same observation period mentioned above, as shown by the differences in the estimated parameters, however, it was not so drastic as to be distinguished by this model.

A final observation from the empirical result is that all four countries seem to be now on a desirable SSG path to the target which they can pursue through external as well as internal drive policies.

To conclude, we will discuss the applicability of this revised model. Needless to say, the revised model presented above cannot fulfil the task of solving the whole range of problems in economic development and policy. It is not the purpose of this article to present a comprehensive model to answer the problem. Instead, what we are emphasizing here is to illustrate that a small revision of a primitive model like the H-D type growth model in its simplest form can go a long way to improve the applicability of the model in the study of economic development.

What we claim here are (1) to have established the conditions classifying LDCs into eight types of economies; and (2) to have suggested alternative policy measures suitable for each type; (3) further, a trial application of the model for four Southeast Asian countries has proved useful in describing the structural differences and to indicate causes of structural changes in their economy.

Though the alternative policies suggested in the subsections above are not designed to meet the sectoral aspect in the economic development of a particular country, we believe the revised model has achieved a step forward in understanding the macro aspect of economic development and policy of LDCs.

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