A NOTE ON THE CHOICE OF A GROWTH MODEL

(For the Case Study of Sweden, Japan and Turkey)

by

Besim Üstünel
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Introduction

1. In my background paper I defined modern economic growth as "achieving greater economic and social efficiency" and explained its content to some extent. I also pointed out there that we should have a "comprehensive" and "explicit" model in order to be able to give a complete explanation for such strikingly different growth performances as those of Japan, Sweden and Turkey, and to easily pinpoint the "critical factors" of growth. In the following I shall attempt to give a brief outline of such a model.

2. An important determinant of the "socio-economic efficiency" is, no doubt, the "productive efficiency" achieved by a country. But, in the standard theory of production, "factors of production" contributing to a country's capacity to produce goods and services are usually presented as labor and capital only. This results in a kind of biased treatment of physical factors of production as against non-physical ones, such as the knowledge, organization and technology used in productive activities, which may sometimes be just as important contributors to the productive capacity as labor, capital and land.

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In its usual presentation a production function of the Cobb-Douglas type is written as

\[ Q = P(L^\alpha K^\beta) \]  

(1)

where \( Q \) is an index of output, \( P \) is total factor productivity, \( L \) is an index of labor input, \( K \) is an index of capital, \( \alpha \) is labor's share of output, and \( \beta \) is capital's share of output. The total of these two parameters showing relative factor intensities in the production should be equal to unity \((\alpha + \beta = 1)\).

When applied to problems of growth, economic growth measured by the changes in total output (GNP) through time, the same principles give the following formula:

\[ \frac{\Delta Q}{Q} = \frac{\Delta P}{P} + \alpha \frac{\Delta L}{L} + \beta \frac{\Delta K}{K} \]  

(2)

where the elements and sources of productivity changes \((\frac{\Delta P}{P})\) are usually not specified, and are either taken as a constant or as something exogenous to the economic system. The natural consequence of this neoclassical treatment of production theory was the neglect of some important sources of growth which might be called "neo-factors" or "non-physical factors" of production [Raymond Vernon, 12].

The implications of this neglect on both theoretical discussions and policy designs and strategies of growth were of great importance, because, until recently, we were presented such simple growth theories based on Harrod-Domar type models, where the only (or major) limiting factor to growth was capital accumulation, i.e. "savings constraint".

In these presentations the quantity of labor \((L)\) is usually assumed to be unlimited for developing countries, and the quantity of physical capital \((K)\) and its changes \((I = \text{investment})\) over time, with a coefficient corresponding to capital/output ratio \((c)\), singled out as the only determinants of growth rates.

Later on various models of a neoclassical character were presented embodying other limiting factors to growth such as the "foreign exchange" and "skill" constraints that are effective in different phases of economic growth of a developing country.
Thus, when national product is assumed to be determined by the size of the accumulated physical capital \((Q = c_K)\), and when the change in its size, i.e. the level of investment, is taken as a function of savings \((S)\) and of import capacity \((M)\) we get

\[ \Delta K = I = f(S, M) \]  

(3)

The conclusions of this approach for the growth strategy were:

(i) that we should increase the"investment ratio" in order to accelerate growth;

(ii) that to achieve this, we should both raise the"savings ratio" and try to obtain foreign savings to fill the savings gap;

(iii) that in addition to foreign aid, we should also take some measures to increase the"import capacity" since its size is always commensurate with needs, and one should introduce "import-substitution" and "export-promotion" policies to fill the foreign exchange-gap and achieve a higher rate of growth.

The implications of these aggregate models, as well as the logic underlying this analysis, proved to be unrealistic in many instances. Apparent frustrations of the development efforts of several countries whose development strategies were based on these models must have shown by now that some of the real "growth-generating factors" were left out of the picture in these analyses.

3. There now exists factual evidence which shows that changes in "non-physical" factors of production contributed more to the economic growth of the West than traditional factors. The works of E.F. Denison [2], S. Kuznets [6], R.M. Solow [10] and many others, designed to measure the contribution of different factors to economic growth, give strikingly similar results, showing that the impact of the improvements of the level of education, advances in knowledge, and changes in technology (with the inclusion of some elements sometimes called the "residual factor") have been much more important than the increase of the supply of labor and capital, i.e. "traditional factors" of production. These

1. Their relative importance as contributors to growth is usually given as 20 to 30 per cent for "traditional factors", 70 to 80 per cent for "residual factors". Similar values may also hold for economic growth in Sweden, Japan and Turkey.
findings suggest that growth economists should give more emphasis in their analyses to the elements of the residual factor and should treat them as distinctly and as explicitly as possible in their analyses in order to get a realistic model with high explanatory power. This, no doubt, is the case when one wants to explain the growth performances of such countries as Sweden, Japan and Turkey, where the degree of successful employment of these "neo-factors" seems to have been so strikingly different.

Outline of the Model

4. The growth model set up to explain differentials in the growth performances and to give an insight into the real contributing factors has to be both "comprehensive" and "explicit" concerning important elements of growth. Two different ways of formulation are possible: the first alternative is to formulate an improved and adjusted version of the Cobb-Douglas function; the second is to give a less formal but more explicit formulation of the production function.

The first approach, that is, the Cobb-Douglas production function adjusted for both changes in the quality of capital and labor to reflect at least some of the new elements contributing to growth, can be summarized as follows:

\[
\frac{\Delta Q}{Q} = \frac{\Delta P'}{P'} + \alpha \frac{\Delta L}{L} + \beta \frac{\Delta K}{K} + \alpha_L \lambda_L + \beta_K \lambda_K
\]  

(4)

where \((Q)\) is output; \((P')\) is an index of total productivity partially purged of quality improvements in both labor and capital; \((\lambda_L)\) is quality improvement of labor per annum; \((\lambda_K)\) is quality improvement of capital per annum. But we can make further changes in order to make this model more explicit and to reflect "vintage" type effects (i) by breaking down the natural resources and physical capital into two separate factors; (ii) by introducing three different variables to show the quality improvements of labor \((\lambda_L)\), capital \((\lambda_K)\) and natural resources \((\lambda_R)\); and (iii) effects of changes in age structure ("vintage effect") of labor \([\lambda_L(\Delta \bar{e})]\), capital \([\lambda_K(\Delta \bar{a})]\) and natural resources \([\lambda_R(\bar{F})]\) on the

2. I have borrowed part of this formulation from a survey article by C. Kennedy and A.P. Thirlwall [5].
other. Then our adjusted Cobb-Douglas formula will be:

$$\frac{\Delta Q}{Q} = \frac{\Delta P''}{P''} + \alpha_{L} \Delta L + \alpha_{K} \Delta K + \gamma_{L} = \gamma_{K} + \gamma_{R} = \alpha_{L} \lambda_{L} (\Delta \bar{e}) - \epsilon_{K} (\Delta \bar{e}) - \psi_{R} (\Delta \bar{e}) \quad (5)$$

Here, some of the productivity changes are shown explicitly and the remainder are expressed as residual factors ($P''$) which can be measured by an index of total productivity. In this model the contribution of each traditional factor of production ($L, K, R$) to the growth of total output can be given in three parts: (1) the growth of labor (or $K, L$) input in physical units, (2) the average rate per annum of its improvement ($\lambda_{L}$ or $\lambda_{K}$ and $\lambda_{R}$), and (3) the effects of changes in its average age, i.e. the improvement in the productive efficiency of new workers, new capital and new resources $[\lambda_{L}(\Delta \bar{e})....]$. By doing this, one can take into account the important factors which improve the quality of labor - such as "learning by doing", "education", and "age distribution", all of which prove to be quite important - and of capital, including the "vintage effect" of accelerated investment. One can also take into account factors which affect the quality of natural resources, such as pollution and other environmental changes.

This model is more "explicit" and based on more variables than the other adjusted Cobb-Douglas formula, and some of these variables may prove to be difficult to measure, yet it still contains a "residual" element which reduces its explicit character to some extent.

5. An alternative model of more explicit character may serve the purpose in a better way. Here, we can introduce a complete severance between "traditional" or "physical" factors of production and "non-physical" or "neo-factors" of production:

$$Q = f [L, C, R; K, O, T] \quad (6)$$

where $L, C$ and $R$ correspond to "traditional factors" and $K$ (knowledge), $O$ (organization) and $T$ (technology) correspond to "neo-factors" of production. 3

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3. This model can be improved by introducing political and institutional factors affecting output and its growth in a country. But, for the time being, we shall treat a major part of these factors as "exogenous" variables. Some of the institutional factors, however, may be considered as either included in or closely connected with the KOT factors.
The growth of output in this model can thus be written as:

\[
\frac{Aq}{q} = \frac{A}{L} + b \frac{AC}{C} + 7 \frac{AR}{R} - \gamma + \left( a \frac{AK}{K} + b \frac{AO}{O} + c \frac{AT}{T} \right) \tag{7}
\]

where \(a + \beta + \gamma = \) total relative importance of physical inputs,
and \(a + b + c = \) total relative importance of productive knowledge, organizational capacity and technological change in its pure sense.

The sum of these two totals should either be equal to unity (constant return to scale assumption) or be greater than unity (increasing return to scale assumption):

\[(a + \beta + \gamma) + (a + b + c) > 1 \tag{8}\]

It is very likely that in our model the sum of these two totals will be greater than unity in most cases because it embodies all dynamic elements of production which create increasing return conditions. This would also mean that one can achieve a certain growth level at a lower price in terms of real resources.

On the relative importance of these two groups of inputs, however, we have a *grosso modo* idea from the empirical works of E.P. Denison \[7\], S. Kuznets \[7\], R. Solow \[11\], T.W. Schultz \[13,9\], M.J. Beckmann and R. Sato \[1\] and of many others. Denison estimated the contribution of education to growth as 23% for the U.S. With the addition of the other elements of the "residual factor" the total contribution of "non-physical" factors to growth reaches 70% for many European countries. S. Kuznets and others also attributed more than two-thirds of the economic growth of nations to rapid improvements in the productivity which were created by technological progress, spread of knowledge, improved organizational efficiency and so on.

We can therefore give some approximate values to our parameters as:

\[a + \beta + \gamma = 0.3 \text{ or } 0.4 \quad a + b + c = 0.7 \text{ or } 0.8\]

It will, of course, be difficult to attach separate values to each of our parameters in the second group. We may even face some difficulties in defining these new concepts, let alone measuring their size or changes in their contributions to growth.\(^4\)

Nevertheless, because of its properties of being both comprehensive

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\(^4\) For the time being we shall not discuss these difficulties, nor shall we pay any attention to the interrelation that may exist among these variables. There certainly are close relations between the knowledge and technology factors and the level of investment (\(AC/C\)) in both directions, just as there is some relation between different elements of each input group, namely that the changes in natural resources may affect capital formation or labor supply. In a similar manner, the changes in the level of knowledge may affect resources as well as inducing new technologies or new forms of organization. Yet, for the sake of simplicity, we shall now assume that the two groups of factors are independent variables.
and explicit regarding growth elements we prefer this formulation to the others for analytical purposes. By using this model one can obtain a better explanation of differences in growth performances of various regions, nations and periods, as well as a better insight into the nature of growth processes on which a sound policy model can be constructed.

6. Let me illustrate first, in a simplified form, one of the ways in which this model can be put to use to explain a country's growth potentials and its actual growth performances. Then we can proceed to explain its possible uses in inter-country comparisons.

Complete separation of the two factor groups can give us the opportunity to construct a set of aggregate "isquant curves" for each country, similar to familiar isquant curves drawn in a two-factor model for each firm. Here, we measure along the vertical axis the values of an "index of traditional factors" (a specially prepared index intended to measure the changes in the supply of physical inputs such as labor, capital and natural resources available in a country), and along the horizontal axis the values of an "index of neo-factors" (again a specially prepared index intended to measure the changes in the supply of KOT factors available in a country). And on this diagram (see Figure 1) we can design a king of "product mountain" and draw on it a set of "isquant curves", each representing different levels of "composite product"; but on each of the isoquants the country is assumed to be able to produce the same amount of "composite product" by using different combinations of "traditional" and "KOT" factors depending upon whether the country is on point $a_1$, $a_2$ or $a_3$.

The substitution between "LCR" and "KOT" factors can take place either through changes in the composition of the total output (composite product) or through changes in the factor combinations for producing the same commodities, or through both channels. But, as each of these changes would have certain limits so also would the substitution between the two groups of factors of production. We would, therefore, get segments parallel to vertical and horizontal axis on each isoquants. But for the area where there are substitution possibilities we can introduce a kind of "price ratio" or a "trade-off" ratio between two groups of factors, similar to usual price lines, representing the marginal rate of transformation between two factors to leave the output unchanged.
FIGURE 1. AGGREGATE PRODUCTION ISOQUANTS AND ALTERNATIVE GROWTH PATHS FOR A COUNTRY
After establishing "isoquants" each representing a certain level of aggregate production and after drawing a series of them to represent the "product mountain" that a country can try to climb by developing her "LCR" and "KOT" factors, we can get certain "growth paths" for each country, similar to the usual expansion paths for a firm.

The growth path actually followed by and alternative paths open to a country can also be shown on this diagram. If a country is assumed to be on point $b_2$ and tries to reach a higher level of production, there may be several alternative ways open. Going from point $b_2$ to point $c_1$ means the country in question will base its economic growth heavily on capital accumulation (thus using more of other physical inputs), and very little on the use of improved technology, knowledge and organizational efficiency. Going from point $b_2$ to $c_3$ or $c_4$ represents different growth strategies, giving higher emphasis to non-physical factors than to physical ones.

Of these alternative growth paths, the both connecting points $b_2$ and $c_2$, for instance, may be considered as the most likely one under the ruling "price ratios" between groups of factors, "LCR" and "KOT", and under the given institutional framework. But other alternatives, such as $b_2 - c_3$ or $b_2 - c_4$, may represent "cheaper" growth paths in terms of physical inputs (LCR). Yet these paths may not be followed by the growing economy either because of the existence of some institutional and political barriers or because of the difficulties of introducing more KOT elements. The price line tangent to $c_4$, which may be interpreted as a "shadow-price" or "world price" ratio between two factor groups, represents a lower cost of physical resources than the ruling price ratio - tangent to $b_2$ or $c_2$ - for achieving the same level of growth, if one can overcome the difficulties of introducing more "KOT" factors into the economy.

7. Before we proceed further in developing our model, it may be necessary to clarify some technical points and present some ideas about the content of our new factors of production, namely knowledge (K), organization (O), and technology (T).

There is no need to redefine the three variables of "traditional factors" - L, C and R - used in our model as they correspond to well-defined con-
cepts of traditional theory of production. They are physical inputs of production. But the other three variables which correspond to "productivity" changes or "residual factors" of traditional models, that is the non-physical inputs of production - K, O and T - require careful definitions. The knowledge factor (K) embraces all kinds of knowledge, concerning production and consumption, embodied in human skills. It covers both "general knowledge", as well as "technical skill", and "firm-specific" or "industry-specific" knowledge. One important part of knowledge, however, can be left out of this (K) variable: the knowledge about creating new knowledge, that is "research and development" capacities.

The organization factor (O) in our model corresponds to all kinds and forms of productive organization affecting economic activities either directly or indirectly. It covers "organizational efficiency" both at the firm's level as well as at the local and central government level. The rules and regulations and different types of institutions concerning economic activities which affect productivity would be included in this concept. But, again, one important exception can here too be introduced: that organizational capacity to change existing organizations, that is the activities of entrepreneurs and high level administrators, can be left out of this concept.

The technology factor (T) in our model corresponds to the "pure technology" element in traditional models. It represents the ways and means of producing goods and services. Here also we can introduce a distinction between two groups of pure technology and leave one group out of our concept of T, viz. the techniques of creating new technologies. We can combine this part of the technology factor with the other two elements excluded from the concepts K and O, that is the R & D, and entrepreneurial and high level administrative activities, and thus we can get our "shift" factor which is expressed by (f) function in our model.

By interpreting properly this shift element (f) we can explain why aggregate isoquants in our Figure 1 are to be convex to the origin, how and when we can get a shift in these isoquants, and why there may be different growth paths on the "product mountain" of a country corresponding to different characteristics of entrepreneurial, administrative and scientific qualities which can be denoted by (f_1), (f_2) or (f_3).
On the concept of "price ratio" or the marginal rate of substitution between traditional factor (LCR) and neo-factor (KOT) one can give different definitions for firms and industries (at the micro level) or for a country as a whole (at the macro level). Although part of the knowledge or organization or even technology can sometimes be considered as a "free-good", in our model they are not assumed to be free goods for firms, industries or countries. At the macro level a country has to make a sacrifice in terms of its traditional factors (LCR) in order to improve its KOT level, by allocating more of its experts, funds and even resources to the transplantation and spreading of new knowledge, organization and technology developed and tested elsewhere. This corresponds to the real costs for a country of improving the level of KOT. For a firm the price to be paid for employing more KOT elements can sometimes be measured by market prices such as licence-fees or royalty payments for a new technology or a new organizational know-how.

One can also draw a kind of "transformation curve", of a partial character, on the diagram shown in Figure 1. From point b, where there are alternative growth paths available for a country for a certain period of time (planning-period), we can draw two new axes - one representing additional labor, financial capital (saving) and new resources expected to be available during the next planning period, the other corresponding to additional KOT elements that can be introduced into the economy during the same period. Then, on these axes one can derive a "transformation curve" showing the possible alternative combinations of the new LCR and KOT elements for the next planning period. The highest isoquant curve that this "transformation curve" would be tangent to would determine the "optimal growth path".

8. Now we can introduce some new concepts concerning "unemployment" or "under-utilization" of factors of production of different categories, "optimal growth locus" and "dynamic efficiency", in a growing economy.

In Figure 2 we tried to improve on Figure 1 by introducing factor limitation lines of different periods, and thus constructed a series of box diagrams in which a country can try to reach the highest isoquant possible for that period by following the "optimal growth locus". What we want to show here is first, that a country can be in a situation of under-employment equilibrium in its actual degree of mobilization of two different groups of factors. If a country is in a situation of
potentially employing (3 LCR) and (2 KOT) factors but if it actually employs only (2 LCR) and (1 KOT) factors - and produces only as much as what \((a_1)\) represents, rather than \((b_1)\) or \((a_2)\) - at a certain point of time, then it can be considered "under-utilizing" both factors. If this country can change its position and move from \((a_1)\) to \((b_1)\), it will be on a higher isoquant curve with no apparent unemployment or under-employment in the traditional sense. Yet, this country can improve its position and reach a still higher production curve - from point \((b_1)\) to point \((a_2)\), or from point \((b_2)\) to point \((a_3)\). For instance - if it can successfully employ in full capacity the productive knowledge, organization and technology factors available to it at that point of time. In other words, if the country can overcome this "under-utilization" of KOT factors, set in its economy in different forms of "low productivity", then it can improve its welfare position.

In this analysis one can think of a series of points on different isoquant curves, corresponding to subsequent time periods, which represent full employment of both factor groups - such as points \((a_2)\), \((a_3)\), \((a_4)\) and \((a_5)\) - which may also be interpreted as the "optimal growth locus" of a country. Then the concept of "dynamic efficiency" can be redefined in this context.

Usually frontiers of knowledge, organizational efficiency and technology move much more rapidly than the increases in the supply of physical inputs (labor, capital and natural resources) especially for those countries which are not in a leading position in the field of technological progress and, therefore, in a position to use up the existing stock of knowledge or to transplant new technologies created and tested elsewhere into their own economy. The expansion of these (KOT) frontier, for these countries, may be of much greater importance than the increasing of traditional (LCR) factors for achieving higher rates of growth.5

But the rapid expansion of this frontier and its inherent uncertainties concerning the directions, sizes and relative importance in different sectors of the economy create enormous difficulties for a country to reach and stay on an ever-changing position of "optimal growth locus". To overcome some of these difficulties requires certain degrees of flexibility and alertness in the administration and decision-making.

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5. High growth rates achieved by most of the West European countries and Japan during the period 1950-1970 can be explained in this way.
FIGURE 2. OPTIMAL GROWTH LOCUS AND UNDER-UTILIZATION OF FACTORS FOR A GROWING ECONOMY
mechanism. It also necessitates wiping out all kinds of institutional barriers that may exist in a society which would reduce its dynamism by limiting its absorption capacity of new ideas, technologies and institutions. "Dynamic efficiency" of an economy in its socio-economic sense can be interpreted in this context.

If a country discovers that it has given too much importance to capital accumulation of a physical nature and too little importance to investment in human capital or transfer of technology, its position (in Figure 2) would therefore correspond to point (b₂) instead of (a₃). In this case, the country can aim at correcting its position through time and attempt to move ahead from point (b₂) to (a₄) directly, provided it has the necessary conditions and ingredients of "dynamic efficiency". But, if it lacks certain critical elements of dynamism, this country would probably follow an inefficient growth path and reach point (b₃) which would represent full employment for traditional factors but at a very low level of productivity growth (compared with existing potentials of productivity growth), and thus would leave a greater portion of KOT factors "under-utilized" than before.

9. Some of the characteristics of the aggregate isoquant curves and factor limitation lines (i.e. "boundaries" imposed by two groups of factor availabilities) would be different for different countries. Differentials of factor endowment (in its traditional sense) and of the comparative growth levels may create certain differences among countries as to the actual isoquant curves on which they can be located, as well as the potential growth paths that they can follow.

A hypothetical geometric presentation of these inter-country differentials is given in Figure 3, where three countries are assumed to have had both different actual factor endowments and growth performances in the past, and also will have different alternative paths for their potential growths in the future. An important point here is that, for a country which is not in a leading position in the world in creating new technologies, a factor limitation line imposed by the level of KOT availabilities has different characteristics. This line can easily be expanded provided that an efficient mechanism is created at home to make the intelligent decisions concerning the choice of technology to be transplanted, and to shorten the "reaction lag", "imitation lag" and "learning period" vis-à-vis new developments abroad. Therefore,
Traditional Factors
\((L + C + R)\)

FIGURE 3. INTER-COUNTRY COMPARISONS OF GROWTH PERFORMANCES AND THE IMPORTANCE OF "KOT GAP"
(A HYPOTHETICAL PRESENTATION)
the greater the "KOT gap" for a country, the more opportunities there are to achieve higher growth rates by moving the position of that country to the right rather than upwards.

But the usual practice so far followed by the LDCs seems to be in the opposite direction; that is, they give primary importance to attacking the problems of "savings gap" (capital formation) and "foreign exchange gap", and not enough attention to the "KOT gap". This biased treatment can also explain, at least partly, their common failures. Narrowing the "KOT gap" will, of course, not be easy for most of the developing countries. And it may sometimes prove to be more difficult than borrowing from abroad and investing in physical capital goods. Investing in human qualities, improving skills and introducing new organizations, institutions and technologies will present some special types of difficulties and bottlenecks. But policies designed to break these bottlenecks may bring higher rates of return in many cases in terms of growth performances in the long run. 6

Besides improving the productivity of traditional factors, increased knowledge, organizational efficiency and technology (that is, improved KOT level) will be of great help in reducing or even eliminating completely the growth bottlenecks of political and institutional origin. Thus, their contribution to the socio-economic efficiency and, therefore, to the growth will be more than their direct contribution to factor productivity in its traditional sense.

10. The interrelation between the two groups of factors affecting economic growth is a complex one. Rapid growth of knowledge and technology (or accelerated dissemination of them) would create greater investment opportunities in an economy, thus leading to higher savings and/or capital formation. Higher savings, on the other hand, will enable a country to spend more on education, R & D activities and organised transfers of technologies; it would thereby create a kind of "vintage effect" for both capital and labor which would, in turn, help to improve the international competitiveness on the world market.

6. Problems created by differentials of KOT levels of different groups of countries and the bottlenecks related to these differentials will not be discussed here. But it is an interesting topic to study.
Figure 4. Limiting Factors of Growth and The Effect of Increased KOT.
Improved KOT conditions would help a country to remove the skill limitations that may exist on its growth rates, on the one hand, and open new avenues for improving its terms of trade on the other. Part of these interrelations can be clarified by a graphical presentation. In Figure 4, we have tried to show, in a conventional way, the interrelations between factors affecting growth and effective constraints limiting growth rates in an economy.

In this diagram we can show in a simplified form different factors limiting growth rate in a country and also the impact of a change of knowledge and technology (KOT) on these "constraints". With a given technology the growth rate is determined first (à la Harrod-Domar) by "savings ratio" up to a point (OA). After that point, "foreign exchange" constraints become effective because of the difficulties of transforming domestic savings into imported investment goods. So, beyond the "maximum effective savings ratio" (i.e. C.3), it is of no use to increase savings as that will not affect the growth rate. This is the area (shown by III on the diagram) where the "foreign exchange bottleneck" is the effective constraint. Up to this point the savings are the limiting factor (I), unless there are "politico-institutional bottlenecks" introducing additional limitations on savings capacity and growth (shown by II on the diagram).

The likely impact of an improvement of KOT factors on effective growth constraints prevailing in an economy can be shown on this diagram by (i) a shift upward of the growth function, from G to G', and (ii) by a series of displacements of the points (A, B and C) further to the right (to A', B' and C'). This means that both political and institutional constraints on growth as well as the ones connected with savings and foreign exchange gaps will be pushed ahead and that higher growth rates are now feasible.

11. This presentation may be improved and completed, in a sense, by

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7. As R. Findlay points out, the foreign exchange gap should not be interpreted always as the manifestation of an over-valued currency. There is also a fundamental "structural" phenomenon here, as the proponents of the theory of two-gaps assert. If there is no possibility to substitute domestic inputs for imported ones in investment and if foreign demand for exports is less than unit elasticity (and there are no imports for consumption to cut), it is possible that more savers can become less and less effective in raising the growth rate and run into diminishing returns through worsening terms of trade. (For further discussion and diagrams see R. Findlay [4].)
showing more explicitly the changes in KOT factors, and their likely impacts on growth rates and effective constraints, as we have done in the formulation of our model. Figure 5 is an attempt to do this.

Here, we have just added one more dimension to the conventional growth diagram, presented first in Figure 4, to measure the changes in the KOT factor (possibly measured by an index again) and assumed a functional relation between the size of the KOT factor used by a country and its rate of growth on the one hand, and its international terms of trade on the other. The KOT function drawn in this diagram should be interpreted as a "limiting" or "permissive" factor in the model, depending upon its level compared to other determinants of growth rate. That is, if a country succeeds in improving its KOT level by an index number of, say, 30 points, then it can achieve a 6 per cent annual growth rate if it also fulfills other prerequisites of that growth rate concerning savings and investments. But if it can improve its KOT level further (say by 40 points instead of 30) then a 10 per cent annual growth rate would be feasible by some improvement of the saving ratio.

On the fourth section of the diagram we have drawn another "terms of trade" curve representing the functional relationship between the growth of KOT factors and export prices in terms of imports of a growing economy. New studies on "export economies" (of the LDC group) and new developments in trade theories emphasizing the role of "knowledge-intensive" industries in the international trade provide strong evidence that there is a close relationship between these two variables, and that very low levels of KOT create the risk of "enclave" economies - or at least "enclave sectors" - and that very high levels of KOT achieved by pioneering countries can enable them as "style-setters" to set also the prices in their favor in the world markets.

12. It is obvious that this approach will have certain implications on the concepts of "gains from trade", the "contribution of trade to growth" or the "export-led growth", as well as on some policy issues concerning protection of domestic industries, export promotion versus import substitution, restrictions on foreign payments, and so on. When one gives greater emphasis to improved productive knowledge and technology, filling the "KOT gap" automatically becomes more important than filling the other "two-raps". Then, in the conduct of industrializa-
Figure 5. Growth Generating and Growth Limiting Factors.
tion and growth affairs, primary importance should be given to the maximum possible improvement in the use of available KOT elements rather than using a simple criterion based on foreign exchange saving or labor-intensiveness or a combination of the two in the selection of investment projects. Within this context, imports of certain types of machinery and equipment embodying new technologies may be more "growth-generating" than so-called "export-led growth", especially if the growth of exports is of staple products only. Again, setting up a modern export industry may sometimes have a more growth-generating effect than the creation of an import-substituting industry, not because it may lead to higher foreign exchange earnings or create more job opportunities, but because of its more favorable effects on the transfers of new knowledge and technology.

Traditional treatment of these issues, therefore, will have to be re-conSIDereD both in theory and in practical policy-making. So will the analysis of the gains from trade. But we do not intend to discuss these issues here, as we shall take up the foreign trade aspect of growth in a separate paper and try to apply it to our cases of Sweden, Japan and Turkey.
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