

This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: The Comparative Study Of Economic Growth And Structure

Volume Author/Editor: Raymond W. Goldsmith

Volume Publisher: NBER

Volume URL: <http://www.nber.org/books/unkn59-1>

Publication Date: 1959

Chapter Title: Supplementary Memoranda - Comparative Studies of Economic Growth

Chapter Author: Jan Tinbergen

Chapter URL: <http://www.nber.org/chapters/c4424>

Chapter pages in book: (p. 193 - 201)

COMPARATIVE STUDIES OF ECONOMIC GROWTH

JAN TINBERGEN
Netherlands School of Economics

Aims of Comparative Studies¹

Any attempt at finding empirical evidence on whatever subject has to consist of comparative studies, since it is only by comparing different situations that we can hope to get evidence on the influence exerted by changes in data. The comparison may bear on differences among phenomena occurring at different time points, or on differences among different objects at the same time. This is the traditional distinction between research based on time series and research based on cross sections of whatever type. In economic research the former type plays an important role and is particularly useful to study rapid, short-run change, but less so to study long-term growth — unless very long series of observations are available. In the short run, growth phenomena, because of their smooth character, give rise to intercorrelations, making it impossible to separate their effects. That is why cross sections are more promising in this field. In this paper we will briefly discuss what can be undertaken to obtain more *empirical*² evidence on growth phenomena. The aims of such studies seem to be, above all, (1) to help all concerned in judging development possibilities of concrete countries or regions, and (2) to devise appropriate policies of development.

These ultimate aims should be reached by trying to find out which extra-economic phenomena or “data” exert a predominant influence on

¹The author apologizes for the loose and sketchy character of this paper. He was asked to write it at very short notice and may have to revise some of the opinions expressed.

²I emphasize the word “empirical” because by this type of research we want to learn from experience, which necessarily implies that we only consider the events and phenomena that have occurred so far. Most of the typical *programming* problems whose solution is based on deduction fall outside the scope of this paper, e.g. problems assuming a number of technical coefficients and considering alternative choices of which industries to develop or production methods to apply. The importance of these problems is by no means denied, however. The problems focused upon in this paper are rather those dealing with the nontechnological choices, connected mostly with the general attitudes of the population and the general policy of a government. There is no sharp dividing line, however.

the growth of an economy and what the structure of this influence is. Before specifying what I mean I want to make one more introductory point. In view of the urgency of the problems involved, it is the responsibility of the economist engaged in this type of work to devise methods apt to yield quick results. We should not, on the one hand, study phenomena or relationships that are only culturally interesting or, on the other hand, engage in long roundabout ways of research. We should produce, in other words, evidence of an "operative" nature.

General Nature of Comparative Studies

If our aim is to judge or influence the process of growth of an economy, we have to think of this process as a whole and to be aware of the fact that the reliability of our knowledge depends essentially on all the causal links involved, and more particularly on the "weakest" link — i.e. the one of which we know least. This is equivalent to saying that we should study our object with the aid of "complete" models. The methods developed in model building seem to apply also here; that is, we should specify (1) the phenomena to be included; (2) the relationships supposed to exist among them; (3) the possibilities of measuring the relevant phenomena; and (4) the possibilities of testing the relationships. These operations may be illustrated by mentioning a number of examples. In this section we shall not try to describe one well-defined model, but rather to sum up some of the phenomena that, in all probability, have to enter into a really elaborate model. In the third section we shall discuss some very simple models as a whole. In the fourth section some scattered remarks on results of research previously undertaken will be presented. The last section is a summary of the author's views.

Phenomena to be included. In a model of growth these are, as always in an economic model, economic variables on the one hand and data on the other. Not very much need be said about the economic variables to be included; they are the usual ones of national income, national consumption expenditure and investment, imports and exports, capital stock, and labor force, possibly subdivided into sector components and supplemented by relative prices. Certain well-known refinements may have to be made as soon as our knowledge or statistical material permits, such as distinctions between durable and nondurable capital goods, production processes of different capital intensity, and the gestation periods of different length that may enter into a specified model. Among these refinements, special mention should be made of external effects and of indivisibilities; the conviction continues to grow that these phenomena may be basic to the process, but unfortunately our quantitative knowledge is lagging far behind.

Particular attention should be given to the data entering into growth models. It is no longer possible now to make the easy assumption, so appropriate for the analysis of short-term movements, of any one single

economy, of constant natural, psychological, and institutional data. These data are the very subject of comparison now. Accordingly we have to reckon with the possible interference of these "data" as variables in our study. A few will be listed under each of the headings just mentioned.

Natural data are those referring to mineral deposits of all kinds, fertility of land, climate, presence of natural transportation facilities, and geographical location.

Psychological data refer to all human qualities relevant to economic growth, such as: value attached to material well-being, technical skill, perseverance, thriftiness, willingness to cooperate with others, inventiveness, and preferences with regard to size of family. One of the major difficulties here seems to be the lack of an established set of independent (quantitative?) characteristics ready for use. An enormous number of vague concepts is used to indicate the qualities; some of these overlap, many of them are composite or mutually dependent; there is a lack of uniformity in nomenclature. On the one hand, a good deal of qualitative analysis might be necessary. On the other hand, some comprehensive composite may sometimes be helpful as a first approximation; we shall mention one or two examples in the third section.

Institutional data refer to the regime of the economy considered. They cover such data as the degree of competition in production, the selection process in education, training and staffing, property rights, training opportunities, material stimuli in the system of income formation, and so on. The size of the market may also belong to this group of data.

Apart from the data so far enumerated, we have to introduce in any concrete study of comparison some economic variables referring to the initial situation from which the economy started, initial wealth being the most important one. The reason is that, even though two nations may be more or less equal in all the aspects just enumerated, their development chances are different because of different initial wealth (Marx' famous concept of *ursprungliche Akkumulation*).

Specification of the relationships between the phenomena. This is the next step in any systematic study of growth. It goes without saying that the order in which the steps are taken in practice will, as a rule, be that several trial-and-error steps are taken which lead ultimately to a well-defined model.

The question of relationships is identical with that of the causal structure of the process of development. The essence of the problem consists in "localizing" the influences exerted by the various data. An example will illustrate this. The degree of thriftiness of a people will influence the growth process primarily through the relationship determining the country's savings. It will not directly affect the efficiency of the production process and hence the relationship between product and quantities of factors used (the production function). Technical skill and inventiveness, in contrast, will act through the production function rather than through the savings relation. Certain national resources will clearly influence the

process only through some of the sectoral production functions, while technical skill will do so on a broader front. Again, thriftiness as a general characteristic will be much more important in a private-enterprise economy than in a centrally planned economy.

These examples may suffice to illustrate the importance of specifying the logical structure of the model. This specification should provide us with a number of equations, in which certain coefficients indicate the strength with which the "explanatory variables" in each relation influence the "variable to be explained." The knowledge of these coefficients, supposed to represent basic reactions, is the immediate aim of any piece of research of this kind. The presumption is that certain basic patterns of reaction exist, even when the variables explicitly specified in the model are assuming changing values. This presumption is a sort of minimum we have to accept if scientific analysis is to make sense at all. When we say that technical skill increases a population's production, we mean that a given increase in technical skill, to be measured in an independent way, influences production by a definite quantity. If we left this quantity indefinite, then we would, in fact, give up the explanation of differences in production in a scientific way and would open the way to complete arbitrariness.

Some very simple examples of relationships will be discussed in the third section.

Measuring the phenomena. This next step of measuring the phenomena introduced as relevant variables meets with considerable difficulties, especially for psychological data, as already stated. Provisionally we shall have to use rough and broad characteristics only, usually indirect indications. Such indications can be found in scores obtained in examinations, percentages of the population satisfying certain standards, etc. There is one trap we should avoid when using such figures: they usually depend on a number of economic variables, such as income, degree of urbanization, etc., and we should be careful to correct the figures for differences in such variables, whenever we can.

There will be less difficulty in collecting statistical and factual material on institutional and natural data as well as on "initial" economic variables. Yet a considerable program may also be developed to fill the many gaps in our information about these data. In order to avoid waste of time and resources, however, I suggest that first of all the material that we need for our simplest models should be collected. An efficient approach seems to be to group the collection of factual information around a succession of models, starting with the simplest and gradually moving toward the more complicated ones. The latter will be of many different types; some of them may specialize in the details of economic structure, while others may specialize in the details of human behavior.³ Still other models may give more attention to the details of political regimes. Models of the first cate-

³ See footnote 2.

gory will require more figures about input-output relations (both for current production and investment) and about gestation periods. The second category requires the systematic collection of "human" data of the kind used in job evaluation and psychotechnical description of individuals. The third category needs more material on the response of individuals to policy measures, e.g. taxes or changes in property rights.

Testing the relationships. This final step of the testing of relationships would then become possible. The basic philosophy here is the same as in correlation analysis, to be applied to comparisons among countries or periods, provided each period is long enough to permit the measurement of growth as distinct from short-run movements. Only the influence of variables that actually have assumed different levels in the cases compared can be determined, and these again under certain conditions only. The number of independent observations available must be substantial, larger than the number of explanatory variables, to quote one condition. More refined statistical criteria will often be needed.

From Simpler to More Complicated Models

As already stated, the phenomenon of growth can be represented by a large number of different "growth models," some of them extremely simple, others more complicated. In a way, the simpler models may be obtained from the more complicated ones by such operations as consolidation and solution. By the operation of consolidation we understand the consolidation of accounts, which may mean aggregation of sectors. By the operation of solution we mean the elimination of certain variables with the aid of some of the relations, so as to be left with fewer equations in fewer variables. The remaining equations, in all these cases, will contain certain conglomerates of coefficients of the original equations. Testing the simpler, consolidated model will provide us with values for these conglomerates, but not with the values of the component coefficients of the original, more complicated model. It may give some clues already, nevertheless, as to the determinants of growth. Passing from a simpler to a more elaborate model will increase our knowledge about the "location" in the model of some of the influences assumed. The program here advocated consists, as already stated, of starting out with the simplest, most consolidated models and proceeding step by step to the more complicated ones. It may be illustrated by some of the first few steps that could be undertaken.

Direct comparison of growth rates. We may start with the assumption that a country's rate of growth of national product in a certain period depends on a number of data intuitively selected from our list as the most relevant ones. To the extent that we have numerical material on the variables concerned, we may then try to test this dependency, using multiple correlation or similar techniques. Some of the data, such as population growth or size of families, may be given a priori coefficients by comparing growth rates for income per capita.

A simple Harrod-Domar model. The next simplest model seems to be the well-known two-equations model

$$sY = I = k\dot{Y} \quad (1)(2)$$

where Y is national product and \dot{Y} its rate of increase, I is net investment, s is propensity to save, and k is capital coefficient. In this model the data are already hidden in two different "coefficients," s and k , each of which may depend on a number of economic data. The former may depend on the level of income, the country's political regime, the population's thriftiness, and so on. The latter may depend on the relative size of the country's various industries, the general level of efficiency, the frequency of double shifts, and so on. Both offer possibilities for comparative studies among countries as well as periods.

Our remarks on the consolidation of equations can easily be illustrated with the aid of this model. The two equations can be merged into one single equation by the elimination of I :

$$\frac{\dot{Y}}{Y} = \frac{s}{k} = g \quad (3)$$

Our previous, and simplest, example of comparative study consisted of a study of g , the rate of growth of income, as a function of various data. Our present, and next to simplest, suggestion means a decomposition of g into its two components, s and k , and an attempt at determining the influence exerted by the various data on each of them separately. This is what we called the localization of these influences. In some cases it may be important to know that a country's g is low, because s is "too low" and not because k is "too high." It may then be more promising to raise s than to lower k . Whether in fact s is "too low" cannot be concluded from the numerical value of s ; it may well be that a low numerical value of s is "justified," e.g. because the income level of the country is low or its distribution rather even, and that s is not lower, for the same level of income, than elsewhere. It then may not be easy to increase s , while it may be that k can be lowered without much trouble.

Further specification of production function. The process of refinement can be continued in many ways. A very natural next step might be to introduce a production function more complicated than the one implied in the hypothesis of a constant capital coefficient. We may assume the Douglas production function to be a better approximation, possibly generalized by the assumption of increasing autonomous productivity over time:

$$y = e(t)a^{3/4}k^{1/4} \quad (4)$$

where y is volume of production, a is labor force, and k is capital stock. Again $e(t)$ may depend on other data also and could be the subject for an international and an intertemporal comparison.

A final remark must be made about the *nature of coefficients*. The reader will have understood that in our examples the coefficients s , k , g , and e are not supposed to be uniform for different countries and periods. In that sense they are not "true" coefficients in our present context; in other words, they are not "invariants." Such invariant or true coefficients will be the "underlying" coefficients in the "explanation," by the data, of s , k , g , and e . This state of affairs illustrates the existence of various levels or a hierarchy of coefficients, or parameters, with different "degrees" of invariance, common to all theory.

Final Remarks: Results of Research Previously Undertaken

In this section some scattered remarks will be made on work already done in our subject. No attempt has been made to give a systematic account of previous work, however; the intention is, rather, to offer some examples. We shall not speak here of pure measurement of the relevant phenomena, but only discuss some attempts at testing, by means of comparative studies, relationships used in long-term economic models.

Colin Clark, in his *Economics of 1960*,⁴ uses various relations tested by international cross sections. It is remarkable that the variables used as a rule are purely economic, meaning that he did not introduce variable data (extra-economic variables) to improve his fits. It appears that income offers a reasonable first approximation to explain differences in consumption (and hence in savings), and that differences in capital per head and land per head offer a reasonable first approximation to explain differences in production per head. To the extent that other explanatory variables should have been included, they at least show rather high intercorrelations with such economic variables as the ones mentioned. This does not imply, however, that, as a consequence, no differences in economic growth can be explained; such differences can be explained by what was called before the "initial conditions." In concrete terms, underdevelopment according to this type of model, is an accident, connected with adverse initial conditions and not systematically connected with basic and difficult to change characteristics of certain peoples or regimes. It is doubtful whether reality is in agreement with such a theory; Colin Clark's relations were rather rough first approximations. It is interesting enough, though, that a first approximation can be given at all along these lines.

Provisionally, similar conclusions can be drawn from recent attempts by Goreux to compare Engel curves for food for different countries and periods. Again, as a rough first approximation, one may say that one equation covers the Engel curves of all cases considered. It is a rough approximation, however, calling for refinement by the introduction of additional economic or extra-economic explanatory variables, as do Colin Clark's relationships.

⁴London, Macmillan, 1942.

Interesting, but also very rough, comparative studies have been made by Allais and Diab. Allais tries to explain differences in real income per head by some economic and some extra-economic variables; among the latter is the intensity of competition, linked by him to the size of the market. Diab compares production per head for different countries, corrects them in an a priori way for differences in capital per head and attributes the remaining considerable differences to differences in "effectiveness."

One of the rare attempts to measure the influence of a regime on human behavior is Break's attempts at determining the influence of income tax on the supply of effort (of auditors) by comparing two periods in Britain with different levels of income tax. This is a careful piece of analysis leading the author to the conclusion that no influence of the income tax level can be discerned.

Another example in this class is Nutter's comparison between American and Russian development. It illustrates the complications one can run into in this work, particularly the complication of how to estimate the influence of wars as a disturbance of growth. Its interpretation depends, moreover, on the "data" that one wants to use as explanatory variables. It is strongly suggested that it is the difference in regime above all else that is responsible for any difference in growth. Remarkably enough, however, the difference in growth changes its sign after elimination of war years, leaving some uncertainty as to which regime was the most effective in producing growth.

Summary

While interesting comparative studies on economic growth have already been made, there is much scope for further efforts to be devoted to such studies. The most efficient method consists, in my opinion, of constructing and testing development "models" aiming at an explanation of observed differences in growth by a number of extra-economic data and economic reaction patterns. It seems wise to begin with the collection of statistical and factual material apt to test the simplest models so far presented and to proceed gradually to more complicated models, while maintaining a balance between the elaboration of theoretical models and the collection of the corresponding material. Some examples are presented.

How to Obtain National Bureau Publications

The National Bureau of Economic Research is a nonprofit membership corporation organized to make impartial studies in economic science.

Its books are published and distributed by the Princeton University Press; its *Occasional Papers* and *Technical Papers* are published and distributed by the National Bureau itself.

The National Bureau's publications may be obtained either on subscription or by purchase.

Contributing subscription rates, effective January 1, 1959, are the standard rate of \$75 a year and the educational rate of \$35 a year. The educational rate is open to teachers, students, other individuals, and libraries of recognized educational institutions, and to public libraries; and to individual members and libraries of scientific societies or of private nonprofit research agencies.

Contributors of these amounts or more are entitled to receive a complimentary copy of each current publication—*books, Occasional Papers, Technical Papers, and the Annual Report*—in advance of release to the public. In addition, contributors are entitled to a one-third discount on all National Bureau publications purchased.

The associate subscription rate is \$10. A contributor of this amount receives a complimentary copy of each current *Occasional Paper, Technical Paper, and the Annual Report*, and is entitled to a one-third discount on all publications purchased. Only the following are eligible to become associates: teachers, students, other individuals, and libraries of recognized educational institutions, and public libraries; and individual members and libraries of scientific societies or of private nonprofit research agencies.

The subscription rate of *Occasional Papers* is \$4 for five issues. A contributor of \$4 receives the next five *Occasional Papers* (or any *Technical Papers* issued during this period may be substituted) and the *Annual Report*.

*Contributions to the National Bureau are deductible
in calculating federal income taxes.*

NONCONTRIBUTORS: Order *Books* from
Princeton University Press, Princeton, New Jersey

NONCONTRIBUTORS:
Order *Papers* and request the
Annual Report from:

CONTRIBUTORS:
Order all *books and Papers* and
request the *Annual Report* from:

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.
261 Madison Avenue New York 16, N. Y.