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# Modern Economic Growth: Findings and Reflections

By SIMON KUZNETS\*

## I. Definitions

A country's economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands. All three components of the definition are important. The sustained rise in the supply of goods is the *result* of economic growth, by which it is identified. Some small countries can provide increasing income to their populations because they happen to possess a resource (minerals, location, etc.) exploitable by more developed nations, that yields a large and increasing rent. Despite intriguing analytical problems that these few fortunate countries raise, we are interested here only in the nations that derive abundance by using advanced contemporary technology—not by selling fortuitous gifts of nature to others. Advancing technology is the *permissive* source of economic growth, but it is only a potential, a necessary condition, in itself not sufficient. If technology is to be employed efficiently and widely, and, indeed, if its own progress is to be stimulated by such use, institutional and ideological adjustments must be made to effect the proper use of innovations generated by the advancing stock of human knowledge. To

\* Harvard University. This article is the lecture he delivered in Stockholm, Sweden, December 1971, when he received the Nobel Prize in Economic Science. The article is copyright © the Nobel Foundation 1972. It is published here with the permission of the Nobel Foundation, and is included in the volume of *Les Prix Nobel en 1971*.

cite examples from modern economic growth: steam and electric power and the large-scale plants needed to exploit them are not compatible with family enterprise, illiteracy, or slavery—all of which prevailed in earlier times over much of even the developed world, and had to be replaced by more appropriate institutions and social views. Nor is modern technology compatible with the rural mode of life, the large and extended family pattern, and veneration of undisturbed nature.

The source of technological progress, the particular production sectors that it affected most, and the pace at which it and economic growth advanced, differed over centuries and among regions of the world; and so did the institutional and ideological adjustments in their interplay with the technological changes introduced into and diffused through the growing economies. The major breakthroughs in the advance of human knowledge, those that constituted dominant sources of sustained growth over long periods and spread to a substantial part of the world, may be termed epochal innovations. And the changing course of economic history can perhaps be subdivided into economic epochs, each identified by the epochal innovation with the distinctive characteristics of growth that it generated.<sup>1</sup> Without considering the feasibility of identifying and dating such economic epochs, we may proceed on the working assumption that modern economic growth represents such a

<sup>1</sup> For a discussion of the economic epoch concept, see Kuznets (1966), pp. 1–16.

distinct epoch—growth dating back to the late eighteenth century and limited (except in significant *partial* effects) to economically developed countries. These countries, so classified because they have managed to take adequate advantage of the potential of modern technology, include most of Europe, the overseas offshoots of Western Europe, and Japan—barely one quarter of world population.<sup>2</sup> This paper will focus on modern economic growth, but with obviously needed attention to its worldwide impact.

Limitations of space prevent the presentation of a documented summary of the quantitative characteristics commonly observed in the growth of the presently developed countries, characteristics different from those of economic growth in earlier epochs. However, some of them are listed, because they contribute to our understanding of the distinctive problems of economic life in the world today. While the list is selective and is open to charges of omission, it includes those observed and empirically testable characteristics that lead back to some basic factors and conditions, which can only be glimpsed and conjectured, and forward to some implications that have so far eluded measurement.

## II. The Six Characteristics

Six characteristics of modern economic growth have emerged in the analysis based on conventional measures of national product and its components, population, labor force, and the like. First and most obvious are the high rates of growth of per capita product and of population in the developed countries—both large multiples of the previous rates observable in these countries and of those in the rest of the world, at

<sup>2</sup> For a recent classification identifying the non-Communist developed countries, see United Nations *Yearbook*, notes to Table 5, p. 156. These classifications vary from time to time, and differ somewhat from those of other international agencies.

least until the recent decade or two.<sup>3</sup> Second, the rate of rise in productivity, i.e., of output per unit of all inputs, is high, even when we include among inputs other factors in addition to labor, the major productive factor—and here too the rate is a large multiple of the rate in the past.<sup>4</sup> Third, the rate of structural transformation of the economy is high. Major aspects of structural change include the shift away from agriculture to nonagricultural pursuits and, recently, away from industry to services; a change in the scale of productive units, and a related shift from personal enterprise to impersonal organization of economic firms, with a corresponding change in the occupational status of labor.<sup>5</sup>

<sup>3</sup> For the non-Communist developed countries, the rates of growth per year over the period of modern economic growth, were almost 2 percent for product per capita, 1 percent for population, and 3 percent for total product. These rates—which mean roughly a multiplication over a century by five for product per capita, by three for population, and by more than fifteen for total product—were far greater than premodern rates. The latter can only be conjectured, but reasonable estimates for Western Europe over the long period from the early Middle Ages to the mid-nineteenth century suggest that the modern rate of growth is about ten times as high for product per capita (see Kuznets (1971), pp. 10–27). A similar comparison for population, either for Europe or for the area of European settlement (i.e., Europe, the Americas, and Oceania), relating to 1850–1960, as compared with 1000–1850, suggests a multiple of 4 or 5 to 1 (see Kuznets (1966), Tables 2.1 and 2.2, pp. 35 and 38). The implied acceleration in the growth rate of total product is between forty and fifty times.

<sup>4</sup> Using the conventional national economic accounts, we find that the rate of increase in productivity is large enough to account (in the statistical sense) for almost the entire growth of product per capita. Even with adjustments to allow for hidden costs and inputs, growth in productivity accounts for over half of the growth in product per capita (see Kuznets (1971), pp. 51–75, particularly Table 9, p. 74; and Table 11, p. 93).

<sup>5</sup> The rapidity of structural shifts in modern times can be easily illustrated by the changes in the distribution of the labor force between agriculture (and related industries) and the nonagricultural production sectors. In the United States, the share of labor force attached to the agricultural sector was still 53.5 percent in 1870 and declined to less than 7 percent in 1960. In an old European country like Belgium, the share of agriculture in the labor force, 51 percent in 1846, dropped to 12.5 percent in 1947 and further to 7.5 percent in 1961 (see Bairoch et al., Tables D-4 and C-4). Considering that it

Shifts in several other aspects of economic structure could be added (in the structure of consumption, in the relative shares of domestic and foreign supplies, etc.). Fourth, the closely related and extremely important structures of society and its ideology have also changed rapidly. Urbanization and secularization come easily to mind as components of what sociologists term the process of modernization. Fifth, the economically developed countries, by means of the increased power of technology, particularly in transport and communication (both peaceful and warlike), have the propensity to reach out to the rest of the world—thus making for one world in the sense in which this was not true in any pre-modern epoch.<sup>6</sup> Sixth, the spread of modern economic growth, despite its worldwide partial effects, is limited in that the economic performance in countries accounting for three-quarters of world population still falls far short of the minimum levels feasible with the potential of modern technology.<sup>7</sup>

This brief summary of two quantitative characteristics of modern economic growth that relate to aggregate rates, two that relate to structural transformation, and two that relate to international spread, supports our working assumption that modern economic growth marks a distinct economic epoch. If the rates of aggregate

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took centuries for the share of the agricultural sector in the labor force to decline to 50 percent in any sizable country (i.e., excluding small "city enclaves"), a drop of 30 to 40 percentage points in the course of a single century is a strikingly fast structural change.

<sup>6</sup> The outward expansion of developed countries, with their European origin, goes back to long before modern economic growth, indeed, back to the Crusades. But the much augmented transportation and communication power of developed countries in the nineteenth century permitted a much greater and more direct political dominance over the colonies, the "opening up" of previously closed areas (such as Japan), and the "partition" of previously undivided areas (such as sub-Saharan Africa).

<sup>7</sup> For further discussion see Section IV below, which deals with the less developed countries.

growth and the speed of structural transformation in the economic, institutional, and perhaps even in the ideological, framework are so much higher than in the past as to represent a revolutionary acceleration, and if the various regions of the world are for the first time in history so closely interrelated as to be one, some new major growth source, some new epochal innovation, must have generated these radically different patterns. And one may argue that this source is the emergence of modern science as the basis of advancing technology—a breakthrough in the evolution of science that produced a potential for technology far greater than existed previously.

Yet modern growth continues many older trends, if in greatly accelerated form. This continuity is important particularly when we find that, except for Japan and possibly Russia, all presently developed countries were well in advance of the rest of the world before their modern growth and industrialization began, enjoying a comparative advantage produced by pre-modern trends. It is also important because it emphasizes that distinction among economic epochs is a complicated intellectual choice and that the continuation of past trends and their changing patterns over time are subjects deserving the closest attention. Does the acceleration in growth of product and productivity in many developed countries in the last two decades reflect a major change in the potential provided by science-oriented technology, or a major change in the capacity of societies to catch up with that potential? Is it a way of recouping the loss in standing, relative to such a leader as the United States, that was incurred during the depression of the 1930's and World War II? Or, finally, is it merely a reflection of the temporarily favorable climate of the U.S. international policies? Is the expansion into space a continuation of the old trend

of reaching out by the developed countries, or is it a precursor of a new economic epoch? These questions are clearly illustrative, but they hint at broader analytical problems suggested by the observation of modern economic growth as a distinct epoch.

The six characteristics noted are interrelated, and the interrelations among them are most significant. With the rather stable ratio of labor force to total population, a high rate of increase in per capita product means a high rate of increase in product per worker; and, with average hours of work declining, it means still higher growth rates in product per man-hour. Even if we allow for the impressive accumulation of capital, in its widest sense, the growth rate of productivity is high, and, indeed, mirrors the great rise in per capita product and in per capita pure consumption. Since the latter reflects the realized effects of advancing technology, rapid changes in production structure are inevitable—given the differential impact of technological innovations on the several production sectors, the differing income elasticity of domestic demand for various consumer goods, and the changing comparative advantage in foreign trade. As already indicated, advancing technology changes the scale of production plants and the character of the economic enterprise units. Consequently, effective participation in the modern economic system by the labor force necessitates rapid changes in its location and structure, in the relations among occupational status groups, and even in the relations between labor force and total population (the last, however, within narrow overall limits). Thus, not only are high aggregate growth rates associated with rapid changes in economic structure, but the latter are also associated with rapid changes in other aspects of society—in family formation, in urbanization, in man's views on his role and the measure of

his achievement in society. The dynamic drives of modern economic growth, in the countries that entered the process ahead of others, meant a reaching out geographically; and the sequential spread of the process, facilitated by major changes in transport and communication, meant a continuous expansion to the less developed areas. At the same time, the difficulty of making the institutional and ideological transformations needed to convert the new large potential of modern technology into economic growth in the relatively short period since the late eighteenth century limited the spread of the system. Moreover, obstacles to such transformation were, and still are being, imposed on the less developed regions by the policies of the developed countries.

If the characteristics of modern economic growth are interrelated, in that one induces another in a cause and effect sequence or all are concurrent effects of a common set of underlying factors, another plausible and significant link should be noted. Mass application of technological innovations, which constitutes much of the distinctive substance of modern economic growth, is closely connected with the further progress of science, in its turn the basis for additional advance in technology. While this topic is still to be studied in depth, it seems fairly clear that mass-uses of technical innovations (many based on recent scientific discoveries) provide a positive feedback. Not only do they provide a larger economic surplus for basic and applied research with long time leads and heavy capital demands, but, more specifically, they permit the development of new efficient tools for scientific use and supply new data on the behavior of natural processes under the stress of modification in economic production. In other words, many production plants in developed countries can be viewed as laboratories for the exploration of natural processes and as

centers of research on new tools, both of which are of immense service to basic and applied research in science and technology. It is no accident that the last two centuries were also periods of enormous acceleration in the contribution to the stock of useful knowledge by basic and applied research—which provided additional stimuli to new technological innovations. Thus, modern economic growth reflects an interrelation that sustains the high rate of advance through the feedback from mass applications to further knowledge. And unless some obstacles intervene, it provides a mechanism for self-sustaining technological advance, to which, given the wide expanse of the universe (relative to mankind on this planet), there are no obvious proximate limits.

### III. Some Implications<sup>8</sup>

I turn now to a brief discussion of some social implications, of some effects of modern economic growth on conditions of life of various population groups in the countries affected. Many of these effects are of particular interest, because they are not reflected in the current measures of economic growth; and the increasing realization of this shortcoming of the measures has stimulated lively discussion of the limits and limitations of economic measurement of economic growth.

The effects on conditions of life stem partly from the major role of technological innovations in modern economic growth, and partly from the rapid shifts in the underlying production structure. To begin with the latter, the major effects of which, for example, urbanization, internal migration, shift to employee status and what

might be called the merit basis of job choice, have already been noted as characteristics of modern economic growth. Two important groups of effects of this rapid transformation of economic structure deserve explicit reference.

First, the changes in conditions of life suggested by “urbanization” clearly involved a variety of costs and returns that are not now included in economic measurement, and some of which may never be susceptible to measurement. Internal migration, from the countryside to the cities (within a country, and often international) represented substantial costs in the pulling up of roots and the adjustment to the anonymity and higher costs of urban living. The learning of new skills and the declining value of previously acquired skills was clearly a costly process—to both the individuals and to society. But if such costs were omitted from measurement, as they still are in conventional accounts, so were some returns. Urban life, with its denser population, provided amenities and spiritual goods that were not available in the “dull and brutish” life of the countryside; and the new skills, once learned, were often a more adequate basis for a richer life than the old. This comment on the hidden costs and returns involved in the shift toward urban life may apply to many other costs and returns involved in other shifts imposed by economic growth, for example, in the character of participation in economic activity, in the social values, and in the new pressures on deviant members of society.

The second intriguing aspect of structural change is that it represents shifts in the relative shares in the economy of the specific population groups attached to particular production sectors. Since economic engagement represents a dominant influence in the life of people, the shift in the share of a specific sector, with its distinctive characteristics and even mode of

<sup>8</sup> Many of the points touched upon in this section are discussed in greater detail in Kuznets (1971), particularly in ch. 2, pp. 75–98, which deals with the nonconventional costs of economic growth, and ch. 7, pp. 314–54, which deals with various interrelations between aggregate change and structural shifts in economic and other aspects of social structure.

life, affects the population group engaged in it. Economic growth perforce brings about a decline in the relative position of one group after another—of farmers, of small scale producers, of landowners—a change not easily accepted, and, in fact, as history teaches us, often resisted. The continuous disturbance of preexisting *relative* position of the several economic groups is pregnant with conflict—despite the rises in absolute income or product common to all groups. In some cases, these conflicts did break out into overt civil war, the Civil War in the United States being a conspicuous example. Other examples, in the early periods of industrialization among the currently developed countries, or, for that matter, more recently within some less developed countries, are not lacking.

Only if such conflicts are resolved without excessive costs, and certainly without a long-term weakening of the political fabric of the society, is modern economic growth possible. The sovereign state, with authority based on loyalty and on a community of feeling—in short, the modern national state—plays a crucial role in peacefully resolving such growth-induced conflicts. But this and other services of the national state may be costly in various ways, of which intensified nationalism is one and other effects are too familiar to mention. The records of many developed countries reveal examples of resolutions of growth conflicts, of payments for overcoming resistance and obstacles to growth, that left burdensome heritages for the following generations (notably in Germany and Japan). Of course, this is not the only economic function of the state; it can also stimulate growth and structural change. And, to mention a closely related service, it can referee, select, or discard legal and institutional innovations that are proposed in the attempt to organize and channel effectively the new production potentialities. This, too, is a matter that may gen-

erate conflicts, since different legal and institutional arrangements may have different effects on the several economic groups in society.

In that modern economic growth has to contend with the resolution of incipient conflicts continuously generated by rapid changes in economic and social structure, it may be described as a process of controlled revolution. The succession of technological innovations characteristic of modern economic growth and the social innovations that provide the needed adjustments are major factors affecting economic and social structure. But these innovations have other effects that deserve explicit mention; and while they are discussed below in terms of effects of technological innovations, the conclusions apply *pari passu* to innovations in legal forms, in institutional structure, and even in ideology.

A technological innovation, particularly one based on a recent major invention, represents a venture into the partly unknown, something not fully known until the mass spread of the innovation reveals the full range of direct and related effects. An invention is a major one if it provides the basis for extensive applications and improvements (for example, the stationary steam engine in the form attributable mostly to James Watt). Its cumulative effects, all new, extend over a long period and result in an enormous transformation of economic production and of production relations. But these new effects can hardly be fully anticipated or properly evaluated in advance (and sometimes not even post facto). This is true also of electric power, the internal combustion engine, atomic energy, the application of short rays to communication and computation, the inventions resulting in such new industrial materials as steel, aluminum, and plastics, and so on through a long list that marked modern economic growth. Even when the

technological innovation is an adaptation of a known technique by a follower country, the results may not be fully foreseeable, for they represent the combination of something known, the technology, with something new, an institutional and ideological framework with which it has not previously been combined. Needless to say, the element of the uniquely new, of exploration into the unknown, was also prominent in premodern times, since innovations in knowledge and technology are the prerequisites for any significant growth. But the *rate* of succession of such innovations was clearly more rapid in modern economic growth, and provided the base for a higher rate of aggregate growth.

The effects of such ventures into the new and partly unknown are numerous. Those of most interest here are the *surprises*, the unexpected results, which may be positive or negative. An invention or innovation may prove far more productive, and induce a far wider mass application and many more cumulative improvements than were dreamed of by the inventor and the pioneer group of entrepreneurs. Or the mass application of a major invention may produce unexpected diseconomies of a scale that could hardly be foreseen in the early phases of its diffusion. Examples of both positive and negative surprises abound. Many Schumpeterian entrepreneurs failed to grasp, by a wide margin, the full scope and significance of the innovations that they were promoting and that eventually brought them fame and fortune. And most of us can point at the unexpected negative effects of some technological or social invention that first appeared to be an unlimited blessing.

The significant aspect here is that the surprises cannot be viewed as accidents: they are inherent in the process of technological (and social) innovation in that it contains an element of the unknown. Furthermore, the diffusion of a major innova-

tion is a long and complicated sequence that cannot be accurately forecast, with an initial economic effect that may generate responses in other processes. These will, in turn, change the conditions under which the innovation exercises its effect on human welfare, and raise further problems of adjustment. To illustrate: we can today follow easily the sequence from the introduction of the passenger car as a mass means of transportation, to the growth of the suburbs, to the movement of the more affluent from the city centers, to the concentration of lower income recipients and unemployed immigrants in the slums of the inner city core, to the acute urban problems, financial and other, and to the trend toward metropolitan consolidation. But the nature and implications of this sequence were certainly not apparent in the 1920's, when passenger cars began their mass service function in the United States.

Indeed, to push this speculative line further, one can argue that all economic growth brings *some* unexpected results in its wake, positive as well as negative, with the latter taking on greater importance as the mass effects of major innovations are felt and the needs that they are meant to satisfy are met. If the argument is valid, modern economic growth, with the rapid succession of innovations and shortening period of their mass diffusion, must be accompanied by a relatively high incidence of negative effects. Yet one must not forget that premodern economic growth had similar problems, which, with the weaker technology, may have loomed even larger. Even if we disregard the threatening exhaustion of natural resources, a problem that so concerned Classical (and implicitly even Marxian) economics, and consider only early urbanization, one major negative effect was the significant rise in death rates as population moved from the more salubrious countryside to the infection-



prone denser conditions of unsanitary cities. Two points are relevant here. First, the negative effects of growth have never been viewed as so far outweighing its positive contribution as to lead to its renunciation—no matter how crude the underlying calculus may have been. Second, one may assume that once an unexpected negative result of growth emerges, the potential of material and social technology is aimed at its reduction or removal. In many cases these negative results were allowed to accumulate and to become serious technological or social problems because it was so difficult to foresee them early enough in the process to take effective preventive or ameliorative action. Even when such action was initiated, there may have been delay in the effective technological or policy solution. Still, one may justifiably argue, in the light of the history of economic growth, in which a succession of such unexpected negative results has been overcome, that any specific problem so generated will be temporary—although we shall never be free of them, no matter what economic development is attained.

#### IV. The Less Developed Countries

Two major groups of factors appear to have limited the spread of modern economic growth. First, as already suggested, such growth demands a stable, but flexible, political and social framework, capable of accommodating rapid structural change and resolving the conflicts that it generates, while encouraging the growth-promoting groups in society. Such a framework is not easily or rapidly attained, as evidenced by the long struggles toward it even in some of the presently developed countries in the nineteenth and early twentieth centuries. Japan is the only nation outside of those rooted in European civilization that has joined the group of developed countries so far. Emergence of a modern framework for economic growth may

be especially difficult if it involves elements peculiar to European civilization for which substitutes are not easily found. Second, the increasingly national cast of organization in developed countries made for policies toward other parts of the world that, while introducing some modern economic and social elements, were, in many areas, clearly inhibiting. These policies ranged from the imposition of colonial status to other limitations on political freedom, and, as a result, political independence and removal of the inferior status of the native members of the community, rather than economic advance, were given top priority.

Whatever the weight of the several factors in explaining the failure of the less developed countries to take advantage of the potential of modern economic growth, a topic that, in its range from imperialist exploitation to backwardness of the native economic and social framework, lends itself to passionate and biased polemic, the factual findings are clear. At present, about two-thirds or more of world population is in the economically less developed group. Even more significant is the concentration of the population at the low end of the product per capita range. In 1965, the last year for which we have worldwide comparable product estimates, the per capita *GDP* (at market prices) of 1.72 billion out of a world total of 3.27 billion, was less than \$120, whereas 0.86 billion in economically developed countries had a per capita product of some \$1900. Even with this narrow definition of less developed countries, the intermediate group was less than 0.7 billion, or less than 20 percent of world population.<sup>9</sup> The preponderant

<sup>9</sup> The underlying data are from Everett Hagen and Oli Hawrylyshyn. These are primarily from United Nations publications, supplemented by some auxiliary sources (mostly for the Communist countries), and use conventional conversion rates to *U.S.* dollars in 1965. The estimates for the Communist countries have been adjusted to conform to the international *GDP* concept.

population was thus divided between the very low and the rather high level of per capita economic performance. Obviously, this aspect of modern economic growth deserves our greatest attention, and the fact that the quantitative data and our knowledge of the institutional structures of the less developed countries are, at the moment, far more limited than our knowledge of the developed areas, is not reason enough for us to ignore it.

Several preliminary findings, or rather plausible impressions, may be noted. First, the group of less developed countries, particularly if we widen it (as we should) to include those with a per capita product somewhat larger than \$120 (in 1965 prices), covers an extremely wide range in size, in the relations between population and natural resources, in major inherited institutions, and in the past impact upon them of the developed countries (coming as it did at different times and from different sources). There is a striking contrast, for example, in terms of population size, between the giants like Mainland China and India, on the one hand, and the scores of tiny states in Africa and Latin America; as there is between the timing of direct Western impact on Africa and of that on many countries in Latin America. Furthermore, the remarkable institutions by which the Sinic and East Indian civilizations produced the unified, huge societies that dwarfed in size any that originated in Europe until recently, bore little resemblance to those that structured the American Indian societies or those that fashioned the numerous tribal societies of Africa.

Generalizations about less developed countries must be carefully and critically scrutinized in the light of this wide variety

of conditions and institutions. To be sure, their common failure to exploit the potential of modern economic growth means several specific common features: a low per capita product, a large share of agriculture or other extractive industries, a generally small scale of production. But the specific parameters differ widely, and because the obstacles to growth may differ critically in their substance, they may suggest different policy directions.

Second, the growth position of the less developed countries today is significantly different, in many respects, from that of the presently developed countries on the eve of their entry into modern economic growth (with the possible exception of Japan, and one cannot be sure even of that). The less developed areas that account for the largest part of the world population today are at much lower per capita product levels than were the developed countries just before their industrialization; and the latter at that time were economically in advance of the rest of the world, not at the low end of the per capita product range. The very magnitudes, as well as some of the basic conditions, are quite different: no country that entered modern economic growth (except Russia) approached the size of India or China, or even of Pakistan and Indonesia; and no currently developed country had to adjust to the very high rates of natural increase of population that have characterized many less developed countries over the last two or three decades. Particularly before World War I, the older European countries, and to some extent even Japan, relieved some strains of industrialization by substantial emigration of the displaced population to areas with more favorable opportunities—an avenue closed to the populous less developed countries today. Of course, the stock of material and social technology that can be tapped by less developed countries today is enormously

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The developed countries include most countries with per capita GDP of \$1000 or more and Japan, but exclude those small countries with a high GDP per capita that is due to exceptional natural endowments (for example, Netherlands Antilles, Puerto Rico, Kuwait, and Qatar).

larger than that available in the nineteenth and even early twentieth centuries. But it is precisely this combination of greater backwardness and seemingly greater backlog of technology that makes for the significant differences between the growth position of the less developed countries today and that of the developed countries when they were entering the modern economic growth process.

Finally, it may well be that, despite the tremendous accumulation of material and social technology, the stock of innovations most suitable to the needs of the less developed countries is not too abundant. Even if one were to argue that progress in basic science may not be closely tied to the technological needs of the country of origin (and even that may be disputed), unquestionably the applied advances, the inventions and tools, are a response to the specific needs of the country within which they originate. This was certainly true of several major inventions associated with the Industrial Revolution in England, and illustrations abound of necessity as the mother of invention. To the extent that this is true, and that the conditions of production in the developed countries differed greatly from those in the populous less developed countries today, the material technology evolved in the developed countries may not supply the needed innovations. Nor is the social technology that evolved in the developed countries likely to provide models of institutions or arrangements suitable to the diverse institutional and population-size backgrounds of many less developed countries. Thus, modern technology with its emphasis on labor-saving inventions may not be suited to countries with a plethora of labor but a scarcity of other factors, such as land and water; and modern institutions, with their emphasis on personal responsibility and pursuit of economic interest, may not be suited to the more traditional life patterns of the agricultural communities that pre-

dominate in many less developed countries. These comments should not be interpreted as denying the value of many transferable parts of modern technology; they are merely intended to stress the possible shortage of material and social tools specifically fitted to the different needs of the less developed countries.

If the observations just made are valid, several implications for the growth problems of the less developed countries follow. I hesitate to formulate them explicitly, since the data and the stock of knowledge on which the observations rest are limited. But at least one implication is sufficiently intriguing, and seems to be illuminating of many recent events in the field, to warrant a brief note. It is that a substantial economic advance in the less developed countries may require modifications in the available stock of material technology, and probably even greater innovations in political and social structure. It will not be a matter of merely borrowing existing tools, material and social; or of directly applying past patterns of growth, merely allowing for the difference in parameters.

The innovational requirements are likely to be particularly great in the social and political structures. The rather violent changes in these structures that occurred in those countries that have forged ahead with highly forced industrialization under Communist auspices, the pioneer entry going back over forty years (beginning with the first Five-Year Plan in the *USSR*), are conspicuous illustrations of the kind of social invention and innovation that may be involved. And the variants even of Communist organization, let alone those of democracy and of non-Communist authoritarianism, are familiar. It would be an oversimplification to argue that these innovations in the social and political structures were made primarily in response to the strain between economic backwardness and the potential of modern economic growth; or to claim that they were inexor-

able effects of antecedent history. But to whatever the struggle for political and social organization is a response, once it has been resolved, the results shape significantly the conditions under which economic growth can occur. It seems highly probable that a long period of experimentation and struggle toward a viable political framework compatible with adequate economic growth lies ahead for most less developed countries of today; and this process will become more intensive and acute as the *perceived* gap widens between what has been attained and what is attainable with modern economic growth. While an economist can argue that some aspects of growth must be present because they are indispensable components (i.e., industrialization, large scale of production, etc.), even their parameters are bound to be variable; and many specific characteristics will be so dependent upon the outcome of the social and political innovations that extrapolation from the past is extremely hazardous.

#### V. Concluding Comments

The aim of the discussion was to sketch the major characteristics of modern economic growth, and to note some of the implications that the empirical study of economic growth of nations suggests. This study goes back to the beginning of our discipline, as indicated by the title of Adam Smith's founding treatise, *Wealth of Nations*, which could as well have been called the Economic Growth of Nations. But the quantitative base and interest in economic growth have widened greatly in the last three to four decades, and the accumulated results of past study of economic history and of past economic analysis could be combined with the richer stock of quantitative data to advance the empirical study of the process. The sketch above draws upon the results of many and widely varied studies in many countries, most of them economically developed; and

the discussion reflects a wide collective effort, however individual some of my interpretations may be.

The most distinctive feature of modern economic growth is the combination of a high rate of aggregate growth with disrupting effects and new "problems." The high rate of growth is sustained by the interplay between mass applications of technological innovations based on additions to the stock of knowledge and further additions to that stock. The disrupting effects are those imposed by the rapid rate of change in economic and social structure. The problems are the unexpected and unforeseeable results of the spread of innovations (with emphasis on the new and unknown indicated by that term). Added to this is the range of problems raised by the slow spread of economic growth to the less developed countries, all of which have a long history, separate and relatively isolated from the areas within which modern economic growth originated. Thus, concurrent with the remarkable positive achievements of modern economic growth are unexpected negative results even within the developed countries; while the less developed countries are struggling in the attempt to use the large potential of modern technology in order to assume an adequate role in the one and interdependent world (from which they cannot withdraw even if they wished to do so).

We have stressed the problem aspects of modern economic growth because they indicate the directions of further research in the field. These aspects, the "surprises" and the implicit explanatory "puzzles," are problems not only in the sense of departures from the desirable (that may call for policy amelioration) but also in the sense that our quantitative data and particularly our analytical hypotheses do not provide us with a full view and explanation. As already noted, the conventional measures of national product and its components do not reflect many costs of ad-

justment in the economic and social structures to the channeling of major technological innovations; and, indeed, also omit some positive returns. The earlier theory that underlies these measures defined the productive factors in a relatively narrow way, and left the rise in productivity as an unexplained gap, as a measure of our ignorance. This shortcoming of the theory in confrontation with the new findings, has led to a lively discussion in the field in recent years, and to attempts to expand the national accounting framework to encompass the so far hidden but clearly important costs, for example, in education as capital investment, in the shift to urban life, or in the pollution and other negative results of mass production. These efforts will also uncover some so far unmeasured positive returns—in the way of greater health and longevity, greater mobility, more leisure, less income inequality, and the like. The related efforts to include the additions to knowledge in the framework of economic analysis, the greater attention to the uses of time and to the household as the focus of economic decision not only on consumption but also on investment, are steps in the same direction. It seems fairly clear that a number of analytical and measurement problems remain in the theory and in the evaluation of economic growth in the developed countries themselves; and that one may look forward to major changes in some aspects of the analysis, in national economic accounting, and in the stock of empirical findings, which will occupy economists in the developed countries in the years ahead.

For the less developed countries the tasks of economic research are somewhat different: the great need is for a wider supply of tested data, which means essentially data that have been scrutinized in the process of use for economic analysis. As already noted, the stock of data and of economic analysis is far poorer for these

countries than that for the developed countries—a parallel to the smaller relative supply of material capital. Yet in recent years there has been rapid accumulation of data for many less developed areas, other than those that, like Mainland China, view data as information useful to their enemies (external or internal) and are therefore either not revealed by government or possibly not even collected. The lag has been in the analysis of these data by economists and other social science scholars, because of the scarcity of such scholars who cannot be spared for research within the less developed countries themselves and because of the natural preoccupation of economists in the developed countries with the problems of their own countries. One may hope, but with limited expectations, that the task of refining analysis and measurement in the developed countries will not be pursued to the exclusion or neglect of badly needed studies of the less developed countries, studies that would deal with the quantitative bases and institutional conditions of their performance, in addition to those concentrating on what appear to be their major bottlenecks and the seemingly optimal policy prescriptions.

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