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# **4** : : The Use of National Income Accounting to Study Comparative Economic Growth

It did not require the invention of national income accounting to demonstrate that the United States was becoming increasingly well-to-do. The expansion of the United States geographically from its original location between the Alleghany mountain range and the Atlantic Ocean to a continental power was obvious. And the growth of the U.S. population from just a few million at the time of the Revolution to more than 100 million people early in the twentieth century was also obvious.

Nor did the numerous technological innovations, which drove the American economy and society forward and transformed American culture, escape notice. Indeed, the commissioner of the 1850 census waxed lyrically as he recounted the technological advances of the previous decade: the vast expansion of the railroad system, the fleet of steamboats that plied our inland waterways, the rapid spread of the telegraph network, and the growth of large-scale plants manufacturing cotton textiles and iron. These technological advances were so remarkable, he concluded, that they could not be matched again in the next decade.

A similar theme was struck by the commissioner of the 1900 census, who reviewed the progress of the preceding half century, which included the laying of the Atlantic cable, electric lights, shortwave radio, automobiles based on internal-combustion engines, the completion of the national railroad network, elevators, typewriters, photographic film, diesel engines, fountain pens, the gramophone, escalators, and

motion pictures. He also believed that this collection of advances was so spectacular that it could not be repeated in the twentieth century.

During the decade following World War II, when Simon Kuznets began to lay out his research agenda for studying and explaining the high, long-term rates of economic growth, he was aware of the persistent tendency of keen observers to underestimate the capacity for continuing technological advances. Half a century after the dire forecasts of stagnation, technological advances not only continued but likely had also accelerated. Developments in urban sanitation and food processing and the substitution of automobiles for horse-drawn vehicles had led to dramatic declines in the prevalence of deadly infectious diseases. Vaccines, penicillin, and other powerful medicines were widely available to deal with once-fatal diseases. The country had been largely electrified, and a host of household appliances was available to improve the efficiency of home production (refrigerators, washing machines, vacuum cleaners) and to provide low-cost entertainment (radios, phonographs, televisions).

In the election of 1928, Herbert Hoover had made the extravagant promise that, if he was elected president, there would be a chicken (the most expensive meat at the time) in every pot and an automobile in every garage. Yet, by 1955, advances in animal feeds had turned chicken into the cheapest meat, and there were about as many cars as households.

Nevertheless, in the 1950s, the specter of the Great Depression still haunted economists and policymakers, who worried that the postwar boom would peter out, like air escaping from a balloon, and the country would be returned to the clutches of secular stagnation. That fear was not cast out of professional and public discourse during the 1950s. The topic continued to be vigorously debated into the 1960s and beyond.

As early as 1949, Kuznets was one of a relatively few economists who thought that the Great Depression was the exception and that strong, long-term growth was the rule. What was needed was not another (more optimistic) speculative theory to confront the plethora of pessimistic theories but a careful study of history that might yield an empirically warranted theory.

But how to proceed? How to organize research into long-term trends of economic growth? One issue was the unit of observation. Should it be individual entrepreneurs? Climate zones? Ethnic subgroups? Economic social classes? Religious denominations? Kuznets rejected all these options in favor of the nation-state because the available data were organized and maintained by sovereign states. Moreover, he believed that the political system governing the operation of a particular nation-state might turn out to be an important variable in explaining economic growth.

Kuznets's plan to use national income measures to describe and explain the long-term economic trends of the industrial nations was formulated in the late 1930s. However, the execution of that plan was delayed by U.S. involvement in World War II and Kuznets's duties as the chief statistician at the War Production Board. In September 1943, when it was clear that peak wartime production goals had been attained and planning had turned to the transition back to a peacetime economy, Kuznets wrote to Wesley Mitchell, laying out his research plans for after his return to civilian life.

Mitchell was not enamored of a project that aimed to quantify the similarities and differences in the long-term growth patterns of a score of industrialized nations. He doubted the reliability of the data available for most of these nations and urged Kuznets to continue his prior emphasis on trends in the U.S. economy.

Mitchell's unwillingness to have the bureau sponsor his project, which Burns later rejected out of hand, led Kuznets to seek other auspices. This he found at the Social Science Research Council (SSRC) with funding supplied by the Rockefeller Foundation. Although the shift to the SSRC took place in 1949, Kuznets continued to work at the bureau to complete the projects under his supervision that were still in progress (de Rouvray 2004). These included a book presenting estimates of U.S. wealth, national product, and capital formation going back to 1880 (Kuznets 1961a) and his supervision of a series of monographs dealing with long-term trends in capital formation in various sectors of the U.S. economy (for an overview, see Jorgenson 1991). Kuznets's final task for the bureau was a monograph that integrated the various sectoral studies into an integrated overview of the

marshaling of capital for economic growth: *Capital in the American Economy* (Kuznets 1961a). With his obligations to the NBER complete, he turned to his project on comparative long-term growth.

Kuznets set out to gather statistics on the growth of nations over a period of at least a half century in order to have secular trends dominate short-term cycles. The data had to be capable of being decomposed in various ways (such as economic sectors and subsectors) in order to study structural changes in the economy during the course of economic growth. The demands of the data meant that his study of growth would be focused on the score or so of nations that had achieved high levels of industrialization by the mid-twentieth century. He characterized the modern industrial system as one in which entrepreneurs applied the empirical findings of science to the solution of problems and the organization of production.

### Ten Monographs on Quantitative Aspects of Economic Growth

This research agenda guided Kuznets as he produced ten monographs that were published as supplements to the journal *Economic Development and Cultural Change* under the general title "Quantitative Aspects of the Economic Growth of Nations." The first of these monographs (Kuznets 1956) brought together data on the growth of national product and its components, of populations, and of per capita growth for nineteen nations during the first half of the twentieth century. The text revolved around the discussion of thirty-one very detailed tables. The collection of the data involved efforts of Herculean proportions, and the analysis of the information in the tables was probing and insightful. Kuznets sought to explain the wide variations in the growth rates of per capita income, from a low of 5.6 percent per decade for Spain to a high of 29.2 percent per decade for Sweden (which means that, in half a century, Sweden's per capita income quadrupled while Spain's increased by only 30 percent).

After carefully pointing out various problems and limitations in the assembled data, Kuznets discussed a number of findings that transcended their limitations. One was the deceleration in growth rates after World War I—not only among the losers but also among the

winners—which he attributed to institutional destabilizations produced by the war. Another finding was that high rates of population growth did not undermine the growth of per capita income, as some neo-Malthusians believed. Quite the contrary: the available data indicated that high rates of growth in per capita income were positively related to population growth, although the sample size was not large enough to establish statistical significance.

The second monograph in the "Quantitative Methods" series was subtitled "Industrial Distribution of National Product and Labor Force" (see Kuznets 1957). Here, Kuznets sought to characterize differences in the industrial structure of rich and poor nations in the late 1940s. This portion of the monograph series relied on data collected by the United Nations. Kuznets was able to describe long-term changes in the industrial structure of twenty-eight countries, going back a whole century in two of the countries and between half and three-quarters of a century in most of the others.

For purposes of analysis, Kuznets sometimes divided the economy into twelve sectors and sometimes compressed those sectors into three, that he identified as *A* (agriculture, forestry, and fishing), *M* (manufacturing, mining, and construction), and *S* (transportation, communications, commerce, public utilities, government, and other services). His analyses of both the cross-sectional data and trends over time revealed that, as countries got rich, the agricultural share of the labor force declined. Since the output of agriculture increased more rapidly than population and the share of the labor force in agriculture declined, labor productivity in agriculture was rising. Indeed, rising labor productivity in agriculture was necessary to have the labor shares of the *M* and *S* sectors rise as rapidly as they did. However, during the first half of the twentieth century, the rate of growth of labor productivity among developed nations was generally much more rapid in the *M* and *S* sectors than in the *A* sector. In general, the shift in the structure of the labor force from agriculture to higher-productivity sectors by itself accounted for about one-fifth of the overall growth in labor productivity, and the remainder was due to productivity growth within each sector.

This monograph was not the first time that Kuznets had shown the relative importance of intersectoral shifts in total economic growth. But never before had he or any other scholar applied this analysis to so many countries over such a long stretch of time.

Kuznets devoted two subsequent entries in the monograph series (Kuznets 1960, 1961b) to the contribution of capital formation to economic growth. One of his principal findings was that rich countries saved more than poor countries (both in cross section for recent years and over time). Moreover, as countries became rich, saving shifted from being concentrated in households to being concentrated in businesses and governments. Surprisingly, the association between savings rates and the growth rates of nations was highly variable, which led Kuznets to conclude that the intensity of capital utilization was more important than sheer accumulation.

The seventh entry in the series (Kuznets 1962) dealt with the share and composition of national product. Kuznets found that, in eleven countries, the household share of consumption was declining while government consumption was on the rise. He also found that, although the share of GDP spent on consumption tended to decline with the rise of per capita income, that decline was limited because changes in technology promoted demand for new goods that satisfied new wants. Consumption was also promoted by the decrease in the inequality of the income distribution.

The eighth entry in the series (Kuznets 1963) reported that the distribution of income in the 1950s was more equal in rich countries than in poor countries. It also reported that inequality of income distribution had narrowed over time, but this narrowing had not generally occurred until after World War I.

The last two monographs in the series (Kuznets 1964, 1967) dealt with the level and structure of foreign trade. From the late nineteenth century to World War I, the foreign trade of most developed countries expanded more rapidly than per capita income. Although this process ground to a halt during the Great Depression of the 1930s, it resumed after the close of World War II. Most of international trade between 1870 and the 1960s was accounted for by Western Europe, the United States, Canada, and Japan either trading among themselves or

with underdeveloped countries. Trade purely among underdeveloped countries was minuscule.

### Kuznets's Theory of Modern Economic Growth

It is worth noting that the first of these monographs was published in 1956 and the last in 1967. Their order reflected Kuznets's notion of the building blocks on which an empirically based theory of economic growth had to be constructed. Although the monographs contained inklings of the shape of that theory, they were focused on the difficulties in amassing the data for the ultimate analysis and on various shortcomings in those data that needed to be taken into account when generalizing from them.

In 1966, Kuznets published his magnum opus, *Modern Economic Growth*. Although it drew heavily on the statistical data amassed in the ten *Economic Development and Cultural Change* monographs, it was a much more contemplative study. In thinking about the meaning of it all, Kuznets pondered the economic epochs of human history and epochal innovations. By the term *epoch*, he meant a long period possessing distinctive characteristics that gave the period unity and also differentiated it from past or future periods.

By *epochal innovations*, Kuznets meant not only major advances in technology that provided the essential basis for rapid economic growth but also changes in society and human institutions that are conducive to the exploitation of the new technology. It was the interplay of technological and institutional changes that was the essence of modern economic growth, growth that was both rapid and sustained.

The epochal innovation of the era of modern economic growth was the application of science to problems of production. The modern epoch of economic growth was, therefore, the scientific epoch. However, the application of science to production required not only institutional changes but also spiritual changes that were conducive to the flourishing of science. Kuznets characterized these spiritual changes with three terms: *secularism*, *egalitarianism*, and *nationalism*.

By *secularism*, Kuznets meant a concentration on life on earth rather than a focus on heaven. By *egalitarianism*, he meant a denial

of inborn differences, except as they manifested themselves in human performance, and recognition that every person was a full-fledged participant in the community of people; there was no hereditary minority entitled by birth alone to a share of economic output. By *nationalism*, he meant a community of feeling, based on history and culture, that tied individuals to other people within the community more tightly together than to people outside the community.

Kuznets went on to list fourteen characteristics of modern economic growth:

1. High rates of per capita growth accompanied by population growth led, in combination, to an enormous increase in total output in the developed nations.
2. The rise in output per capita was due mainly (80 percent) to increased economic efficiency.
3. These improvements in efficiency were particularly striking in commodity production, transportation, and communications.
4. Differential rates of technological advances contributed to the substantial changes in the distribution of output across the main production sectors of the economy.
5. Changes in the structure of output also reflected changes in the structure of demand as income increased.
6. The change in economic structure—particularly the shift away from agriculture, where small firms predominated—led to a significant increase in the scale of firms and a marked rise in the share of the labor force employed by large firms.
7. The change in the structure of output and industry called for rapid institutional adjustments, including changes in fertility rates and migration patterns, and greater government involvement to limit friction among competing groups of workers and between workers and business leaders.
8. Despite the far-reaching changes in the structure and organization of production, the share of labor and capital in income remained relatively stable, as did the distribution of income across income classes (top 10 percent, next 10 percent, etc.), although there had been some narrowing of inequality. Moreover, because

of the opportunities created by the rise of new industries and occupations, individuals were increasingly able to move up the economic ladder.

9. Despite the enormous rise in the reproducible capital stock per capita, consumption still accounted for the overwhelming proportion of national product. However, there were marked shifts in the structure of household consumption, from food, clothing, and shelter to consumer durables (appliances), health services, recreation, and education.
10. International aspects of economic growth were promoted by the technological revolution in transportation and communication. Technological advances in England spread rapidly to the Continent and to European offshoots overseas. This promoted a gap between the developed nations and the other three-quarters of the world.
11. The relatively unrestricted flow of goods and people between Europe and its offshoots prior to World War I promoted economic growth in both areas and also in European overseas colonies.
12. Between 1825 and World War I, the flow of European capital into overseas offshoots and colonies grew rapidly and helped finance economic growth in the recipient countries.
13. The aftermath of World War I, including global economic depression, led to a decline in international flows, particularly in international migration, but also in the flow of capital and, to some extent, in the trade of goods.
14. The fact that the spread of modern economic growth across nations was sequential, not simultaneous, led to marked shifts in political power across nations, which promoted international strain and conflict.

Kuznets's theory of modern economic growth was highly complex. It was a dynamic model because economic relations changed markedly over time. Hence, a set of factors that promoted economic growth at one period of time could become barriers to economic growth later on. His theory also had complex feedback systems that produced

unintended and sometimes undesirable consequences, such as high levels of unemployment in low-tech industries or immigration from the countryside to the cities, which led to overcrowding and severe pressure on urban water supplies and sewage disposal systems.

Despite the various dangers that might thwart economic growth, Kuznets was optimistic about the future. He expected technological advances not only to continue but also to accelerate. The increase in population, together with the increasing share of the population that was highly educated, meant that more individuals would become immersed in scientific and technological research. This pool of talent would be enhanced by a growing efficiency in the manufacturing of traditional products that would release workers to the technologically advanced sectors of the economy. Themes of *Modern Economic Growth* were reprised in Kuznets's Nobel Prize lecture (Kuznets 1971).

In *Modern Economic Growth*, Kuznets realized his goal of an empirically based theory of economic growth that would provide a sound basis for economic policy and smooth the institutional adjustments required by accelerating technological advances. He did not consider his theory the last word since unforeseen advances in science and technology would require continuous modifications of the theory.

What was distinctive about Kuznets's theory was that it was a handmaiden of public policy. This characteristic set it apart from the main body of theoretical modeling, which was stimulated more by intellectual curiosity than by the needs of policymakers. Much of economic theory is too abstract to have immediate practical relevance, although it often provides later foundations for policy-oriented theory.

The last point touches on a second aspect of Kuznets's approach: his concern with the role of long-term factors in the determination of current economic performance. In his view, many current economic opportunities and problems were determined by economic conditions and relations that evolved slowly, often taking many decades to work out. At a time when Keynes declared that "in the long run we are all dead," an aphorism reiterated by many economists not only during the 1930s but also during the 1910s and 1950s, Kuznets continued to call attention to the role of long-term factors that had to be taken into account by policymakers, factors that led him to conclude that

the opportunities for returning to high employment levels and rapid economic growth were greater than generally believed.

Current social problems, Kuznets emphasized, are often the result of past growth—the consequence of past desirable attainments that at a later time produce socially undesirable consequences that require remedial policy action. Of his numerous illustrations of this principle, one is particularly cogent: the explosive population growth in the less-developed nations of Asia, Africa, Oceania, and Latin America in the quarter century following World War II. This population explosion threatened to thwart efforts to raise per capita incomes from their dismally low levels because birth rates remained traditionally high while public health policies and improved nutrition cut death rates by more than 50 percent in less than a generation. One obvious solution to the problem was to reduce fertility, yet there was a web of traditional patterns of behavior and beliefs that tended to keep fertility high. Nevertheless, Kuznets believed that properly designed public policies could hasten the social and ideological changes required to reduce fertility and lead these societies to prefer a greater investment in a fewer number of children. Such a program required not only government and private campaigns to disseminate the technology of birth control but also a restructuring of social and economic incentives that would provide rewards for families with fewer children.

Kuznets pointed out that this urgently needed program to reduce fertility would have its negative as well as its positive side. Since it was those in upper income brackets who would respond most rapidly to the new incentives, the immediate impact of a campaign to reduce birth rates would be to increase the inequality of the income distribution. This initial impact could be overcome by a determined effort to change the social and economic conditions of the lower classes in a way that would promote an interest in smaller families. Yet, as the experience of the United States and other developed nations has shown, the success of the program to curtail fertility is bound, much further down the line, to create a new set of problems, similar to those that are currently at the center of the modern women's movement: the restructuring of society in such a way as to promote equal opportunity for women in all occupational markets.

Economic growth creates social problems because it is profoundly disruptive to traditional values and religious beliefs, to long-standing social and family patterns of organization, and to numerous monopolies of privilege. Despite the fact that modern economic growth has brought with it tremendous increases in longevity and good health, brought to the lower classes standards of living as well as social and economic opportunities previously available only to a tiny minority, and greatly reduced the inequality in the income distribution of developed nations, the social restructuring that it requires has been fiercely resisted—sometimes because of an unwillingness to give up traditional values and ways of life, sometimes because entrenched classes are determined to protect their ancient privileges. Because of the complex responses to change, and because the epoch of modern economic growth was still unfolding, many aspects of the social restructuring that was under way were still obscure and difficult to predict (Kuznets 1966).

As late as 1972, Kuznets felt compelled to point out that, despite the multitude of tentative partial generalizations, cross-sectional studies, and econometric exercises, there was as yet no "tested generalization, significantly specific to permit the quantitative prediction of aggregate growth, or even of changes in the structural parameters in the course of growth" (Kuznets 1972, 58). The difficulty of predicting the future relates to two methodological problems with which Kuznets continually struggled: How long a period of observation is needed to identify the underlying process at work in any specific aspect of economic growth? How can one determine whether such a process, once identified, is sufficiently stable to provide a reliable basis for prediction? These problems are illustrated by an issue of which Kuznets was the preeminent investigator of his age, the interrelation between demographic processes and modern economic growth.

In the early morning of October 15, 1971, Kuznets received a call from the secretary of the Swedish Academy of Science informing him that he was the winner of the Nobel Prize in economics. The award was made in recognition of his empirically based theory of economic growth. Among the achievements that were singled out were the immense amount of data on which the theory was based, the careful de-

lineation of the uses and vulnerabilities of these data, and some of his insightful new findings. Thus, despite Mitchell's grave doubts about the usefulness of a comparative study of the ways in which various rich nations achieved their high growth rates, such a study was not only feasible but also produced a major advance in knowledge, an assessment certified by the Swedish Academy of Science.

The media picked up on the announcement within minutes, and Kuznets was bombarded with questions about his reaction to the award and what he planned to do with the money. After the flood of interviews subsided, he turned his attention to writing the address he was required to make as part of the week-long agenda of activities organized for him and his party (up to ten family members and friends). It was also a hectic time for Edith, who had to buy a formal gown and deal with the many choices laid before her and Simon by the assistant secretary of the Swedish Foreign Ministry, who functioned as their aide-de-camp both before and during their visit to Sweden. There were receptions galore, visits to universities in Stockholm and Uppsala, and both formal and informal talks at several venues.

On the instruction of the Nobel committee for economics, Kuznets prepared an address that summarized the work for which he was receiving the prize. At the same time, his address went beyond his previous work in some respects, reflecting new lines of research that continued to the end of his career, particularly his analysis of the factors that limited the spread of modern economic growth in the less-developed countries. In this connection, he stressed the obstacles to modern economic growth created by rates of population growth so extraordinary that they threatened to overwhelm efforts to modernize economies.

## The Role of Population Growth

Few economists of his era investigated the interrelations between economic growth and population growth as fully as Kuznets. He was impressed more by the salutary effects of rapid population growth than by its negative effects. The evidence, he noted, indicated no cases prior to 1970 in which large increases in population were accompanied by

declines in per capita income. Rapid population growth tended to increase per capita income because it increased the number of contributors to useful knowledge. It tended to increase savings because it both increased the ratio of savers to dissavers and increased the amounts saved by upper income groups. Larger populations also promoted economies of scale and responsiveness to new products (because of changes in the age structure of the population). Despite these generally positive aspects of high rates of population growth, Kuznets recognized that the sharp acceleration in the populations of less-developed nations, generally brought about by sharp declines in death rates, sometimes overwhelmed the economies and impeded growth in per capita income.

Kuznets pointed out the economic significance of the fact that accelerated population growth was due primarily to a decline in death rates. The associated decline in morbidity rates served to increase labor productivity, to increase the payoff on the investment in raising and educating children, and to improve the quality of life.

Moreover, the more rapid decline of death rates in cities than in rural areas promoted urbanization and speeded industrialization. The tendency of declining death rates to induce lower fertility rates and promote migration also contributed to economic growth by adapting social institutions to new economic opportunities. The reduction in completed family size and the fact that this occurred at differential rates in rural and urban areas led to a removal of younger generations from the influence of the family and exposed them to modern ethics that promoted participation in a rapidly changing economic system. Kuznets saw this break between ties of blood and economic rewards as a central factor in the victory of objective tests of economic performance over the more traditional rewards given to family connections.

Kuznets's investigations of the synergism between economic change and demographic change were multifaceted. One of his most influential lines of study pertained to the impact of demographic factors on the measured inequality of the distribution of income. Early in his career, Kuznets began to struggle with problems of how to measure the degree of inequality in the distribution of income and how to identify the factors contributing to the inequality. Such decomposi-

tion would point to policies that could relieve the appalling economic conditions of the poor that prevailed in all countries at the beginning of the twentieth century. Kuznets believed that, unless the poor shared in the benefits of economic growth at least as fully as the more well-to-do, the stability of society was at risk. He regarded rapid economic growth and greater distributional equality as desirable and generally consistent goals.

During the 1960s and 1970s, when it was apparent that a number of Asian nations had entered onto the paths of both rapid population growth (owing to rapidly declining mortality) and rapid growth in per capita income, some of the available evidence seemed to indicate that these developments were increasing the inequality of the income distribution and hence vitiating the benefits of the modernization of these countries for the poor. Studying the evidence on which this conclusion was based, Kuznets noted that the mechanical application of procedures used for the United States and other developed nations was inappropriate in the Asian context because those procedures failed to take account of the differences in institutions. A key point related to the nature of Asian family cultures, which were different from Western family cultures. As a consequence, the variance in the size of the Asian family (or household) was much larger than in that of the U.S. or Western European family. Not only were the household arrangements of the extended family different, but intrafamily income flows were also different, and these differences were not reflected in standard measures of household income.

When these differences were explicitly acknowledged, a number of important statistical relations emerged. For example, there was a negative correlation between the number of persons per family and the per capita income of families. Consequently, the very identity of the lower and upper income groups changed, depending on whether the size distribution of income was measured by the total income per household or by the average income per person in the household. Moreover, the rate of population growth changed the age structure of households. Countries with rapidly growing populations and high fertility rates had a higher proportion of younger household heads and lower shares of heads over age sixty-five than countries with low

population growth. Such demographic variations might increase inequality measured in cross section, even though lifetime income distributions were relatively equal. All these issues could be adequately addressed, Kuznets pointed out, if the sample surveys were designed on the basis of an appropriate theory of the impact of demographic factors on income distributions.

### Population Growth as a Propellant of Technological Change

In the 1960s and 1970s, most scholarly opinion held that, even in developed nations, rising population was a severe threat to the continued growth of per capita income. Kuznets strongly dissented from this proposition, arguing that, in modern times, the empirical evidence from developed nations indicated that growth in population accompanied high rates of growth in per capita income. What, then, was the process that prevented output per capita from declining as population pressed against existing resources?

Kuznets stressed three factors. First, labor productivity increased as the labor force grew because there were a variety of unexploited natural resources that were available, and this, combined with a more specialized division of labor, would lead to greater productivity of labor.

Second, when the increase in population was due to a high fertility rate (rather than to immigration or a declining death rate), rates of increase were assisted by internal migration from areas of lower per capita income (rural places) to areas of higher per capita income (the cities). Mobility was important because it permitted a supply of labor to the new industries promoted by technological change. In this connection, young workers were more adaptable to the needs of new industries than older workers, who, because of ingrained habits, were more resistant to change.

Third, because the younger people were better educated than their elders, the absolute number, and probably also the proportion, of gifted contributors to new knowledge would increase. But, even if the proportion of geniuses and other gifted individuals remained constant, the increase in the absolute number of such people would ac-

celerate the advance of knowledge because creative efforts flourished in a dense intellectual atmosphere where many people addressed particular problems and could easily interact with each other with regard to their findings. It was no accident, Kuznets said, that the locus of intellectual progress had been preponderantly in large cities rather than in the thinly settled countryside. There was, he concluded, an interdependence of knowledge among the various parts of the economy and society. Thus, a greater knowledge in chemistry contributes to a greater knowledge of physics, and progress in both fields advances scientific knowledge in physiology and biology.

Kuznets also argued that, in rich countries, population growth increased the investment in human capital, especially when the population growth was due to a decline in the death rate, because then the return on the investment in the education of children increased. Moreover, the expectation of a future in which larger markets and wider opportunities would prevail encouraged the extension of capacity, both personal and material. Such a buoyancy promoted investment in new products and other forward-looking endeavors.

It is now a half century since Kuznets made these forecasts. How well have they held up? In the U.S. case, the answer is, quite well. The U.S. population has increased by two-thirds, and per capita income has tripled. Kuznets was right, and the pessimists were wrong.

## Kuznets and Theory

Was Kuznets an economic theorist? Some prominent economic theorists said, Not really. They recognized him as outstanding for his work in the study of business cycles and for his measurement of GDP and inequality. Although they acknowledged that his early work on human capital and on some other issues were contributions to theory, the sum total of these contributions was, they said, modest.

This view was not embraced by the Swedish Academy of Sciences, which awarded Kuznets the Nobel Prize for his elaboration of an empirically derived theory of economic growth. It distinguished his approach to theory from abstract theories that had little bearing on how economies actually worked (Ohlin 1971).

The evolution of economics over the past half century has introduced a dubious equation of economic theory with mathematical models of economic behavior. The confusion between models and theory is unfortunate. Fifty years ago, it was common to call courses in economic theory *economic theory* and to call courses that dealt with mathematical models of economic behavior *mathematical economics*. In the 1950s and 1960s, a course in economic theory was presumed to summarize the body of generalizations about the operation of the economy that economists thought were usually valid. Such generalizations were the core of the basic theory course, even though interesting but controversial generalizations were also presented. In the assessment of economic theories, emphasis was placed not on their intellectual elegance, much as that might be admired, but on their empirical validity.

In the late 1950s and early 1960s, it was not necessary to emphasize that history was one of the principal sources of generalizations about the economy. The contribution of historical knowledge was evident not only from the way in which theory was taught but also from courses in the history of economic doctrine. After all, most of the great theorists between Adam Smith and John Maynard Keynes relied heavily on historical information in propounding their theories. This reliance was evident not only in the work of such verbal theorists as Smith, Thomas R. Malthus, John Stuart Mill, Karl Marx, Thorstein Veblen, J. B. Clark, and Wesley C. Mitchell but also in the work of those economists who were more versed in mathematics, such as Augustin Cournot, W. Stanley Jevons, Alfred Marshall, and Irving Fisher.

It may seem odd to younger economists that a theorist of Joseph A. Schumpeter's stature would have argued, as he did, that economic history was the most essential foundation of a sound training in economics. Schumpeter used the term *economic history* to include not only past but also present-day facts. It was not merely the need of theorists to be versed in facts that led him to make economic history primary. To theorize adequately about economies, he insisted, one had to recognize that "the subject matter of economics is essentially a unique process in historic time." This point implied not only that the economic system was evolving over time but also that recognition of the

institutional aspects of economies at particular points in time was essential to good economic analysis. The critical institutions that had to be taken into account were not, in his view, purely economic. Economic history, he argued, afforded the "best method for understanding" how economic and noneconomic institutions "are related to one another and how the various social sciences *should* be related to one another" (Schumpeter 1954, 13).

Emphasizing the role of historical knowledge in the formulation of models does not imply that models—either those formulated mathematically or those formulated verbally—were absent from reasoning about economic behavior until the middle of the twentieth century. After all, Malthus used a very simple mathematical model in his theory of population, and Charles Davenant, Cournot, and Jevons had already formulated mathematical demand curves before Marshall so thoroughly investigated their properties within the context of a simultaneous equation system.[1] See also Fogel (1992); Jevons (1970); and Slicher von Bath (1963). For more on the influence of Cournot, see Creedy (1992), Debreu (1984), and Neihans (1990). Verbal models could be as abstract as mathematical ones, a point that Eugen von Böhm-Bawerk demonstrated with his stories about Robinson Crusoe (see Böhm-Bawerk 1890). Of course, whether verbal or mathematical, these abstract models were presumed to be not an end in themselves but a basis for arriving at valid generalizations about how some aspect of the economy actually worked.[2]

1. Davenant's curve, also called King's law, was represented arithmetically but is

$$Q = P^{-0.403}.$$

2. Economists sometimes tend to equate theory with generalizations that involve cause-and-effect statements. These are a very important subclass of theories, especially if one wants to probe the empirical validity of counterfactual conditional statements (e.g., Fogel 1964; Fogel and Engerman 1969). However, some theories are purely descriptive. Perhaps the most famous is the Darwinian theory of evolution, which will not support counterfactual conditional statements (cf. Blaug 1980; and Lewontin 1970). However, even statements that will support counterfactuals are also descriptions because they purport to describe how one or more variables will change as other variables change (cf. Fogel 1970). On laws and lawlike sentiments in history, see Joynt and Rescher (1961). On counterfactuals and causal statements, see Simon and Rescher (1966) and Rescher (1971).

The last point needs to be emphasized. Mathematical models are not generalizations about the economy. They are, as the word *model* implies, an abstract representation, which in engineering, physics, and chemistry is sometimes constructed in relief from clay and at other times constructed in plastic or some other material to represent a variety of surfaces and objects. In economics, models are often mathematical analogies that serve to represent in a simplified way some aspect of economic behavior. Analyzing the properties of a mathematical model is not the same thing as analyzing the way in which the economy actually works. Indeed, the properties of equilibrium in the real world do not depend, as they do in some models, on whether the number of markets is odd or even. As Lionel W. McKenzie said to Bob Fogel in conversation in the early 1960s when he and other mathematical economists were struggling to prove the existence and uniqueness of an equilibrium within a Walrasian model: "We know that equilibria exist because markets produce them every day. The problem is that we ran into difficulties in demonstrating their existence in our models."

Economists study the properties of models because experience has shown that doing so yields useful, sometimes powerful analytic tools that help explain how the economy actually works. For example, linear programming, a mathematical procedure developed shortly after World War II as a planning instrument for the U.S. Air Force, turned out to be a powerful addition to economic analysis. One important aspect of programming is the concept of duality: for every primal problem in which the inputs of labor and capital are combined to maximize output, there is a dual problem in which the shadow prices of these inputs are chosen to minimize their costs. The two solutions are equal. The concept of duality, carried over to production theory, made it possible for economic historians and other empirical students of economic growth to circumvent the paucity of data on physical inputs and outputs by using the relatively abundant data on prices to estimate technological change in various industries going back as far as 1600.

Another virtue of mathematical modeling is that it frequently makes apparent not only logical errors but also empirical errors and

unwarranted conclusions that beset more informal types of reasoning. Robert M. Solow showed that the widespread belief of the late 1940s and early 1950s that physical capital formation was the key to economic growth stemmed from the assumption that the capital-output ratio and the savings rate were fixed. Using a more flexible production function, he demonstrated empirically that, in a model with two or more variable inputs, changes in the amount of physical capital (per se) explained only a small part of the record of U.S. economic growth.[3]

Thus, history and mathematical models are two productive, often complementary ways of searching for valid generalizations about the economy. Another case in point is Douglass C. North's use of the price dual in production theory to demonstrate his discovery that most of the productivity gains in ocean shipping between 1600 and 1850 were due not to new technologies but to institutional changes: the elimination of piracy changed the distribution of preexisting ships crossing the Atlantic, permitting large, lightly armed vessels with high carrying capacity and low costs to become predominant (North 1968).

Although the application of the duality theorem provided more precision, it was North's historical research that led to the discovery that the elimination of piracy was crucial to the improvement in productivity. This striking discovery brought new attention to the key role played by the institutional context in influencing the rate of the diffusion of existing technologies. So it is the substance of the findings, not infatuation with the methods, that is crucial in producing valid theoretical generalizations. Neither the elegance of a mathematical model nor the beauty of a literary passage in economic history by itself guarantees that the generalizations derived from each of these sources is useful in giving guidance to policymakers.

3. One other point worth making about mathematical models pertains to empirical tests of the validity of a theory. Whether the theory comes from a mathematical model or from a study of history, it is often necessary to formulate some aspect of the theory mathematically in order to measure the key variables of the theory or to estimate key parameters. Measurement also involves modeling, although the models used to test or explore the range of applicability of a particular theory might be quite different from the mathematical model that produced the generalization to which we apply the epithet *theory*. See Solow (1957).

We have stressed Kuznets's theoretical generalizations not because we consider all of them to have been validated empirically but because so many of them are still central to theoretical discussion about economic growth, for both the developed countries and the developing countries. By contrast, *some* of the generalizations derived from the mathematical modeling of economic growth, such as the implications of "putty-clay models," ceased to be of interest shortly after they were put forward, despite the initial enthusiasm for them.

Kuznets's work has much in common with the work of Schumpeter and Theodore W. Schultz. Schumpeter was the most important growth theorist between the deaths of Smith and Malthus and his own death in 1950. His earlier work focused on long cycles in economic output, which he attributed to fluctuations in the rate of inventions and innovations. His analysis led him to single out entrepreneurs as the dynamic agents of change, to point to the equity effects of economic growth (embodied in his concept of "creative destruction"), and to make the creative clusters of innovations inherently inflationary.[4] It is the late Schumpeter, however, rather than the early one, who is closest to North's concerns. The late Schumpeter focused on the conflict between the capitalist system of economic organization and the political, social, and intellectual movements that were hostile to capitalism for ideological reasons. It was these conflicts, he argued, rather than the secular diminution of investment opportunities that threatened the continuation of economic growth under a system of political democracy (cf. Rostow 1990).

Schultz has received the most acclaim for his contributions to the theory of human capital. But that was only one aspect of his broader concern with economic growth and the elimination of poverty. These broader concerns led him to examine closely the impact of government fiscal policies and specific interventions into agriculture in both developed and developing countries, policies that distorted agricul-

4. This arises from Schumpeter's assumption of full employment in his model. If entrepreneurs require credit to finance their innovations, the initial injection of credit into the economy expands the money supply through the multiplier effect. However, since innovation takes time, there is no immediate expansion of output. Hence, in the short run, innovation leads to inflation. If innovation is continuous, inflation will be as well.

tural production and had perverse effects on the distribution of income. Like Schumpeter, Schultz was concerned about new sources of future income growth, and this concern led him to recognize that, in the twentieth century, human capital had become more important than physical capital in explaining both economic growth and the inequality of the income distribution. His theory of human capital led him to conclude that unregulated high fertility was a major factor in destabilizing the agricultural sector. Such considerations also caused him to emphasize the importance of the investment in improving nutrition and health as a key to economic growth in poor nations and to identify investment in "allocative skills" as a key to dealing with problems of disequilibria (cf. Bowman 1980).

Each of these economists was heavily influenced in the formation of his theory by the pressing policy issues of his era. Schumpeter was concerned with the unevenness in secular patterns of growth across nations as well as over time and across classes within nations, an unevenness that created sharp political tensions and promoted international conflicts. Kuznets, during his early years, shared Schumpeter's concerns about the instability of economic growth in particular nations, although he recognized that, after aggregation across the advanced European nations, the secular pattern of growth was much more even. Like Schumpeter, he saw technological change as the engine of economic growth but focused on the unevenness brought about by the life cycle of an innovation, the pattern of population change, and the changes in the demand for output. In his later years, during the exceptional worldwide spurt in economic growth that began early in the 1950s, Kuznets focused on the continuing potential for economic growth and the policies that would do most to promote economic growth in the developing nations.

Schultz was influenced in his thinking about human capital by his experiences with postwar reconstruction. Despite the devastation of Europe, all the war-ravaged countries experienced rapid economic growth in the 1950s, quickly exceeding their prewar levels. This led Schultz to dwell on the key role of human capital in modern economic growth, to consider the possibility that a significant share of the so-called residual factor in economic growth was due to improvements in

the quality of the inputs, particularly in the quantity of capital embodied in human labor. Although his empirical work on this question focused on education, he recognized that, theoretically, improvements in health, in the capacity to process information, in the development of allocative skills, and in on-the-job training might be more important than the effects of formal education per se.