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U.S. ECONOMIC GROWTH FROM 1976 TO 1986: PROSPECTS, PROBLEMS, AND PATTERNS

Volume 8—Capital Formation: An Alternative View

STUDIES

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LETTERS OF TRANSMITTAL

DECEMBER 22, 1976.

To the Members of the Joint Economic Committee:

Transmitted herewith is the eighth volume of the Joint Economic Committee study series entitled "U.S. Economic Growth From 1976 to 1986: Prospects, Problems, and Patterns." This series of over 40 studies forms an important part of the Joint Economic Committee's 30th anniversary study series, which was undertaken to provide insight to the Members of Congress and to the public at large on the important subject of full employment and economic growth. The Employment Act of 1946, which established the Joint Economic Committee, requires that the committee make reports and recommendations to the Congress on the subject of maximizing employment, production and purchasing power.

Volume 8 comprises three studies which address the question: Must business investment and growth be altered and if so, in what ways? Their examination of future capital needs and how capital contributes to economic growth is done in a manner that challenges the conventional wisdom on these issues. The authors are Prof. Carl Madden, Dr. Burkhard Strumpel and Prof. Mason Gaffney. The committee is indebted to these authors for their fine contributions which we hope will serve to stimulate interest and discussion among economists, policymakers and the general public, and thereby to improvement in public policy formulation.

The views expressed are those of the authors and do not necessarily represent the views of the committee members or committee staff.

Sincerely,

HUBERT H. HUMPHREY,
Chairman, Joint Economic Committee.

DECEMBER 17, 1976.

Hon. HUBERT H. HUMPHREY,
Chairman, Joint Economic Committee,
U.S. Congress, Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith are three studies entitled "Toward a New Concept of Growth: Capital Needs of a Post-Industrial Society" by Prof. Carl Madden, "Induced Investment or Induced Employment—Alternative Visions of the American Economy" by Dr. Burkhard Strumpel, and "Capital Requirements for Economic Growth" by Prof. Mason Gaffney. These three studies comprise volume 8 of the Joint Economic Committee's study series "U.S. Economic Growth from 1976 to 1986; Prospects, Problems, and Patterns." This series forms a substantial part of the Joint Economic Committee's 30th anniversary study series.

These papers are innovative in their approach to examining future capital needs and how capital contributes to the economic growth

process. They basically conclude that the conventional wisdom must be changed if we are to respond with policies that will be capable of dealing with changing realities.

The paper by Prof. Carl Madden holds that debate about capital requirements turns largely on the deeper questions of growth problems, prospects, and patterns. Rather than seeking more labor-intensity or exploring a "no-growth" society, he argues that we need a deeper understanding of growth and its twin sources, knowledge and enterprise. He suggests an alternative analysis of capital needs, differing both from the approach of conventional demand-supply and of "no-growth." He sees growth as a vast and irreversible transformation process having integral social, political, and economic dimensions involving not only a rapid rise in per capita output and productivity, but also a transformation both of society and the economy, growing world interdependence, ideological change, and a lag of about three-quarters of the world's population behind the rapidly growing societies.

He stresses that investment policy has to recognize that growth means changes in the structure of public and private processes, institutions, and industries, e.g., appropriate investment policies should emphasize investment in human capital; and the need to change our over-consumption style, fostered by three decades of conventional growthmanship. Shifting the tax base from income to a progressive consumption tax he believes is sound post-industrial investment policy for a people and Nation of great wealth.

Dr. Strumpel attempts to "stimulate a reorientation of thinking". He asserts that the core of the present economic difficulties is of a structural rather than cyclical character. He also maintains that the frontier of economic growth has shifted from natural resources to human resources. Thus, in order to achieve growth we must change our factor input and utilization so as to make more intensive use of available human resources while husbanding scarce physical resources. A third conclusion is that it is hardly possible to produce the currently produced set of material goods with a greatly different factor mix containing more labor. He believes that the main obstacle to growth which faces the American economy is rooted in the existing composition of final production and demand. Since conventional fiscal and monetary policies are geared to aggregate demand management, and due to various ideological and technical reasons, they are hardly able to influence the composition of final demand. He discusses in considerable detail the government programs and initiatives which he feels bring together underutilized human resources with unfulfilled human needs for public and private services.

Prof. Mason Gaffney claims that we can achieve our growth goals by lowering the capital and resource coefficients per worker and consumer. He asserts that the resource and capital coefficients of labor are not fixed and therefore can be lowered. He urges that we produce commodities having a faster pay-out so that the capital associated with each unit of labor is tied up for a shorter period of time. His study points out various institutional biases that need correcting and goes into some detail on tax policy which tends, in his view, to encourage the substitution of capital and labor for land. To remove the bias, he calls for reducing taxes on payrolls and increasing the

tax cost of holding land and capital. He also calls for removing the capital-intensive bias from Federal spending programs and regulatory policies.

The committee is deeply grateful to these authors for their creative and challenging papers. Prof. Madden is on the faculty of the School of Business Administration at American University, Dr. Strumpel is the Program Director for the Institute for Social Research at the University of Michigan, currently on leave as Senior Fellow, International Institute for Environment and Society in Berlin, and Prof. Mason Gaffney is on the faculty of the Graduate School of Administration of the University of California at Riverside.

Dr. Robert D. Hamrin of the committee staff is responsible for the planning and compilation of this study series with suggestions from other members of the staff. The administrative assistance of Beverly Mitchell of the committee staff is also appreciated.

The views expressed are those of the authors and do not necessarily represent the views of the Members of the committee or the committee staff.

Sincerely,

JOHN R. STARK,
Executive Director, Joint Economic Committee.

CONTENTS

TOWARD A NEW CONCEPT OF GROWTH: CAPITAL NEEDS OF A POST-INDUSTRIAL SOCIETY

By CARL H. MADDEN*

SUMMARY

Debate about capital requirements in important part turns on a deeper question of the possibility and desire for economic growth which affects growth problems, prospects, and patterns. Seeking more labor-intensity or exploring a "no-growth" society is not the issue. Rather, we need deeper understanding of growth and its twin sources, knowledge and enterprise. To argue this way is to offer an alternative analysis of capital needs, differing both from the approach of conventional demand-supply and of "no-growth".

A New Concept of Growth

The idea that growth is merely as "an increase of output per head of population" is absurdly too simplistic. Both logic and empirical evidence suggest a new concept. Growth is a vast and irreversible transformation process having integral social, political, and economic dimensions. Empirical evidence for this view is the authoritative work by Kuznets and others examining the "modern growth epoch" of the last two centuries. Hallmarks of the growth process are not only a rapid rise in per capita output and productivity. Also integral is rapid transformation both of society and the economy, growing world interdependence, ideological change, and a lag of about three-quarters of the world's population behind the rapidly growing societies.

The evidence supports the hypothesis that, despite the complex causation of growth, the advance of science was the great innovation propelling the astonishing growth record of the last two centuries. However, economists have neglected study of the impact of science.

Now, evidence abounds that science itself in the twentieth century is undergoing a revolution. Its form is to supplant earlier basic scientific assumptions about the nature of time-space, human life, and its origins, the nature of organisms, the structure of matter-energy configurations, the structure of the universe.

Study of scientific revolutions by Whitehead, Kuhn and others concludes that these conceptual happenings change a culture's prevailing image of mankind and the basic tools of thought about reality. Of course, they also create ensuing advances of knowledge and new human insight. Twentieth century science rejects the earlier materialist and mechanistic view of reality as faulty and misleading. Processes

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and institutions patterned after these earlier ideas have encountered "failure of success". Economic growth as conventionally understood derives from earlier views and suffers from its own defects.

The central concepts of twentieth century science do not interpret reality as collections of material objects independently and identically existing in absolute time or simply located in space. Instead, reality is seen as patterns and configurations of wholes, of systems whose parts can exist and be identified only in relation to the whole. Reality also appears as process in action, as events irreversibly unfolding in growth, development, rhythm, and flow. Processes are irreversible in that they change their own character, that through sub-periods of time identity alters from within, that change is irreversible.

The idea of evolution has spread from biology to encompass the origin and development of the elements, their constituent sub-atomic parts, the creation of matter itself, and the interplay of energy and matter in the formation of the constituent parts of the universe itself.

Economic evolution is hardly a subject fit for conventional discussion. Apart from a small handful of intellectual giants, economics remains dominated in conventional thought and study by mechanistic ideas that are analogies to eighteenth century physics and mathematics. They depict activity in terms of mechanistic balancing of forces, of "equilibrium states" of self-identical systems. Indeed, the logic of "limits to growth" models itself suffers from difficulties precisely associated in other sciences with the logical fallacies that have eventuated in anomolies, in observed behavior inexplicable in the terms of the pre-twentieth century theories or models of behavior. Furthermore, leading "no-growth" critics see growth in similar simplistic terms, so they reject the idea of using advances in knowledge to increase human effectiveness. They prefer "steady-state equilibrium". But it is a notion that hardly accounts for the brute and stubborn facts of irreversible evolutionary advance.

Twentieth century study of energy and its behavior in concrete processes has such general application that it illuminates economic processes and the idea of growth. After all, economic processes are energy processes. The laws of energy-mass conversion, conservation, and dissipation strongly support the idea that advancing knowledge and ordered structures are always threatened by inherent tendencies towards disorder and waste in all energy processes, including economic ones. Indeed, economic inputs are poorly depicted as capital, land, and labor. Rather, these sources are better understood as energy, knowledge, materials, and organization. But since energy and matter are convertible, and since organization is itself a form of knowledge, these reduce to knowledge and energy.

To realize that knowledge and energy are key sources of wealth, that economic growth is a vast and irreversible energy transformation process, represents a fundamental change in the concept of growth. The realization sets in motion new trains of thought, that recognize generally the integral and inherent role played by what conventional economics interprets only as "exogenous" forces or "externalities" often neglected or dismissed to other fields as being secondary to economic policy considerations, now held to be dominant and primary. It is time to realize along with Kuznets and twentieth century science that those who want growth must also take urbanization, industriali-

zation, increases in scale of organizations, changes in the family, changes in ideology, problems of social complexity; and then they must use the fruits of growth to do something sensible about them.

POLICY IMPLICATIONS

Growth as transformation impelled by advances in knowledge and enterprise should accelerate, not slow down, if knowledge keeps growing and enterprise flourishes. What future growth requires is steady infusion into social and economic processes of more new knowledge and understanding. Indeed, new and innovative economic processes are themselves an important aspect of advances in knowledge.

What surely is required is net new investment, both public and private, to imbed know-how into concrete physical configurations. Structural change ensues irrevocably. Therefore thought should be given to anticipating its benefits and costs. Basic economic concepts will change in content as new insights change people's perceptions and values. Above all, productivity flows from healthy, vigorous, choiceful and free individual human beings possessing knowledge, understanding, skill, and good will. Therefore, public policy about education, jobs, and welfare is paramount. Increased effectiveness also flows from organization in free and competitive markets that test the survival value of competing technologies. But it hardly flourishes amid joblessness and welfare dependency.

Investment policy has to recognize that growth means changes in the structure of public and private processes, institutions, and industries. A strong case can be made that subsidizing real costs of existing industries amounts to slowing down the growth process, while policy that levies full real costs impartially speeds it up. Policy fostering monopoly is likewise anti-growth policy, compared to fostering new enterprise and impartial competition. Vested institutional interests, both public and private, already have too many advantages over newcomers.

Finally, it is clear that we are lagging in the full use of knowledge—of science and technology—in many of our major institutions. Large net social benefits are available in innovative and large scale adaptations of knowledge. in both social and economic processes, that would add to human wealth and effectiveness while sharply economizing energy and materials.

To be more specific:

1. Appropriate investment policy should emphasize investment in human capital. We need more rapid. widespread, and continuous improvement in people's knowledge and skill, to put the need paramount. Our view of formal education is far too narrow. Involvement in goal-setting is education; voluntary leadership is education: meaningful work is education. We need to infuse our society with concrete learning experiences for everyone, continuously, without outmoded and invidious distinctions between the employed and the jobless, the independent and the welfare-dependent, the non-old and the old. We engage in gigantic and ignorant waste of human potential out of lack of imagination and outmoded ideology. But we need also to achieve widespread mean-

ingful lifetime employment for every person wanting it and seeking it.

2. We need to change our over-consumption style, fostered by three decades of conventional growthsmanship. To achieve capital needs while conserving resources, and to expedite the shift of capital and human effort from old to new processes, we need to generate more savings by rewarding it better. Shifting the tax base from income to a progressive consumption tax is sound post-industrial investment policy for a people and nation of great wealth.

Investment policy should promote new forms of interaction between government, business, and society to create new markets, set new standards, create supply for new life styles, and systematically address basic world goals by full and organized use of science and technology widely understood and of beneficent purpose. Then, enterprise can flourish and human effectiveness can advance. The issue before policy-makers is not protecting vested interests, hurling outworn programs at old problems, abandoning growth, or creating make-work jobs for listless people on unproductive projects. The issue is a deeper understanding of growth all round and creative action in response.

A full explanation of economic progress involves a study of the society's entire culture.—George J. Stigler, "The Theory of Price" (New York: Macmillan, 1974), p. 39.

Short run appraisal of capital needs relies on conventional analysis of the demand and supply of capital executed with greater or less sophistication of logic or mathematics and greater or less awareness of elementary capital theory. The result is often a turgid debate over numbers, obscuring as much as it clarifies.[1]

To provide some sense of the meaning of the debate requires taking one view or another about the possibility and the desire for economic growth, a view that in turn affects its problems, prospects, and patterns. Critics of prevailing economic and political orthodoxy, in a recent outpouring of literature, have challenged the growth obsession of the last twenty years. When exploring the possibilities of a "no-growth" society, the critics have invoked the well-known Malthusian devils of population explosion and resource exhaustion. And they have added a new devil of pollution accumulation.

It has become fashionable to say that from now on, economic growth will slow down. Yet, there are more reasons than ever to think that after a transition period, economic growth is much more likely to accelerate. For it becomes ever clearer that economic growth depends mainly on the advance of knowledge; indeed that such growth is itself a form of the advance of knowledge, plus the innovator's drive to put that knowledge into productive effect. It is of vital importance that we achieve a deeper understanding of what growth means.

Growth means learning how to get more from less and then having the will to do it. Kenneth Boulding has characterized the present period as "the moment in this history of the planet when exhaustible

[1] See Henry Wallich, "Statement before the Committee to Investigate a Balanced Federal Budget of the Democratic Research Organization," Washington, D.C., March 26, 1976.

resources have to be turned into enough knowledge to enable us to do without them." [2] But it would be odd if, at the very time when human ability to perform logical and mathematical calculations and to transmit information seems to be growing exponentially, we are seeing the prelude to a slowdown in the advance of knowledge. What instead we may be seeing is a temporary social withdrawal from its implications.

The issue of the need for capital to fuel a post-industrial economy is not that of explicitly seeking more labor-intensity or of exploring a "no-growth" society, but of developing a deeper understanding of the wellsprings of economic advance in its twin sources, knowledge and enterprise. To argue along such lines is to offer an alternative analysis of capital needs, differing both from the conventional demand-supply approach and from the no-growth approach. The purpose here is to sketch out such an analysis and explore some of its implications for policy.

Growth as Usually Portrayed

A simple definition of growth is "an increase of output per head of population." [3] A slightly more elaborate definition is "a long term rise in the capacity to supply increasingly diverse economic goods to a population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands." [4] Economic growth in the last two centuries, so defined, has been nothing short of startling. In 1776, output per head for the world's estimated 750 million people was only about $100 in terms of today's money, scarcely more than it had been in A.D. 1 for 250 million people living then. The average Roman citizen seems to have had a slightly higher standard of living in A.D. 1 than his successor U.S. citizen in 1776.

But, as London *Economist* editor Norman Macrae points out:

> Between 1776–1975, world population has increased sixfold, real gwp [gross world product] eightyfold, the distance a man can travel a day between a hundredfold and a thousandfold, the killing area of the most effective megadeath weapon over a millionfold, the amount of energy that can be released from a pound of matter over 50 millionfold (with much more to come), and the range and volume of information technology several billionfold.[5]

For the non-Communist developed countries in the epoch dating back to the late eighteenth century (most of Europe, the overseas offshoots of Western Europe, and Japan—barely one-quarter of world population), rates of growth were almost 2 percent for product per capita, 1 percent for population, and 3 percent for total product. These rates 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.[6]

Kuznets points to six characteristics of such modern economic growth: (1) A high rate of growth of per capita product and of population; (2) a high rate of rise in productivity, i.e., of output per unit of all inputs; (3) a high rate of structural transformation of the economy, including a shift from agriculture to industry and then

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[2] *Daedalus*, Fall, 1973, p. 99.
[3] W. Arthur Lewis, *The Theory of Economic Growth* (Homewood, Ill.: Richard D. Irwin, Inc., 1955), p. 9.
[4] Simon Kuznets, "Modern Economic Growth: Findings and Reflections," *American Economic Review*, June 1973, p. 247.
[5] "America's Third Century," *The Economist*, October 1975, Survey p. 19.
[6] Kuznets, *op. cit.*, p. 248, footnote 3.

from industry to services, an increase in the scale of production, and a change from personal enterprise to impersonal organization of economic firms; (4) a related rapid change in the structure of society and its ideology, such as urbanization and secularization; (5) a growing interdependence of the world, as transport and communications allowed economically developed countries to reach out (both in war and peace) to the rest of the world; and (6) a remaining three-quarters of world population (about 3 billion people in 1975) in countries whose economic performance still falls far short of minimum levels feasible with the potential of modern technology.[7]

Kuznets concludes that the six characteristics of modern economic growth justify the working assumption that modern economic growth "marks a distinct epoch"; that is, represents a major breakthrough in the advance of knowledge justifiably termed an epochal innovation. And although the causation is complex, it can be argued that the major growth source generating radically different patterns of the last two centuries is the emergence of modern science.

Kuznets notes that high aggregate growth rates have been associated with rapid changes in economic structure and in other aspects of society—family formation, urbanization, man's view of his role and the measure of his achievement in society. It has been, as Kuznets has observed it, the difficulty of making institutional and ideological changes "needed to convert the new large potential of modern technology into economic growth in the relatively short period since the late eighteenth century" that has limited the spread of the system. Some of the obstacles to such a transformation were, and still are, being imposed on the less developed regions by the policies of the developed countries, according to Kuznets.

A New Economic Epoch

That the world is now entering still a new economic epoch is more than a mere cliché today. As a study by the Chamber of Commerce of the United States in 1976 stated:

> Rapid and radical changes are going on at present in values, in traditional concepts, and in the global configuration of resources available to mankind. . . . Their substance is barely suggested by the commonplace observations that "knowledge" is doubling every ten years; that as a population we Americans are becoming older, richer, better educated, and more highly urbanized; that our economy is shifting from one predominantly of manufacturing to one primarily of services; that we are at the threshold of "a post-industrial society"; or that the world is entering a new "era of shortage."[8]

What is the basis for holding that we are entering a new epoch? The essence of the explanation is that we are experiencing the consequences, not of science emerging as a major force, as was true earlier, but of a massive, twentieth century revolution in science itself. Study of the science revolution ought not to lie outside the scope of a study of economic growth. If science may well be the epochal innovation of the modern economic age, as seen by the nation's pre-eminent authority on economic growth, the neglect—by orthodox growth analysts and their critics alike—of the study of scientific revolutions and

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[7] *Ibid.*

[8] *Economic Growth: New Views and Issues*, Chamber of Commerce of the United States, Washington, D.C., 1976, p. 1.

their social and economic implications is one of the curiosities of our over-specialized age.

The Twentieth Century—Scientific Revolution

At risk of belaboring the obvious, the list by the late astronomer Harlow Shapley of what he considers to be the 10 most far-reaching achievements of 20th-century science can be cited: (1) Knowledge of the chemistry of life's origin; (2) cosmic evolution—from neutrons to man to the sentient universe itself; (3) relativity theories demonstrating that matter and energy converge; (4) the subatomic world of physics and chemistry; (5) computers and automation (cybernetics); (6) the exploration of space, including journeys of machines to Mars 214 million miles away; (7) discovery of galaxies, quasars, pulsars, the expanding universe; (8) medical triumphs, including temporary triumph over major diseases; (9) molecular biology, including DNA, RNA, and synthetic genes; and (10) the exploration of the mind, including electric inducement of behavior.

The 20th century has also produced significant discoveries in the social sciences. National income accounting has restructured beliefs, perceptions, and behavior of economic decision-makers. Use of statistical advances to measure opinion, taste, and epidemiology has influenced beliefs of people everywhere. Advances in mathematical probability have enriched ideas of "rationality" in managing and allocating resources. Tracing the expected consequences of social or institutional change has been improved by cybernetics, still in its infancy. Major legislative changes can be analyzed for their expected effects through mathematical simulation. And there exist many more such major developments in the 20th century social sciences too numerous to mention here.[9]

The Industrial Age Now Passing

What is the most profound effect of the scientific revolution on twentieth century culture? A powerful argument is that it changes the presuppositions of thought, the world view, of the dominant culture, defined by the views of thought leaders of the times. The scientific revolution through which we are living changes before our eyes the cultural presuppositions of the modern epoch. And there is a strong connection, even though not widely recognized, between what people believe is so obvious it is hardly noticed and the rest of their beliefs. The scientific revolution and its discoveries therefore profoundly change people's values: [10] that is, their beliefs about what is the hierarchy of things they hold to be dear.

Knowledge of the structure of scientific revolutions makes it plain that sciences do not grow by simple accretion. In their early developmental stage, sciences find continual competition between a number of distinct views of nature. The competition is somehow resolved so that the range of admissible scientific beliefs becomes restricted, usually on philosophic grounds. These appear often as arbitrary from

[9] See Carl H. Madden. *Clash of Culture: Management In an Age of Changing Values* (Washington, D.C.: National Planning Association, 1972), pp. 16–17.
[10] Alfred North Whitehead, *Science and the Modern World* (New York: The Macmillan Company, 1925, p. 71, ff.)

within the perspective of the history of science but connect the science with the broader culture. Then, "normal science" takes over; that is, research characterized as "a strenuous and devoted attempt to force nature into the conceptual boxes supplied by professional education." [11]

Normal science is predicated on the assumption that the scientific community knows what the world is really like. Normal science therefore often suppresses fundamental novelties because they would of necessity threaten to subvert its basic intellectual commitment and depreciate its intellectual capital. It is only the advent of a crisis, an anomaly that, despite repeated effort, cannot be aligned with the expectations of normal science, which generates extraordinary investigations, tradition-shattering study that transforms the scientific imagination. Thus, unexpected discovery is not merely factual in import but can qualitatively transform the scientist's postulated world.[12]

The twentieth century revolution of science is a revolt against the earlier world view of Renés Descartes, the French philosopher and mathematician. For three hundred years Descartes determined what problems would appear important, or even relevant. He determined the limits of "normal science" by setting the scope of modern man's vision, his basic assumptions about himself and the universe, and above all, his concept of what is rational and plausible.

First, Descartes set for the modern world its basic axiom of thought, its prime assumption about the nature of the universe and its order. It is that "the whole is the result of its parts."

Next, Descartes provided the method to make his axiom effective in organizing knowledge and searching for it. His discovery of analytical geometry was a stroke of genius that linked together by a one-to-one correspondence the points on a plane and the real number system. Analytic geometry allowed analytical use of algebra to be brought to bear on the dynamics of change that could be depicted geometrically. Descartes gave the modern age the conviction restated by Lord Kelvin in saying, "I know what I can measure." Descartes generated the modern passion for seeking knowledge through measurement and limiting the scope of knowledge to that which is measurable.[13]

What was the resulting world view that dominated the modern economic age of growth, as that growth is currently perceived and defined? The simplest portrayal is that it was materialistic and mechanistic. The stuff of the universe was thought to be bits of matter. The primary and inherent qualities of matter were designated as mass and dimension; all else was secondary. Matter was seen to exist within time and space like billiard balls on a table. The idea was that of simple location. To be sure, matter "occupied" space, so that dividing its space divides the matter. But dividing the time did not divide the object. If material existed during any period, it was equally and identically existent during any portion of the period.

So, objects in time and space were seen mainly as identical through periods of time and simply located in space. The seventeenth century gave as the answer to the question, "What is the world made of," the answer, "A succession of instantaneous configurations of matter." In

[11] See Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Second Edition (Chicago: University of Chicago Press, 1970), pp. 1–9.
[12] *Ibid.*
[13] Peter R. Drucker, *Landmarks of Tomorrow* (New York: Harper and Row, 1959).

his classic study of scientific revolutions, Alfred North Whitehead wrote:

> A brief, and sufficiently accurate description of the intellectual life of the European races during the two succeeding centuries and a quarter up to our own times (1925) is that they have been living upon the accumulated capital of ideas provided for them by the genius of the seventeenth century.[14]

The Cartesian world view secured by the genius of the seventeenth century and familiar to all, involved: (1) A materialist view of reality; (2) a picture of events as cause-effect outcomes of mechanical systems; (3) growth and systematic use of scientific method; (4) creation of industrialization through division of labor; (5) increasing partition of knowledge through specialization and growth of professions; (6) indifference to non-mechanistic aspects of nature—acceptance of the Promethean myth, that man can gain and should seek control over nature with impunity; (7) a positivistic theory of knowledge—holding that we know that and only that which we can measure; and (8) the values of acquisitive materialism, the work ethic, and the dominance of economic policy.

The results of this world view, of course, have been the fabulous products of modern technology and industry. But as Herman Kahn and others have pointed out, the beginnings of the breakdown of this world view are dramatically shown in the fact that its *successes* underlie many serious *problems* of our day: (1) A prolonged life span produces overpopulation; (2) national defense weapons threaten mass world destruction; (3) machine replacement of human labor creates new problems of joblessness; (4) transport and communication advances produce urbanization, complexity, risks of societal disarray; (5) industrial engineering yields dehumanized jobs; (6) cybernetic information processing threatens privacy and personality; (7) affluence generates environmental injury; (8) rising expectations create social disruption and increased control; (9) developed-nation growth widens the gap between haves and have-nots.[15]

Challenges to Growth

Growing awareness of the role of science and technology in the modern economic epoch, especially since Wortld War II, has led Americans to take it for granted that the economic system should be able to provide high levels of material prosperity and economic security. More and more, people are looking to the economic system—indeed all institutions in society—to respond to new expectations. At the same time, people have also begun to perceive a whole new range of largely ignored and uncounted social and environmental costs of growth, as conventionally defined.

Classic Concerns About Growth

Ever since the beginning of the modern economic growth epoch, growth has had its critics. Its benefits carry costs some people have not wanted to pay. Growth increases people's range of choice and their command over resources but not necessarily their happiness.

[14] Whitehead, A. N., *op. cit.*, p. 58.
[15] Madden, C. H., *op. cit.*, pp. 101–102.

Growth makes possible multiple numbers of human lives in existence without necessarily increasing human satisfaction. It gives humanity greater control over its environment in the short run at the risk of long run harm. It gives people on earth more freedom from drudgery, the choice of more leisure supported by a given level of living, more services. It improves differentially the life of women, freeing them from the life of unremitting domestic toll that marks traditional farm or nomad cultures.

Still, many people oppose the attitudes and institutions engendered by classic growth societies. The acquisitive spirit needed to economize resources is seen as a vice, not a virtue. Emphasis needed on individual self interest to achieve conventional growth has its ugly side. Advancing technology requires a reasoning and agnostic mind incompatible with acceptance of authority. As growth advances, the scale of activity enlarges, old handicrafts are destroyed, work is subdivided and made monotonous, administrative units grow in size, people are separated from ownership of their tools. Large scale organizations induce subordination, as they grow along hierarchical lines and few command while many obey. Such organizations, some feel, create social tensions, impose routines and mechanical disciplines. diminish work roles to cog-in-machine character, create human bee-hives. Finally, growth creates urbanization through gains in farm productivity that release workers from agriculture; and, although most people when given the chance choose urban over rural life, there are those who throughout the modern era have decried urbanism and extolled country living.[16]

New Concerns About Growth

New concerns about whether growth as conventionally defined is desirable assume a different character. As people's values change from the impact of new knowledge yielded by the scientific revolution, the nature of economic demand changes. People more and more want goods that stretch traditional definitions of output, productivity, and cost, as well as traditional notions of profit, such as environmental improvement, health care, and other amenities marked by high risk, long-term payouts, and weak or ill-organized markets. The world's poor clamor for wider sharing of the fruits of growth.

The change in demand creates difficult trade-offs, such as that of population growth and environmental quality. People grow more concerned about assurance of health and safety as technology grows more complex and potentially lethal. As greater numbers of people have to be fed, the growth of monoculture, the use of chemical pesticides, the ingestion of highly processed or synthetic food increases. We are unlikely to reconcile growing urban populations, the demand for a quality environment, and traditional property rights. The income gap between rich and poor nations eventuates in a food gap that challenges food consumption patterns in richer and more advanced areas.

There is also growing recognition that new kinds of costs are associated with the response of growth-oriented economic systems to increases in demand. Ways will have to be found to take these new costs and benefits explicitly into account in both public and private decisions. The traditional economic concepts of "spillovers," of "external-

[16] Lewis, W. A., *op. cit.*, pp. 420–430.

ities" of individual firms and their operation, just like the concept of "side effects" of technological advance, are perceived more and more as fundamentally unsatisfactory ideas. They come to resemble in more people's view the kind of anomaly referred to by Whitehead and Kuhn that, despite repeated effort, cannot be aligned with conventional expectations in a science and therefore creates an intellectual crisis. Externalities appear to be integral to growth processes.

Another type of cost phenomenon is the acceleration of cost for many traditional resources. Such resources are likely to become more scarce and costly not because they are "running out," but for other reasons important to understand. Rising world demand, as it assures increasing competition for these resources, and the environmental costs that will mount with their increasing use, are likely to push up the total cost of these resources more than in proportion to their consumption.

The impact of these new concerns on more and more people's thinking is to raise serious questions about the continuing ability of our political and economic systems and institutions to respond. There is doubt in many quarters that private enterprise can take into account social costs and environmental costs of its activities without being so heavily regulated as to defy the meaning of "private." The doubts go further, to question whether a market economy can take long run scarcity factors well enough into account in allocating resources. Some feel, as do the co-founders of the Club of Rome, that both "private and state capitalism are stale . . . we have to develop something else."

It is not without public policy significance that these concerns about growth are explicitly and carefully acknowledged by a group of business and academic leaders whose role is to look ahead for the nation's leading business federation.[17]

Doubts About Orthodox Growth Concepts

Symptoms of an intellectual crisis surrounding orthodox ideas of growth are not hard to find in the behavior of communities and regions, the views of growth critics, and the advent of ecology in public thinking and policy.

No more than a decade ago, it was almost heretical to suggest that growth might not be desirable. Nearly everyone knew without thinking that orthodox growth meant a better life. Serious attention was paid by national policy makers to setting growth target rates for GNP. Local communities, states, and regions competed for industrial growth. Presidential advisers promoted the notion of a "growth dividend" in GNP terms. Growth, it was held, "created" resources, opened up new opportunities and new jobs, and made unnecessary substantial redistribution of income and wealth. Growth was seen as simple and cheap. It involved hardly more than keeping up the rise in total national monetary demand to the expected rise in the nation's projected growth potential. The early 1960's saw the triumph of such "growthmanship" in domestic economic policy, although foreign aid based on orthodox growth concepts already was having trouble surmounting "cultural barriers" in some underdeveloped countries.

[17] Chamber of Commerce of the United States, *op. cit*

What are the sources that cast into doubt the validity of orthodox growthsmanship? In only a decade, values and expectations had changed enough to achieve political significance. One reason was the inflation that got underway after 1965 from the guns-and-butter policy. Another was the continued rise in affluence, education, and economic security that led people to expect higher quality in output, more humane treatment in the market place, and less destruction of amenities such as privacy, convenience, recreation facilities, and urban life than was in fact occurring.

Also, the last decade saw the rise of the "transfer economy" in the United States, the multiplying set of programs, regulations, and interventions that keeps having an increasingly important impact on incomes. Government redistributes income in many ways: through direct grant programs; through its influence on prices, wages, and interest rates; through differential effects of monetary and fiscal policy on individual incomes and shares of labor, management, owners of capital and land. By 1973, government through direct transfer payments alone—benefit payments from social insurance and public assistance programs—was redistributing 11 cents out of every dollar of personal income.

Growing redistribution of income by government acknowledges the erosion of the link between incomes and productivity. The erosion results from many factors related to the increasing complexity of economic processes. As a result, says the Chamber of Commerce study of growth:

> The neoclassical economic theory that an individual's income is determined by the productivity of his labor and his property clearly has become an increasingly poor explanation of the real situation.[18]

Perhaps the most fundamental source creating doubt about orthodox growth concepts is the impact of ecology on economics. Ecology, as a branch of biology dealing with environmental relations, or even as a branch of social science dealing with human relations to the physical environment, is not new. What is new is public awareness of ecology. It derived from the shock of postwar nuclear testing that showed people how little was known about the environmental network. Since the 1950's, many other instances were reported of far-removed, delayed, and unintended effects of technology, drugs, tobacco, all showing that the earth's natural systems, including human beings, exist in an intricate balance easily upset to people's detriment by man's activities. Ecology has gained significance from "technology gone wrong"—nuclear fallout, smog from auto exhausts, DDT in food chains, chemical pesticides in such chains and on food for humans, water eutrophication from nitrogen fertilizer runoff, and the like.

These revelations, combined with disgust over deployment of high technology weapons and technologically-managed policies of "graduated response" in Vietnam, had a powerful impact on attitudes towards technology. They effectively shattered the naive faith in technology that permeated public thinking only a decade before. And they gave rise to the Congressional initiative to assess technology, first set down in the National Environmental Policy Act of 1969 requirement

[18] *Ibid.*, p. 19.

of "environmental impact" statements in every major proposed law or Federal program activity and then in the 1972 law setting up a Congressional Office of Technology Assessment. By now, thought given to environmental consequences of new projects designed to feed growth have had significant impact in delaying and increasing conventional costs of the Alaska pipeline, many land development schemes, utility expansion, the mining of Western coal, dredging and dam-building by Federal agencies, and many other schemes.

Less fundamental but more highly visible than the impact of ecology is the effect of inflation and shortages. During the quarter century after World War II, orthodox economic growth has been perceived in the guise of Keynesian economics. Economic growth has been, albeit superficially, seen mainly as the growth of aggregate demand—total national monetary demand. The assumption has been that national aggregate demand creates its own supply. The growth of productive capacity and its internal structure have both been largely taken for granted, while "growth policies" have been aimed at keeping demand for goods and services growing fast enough to assure full employment of productive capacity. Indeed, the recession of 1974–5 only re-emphasized Keynesian doctrine and came as a relief to some who have, like devotees of "normal science," resisted giving attention to the anomalies crowding around orthodox growth theory.

The real possibility that availability or accessibility of resources might become a serious constraint on growth neither fit into orthodox growth theory nor was believed by prevalent economic thinking. That the resources of the earth are finite and impose a volumetric limit to growth is an old and obvious idea. During the past three centuries of modern economic growth, however, advancing technology has actually expanded manyfold both the quantity and the number of resources earlier thought to be available. Most lately and dramatically, the "Green Revolution" of the 1960's at first appeared to offer the hope of raising yields per acre to ease the Malthusian grip on population in some less developed countries.

Most recently, however, worldwide inflation, the "energy crisis," crop failures from unexplained weather changes, the shrinking of world grain reserves, and rising prices of key raw materials have dramatically questioned the assumption that the supply side of the growth equation can be taken for granted. The inflation does seem to suggest that worldwide demand has grown faster over the last decade or two than capacity in many primary industries. The world population of 4 billion keeps growing and may reach 6 billion by the end of the century. Growth itself maintains the pace of industrialization and urbanization, both processes that feed on resource supplies. Price regulation badly conceived has spurred consumption of scarce materials at less than full cost to consumers. It has also inhibited investment in added supply. Inflation itself has created phantom inventory profits and led to understated allowances for capital consumption; therefore, it has discouraged investment. Finally, rates of return in mature primary industries have been lower than those in newer high technology industries from a combination of higher environmental costs and a more cyclical character of demand changes.

Growth as Transformation

It becomes increasingly clear that short-run and mainly neo-classical perception of economic growth is seriously if not fatally flawed. Although economic greats from Adam Smith, Karl Marx and Thorstein Veblen to Joseph Schumpeter have pounded away at the point that economic growth is a cultural process marked by social transformation, economic orthodoxy persists in clinging to basic economic ideas derived from analogies to the statics and dynamics of Newtonian physics. Hemmed in by the most mechanistic character of the modern social sciences, economic theory creates too narrow a pattern of analysis to gain a grasp of or integrate anomalies representing the major insights of the scientific revolution of the twentieth century. That revolution questions the conceptual foundations of economics. The current concern over environmentalism, the antigrowth movement are symptoms of the crisis. As these movements express and affect new human values, they are a stimulus to the search for new means of more effectively understanding economic growth and relating growth to human welfare.

The evidence seems overwhelming that modern economic growth represents an irreversible process of cultural and social, as well as economic, transformation. It has resulted from the increasingly systematic use of new scientific knowledge in the processes of allocating resources in industry and agriculture. To the extent that the process of growth conforms to human understanding and human values, it can and does contribute to human welfare. To the extent that economic growth, conceived in an orthodox way, violates canons of knowledge about nature and human settlement patterns, such growth is threatening to human life and welfare. In any event, the real concrete process of the last two centuries has been a social, ideological, and economic transformation marked by advancing technology and by institutional and ideological adjustments, as the evidence of Kuznets clearly shows.

New Postulates of Science

Now, the scientific revolution of the twentieth century questions the conceptual foundations of industrial society itself. First, it rejects the view that we can only know the whole of an event, organism, system, or institution by identifying or knowing its parts. It rejects the Cartesian view that there is no "whole" as altogether separate from the different sums, structures, and relationships.

The central concepts of twentieth century science, in every one of our disciplines, sciences, and arts are not concepts of individual objects independently and identically existing through periods of time and simply located in space. The central concepts are of patterns and configurations, concepts of a whole. Indeed, the parts can exist only, and can be identified only, in contemplation of the whole.

Second, the new world-view assumes the idea of process, of an unfolding of events that are irreversible. Every single one of these concepts embodies in it the idea of growth, development, rhythm, becoming. Processes are irreversible because it is seen that the process changes its own character, that through subperiods of time identity alters from within; that change is self-generating.

Third, the twentieth century scientific revolution makes abundantly clear that the prospect is open to the human race to recognize and adapt to the dawning possibility of conscious cultural evolution. It is the knowledge provided by science that makes possible the realization of the age-old dream of adequacy for all the people of the earth. Even though since 1776 world population has grown from under 1 billion to over 4 billion, the goods and services available to people on average has also grown, and faster than population. The risk incurred from taking up added resources in continued rapid population growth is the risk to human survival in future generations but it is a surmountable risk.

Organic evolution rather than mechanistic equilibrium is the characteristic of post-industrial culture. The evolutionary process is marked by naturalism, holism, and immanentism. Naturalism holds that man is part of nature, not separate, and that he must learn to live in harmony with the natural order rather than assuming dominion over nature. Naturalism follows the Orphic rather than the Promethean myth. Holism is the perception of how it is pattern and configuration that determines, indeed identifies, parts; that a philosophy of stark individualism is biologically inaccurate; that the view of nature as a collection of objects falls far wide of the mark. The third is perception of the immanence of events and organisms; the recognition that organisms and processes are importantly determined from within themselves and not from outside.

Anti-Growth and Global Equilibrium

The Forrester-Meadows studies for the Club of Rome intentionally seek wide debate over their "world model," and Forrester has called for "an end to population and economic growth" as the only way to avert an alarming future.[19] However, in the debate over "no-growth," there is much confusion. Hardly anyone has seriously suggested no-growth as the best way, or even a possible way, to deal with environmental and resource problems. Rather, the call has been for development and use of products, processes of production, and "life styles" more economical of resources and less damaging to the environment.

Even the authors of the Club of Rome study do not discuss zero economic growth. They try instead to explore the idea of a "global equilibrium state," a state of ecological and economic stability that could be perpetuated over a long period. Their global equilibrium state has three minimum requirements:

1. The capital plant and the population are constant in size. The birth rate equals the death rate and the capital investment rate equals the depreciation rate.
2. All input and output rates—births, deaths, investment, and depreciation—are kept at a minimum.
3. The levels of capital and population and the ratio of the two are set in accordance with the values of the society. They may be deliberately revised and slowly adjusted as the advance of technology creates new options.

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[19] See D. H. Meadows, D. L. Meadows, J. Rangers, W. W. Behrens III, *The Limits To Growth; A Report for the Club of Rome's Project on the Predicament of Mankind* (Potomac Associates-Universe Books, New York 1972; J. W. Forrester, *World Dynamics* (Wright Allen, Cambridge, Mass., 1971).

It is clear that such a global equilibrium state is not a stagnant one with no technological change. The authors suggest that substantial advances in technology would be needed merely to arrive at equilibrium and specifically say that "technological advance would be both necessary and welcome in the equilibrium state." Their examples of enhancing discoveries for the stationary state are scarcely radical: new methods of waste collection, to decrease pollution and make discarded material available for recycling; more efficient techniques for recycling, to reduce rates of resource depletion; better product design to increase product lifetime and promote easy repair, so that the capital depreciation rate would be minimized; harnessing of incident solar energy, the most pollution-free power source; methods of natural pest control, based on more complete understanding of ecological interrelationships; medical advances that would decrease the death rate; contraceptive advances that would facilitate the equalization of the birth rate with the decreasing death rate.

Is it not, however, apparent that the hypothetical construct of the "global equilibrium state," concentrating as it does on levels and rates of change in physical objects existing identically in periods of time and simply located in space in a mechanistic system of equations exactly repeats the fallacy characteristic of the thriving of the industrial age? It is the fallacy of misplaced concreteness. The analysis of the world model in the Forrester and Meadows work for the Club of Rome, to be sure, omits price considerations, but such an omission is not fatal. What is fatal is more subtle and concerns the assumptions of the model regarding the nature of the concrete processes of the real world. The simple location of instantaneous material configurations—lumps of capital, mounds of pollution, truckloads of food, tons of natural resources, and numbers of human bodies—through a stretch of time has no inherent reference to any other times, past or future. If this is the nature of the concept of time employed—and such is the assumption behind the definition of time in Cartesian analytic geometry—then, as Whitehead long ago pointed out, "it immediately follows that nature within any period does not refer to nature at any other period. Accordingly, induction is not based on anything that can be observed as inherent in nature." [20]

The point is that we do not see growth in the guise of relationships between lumps of capital, mounds of pollution, truckloads of food, tons of natural resources and numbers of human bodies. These ideas are high level abstractions from a concrete process that remains undisclosed by examining such relationships. To be sure, watching such relationships has its uses, and they are important uses. Similarly, body counts in Vietnam, analysis of bomb hits in North Vietnam, accounts of acres defoliated in Vietnam had their uses. However, they failed to reveal the processes at work in Vietnam for exactly similar reasons.

To be sure, it is possible to treat the "global equilibrium state" as "normal science," and to explore its limitations. Boulding's analysis points out some implications. First, the quality of a stationary state depends almost entirely on the relationships relating stocks to flows. At one extreme is the "state of misery," where Malthusian relationships prevail. Along the spectrum are many quasi-stationary states, in which, for example, a change in the structure of the capital stock

[20] Whitehead, A. N., *op. cit.*, pp. 74–75 *et passim.*

through technological advance produces a larger throughput of resources, thus larger production and consumption, with a fixed physical size of capital stock. The trouble is that the model gives little basis to determine the future shape of functions and parameters.

Taking population, what changes in policy are appropriate for a stationary population with rising average age? How does society adapt to the shift from a triangular-shaped to a top-heavy age distribution? It means, in a society of large-scale organization, that more oldsters are bypassed in leadership and rising income as age advances. What policies to redistribute income between generations would be appropriate?

Taking real income itself, is added real income from technological advance to be distributed only in increased leisure? In a global state placed into balance through limiting physical stocks and flows, one region's gain in such stocks and flows is another's loss; the net gains of physically redistributing physical wealth to some regions are perforce net losses to others. The tendency toward exploitation of one region by another is increased where competition becomes a zero-sum game.

The implications of a society throughout the world in which net additions to the physical capital stock are zero, net increases in population are zero, net physical amounts of resources used are zero, and net physical quantities of food produced and consumed are zero are mind-boggling, mainly because human experience is so extremely limited in such an accounting scheme. How to impose this type of accounting as a regulatory device is equally unclear.

Is Growth Itself an Anomaly?

Critics of growth have questioned whether the past two centuries of rapid economic growth may not be simply a rare event in the evolution of the human species.[21] Humanid ancestors, dating back 3.5 to 4.0 million years, have left evidence in the Olduvai Gorge of Tanzania and in Ethiopia. Man lived as food gatherer throughout the 600,000 years of the Old Stone Age, numbering hardly more than 20,000,000, the population ceiling for such a technology, assuming two square miles per person needed in the limited areas suitable for gathering and hunting. Taking the last 50,000 years and dividing them into 800 lifetimes of 62 years each, about 650 such lifetimes have been spent living in caves or makeshift temporary reed and thatch houses. People have been able to read and write only about 70 lifetimes, print about 5, tell time exactly about 4.

Another argument is that if growth at 3 percent per year per person is extended only another 150 years, to 2125, average income would be 100 times as large as today, and in still another 150 years would be 10,000 times as large. How can the earth yield energy and materials to meet such fantastic standards or how on earth (literally) will a family manage to absorb them? [22]

As to the first argument, the rarity of economic growth is no more a mystery, taking the argument seriously, than is the mystery of biological evolution, going on for about 3 billion years on earth, that has

[21] Boulding, *op. cit.*, p. 98.
[22] E. J. Mishan, "Growth and Anti-Growth: What Are the Issues?," *Challenge* May/June 1973, p. 28.

seen that improbable event, life, advance in variety and organization from submicroscopic, preamoebic units to vertebrates, even far rarer events than life. No more a mystery than evolution, no more rare than evolution, economic growth is hardly defensible within the development of human culture when interpreted as a mere chance event, randomly propagated. The argument that rarity of growth implies it should or is likely to stop is essentially a Chicken Little argument; and it is indeed possible that the sky will fall in, though not high on the scale of risks human life must face and deal with.

The second argument, that today's growth projected 300 years ahead yields fantastic incomes, would have been valid 300 years ago. In 1676, scholars would have scoffed at many modern developments as fantastic. The idea that the earth may be 4.5 billion years old seemed fantastic to prelates convinced it was either 6,200 or 6,400 years old. The idea of talking at global distances, sending pictures at global distances, curing infectious diseases with molds, hurling machines 214 million miles to Mars and receiving pictures back, coping with a world population of 4 billion people, and so on, all would have seemed fantastic to scholars 300 years ago. This would not have made their argument cogent, it would only have attested to their lack of imagination and open-mindedness. There is no logical way to resolve an argument questioning human ability to achieve results that are not inconsistent with physical scientific principle. For example, the argument asks how can *the earth* yield energy and materials to support such incomes. It is not necessarily true that the earth itself would be the only source. It is not necessarily true that real incomes 10,000 times present incomes are impossible with energy and materials from earth.

Growth and Evolution

Widespread evidence from astronomy, geology, biology, nuclear physics, and nuclear chemistry suggests the hypothesis of cosmic evolution. Twentieth century concepts of the space-time continuum disallow simple location in time and space of material as the stuff of reality. Up to now, economic theory employs a concept of time drawn directly from classical Newtonian physics, in turn derived from Cartesian mathematics. Economics employs a concept of economic growth that is permeated with seventeenth century ideas of matter as being made up of objects having an identity through sub-periods of the time period in which they exist. The exceptional theorists of economic evolution such as Karl Marx, Max Weber, Thorstein Veblen, and others have remained at the periphery of normal economic science, their insights largely ignored.

Cartesian analytic geometry assumed that time is cardinally measurable. That is, it assumed that in measuring events through time, the qualitative differences between sub-periods of time could be ignored, just as when we count objects we ignore qualitative differences between them. Cartesian mathematics allows for subtraction of units of time, just as numbers of objects can be subtracted because qualitative differences between them are ignored. Cartesian mathematics, because it assumes that time is cardinally measurable, also assumes that time is reversible.

Economists, in employing the mathematics of Descartes to formulate fundamental economic concepts of cost, price, revenue, and value

also assumes that time is reversible, that the "stuff" of economics consists of self-identical objects hanging independently in absolute and simple configurations in time and space.

Therefore, in analyzing the relationships between revenues and costs, economists pay little or no attention to evolutionary processes, to the energy-chain of costs, to the dissipation of energy in economic processes, or to the relationship of benefits and costs connected with the dissipation of resources. These aspects of economic processes are considered, if at all, as "externalities," that is, as costs or benefits which are "external" to the theory of the firm, or the market, or the history of economic development. In the large, historic resource depletion is observed as "exogenous" to historic analysis; is taken for granted. In the same manner, economists pay little attention to the dynamics of the evolution of advancing technology.

It has been in the theory of thermodynamics that physicists have had to face up to the concrete nature of time as we have so far observed it in the universe, as irrevocable and irreversible; and in the theory of relativity, in which simple location and simultaneity have given way to the realization that there is no unique meaning to be given to space or to time, time inheres in events as perceived by observers, and there is no unique present instant.

Thermodynamics arose to account for the flow of energy in physical systems, such as heat engines. The first law of classical thermodynamics holds that, throughout the concrete flow of time, in any closed physical system, total energy remains constant. Energy may be transformed (e.g., from heat to mechanical motion) but not created or destroyed.

The second law involves entropy. Broadly, entropy measures the rate at which available energy called free or latent, becomes bound energy no longer able to do work. The Entropy Law, the second law of thermodynamics, says simply that the entropy of energy increases steadily and irrevocably. In other words, in any energy system (apparently including the universe, although this is debated), there is a continuous and irrevocable qualitative degradation of available energy into unavailable energy, of free into bound energy. If this were not true, we could burn a piece of coal, a barrel of oil, over and over again. Scarcity would not exist because, up to a certain level, with increases in the population, we could simply use our existing stock of supplies more frequently.

The Entropy Law means that waste and pollution (i.e., bound energy, unavailable to do work) increase inevitably in the flow of energy in any closed energy system operating through concrete, dynamic and irreversible time.

The Entropy Law, as Nicholas Georgescu-Roegen has demonstrated, clearly applies to any other energy process.[23] As energy is transformed from a free to a bound state, dissipated energy piles up. Indeed, other things being equal, waste and pollution pile up at a faster rate than "useful" output grows. In this sense, energy systems tend to run down.

A probabilistic interpretation of entropy in sub-atomic physics holds that all closed energy systems tend toward randomness; that is,

[23] See Nicholas Georgescu-Roegen, *The Entropy Law and the Economic Process* (Cambridge, Mass.: Harvard University Press, 1971).

toward equal probability that sub-atomic particles will be located in any given region of space. Such a definition of spatial distribution of particles equally probable to occupy any neighborhood is the exact equivalent of disorder.

To offset the qualitative degradation of energy and the tendency of energy systems to run down towards disorder, living organisms convert free energy ultimately, on earth, from the sun, into non-random patterns, configurations, and action, seeking low entropy from their environment in order to compensate for the entropic degradation referred to as death, to which they are continuously and irrevocably subject. Without the ability to prevent such degradation eventually, and without the ability to prevent the continuous degradation of the entire life system, when viewed in relation to appreciable evolutionary time durations, life is characterized as the struggle of ordered (and therefore improbable) organisms against the entropic degradation of the environment.

Ecological processes, as concretely observed in nature, contain inherent evolutionary principles associated with gene mutation, itself a rare event, which are favorable and not deleterious to survival of a given species, an even rarer event because most mutations are deleterious to survival of individuals. In a fairly exact sense, biological evolution over three billion years on earth, by advancing the variety, organization, and complexity of species, is an extraordinarily rare series of events. In nature, evolutionary processes have moved from simple to complex life forms, from simplicity to diversity, from few to many life forms. Driving these movements is the characteristic of living systems to generate negative entropy within life systems, to develop order through non-random activity which makes useful energy always available. Of course, in evolution survival of species is rare as well, in the sense that about 95 percent of species that have existed on earth have failed to survive to the present.

The conclusion of the argument thus far can be stated simply. The evidence both of evolution and of the growth records of the modern economic epoch strongly suggests that economic growth represents an irreversible process of cultural, social and economic transformation resulting from the use of knowledge to organize behavior towards survival.

Knowledge: Source of Value

The case for the evolution of culture has been well made by the anthropologists. Modern twentieth century science—that is, the body of knowledge generated by our culture through practice of a well-defined method of discovery—opens to us the dawning possibility of choosing the directions for humankind to follow in seeking to achieve its potential for survival and for living. The new vision of man's destiny, as Julian Huxley observed, which is to seek conscious evolution, merely extends the reality of biological evolution. As Huxley observes, whether mankind likes it or not, he is "the sole agent for the whole evolutionary process on this earth. He is responsible for the future of this planet."

The Redefinition of Wealth

To envisage wealth as a growing pile of self-identical objects affixed in given configurations through sub-periods of time and space may be

adequate for some measurement purposes. It is utterly misleading in understanding what wealth is, how wealth has been created, and how wealth may be created in the future.

The two sources of wealth available in the future are energy and knowledge. Wealth is incorrectly envisaged as a pile of physical objects having value in the past. The value of an economic commodity (whether a physical good or a human service) is the present value, discounted, of a potential future stream of services it yields to people.

All physical inputs to economic processes of production and consumption eventuate in waste. The only input to economic processes that does not itself result in waste, in bound energy, is knowledge. To be sure, as earlier mentioned in this discussion, in the broader processes of society, some knowledge is supplanted, absorbed, qualified, or rejected. But in the broad sweep of cultural evolution the stock of knowledge has grown.

Economic processes are themselves particular forms of knowledge that evolve. Our view of growth seems quite wide of the mark because we have not perceived the evolutionary transformation of social, ideological, and economic processes resulting from the advent of new knowledge employed to pattern and configure evolutionary economic processes. Therefore, we do not know very well what wealth is.

If the two sources of wealth in the future are energy and knowledge, at the simplest it would seem to follow that there are two very broad strategies for increasing wealth consistent with evolutionary choice favoring human survival. One is to delivery energy to our economic processes more usefully. An important sub-strategy is to substitute knowledge for physical resources in energy systems. The second strategy is to pursue widespread dissemination of forms of knowledge and bring to bear more useful information in social processes.

To deliver more useful energy to our economic processes means to improve energy-balance economic calculus to supplement other modes of analysis. The issue ranges from full appraisals of energy-balance and cost effectiveness of energy modes to benefit-cost analysis of human nutrition in relation to health. We do not eat as well as we know how to, in order to maintain health, despite marvelous means to educate and inform ourselves. But neither do we live holistic, natural life-styles aimed to bring more useful energy to homes, offices, and industry.

To substitute knowledge for physical material means systematically learning to "get more from less." House design profligate of material and energy; urban design profligate of municipal facilities; waste disposal design profligate of plumbing and water; food growing profligate of fertilizer and pesticides—the list could be multiplied.

The second strategy, to bring more useful information to bear on social and economic processes, has wide-ranging ramifications. We need to use our existing powerful means of vivid communication to educate people of all ages about the comprehensive and unifying ideas and imagination of modern science. We need to use science systematically in social and economic affairs, just as we learned in the nineteenth century to use science systematically in industrial affairs. We need to have our corporations, as assemblages of organized knowledge and sources of advancing technology, to communicate effectively to people their beneficent purposes. We need to organize knowledge in

our educational processes to inculcate comprehensive understanding, to fuse together social utility and scientific merit in designing institutions.

Improving and Broadening Productivity

Identification of economic growth, a social transformation process, with GNP, a statistical measure, creates great confusion in perceiving the meaning of growth. Daly and others have pointed to the absurdity of counting output without counting its costs. When output rises, pollution also rises, but GNP goes up by the full amount of the increase in output. When pollution is cleaned up, GNP goes up some more. When people harmed by pollution get medical care or die and incur burial expenses, the spending is again added to GNP. In a pioneering study in 1970, economists William Nordhaus and James Tobin tried to clarify the "growth versus welfare" argument by constructing what they called a "measure of economic welfare," MEW. They reclassified certain items in the GNP accounts to get a better measure of final consumption. They added value imputed to leisure, non-market work, and capital services of consumer durables and government investments. They subtracted a calculated disamenity cost of urbanization, estimated as the income differentials needed to get people to live in densely populated areas. MEW did increase, demonstrating to the authors that "the progress indicated by conventional national accounts is not just a myth." However, the growth of MEW in the postwar period, 2 percent per annum from 1947 to 1965 by the authors' preferred estimate, was slightly more than half that of GNP.[24]

Growth is often viewed naively because of the confusion between the statistical measure and the process. Above all, growth does not involve the constant replication of the same products, technologies, and patterns of consumption. Kenneth Boulding distinguishes between "printing" and "organizing" as forms of knowledge. Printing involves replication, the ability of a structure to reproduce itself, to make a copy of itself. Mass production of commodities is largely three-dimensional printing. Organizing is like the ability of a blueprint to determine a building or of an idea to create a new invention or organization. The process of economic growth is not printing but organizing. It is therefore incapable of being simulated by equations, since novelty is inherent in it.

The self-generating aspect of the process of growth results in its changing tastes and values, changing relative scarcities, changing the mix of industries that survive in the industrial structure, changing the physical configuration of population and markets, and changing the relative prices of resources because of changing relative scarcities. Technology also changes, historically in direct response to changes in relative scarcities. Innovation, studies show, comes mainly in response to market demand, not the availability of knowledge alone.

Continued growth does not necessarily depend on the continued growth of the labor force or net additions to the stock of physical capital. The growth of wealth is a growth of total human value avail-

[24] William Nordhaus and James Tobin, "Is Growth Obsolete–," *Economic Growth, Colloquium V*, National Bureau of Economic Research (New York: Columbia University Press, 1972), pp. 1–81.

able in markets. Rising factor productivity can make growth possible without any volumetric physical additions to the fixed capital stock or additional inputs of physical bodies of labor.

Can we be assured that the shifts in output composition and in technology will avoid ecological disaster? The answer depends on our ability to know and predict ecological consequences. Running out of resources is not a real problem, and if environmental costs are internalized, environmental damage need not halt growth.

The idea of productivity is in for change. Productivity now refers to the ratio of "useful" output to the inputs in a market-determined production process. Productivity bears some analogy to physical efficiency, the ratio of useful work to energy input in energy processes. Both ideas are anthropomorphic; human beings have to decide what is "useful." Productivity may be expressed either in physical or in value terms. Up to now, the concept of productivity has been confused with its statistical proxy, labor-productivity, which is convenient to measure.

It goes without saying that increased well-being, however conceived, depends upon increased productivity—upon how well all the resources of society are used to produce the outputs that people value most. The misconception of many non-economist growth critics that economic growth derives exclusively from numerically larger inputs of labor and amounts of physical capital emphasizes the importance of rising factor productivity as a source of economic growth, especially because the U.S. labor force will grow more slowly in the next two or three decades than in the recent past.

Studies by Kendrick of total factor productivity [25] show that its chief determinants have been investments in intangible capital designed to improve the tangible capital stock. They are qualitative improvements in the capital stock resulting from technological advance; qualitative improvements in the labor force resulting from education, training; similar improvements resulting from improvements in health and safety; innovations in organization and management that improve the way capital and labor are used in production; and the mobility of capital and labor that allows them to be shifted from industrial and geographic sectors of the economy where their productivity is lower to those where it is higher.

Continued growth therefore requires increased investment of physical and human resources in both intangible and tangible capital. Even if the physical capital stock does not grow, increased productivity requires replacing part of the physical capital stock to embody in it new configurations to keep pace with advances in technology and changes in values, tastes, and demands. The investment in physical capital stock increasingly in the future, because of resource shortages and environmental knowledge, should aim to be less heavily dependent upon energy inputs and material inputs per unit of output. This does not mean that all processes should become low-energy and low-material using. It means instead that full pricing of large scale production, say of aluminum lawn chairs or aluminum beer cans, taking respectively 50 kilowatt hours and one-third a kilowatt hour, should

[25] John W. Kendrick, "Productivity Trends," *Business Economics*, Vol. 8, No. 1, January 1973.

allow accurate market evaluations of their usefulness, including recycling gains and losses, relative to substitutes.

If we are moving into a period of rapidly changing relative scarcities, if energy and many widely-used materials will be in short supply and rising prices, if environmental costs are to be rightly included in production costs, then increases in production will depend very much on the improved health, safety, and mobility of labor and capital. Productivity gains will depend on the speed with which labor and capital can be moved from industries in which the costs of energy, resources, and pollution are high relative to the value of output to industries where the ratios are lower. Shifts of capital and labor to recycling, to substitutes of communications for transportation, to move information, images, and ideas with far less expenditure of energy, seem likely.

In the post-industrial epoch, the predominance of the service industries and other non-manufacturing industries over manufacturing and direct mining and agriculture will increase. Productivity gains in the service industries do not come primarily from increases in the ratio of physical outputs to inputs of labor and capital. They come instead from qualitative changes in the service often resulting from changes in the nature of "output" or substantial restructuring of the industry.

Health care is a notable example in which confusion about the nature of output, the structuring of service delivery, and the role of life-style, including nutrition, work habits, and life-stresses, has resulted in inordinate rises in cost and an emphasis on the treatment of illness rather than the maintenance of health for the entire population.

The legal system is likewise in drastic need of productivity advances, ranging from concepts of liability to the deplorable state of the administration of justice. At present, little if any private or public efforts are being made to restructure the system along more productive lines.

Non-market sectors of education and government services as well as some regulated sectors where excessive regulation impedes normal market incentives are in need of productivity gains. The principle of privatizing some services traditionally provided in the public sector, de-regulating certain industries, and the systematic use of market-type incentives—such as pay-TV education—to encourage efficiency and innovation in education and public services may be ways to achieve further productivity growth in a post-industrial epoch.

The content and measurement of productivity should be broadened. As to productivity content, the present concept of "useful output" takes no account or related "useless output." That is, proponents of technology assessment have shown cases in which economic changes that appeared to raise productivity in the short run have eroded productivity or built up unforseen costs and claims on resources later. Despite the difficulties of technology assessment, of foreseeing consequences, the cost of the most careful anticipatory planning and forecasting should be built into the total costs of major investment projects and major national programs. For example, such analysis of nuclear power investment should be promptly made.

Total factor productivity, as a measure of productive gains, is far superior as a measure than output per manhour, which becomes increasingly misleading in international and domestic comparisons. Out-

put per manhour distorts the public's understanding of what productivity is and what causes it to rise. However, the role played by pollution and waste in economic processes makes mandatory the inclusion of costs associated with reducing them in measures of inputs to production processes.

Investment Policy Implications

If we recognize that economic growth is an irrevocable process of cultural, social, and economic transformation resulting from entrepreneurial use of the advance of knowledge, what does this imply about future growth? Growth is likely to accelerate and not slow down, if knowledge keeps growing and entreprenurial ability can be appropriately released. Such growth need not require or result in net physical additions to the stock of capital or labor, nor need it involve huge added amounts of energy and materials. What future growth will require is the steady infusion into social and economic processes of more new knowledge and understanding.

This means that what is surely required is net investment, both public and private. Physical capital is, after all, only knowledge made concrete; it is know-how imbedded in physical configurations. Net new investment is needed to reshape existing physical capital, both public and private, to conform new knowledge; that is, so as to embody the innovations in economic processes that themselves represent a form of new knowledge. Of paramount importance is the steady and systematic improvement of the stock of human capital; or, to put the point plainly, the improvement of people's knowledge, skill, and understanding, their health and vigor.

It is knowledge, supported by people's health, safety, and mobility (i.e., free choice), that moves us towards the advance of human effectiveness—towards broadly defined productivity gains—by "getting more from less"; that is, getting more human value from processes using less energy and materials. Productivity, to be sure, involves individual effectiveness. But its more profound meaning lies in the voluntary organization of human group effort in a society to create greater human effectiveness.

Basic economic concepts need to change in content. It is not self-evident that our present ideas of fundamental economic inputs—capital, labor, land, and management—are much more astute than the Greek view of the basic elements as earth, air, fire, and water. A strong case could be made for considering these fundamentals as knowledge, energy, materials, and organization (itself a form of knowledge). Our concepts of wealth, income, cost, and productivity are all in for changes in content. The need for better knowledge of long-time demand and supply factors suggests that more anticipatory planning by all public and private institutions should be done, but on a non-centralized and non-authoritarian bases.

The market system—a competitive enterprise market economy—is more than ever to be valued. The enormous demands on the economy are unlikely to be met without maximum and workable mobilization of private initiative, resources, and capital. The market system avoids reliance on single institutions for knowledge, wisdom, and foresight. The system has served and can continue to serve as a survival mech-

anism for the competitive evaluation of new technologies. The interests of society as a whole are likely better to be served by competition of ideas, judgments, products, and technologies within a highly responsive price-demand information system than by centralized judgments and decisions. The major issue facing the market system is that of assuring competitiveness in the face of regulation that is in many cases outmoded and in others perfectionist.

The problem of externalities is one of putting price tags on them and deciding who will pay the costs, and doing so is a political decision. As externalities become more important, government should avoid excessive and detailed regulation in favor of imposing costs in response to performance specifications. Otherwise, decisions concerning technology will be made by bureaucracies through narrow technical analysis instead of being made by the joint interaction of producers and users in markets. Common property resources should where possible be converted to private property interests consistent with understanding of Garrett Hardin's account of "the tragedy of the commons."

Changes in Investment Structure

Changes in the structure of investment, both public and private, are likely to be as radical if not more so in coming years than in the past two centuries. Public policy, therefore, which subsidizes existing or traditional industry investment through mistaken understanding of growth processes will inhibit productivity gains and retard the growth of wealth.

Capital availability is perhaps the major constraint on the rate at which the new goals of the post-industrial world can be reached. These include achieving an adequate standard of living for people throughout the world, providing useful and meaningful work opportunities, protecting the earth's natural capital through a safe and clean environment, developing new and renewable sources of energy, and conserving scarce materials.

Lacking the right kind of capital capacity, we have to face up now to the need for changes in the pattern of investment in the next decade and beyond. Business capital is an example. Already, the pattern of consumer demand is changing from the demands of the first post-World War II generation for conventional durables to more emphasis on spending for travel, recreation, and experience. Much of U.S. and foreign manufacturing capacity is structured to supply conventional homes, suburban amenities, automobiles, air conditioners, and other large electrical appliances. Apart from the energy problem, today's generation of consumers appear less likely to use so large a part of their income for these durable goods.

Because of the sharp rise in energy prices, it is not clear what should be the pattern of business investment over the next decade. Less capital will probably be needed in auto and related metalworking production, but how much more investment will be needed to provide basic materials, fuel, chemical feedstocks, nuclear power, synthetic fuel plants, large-scale coal and metals mining, and offshore oil production? All involve more difficult technical, environmental, and financing problems than conventional oil wells, power plants, or auto assembly plants. Investment in them, and in capacity for paper, steel, and other materials,

involves inflation-cost-escalation plus new environmental costs. In short, the relative price of these products will be rising.

Effects of Relative Price Rises

However, profits—when corrected for inflation and adjusted for essential reinvestment—are not high enough to attract capital into such industries as oil and gas, electric utilities, steel, aluminum, paper, and other materials. In many countries, public attitudes will not tolerate and government will not permit price rises in basic industrial commodities adequate to attract private investment into new energy sources, mining, large-scale chemical and metallurgical facilities. Without tax subsidies to pay added costs that consumers now won't pay, capital expenditures won't be made big enough to avoid output shortages later in the next decade.

However, the growth process requires reflecting fully the real costs of production in pricing policy. In general, goods and services whose production involves heavy use of energy and materials and causes heavy pollution will then rise. If rising real costs are fully reflected in prices without being hidden and shifted to taxpayers by subsidies, beneficial changes occur for growth. First, the rise in relative price forces producers of these products sharply to economize their own use of energy and materials by innovative responses in technology and to search avidly for less polluting processes. Second, consumers are led to demand more durability, fewer frills, and attention to basics in their purchases. Third, substitute products and processes inherently more adroit in energy and material use and less polluting will be brought into the marketplace faster than otherwise. Already, the quintupling of energy prices, the rise in material prices, and environmental regulation are shifting durable goods design in these directions. The structural shift in output and in industry growth will in turn move toward getting more human value with less energy, materials, and pollution, in turn improving human effectiveness. Redesign of housing, durable goods, and services towards more economizing of energy, more miniaturization, more durability and reliability, more economizing of heavy materials is a route to structural change that shifting capital in response to changed relative prices will accomplish. At the same time, if people weigh real costs of over-elaborate use of energy against comfort, convenience, or even human energy, they will respond to lower thermostats, consider heat pumps, tackle do-it-yourself projects, and adapt to simplicity of life-styles that conserve materials and energy and free financial and real resources for other new or unsatisfied wants that generate economic growth less profligate of non-human resources and less tolerant of outmoded technology.

Lagging Use of Science and Technology

The business example of the threat of a capital shortage just cited is only one among others. A more general case can be made that while our nation today has more capability than ever before in science and technology—scientific and technical know-how that would yield a net, high social reward if applied—we are using it less. Science and technology, if fully employed, could improve the value of our resources, both human and natural. They could create new and useful economic

goods and services and create new work. They could create new methods and processes for increasing supply and lowering costs by creating substitutes for materials in short supply. But we have become slower, more timid, and less innovative in using science and technology creatively and beneficially.

There are some general principles to use in designing and implementing governmental policy that would employ our high potential for technological advance and foster the expected transformation to a more humanistic and developmental form of capitalism.

(1) Bringing to bear more useful energy to social and economic systems means using energy efficiently by matching the quality of the work to be done with the type of energy available. It is not a question of multiplying energy use but of using energy more adroitly. This is a question of widespread application, involving energy policy analysis over a wide range, to answer questions going to the heart of energy use. The question concerns systems and processes, not merely particular products. Does it make sense to burn tons of oil to produce electricity whose generation wastes huge amounts of heat and whose transmission loses large amounts of electrical energy, in order to use the resultant energy to heat a house? Does it make sense to build nuclear reactors to boil water to create steam to power generators to produce electricity so homeowners can use the electricity to boil water on electric stoves? How does a diesel-powered heat pump compare in energy adroitness? More broadly, how can we develop a strategy of energy use aimed systematically towards eventual energy supply from renewable sources?

It is not merely that the products now designed are maladroit in energy and materials conservation. The issue for investment policy is more general. It concerns the structure and the evolution of our systems for producing energy, for generating transportation, for growing food, for moving goods and services to consumers without provision for waste recovery and use, for communicating, for disseminating knowledge, providing health and safety, and the like.

Organizing Investment for Growth

The same general principle therefore applies to the major goals of the post-industrial world. The problem of food and nutrition, of shelter and basic services, for the people of the world; the problem of world environmental observation and protection; the problem of urban transportation; the problem of work opportunity all are affected by energy policy and are linked to it in systematic ways. Vital to an astute national investment policy is a clearer understanding of the nation's and government's goals in addressing such long run and basic considerations. We need an anticipatory process of defining and involving people in the real choices facing us that fosters rather than supplants the market system, but that does not succumb to avoiding needed changes in industrial structure because of a mistaken and growth-inhibiting policy of protecting vested industrial, professional, institutional, and government interests.

(2) Bringing more useful information to bear on social and economic problems means achieving a vastly better overall matching of scientific and technical advance to social needs and progress. The problem of using science and technology concerns the broad relation-

ship of know-how to the society, government, and marketplace. The issue is one of systematically establishing a better process for cooperation among society, business, and government to use science and technology in the long-run interests of the human race.

U.S. private corporations cannot now risk investment in systematic activity aimed at major domestic social problems amenable to advance through science and technology. Technological businesses are not now earning enough on average to provide funds for scientific research and new technology. Major new projects involve risks and start-up costs beyond their capability, including political risks that are unforeseeable, sudden, and arbitrary. Government has to play the leadership role of specifying performance, serving as regulator, partner, or insurer.

In many of these basic fields, the U.S. is a world leader in know-how. In food, the U.S. is close to unique in research, technology, soil, weather, topography, and size; in mechanization; in know-how of growing, processing, storing, and distributing food; in the cultural flexibility of our farmers and food processors in their responsiveness to change. Yet, we lack answers to basic research questions about nutrition, the food requirements of humans, the entire process from food to mouth; our food processing industry is poorly adapted to supplying nutrition as such; and our medical schools have scarcely begun to study nutrition.

We are neglecting any organized attack on problems of environmental monitoring or control in the country or the world. We have the mixture of creativity and common sense to undertake massive but selective study and selective depolluting of waterways, with resulting calculable benefits in health, quality of life, and long-term economic gain. We need far more systematic research to understand pollution in detail, to relate it to technology used. Doing something systematic also means learning by doing. However, despite advancing technology in environmental control, nothing like the degree of cooperation is evident between the private sector, the academic community, and the government.

In still another area, electronic information technology, we have capabilities that far outstrip our ability to use the technology to meet national needs. Electronic data systems can now absorb, store, categorize, process, ponder, move, and present information in vastly greater quantities, yet greater speed, radically reduced cost, and increased reliability and accuracy, than has ever before been conceived. The U.S. is almost unique in possessing the know-how, the market, the need, and the opportunity of high return on investment. Although growth here is already steady and strong, it is nowhere near what it could be. Full use would radically change the way we communicate. Nothing but organization stops us from having nationwide TV universities, computer-based nationwide reference libraries, electronic money exchange, and many other advances. The issue again is not the technology but the complexity of the organization problem. Our capacity to use a combination of earth resources satellites and a network of computers, communications equipment, and data analyzers on earth would yield enhanced world weather prediction, better prospecting for water and minerals, improved world agricultural planning, and other valuable

information. But how can a private entity undertake such investment without government sanction?

Coal technology, the recycling of materials, housing research and design to minimize energy waste, intermediate technology applications, and a host of other vital subjects for study and action represent a need of the post-industrial era, tied to investment policy, that is going largely unfilled. Meanwhile, forecasts of slowdowns in long run economic growth as conventionally defined come not only from critics of growth but from conservative business analysts.[26] A fundamental reason advanced is declining capital productivity, along with a market slowdown in the growth of labor resources. These two factors suggest the opportunity available in greater saving combined with the need for making human effort more productive here and elsewhere in the world in order to increase our own wealth and the wealth of the world on behalf of human welfare.

Appropriate Investment Policy

(1) HUMAN CAPITAL INVESTMENT

The U.S. lags in investment in human capital but has the means to improve. Idealogy stands in the way of realizing that the basic source of future wealth is a people who are healthy, vigorous, safe, able to choose, and both broadly and technically educated. A key part of an appropriate investment policy is one that requires rapid advancement in educational productivity through use of science and technology fully where human benefit results. Education and training of all our people should be continuous.

Education needs, particularly of low-income urban people both young and old, are being egregiously neglected. Reorganized aid to education is called for. Also, welfare and unemployment compensation systems ridiculously pay people to be idle when they need and want both genuine education and genuine jobs. Public investment in already existing effective voluntary efforts to teach people and get them to work at useful jobs is a sounder human approach than massive government operated programs, beset by red tape and bureaucracy, that mainly subsidize idleness or generate unimaginative and temporary make-work programs.

Continuing education deserves more than lip-service. It deserves to be developed systematically through government substitution of learning and working for the current policy of indifference to human welfare and self-esteem reflected in current welfare programs that create dependency in the name of beneficence.

(2) CHANGING OUR OVER-CONSUMPTION STYLE

The last twenty years of growthsmanship has produced an overconsuming society. We have assumed that, to increase capital investment, all it takes is saving and investing a fairly constant share of a growing national product. The gap between gross national product (GNP) and national economic welfare (NEW) reminds us that life-quality

[26] Leonall C. Anderson, "The Outlook for Long-Run Economic Growth," *Business Economics*, September 1976, pp. 32–39.

has grown slower than the output of goods-plus-bads. Now, it may be that the old approach is too inflationary, too demanding of resources, too hard on the environment, and too indifferent to the national security that would be gained by spreading the fruits of know-how more widely than in the past around the world. It may be time to take a serious look at relative incentives to consume and save that current policy provides.

A major bias of incentives toward consumption follow from taxing income. Both saving itself and the income from saving are thereby taxed; both capital outlays and the net return generated by capital over its lifetime are taxed. We can either remove saving from the tax base entirely or allow deductions for capital outlays in the year made (including increases in inventories). In the middle of inflation and threatened resource shortages, when much social and industrial capital needs replacing and improving, it may be time to tax people for what they take out of the economy instead of what they put in. Taxes on consumption can be made progressive, and the time seems right to reward people better for saving. Inflation, otherwise, makes government transfer payments due in the future a shaky source of security for recipient dependents.

(3) GETTING BETTER INTELLIGENCE

We need, as part of an appropriate investment policy, to make major improvements in our processes of economic intelligence. Are our national income and product accounts adequate for the post-industrial world? Our productivity measures? Our reflection in statistics of the output of the new environmental enhancement industry? Our measures of energy-related aspects of economic processes? These, and many other questions of economic intelligence, are vital to reaching sound investment conclusion.

(4) A POSITIVE INVESTMENT POLICY

We need to re-think government investment policy, using the insights of a new concept of growth, when seen as irreversible social and economic transformation process. The ensuing policy would not merely avoid subsidizing conventional and wasteful economic processes and the industries using them. It would positively promote the two strategies of bringing more useful energy to social and economic processes and of bringing more information to bear. It would directly address the serious issue that in the U.S. we are falling behind in using to its fullest the very advances in science and technology that mark the new epoch we are entering. And it would change U.S. attitudes toward work and welfare by making concrete the lip service now paid to the doctrine of full human development.

Conclusion

A strong case can be made that throughout nature the mandate of life is, grow or die. The thesis here is that if we understand growth rightly, our concern is with the growth of human value, as expressed in social and economic systems undergoing irreversible transformation. The growth in value can come only from growth in human

knowledge, as applied to energy and material configurations, and preferably through voluntary organization of effort. If we can improve in cooperatively organizing the use of knowledge throughout society, we can and will grow faster, for we are nowhere near the limits to the advance of knowledge or the curiosity of the human mind. Nor are we anywhere near the limits of human potential for effectiveness, individual growth, or accomplishment.

INDUCED INVESTMENT OR INDUCED EMPLOYMENT—ALTERNATIVE VISIONS OF THE AMERICAN ECONOMY*

By BURKHARD STRUMPEL**

MAJOR CONCLUSIONS AND RECOMMENDATIONS

(1) The core of the present economic difficulties—unacceptably high rates of unemployment and inflation and low rates of growth—is of a structural rather than cyclical character. This is due partly to a newly developed recalcitrance of the physical environment, namely, lesser availability of raw materials, limits to the natural absorption of effluents, and partly to changing popular needs and wants, namely, decreasing tolerance of low-quality jobs, pollution, noise, dislocation.

(2) The frontier of economic growth has shifted from natural resources to human resources. While growth in the production and processing of primary materials and production of "throughput" intensive goods for the time being encounters increasing barriers, manpower has become more abundant, both quantitatively and qualitatively, due to high and rising rates of labor force participation characteristic of the United States, as well as increasing educational attainment and job experience. In order to achieve growth we must change our factor input and utilization so as to make more intensive use of amply available (human) resources while husbanding scarce (physical) resources.

(3) Considering the close links between productivity, and the state of technology, it is hardly possible to produce the currently produced set of material goods with a greatly different factor mix containing more labor. We, therefore, need a differently composed basket of goods and services. The main obstacle to growth facing the American economy then is rooted in the existing composition of *final* production and demand.

(4) Conventional fiscal and monetary policies are geared to aggregate demand management and, for both ideological and technical reasons, are hardly able to handle the task of influencing the composition of final demand.

(5) There are vociferous and powerful advocates of preserving the old structure of production and demand by way of a massive capital

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infusion into the private manufacturing, mining, construction and utility sectors. This strategy, rather than adapting to the natural and environmental limitations, attempts to overcome them. It most likely would—

Entail rising marginal costs, more inflation, and less economic growth;

Forego the chances for full employment; and

Ignore current trends in changing needs and tastes as well as the longer-term market signals (declining profits, capacity utilization and investment in the manufacturing sector).

(6) This paper recommends government programs and initiatives that bring together underutilized human resources with unfulfilled human needs for public and private services. This strategy would aim at—

Directly achieving high employment by job creation;

Maximizing the utilization of abundant rather than scarce factors of production, of labor rather than "nature" or raw materials;

Satisfying unfulfilled needs that cannot now be fulfilled by the market or the public economy;

Reducing the public and private costs, both economic and non-economic, of prolonged unemployment, under-employment, obsolescence of skills; and

Channelling economic expansion in a direction that would place less burden on the environment than growth has done in the past.

(7) The extent of public support for an ambitious, innovative and expensive government program for reducing unemployment would largely depend on the specifics of such a program. Survey data reveal that the pervasive decline in trust in government and other institutions is not accompanied by indifference toward government services and employment programs. Quite to the contrary, there has been rising demand over the last seven years for government activism in the areas of employment, health, education, and housing, and a commensurate expressed willingness to pay additional taxes for the desired services.

It is the purpose of this paper to stimulate a reorientation of thinking rather than to present a fully detailed and documented blueprint for action. New approaches to structural economic reform can only emerge from fresh concepts and paradigms with which to interpret the world around us, and its changes. It is important to keep in mind the middle-range perspective of this view. While looking beyond the business cycle, we are not dealing with the 21st century about which we know very little. We are on much safer grounds in characterizing the differences in economic structure and trends between the 1970's and the 1950's, and thus in judging the prospects for the 1980's. While solar energy, for instance, may have solved the energy problem by the year 2000, no "technological fix" will permit the continuation of past growth rates in energy production for the next 10–15 years. And one more clarification: while the emphasis is placed on structural reorientation, it is not suggested that the traditional instruments of fiscal and monetary policies should not be important or in need of improvement, and, if used properly, cannot help us to reach our goals.

To state that our economy is in deep trouble is to belabor the obvious. Unemployment and inflation are on historically very high levels. Both are remarkably immune to the cures that one decade ago were praised as a "new economic policy" capable of keeping the economy straight on the course of full employment and growth. A mere slowdown in the increase of production and mass incomes has generated widespread disenchantment with the economy, fear of crisis, distrust in the government's economic policies, in short: a malaise that reinforces the actual difficulties. In spite of continuously high levels of production, the economy fails to live up to people's expectations and in particular to satisfy their needs for continuity, equity, and self-actualization through meaningful work. Our economy is highly productive and yet fails according to many or most of the criteria that are used to judge its performance. Conventional economics has not been helpful to the public and decision makers in understanding and mastering the unfolding turbulence. There was much more than the usual disagreement between practitioners of the art, leading to confusing analysis and conflicting advice.

This then is a time for stock-taking and rethinking. The miserable welfare performance of our economy under conditions of fairly high levels of output suggests that it may be less the quantity of the product and more its composition or distribution that determines whether the economy fulfills its objectives. Joan Robinson, in a paper entitled "The second crisis of economic theory," says:

> The first crisis arose from the breakdown of a theory which could not account for the level of employment. The second crisis arises from a theory that cannot account for the content of employment. . . . Now that we all agree that government expenditure can maintain employment we should agree about what the expenditure should be for.[1]

Joan Robinson calls for nothing less than an alternative vision of the contemporary economy, a vision that can guide our understanding of employment policies quite like the Keynesian system had provided guidance in the past. While a similarly comprehensive, systematic, and persuasive paradigm for our time is not now in sight, it is worthwhile to examine the highly resilient remnants of the old beliefs in the light of new realities and to draw some lessons for present-day full-employment policies.

In the past, growth had relied mainly on perfecting the mastery of man over nature. The utilization of natural resources was the frontier during the period of industrialization. Human ingenuity, extensively combined with natural resources, made possible exponential growth in production. Recently, the mastery of man over nature has started to yield fewer additional benefits, due to declining accessibility of raw materials, approaching limits of absorption of pollutants by the environment, and decreasing public tolerance of ecological damage.

There are some who feel challenged to overcome the new barriers to growth stemming from the recalcitrance of the natural environment Since some goods have become more difficult to produce, so they say we must try harder to create the conditions that make further growth

[1] J. Robinson, "The Second Crisis of Economic Theory," *American Economic Review*, Vol. 62, 1972, p. 6.

in the production of those goods possible. To this end, we most urgently need a boost in capital investment, mainly for increasing our production of energy and processing of raw materials. Once resources are abundant again, high employment will return. Already before that time, the investment program itself will absorb labor. Employment in this scenario is a by-product of investment in plants and machinery which in turn is induced through capital infusion. Rather than the composition of final product, it is the intermediate product that is the subject of intervention.

To sum up, the latter position holds that an additional rapid increase in the production of goods making heavy demands on the environment is both possible and desirable. The counter-position taken in this paper advocates a change in the composition of final product. Future GNP increments would go less to materials-intensive and more to labor-intensive production which also involves a relative shift from private to public or at least publicly financed services. As is well known, a shift of employment from the agricultural and industrial sectors to the service sector has been under way for several decades in the United States and other industrial countries. It must be noted, however, that this trend has not been accompanied by a stationary or slowly growing materials consumption. E.g. in the United States, energy use *per unit of GNP* not only has been considerably larger than in West Germany and France but has also been growing over the last 15–20 years. Furthermore, the service sector has not been fully able to absorb the declining share of the labor force of the other sectors.

The Ideology of Induced Investment—A Critique

The latter position, while not out of line with the Zeitgeist, is at odds with the beliefs and implicit theories that are with us as a heritage of classical and Keynesian thought and policies. It is in particular Keynes' call for induced capital investment—often heard at present—that must be carefully examined as to its underlying assumption. Part of the popularity of capital infusion is due to its success as a "pump primer" in counteracting the exceptional unemployment of the 1930's. Later Harrod and Domar pointed out that capital investment beyond its importance for employment, had the effect of increasing production and promoting economic growth. These writings set the stage for the predominance of capital in the non-empirical theory of economic growth which emerged after World War II. It is no wonder then that capital-oriented strategies play a large role in the current debate dealing with the persisting deficiencies of the American economy.

This set of views may be represented by resent statements of several leading spokesmen of the U.S. government. Treasury Secretary William E. Simon writes:

> We must achieve a basic shift in our domestic policies away from personal consumption and enormous government spending and toward greater savings and capital formation.[2]

Arthur F. Burns singles out "improvements in productivity through larger investment in modern plants and equipment" as the first "line of attack on the dual problem of underemployment and inflation." This objective, he says—

[2] *The Conference Board Record*, August 1975.

Would be promoted by overhauling the structure of federal taxation, so as to increase incentives for business capital spending and for equity investments in American enterprises.[3]

Other strategies suggested by Burns include stretching time-tables for environmental and safety goals, encouraging price competition, relieving federal minimum wage laws, and public employment programs to substitute temporary for slackening demand for labor of the private sector.

And Henry C. Wallich[4] foresees higher demands for capital, "mainly as a result of prospective increases in environmental, energy, health and safety, and mass transit investment." Referring to various studies of capital requirements, he advocates an increase in the fraction of GNP spent for nonresidential investment from the historic 10.5 percent to 11.5 percent. In order to facilitate capital accumulation to meet that goal he suggests a gradual shift from taxes on profits toward taxes on interest income as well as a reduction of the government budget deficit.

There are three beliefs implied in these statements, referring respectively to the criteria a) resource utilization or employment, b) efficiency of technical progress, and c) utility of output.

Resource Utilization

Induced investment is assumed to create additional employment mainly by virtue of its income effect. Those who supply the services needed for producing investment goods receive (additional) income. And their (added) demand reverberates through the economy by creating further employment and income (multiplier effect).

Efficiency

Induced investment, so it is held, leads to productivity increase and "embodied technical progress." Mechanization substitutes machine power for manpower and thus increases labor productivity. Moreover, replacing old machines by new machines typically has been accompanied by technical improvements.

Utility of Output

It is believed that additional productive capacities created by induced capital investment will encounter receptive markets and that the ensuing production can be sold. The emphasis on investment in the private sector rather than the public sector is due to the belief that the former is more productive and enjoys a higher priority for society and the people.

These beliefs clearly have been reinforced by the success story of postwar growth which still shapes our understanding of economic processes. Consequently, a review of economic trends in the United States in the perspective of recent history is required as a first step toward examining the role of induced investment. The two decades following World War II brought unprecedented growth to Western

[3] *Challenge*, the Magazine of Economic Affairs, January/February 1976, p. 10.
[4] Is There a Capital Shortage? in *Challenge*, September/October 1975, pp. 30ff.

industrial nations, due to a constellation of circumstances that may be described as follows:

Ready availability of most raw materials, the relative prices of which declined over time;

Availability of mobile labor from a shrinking agricultural sector, the closing of small and inefficient enterprises, an increase in female labor force participation, and immigration;

Increasing availability of skills due to the rapid expansion of educational attainment;

Private households that readily absorbed an increasing production of goods and services. Consumers were optimistic, unsaturated, "thing-minded." There was rapid population growth. There was the growth of suburbia accelerated by government subsidies to homeowners and Federal highway construction. Suburbanization, in turn, led to the strong expansion of the housing and automobile industries, but also to the demise of the inner cities; and

Availability of capital: There was a fairly constant rate of saving, high enough to provide for the needs of investors at reasonably low rates of interest.

Economic activity is generated by a complex interaction of demand conditions with a variety of productive factors: resources, labor, capital, management. A particular factor becomes the more important or central the scarcer it is in comparison with other factors. The phenomenal success of the Marshall Plan in stimulating the economic resurgence of Western Europe was due precisely to the fact that capital, along with superior technology, was infused into economies that were well equipped with labor, resources, management skills, and were full of people hungry for goods.

For the United States, in contrast, there is little reason to identify investment as the single strategic factor. To the extent the sequence of events during business cycles can serve as a clue, business investment tended to lag behind consumer expenditures for durable goods over the past thirty years.[5] Yet high growth rates of private investment in plant and equipment, necessitated by an expansion of goods production in the 1950's and 1960's, undoubtedly contributed to a high degree of *resource utilization*, as well as to rapidly rising *productive efficiency*, much of it consisting in a transfer of resources from places with lower to places with higher productivity. Human labor was made more efficient by energy operating through machines while investment both in human know-how and materials was required to make mechanization possible. Reasonably high levels of employment were maintained through the expansion in overall production, particularly through the rapid growth of the capital goods industries. Turning to the criterion of *utility of output*, Americans readily adapted to the availability of more goods. They were thing-minded, willing to invest in consumer durables and incur debt.

Most of the basic coordinates governing the present situation differ in important respects from those prevailing in the postwar period:

Raw material prices are sharply up after a long period of relative decrease;

[5] George Katona and Burkhard Strumpel, "Consumer Investment vs. Business Investment," in: *Challenge*, January/February 1976, p. 13.

The proportion of the labor force employed by goods producing sectors (manufacturing, mining, construction) has decreased;

Pollution control standards and other environmentalist constraints have raised the operating costs for industry; and

Population growth has slowed down considerably. Rates of labor force participation have increased mainly due to a larger number of working wives.

Several of the changes listed above and documented in Table 1 are the outgrowth of exogenously imposed contraints: diminished resource availability and ability of the environment to absorb waste and pollution, coupled with reduced tolerance levels on the part of the people. Since they are central for the subsequent argument, they will be discussed in more detail.

TABLE 1

	1967	1968	1969	1970	1971	1972	1973	1974 (3 quarters)
A. Annual percentage increase in the dollar price of minerals and metal ores: [1]								
Minerals	−1	−1	+2	+6	+14	+11	+35	+165
Metal ores	+4	−1	+6	+6	+3	+7	+20	+27
				1955	1960	1965	1970	1974
B. Proportion of employment by the goods and energy producing sectors [2] out of total employment (percent)				48.6	45.0	42.5	39.6	37.6
						1972	1973	1976
C. Pollution control expenditures as a percentage of capital spending: [3]								
Durable manufacturing						6.6	8.3	8.4
Nondurable manufacturing						9.8	12.2	13.8
Electric utilities						7.9	6.8	5.9
All business						5.1	5.9	5.9
				1955	1960	1965	1970	1974
D. Labor force participation: [4]								
Civilian labor force as a percentage of total population				37.4	36.4	36.5	38.3	40.6
Female labor force participation rates [5]				35.7	37.8	39.3	43.4	45.7

[1] The index for minerals, while including metal ores, is dominated by fossil fuels.
[2] Includes mining, construction, manufacturing, public utilities, and transportation. Source: "Manpower Report of the President," 1975, p. 278.
[3] McGraw-Hill, "Sixth Annual Survey of Pollution Control Expenditures" (McGraw-Hill, 1973; processed).
[4] Manpower Report of the President, 1975, pp. 203 and 205.
[5] Calculated from "Manpower Report of the President," 1975, p. 203, and census reports. Percentages refer to the universe of noninstitutionalized women 16 yr and over.

Through the past century, in particular the period after World War II, the relative prices of physical goods have decreased. Energy, cars, refrigerators, furniture, food products—raw or processed—have been rising less than doctor's bills, education, domestic service. This trend has been brought about mainly by the spectacular increase in the productivity in the primary and secondary sectors as observed by Clark and Fourastié. There are indications that this trend is slowing down, coming to an end, or may actually reverse itself, for two reasons:

(*a*) Physical production is increasingly being blamed for external or social costs connected with pollution, agglomeration, and even social disruption. The internalization of these costs in product prices by way of legislation is underway;

(*b*) Productivity increases in the production of physical goods appear to be more difficult to achieve in the future. In the past, such increases were largely a result of artificially low prices for new materials, especially energy. For example, labor productivity in agriculture increased at the expense of profligate use of energy, leading to drastically reduced "energy productivity." Furthermore, raw materials have become more resistant to further expansion in production. It is natural to work the richest and most accessible ores first before moving on to the leaner and less accessible ones. But as this move is forced to take place, the energy, capital, and labor requirements needed to produce the same quantity of industrial material increases, an increase that must be superimposed on the rising worldwide demand for material.[6]

Correspondingly, the owners of natural resources have become more aware of their finite wealth and set the price accordingly in order to prevent depletion. The events of the last few years have reminded us of an elementary fact first pointed out by Ricardo but all but forgotten during the long era of resource-extensive growth: there are three factors of production, namely labor, capital, *and land.* In the past, workers and capital owners, supported by a congenial power constellation, had divided up almost the whole product between themselves. Yet recently the third factor of production has reasserted itself forcefully, both as a constraint to production and expansion and a cost component. It is here to stay.

Does this scenario ignore the potential of human ingenuity in overcoming emerging scarcities and environmental resistance? Cannot substitute materials and processes be found that are amply available and harmless to the environment? At a given state of technology, substitutes are more expensive than the material or items for which they are substituting, otherwise they would probably have been used in the first place. The substitute may be a costly material or have inferior performance, incurring more frequent repair costs. Human ingenuity indeed will help us to overcome scarcities, but overall growth is likely to be lower if technical progress must be employed defensively to counteract diminishing resource availability, as opposed to a situation when man can combine his inventiveness with the opportunities of an expandng frontier. Extensive growth, based on both innovation and more resources, is faster than intensive growth, based solely on the former.

What are the implications of these changes for the role of investment? The strategic role of private investment has declined; there are no indications for underinvestment due to "capital shortage." Investment in plans and equipment, in constant dollars, while claiming a fairly constant proportion of GNP, has been increasing at a slower pace over the average of the last five years than in the preceding periods. If we exclude that (growing) part of the costs that is needed for meeting environmental regulations, the proportion of investment in primary productive capacity out of GNP may even have declined somewhat. The case for induced investment rests crucially on the presumption that the market does not offer capital at favorable or acceptable interest rates. Furthermore, there should be evidence to the effect

[6] Alan G. Chynoweth. Materials Conservation—A Technologist's Viewpoint. in *Challenge,* January/February 1976. p. 35. A comprehensive inventory of resource availability is contained in the report by the Commission on Natural Resources and the Environment of the National Research Council, National Academy of Sciences, Washington, 1975.

that the existing capital stock earns a satisfactory rate of return or, failing that, that increments to the stock of capital would be able to do so. Finally, there should be an appropriately high rate of capacity utilization. Let us now look at all three variables: capital availability as expressed by an approximation of the rate of interest in real terms, profitability, and capacity utilization in a longer time perspective.

Table 2 leads to the following conclusions:

(1) The real rate of interest for long-term capital as approximated by a simple difference between the nominal rate and the GNP-deflator both for one particular year has at least not risen since the late fifties.

(2) Net rates of profit on invested capital moved downward in spite of reduced profit taxation.

(3) Capacity utilization has declined as well over the decade. It is apparent from these data that the decline of both profitability and capacity utilization is not due exclusively to cyclical developments.

TABLE 2

RATE OF INTEREST, RATE OF PROFITS, CAPACITY UTILIZATION

[In percent]

	Real interest rate [1]	Real rate of return for nonfinancial corporations (after tax)[2]	Capacity utilization (manufacturing, mining, construction)
Year:			
1951		6.4	94
1952		6.0	92
1953		5.5	96
1954	1.4	6.2	85
1955	1.7	7.9	91
Average	1.6	6.4	92
1956	0	6.5	89
1957	.2	6.1	85
1958	1.3	5.4	77
1959	2.7	6.8	82
1960	3.6	6.3	80
Average	1.6	6.2	83
1961	3.1	6.3	78
1962	3.2	7.9	82
1963	3.0	8.1	84
1964	2.8	9.1	87
1965	2.7	10.0	90
Average	3.0	8.3	84
1966	2.3	9.9	92
1967	2.3	8.8	88
1968	2.2	8.1	88
1969	2.2	6.4	87
1970	2.5	5.3	80
Average	2.3	7.7	87
1971	2.9	5.7	76
1972	3.8	5.6	80
1973	1.8	5.4	83
1974	−1.6		78
Average	1.7	5.6	77
1975			69

[1] Aaa corporate bond rate (Federal Reserve bulletin) minus GNP price deflator (Economic Report of the President).
[2] The data are from William D. Nordhaus, "The Falling Share of Profits," "Brookings Papers on Economic Activity, I," 1974, p. 180. The real rate of return is defined as the capital income (excluding capital gains) divided by the net stock of capital.
[3] From Business Conditions Digest.

The behavior of American manufacturing industry, seen in an aggregate perspective, may appropriately be described as "overinvesting." Hyman P. Minsky has shown that there is a serious increase in indebtedness by private corporations. The calculation of the ratio of liabilities to liquid funds showed that the financial situation of nonfinancial corporations turned from "robust" to "fragile" during the last five years. Minsky concludes:

> **In the face of excess supplies of housing, commercial properties, and industrial capacity, as measured by their ability to validate debt, we now have a national policy to induce private investment and construction. . . . The market signals are clear: a rapid pace of investment will be an inefficient use of resources. It is now time to manage our affairs so that we achieve a closer proximation to full employment in the context of a low investment economy.[7]**

According to Minsky, any artificial, induced infusion of investment capital into an industry would only endanger the financial balance of that sector by invalidating part of the capital already fixed there. For instance, more capital into housing construction would eliminate marginal housing from use and thereby drastically depress its value.

Henry C. Wallich, as may be recalled, bases his plea for induced investment on a projection of capital "needs." He relies on a number of recent studies on investment requirements and saving, notably the influential Brookings study by Bosworth, Duesenberry and Carron, published in 1975. This study "projects" gross private domestic capital formation for 1980 at 15.8 percent of GNP, about the same as the average for the 1950's.[8] The projections are made under the assumption of an economy "having returned to a full employment growth path" of 4 percent unemployment. At the time of this writing (Spring 1976) the figures as well as the assumptions on which they are based must be considered obsolete. Unemployment, seasonally adjusted, hovers between 7 and 8 percent. Let us have a closer look at the figures for energy in the Brookings study. Energy consumption is projected to grow at 4.2 percent a year—in line with historical trends and potential GNP growth. Capital investment by electric utilities is projected to rise *in real terms* at a rate of 8 percent for the remainder of this decade. The investigators failed to notice that the electric utility industry has drastically cut back its expansion plans.[9] These cutbacks have been motivated by both downward adjustments of prospective growth rates of output under conditions of industrial and household conservation, burgeoning costs of capacity expansion, and by difficulties in attracting capital, given the precarious profit position of utilities.[10]

The most recent estimates by the Edison Institute list an annual growth rate in construction expenditures of about 4 percent in real terms rather than the 8 percent projected by the Brookings study.[11]

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[7] *Challenge*, July/August, 1975, p. 13.

[8] Barry Bosworth, James S. Duesenberry, and Andrew S. Carron, *Capital Needs in the 70's*, The Brookings Institution, Washington, D.C., 1975, p. 3.

[9] Already in February 1975, cutbacks amounted to 214,000 megawatts, of which 133,000 are nuclear, most of which are due to be completed in 1980 or later. To put this in perspective, private utilities now have a total generating capacity of some 375,000 megawatts, of which about 30,000 are nuclear.
Source: *Electrical Week*, February 17, 1975.

[10] The problem has not been one of finding adequate capital sources. "It is a question of getting adequate earnings to attract capital." (An investment banker quoted in Murray L. Weidenbaum: "Financing the Electric Utility Industry—A Report prepared for Edison Electric Institute," New York, 1974, p. 92).

[11] Communication by the Edison Institute to the author, January 1976.

The estimates for the energy sector, being by far the largest component of nonresidential investment, are only illustrative for the inadequacy of most of the current "capital needs" calculations in a time of rapid structural change. Underlying the Brookings study, released in 1975, are assumptions derived from a world that has faded away at the latest with the Arab oil embargo of 1973: Low relative prices for primary and secondary energy, low relative costs for capital goods, sizeable economic growth and full employment. Even the recession is assumed away. By ignoring the profound structural changes and readily available data on recent facts, these estimates perpetuate the myth of the capital shortage and inflate the case for a government induced reallocation of resources toward investment in plant and machinery.

Our evaluation of the capital-oriented interventionist strategy this time starts with the last of our three criteria: *utility of output.* Would induced investment conform to people's needs or market demand? This position, by a large margin, fails the market test, crucial for investment in private industry. There is no scarcity of capital investment. A certain sluggishness of the American investment performance is explained by the decline in growth rates of aggregate demand, and is matched by slow growth of investment in other Western economies, e.g., Western Germany and Japan. It is a simple consequence of the declining attractiveness of material-intensive production characteristic of the present stage in industrial development. Any large-scale capital injection into the manufacturing sector would have to be made against the votum of the consumer.

Employment

Much of the additional employment generated by induced investment in plant and equipment in the private sector would benefit skilled unionized workers with relatively high incomes and low rates of structural unemployment. Most or much of it would never trickle down to the structurally unemployed but would go into overtime pay, (increased) rent payments to resource owners, and, given the high extent of regional and occupational segmentation of the labor market, into increased wages for those already employed.[12] The strategy then would have dubious effectiveness in absorbing unemployment.

Efficiency

The productivity growth generated by incremental investment in the manufacturing sector, is likely to be lower than during the golden age of rapid economic growth. There is some evidence that marginal costs of capacity expansion have drastically risen in relation to average costs: The resource frontier (low or declining relative prices for raw materials and energy with which to substitute for labor) is largely closed, and the increasingly comprehensive "internalization of exter-

[12] According to crude calculations by the Congressional Budget Office, $1 billion in additional federal budget outlays annually "buys" about 200,000 public service jobs, 100,000–150,000 jobs through accelerated public works or countercyclical revenue sharing, and 40,000–70,000 jobs through increased government purchases of goods. (Statement of Alice C. Rivlin before the Joint Economic Committee, March 19, 1976.)

nalities," as well as environmental resistance and regulations, affect newly built plants much more than older existing plants.[13]

In a more fundamental vein, it is not implausible to think that innovation goes together with investment. Yet the almost exclusive emphasis on investment in physical capital is misleading. In a modern technological economy, innovation more than anything else requires human capital—expertise, training, schooling, research. For instance, the spectacular progress of medical knowledge and quality of treatment, unreflected in the productivity statistics, has been brought about to a larger extent by human capital and only to a small extent by physical capital. Given the complex and sensitive processes that make up research and development, invention and innovation, there is little reason to expect a strong boost in productive efficiency from a wholesale redirection of national resources to investment in private manufacturing. This is true particularly if the opportunity costs in terms of alternative uses of the respective funds are being considered.

The Case for Induced Employment

The preceding discussion suggests that mastery over the physical environment no longer is the frontier that readily provides economic growth and absorbs the employable labor force. After the accumulation of hardware ceases to be an effective guiding principle, what else is there to move toward? Or must we do without growth altogether?

Our vision includes the possibility of continuous growth in what is customarily measured as GNP. Whether or not we will succeed in maintaining growth depends only partly on our technological ingenuity in meeting the challenge from an increasingly recalcitrant physical environment. It largely depends on our ability to identify idle resources that can be used to produce output that conforms to people's evolving tastes and aspirations in a similar way as the combination of technical progress, ready availability of natural resources and "thing-mindedness" of the increasingly nouveau-riche consumer led to the mass consumption society of the past quarter-century. We must bring together new frontiers of production with new frontiers of consumption.

At present, two kinds of underutilized resources meet the eye: plant and equipment, as measured by idle capacities, and people, as measured by unemployment. The overcapacity in physical capital will be only temporary, given appropriate market responses and considering the depreciation of the existing stock. Things are different with respect to the underutilization of people as most evident in the unemployment statistics. Actually, unemployment is only the tip of the iceberg. Less visible are the detrimental effects of an underutilization of skills, dearth of alternative job opportunities and career advancement, involuntarily short working hours, job insecurity. It is widely accepted that a large proportion of our underemployment is of a structural rather than cyclical nature. This is indicated by—

The well-known trend of rising unemployment that has superseded cyclical changes.

[13] For instance, the average original cost of all electric generating units in operation at the end of 1974 was about $150 per kilowatt. For plants inaugurated in 1975 it has about doubled to $300 per kilowatt, and for plants going into service later this decade, the industry anticipates $500 per kilowatt. (Speech by Robert F. Gilkeson, Chairman, Edison Electric Institute, before the Security Analysts of San Francisco, Thursday, March 6, 1975.)

The deteriorating market for labor force entrants. For instance, the starting salaries of college graduates between 1969 and 1975 have strongly declined in *real terms*. Higher educated people are forced to accept lower paid jobs otherwise occupied by individuals with lower education. Underemployment tends to trickle down.[14]

A dramatic drop, since 1948, in the labor force participation of nonwhite adult males: from *97.2* percent to 92 percent among 35- to 44-year olds and from 94.7 percent to *86.9* percent among 45- to 54-year olds. Among white males in those age groups the changes were extremely small: from 98 percent to 97 percent and from 95.9 percent to 94.7 percent. Note that nonemployed individuals who are not looking for work do not enter into the calculations of the rate of unemployment.

Americans, as a nation, unlike Western Europeans, have chosen not to reap the fruits of affluence in the form of more leisure and less paid work. Notwithstanding a trend toward early retirement, ever higher proportions of adults are flocking into the labor force, mainly married women. (See Table 1, p. 39.) The quality of the labor force is also increasing, due to rising educational attainment. It is not likely that continuing underemployment will change these revealed preferences for work of high quantity and quality. In sum, underemployed labor is a resource that is lastingly underutilized.

There is little chance for absorbing most of the now idle labor in our economy unless we shift our tastes from buying more goods toward buying more services, more exactly, toward consuming final products that incorporate more labor and less materials. The rule that today's consumption level of the rich will be the mass consumption tomorrow is no longer valid. In 1940, refrigerators, washing machines, automobiles were owned by the wealthy only. Today they are in most households. Yet the second home in Florida, the snowmobile, the private plane, the heated swimming pool, the vacation trip around the world cannot be for everybody: Space and energy constraints intervene. Which political power will be able to find sites for scores of new airports and power stations against the resistance of the adjoining communities? But suppose we should indeed succeed in dividing up most of our land into airports, highways, parking lots, and trash disposal sites, the meteorologists would have to veto a further expansion of energy-intensive long-distance travel and other mass pursuits that massively go beyond present levels of resource utilization.

Growth then depends on our ability to shift our tastes to what we can produce in increasing quantity and quality and to stop clinging stubbornly to the consumption and production patterns which we have learned to adopt in a different era, under different economic

[14] "College placement data show a decline of 23 percent in the real starting pay for men with social science and humanities degrees between 1969 and 1975, a fall of 21 percent in the real pay for beginning BS mathematics majors; and of 17 percent for beginning electrical engineers with doctorates. . . . New college graduates are having severe problems obtaining desirable work. (This analysis views college graduates in aggregate. . . . In engineering, for example, for very special reasons, starting salaries have not fallen since 1968 in real terms.) Over 30 percent of the graduating men and 25 percent of the women in the class of 1972 were holding nonprofessional, nonmanagerial jobs in the early seventies, compared with just over 10 percent of graduates in a roughly similar status in the class of 1958. Between 1969 and 1974, the relative number of male college graduates working as salesmen and the proportion of female graduates employed in clerical positions both increased by 30 percent." (Richard Freeman and J. Herbert Hollomon, The Declining Value of College Going, in *Change*, September 1975, p. 25.)

conditions. Products (goods or services) differ in the extent to which their supply can be expanded, more exactly: in their marginal production costs, or in the price elasticity of supply. For a commodity the supply of which lacks price elasticity entirely, the price serves only as a distribution device: the highest bidder prevails. For the price-elastic commodity, the price also serves an allocation function: Depending on the demand, fewer or more resources will be mobilized to expand production, or more sellers will be stimulated to enter the market. It can be shown easily that consumers are better off collectively if they manage to shift demand from price inelastic commodities. Demand for the former imposes heavier costs on other consumers and often increases the rent of the producer or owner.

Tastes have conventionally been accepted as exogenously given by economists. Yet consumer choices must not only be seen as individual or psychological attributes but rather as characteristics that have been generated by specific cultural and institutional conditions. The peculiar expansion of wants for physical, throughput-intensive products, mainly suburban housing, automobiles, consumer durables, was stimulated by declining relative prices for these goods. It was facilitated by a variety of government interventions and non-interventions such as the Interstate Highway Program and the deductibility of interest payments for home mortgages as well as the failure to legislate the internalization of external and social costs such as environmental damage and resource depletion. Yet it would be erroneous to assume that a reversal of these economic conditions and a mere elimination of explicit or implicit public subsidies to the exploitation of raw materials and the processing and consumption of physical goods would be sufficient to assure smooth and fast adaptation to fundamental changes of the type described above. Tastes and consumption styles are shaped during childhood and early adult socialization. Their modification requires cultural change that tends to unfold only slowly—instance, by way of generational change. It can also result from major disruptions (wars, catastrophies) or be brought about by social engineering which in turn presupposes a change in beliefs by elites and mass publics. It is the latter avenue that appears most promising in our present context.

An ambitious public employment program might qualify as the "pump-primer" for the economy of the next decade quite like induced investment served as an effective stimulus in bygone times. Consumer demand on the market cannot be expected to shift vigorously enough from goods to services to make a real dent in unemployment. Government demand, subject to the constraints of public approval, can take the initiative to introduce services for the people that may become popular only after rendered. One example for such an initiative is the Social Security Program, or the establishment of state universities and community colleges. Here is a unique chance for a joint engineering of the two necessary changes outlined above: shifting the composition of tastes *and* creating employment.

Conventional employment programs are based on the unrealistic assumption that workers have an unlimited ability and willingness to adjust to any opportunities on the labor market. Yet, the average unemployed or underemployed worker, supported by a more generous

system of income maintenance, is more choosy now. According to Martin S. Feldstein—

> The picture of a hard core of unemployed persons unable to find jobs is an inaccurate description of our economy and a misleading basis for policy. A more accurate description is an active labor market in which almost everyone who is out of work can find his usual type of job in a relatively short time. The problem is not that these jobs are unavailable but that they are unattractive. Much of the unemployment and even more of the lost manpower occurs among individuals who find that the available jobs are neither appealing in themselves nor rewarding as pathways to better jobs in the future.[15]

Unemployment is no longer tantamount to poverty. The unemployed are hardly more likely to fall below the officially stipulated poverty line than the rest of the population.[16] Conversely, employment is not completely effective in guaranteeing a decent level of consumption. The full-time equivalent wages for no less than 19 percent of wage earners 18–60 years of age fail to lift a family of four beyond the poverty level.[17] It is not surprising, then, that even in times of high unemployment, there are numerous job vacancies. Many jobs are badly paid and do not offer much higher wages than the income maintenance foregone. Furthermore, income maintenance permits unemployed workers to hold out for an attractive job opportunity rather than forcing them to accept the first offer. This inflexibility makes it impossible for employers in a depression to hire unemployed workers at lower wages and thereby thwarts both employment and anti-inflationary policies. A similar effect results from the market insensitivity of the "non-entrepreneurial" sector of the economy—government, non-profit institutions, and regulated industry. Robert E. Hall states:

> A drop in demand and a rise in unemployment tend to lower wage offers by the entrepreneurial but do not alter those of the rigid-wage nonentrepreneurial sector, thus widening the wage differential between the two. This widening, in turn, is perceived by the unemployed and encourages them to wait for non-entrepreneurial jobs rather than accept jobs offered by the entrepreneurial sector. At the same time, firms in the entrepreneurial sector are discouraged from offering lower wages than they do for fear of not attracting and keeping the workers they need, even in periods of considerable unemployment.[18]

In this situation, intervention designed to push the many unemployed back into employment, must either (*a*) weaken the income security of the employed, or prevailing levels of income maintenance and individual rights to choose of the unemployed, *or* (*b*) offer jobs that are attractive in terms of pay, location, and utilize available skills of idle workers. The crucial difference is whether workers must go full distance to adjust to demand or would employment programs go toward meeting the worker's needs and preferences? The former strategy, while advocated by some (see e.g., Arthur F. Burns' call for relieving the federal minimum wage laws), is unrealistic as a

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[15] Martin S. Feldstein, "Lowering the Permanent Rate of Unemployment," a study for the use of the Joint Economic Committee of the Congress of the United States, Washington, D.C.: U.S. Government Printing Office, 1973, p. 11.

[16] In 1974, 11 percent of unemployed household heads, and 4 percent of unemployed wives belonged to households receiving incomes below the poverty line stipulated by the U.S. government, as compared to 10 percent of all individuals. Source: Longitudinal Survey of Income Dynamics, Survey Research Center, University of Michigan.

[17] Source: *Ibid.*

[18] Robert E. Hall, The Rigidity of Wages and the Persistence of Unemployment, *Brookings Papers on Economic Activity*, 2, 1975, p. 331.

political option, runs counter to the values of this author, and will not be pursued here.

The program required would have to attract the type of labor that is available, focused on specific skills and locations where unemployment or underemployment exists, and pay wages comparable to those of employed workers with similar skills and performance. Yet workers must only be hired if the services rendered can be sold or fulfill clearly perceived needs. Public support for an employment program that could be considered "leaf-raking" make-work is unthinkable. Moreover, work that does not create a clearly perceptible and appreciated output could hardly be satisfying to those who engage in it. Actually, there is little indication of saturation. Perceived needs for social and community services, entertainment, health care, nonconventional types of education, care for the sick and aged, municipal services such as fire protection, police, sanitation, home services, are immense.

The preceding considerations define the principles on which a massive public employment program would have to be based:

The program would be highly disaggregated; it would offer jobs to labor markets specific in skill and location.

The program would try to produce services that are labor-intensive. It would refrain from capital-intensive production.

Rather than confining itself to offering low paid jobs, it would recruit at all levels. There is no need to avoid attracting some of those employed at present in the private sector as long as the number of jobs there is not reduced. Therefore, the services created ought not to compete with services provided by the private sector.

The program would not be planned as a stopgap measure, it would be there in order to stay and yield valuable continuous services. In effect, it would have to serve two goals of equal importance: full employment and the provision of badly needed services, mostly public services.

It would aim not at the elimination but more realistically, at the drastic reduction of involuntary nonfrictional unemployment. It would most likely fail to employ many marginal workers as well as those who cannot or do not want to be integrated into the production of services that are considered valuable or needed.

It would be highly undogmatic with regard to who runs a particular project: the Federal government, local governments, private organizations, or combinations of these. Creating private sector jobs, or services that are being directly paid for by their recipients is appealing from the viewpoints of both revealed preference and reduced budgetary costs. For instance, there could be government seed money for setting up an organization, attractive to potential workers in terms of social status, that delivers nonpersonalized domestic services such as cleaning or gardening. Or there could be new incentives for hiring certain problem groups of unemployed, such as workers at both ends of the age spectrum, as proposed for the young by Robert Eisner.[19] Yet it must be recognized that, while government services can be enlarged without competing with private services, it is more diffi-

[19] Robert Eisner, A Way to Create Jobs: Cut Payroll Taxes, *New York Times*, August 17, 1975.

cult to create jobs in the private sector and avoid the elimination of existing jobs.

Coming back to the last two of the three criteria used to evaluate the investment-oriented strategy, we must deal with the impacts of a large-scale employment program on *utility of output* and on *efficiency*. Both are controversial since the bulk of the resource allocation under this program would have to take place outside of the market, through the institutionally mediated mechanism of political choice, devoid of the strict direct sanctions often associated with the market test.

Utility

One basic tenet of neoclassical economics is the notion of consumer sovereignty. According to the model the consumer can choose between consumption and saving, between goods and services. Would not a program as outlined tamper with preferences as "revealed" through the market? "Consumer sovereignty" stands for freedom of choice. Choice depends on opportunity, which must be established or maintained on the labor market as well as on the commodity market. There is little inherent reason why the opportunity of the worker to sell his labor under conditions similar to the next fellow (who has a job) should command less authority than the right of the consumer to get fair treatment on the commodity markets. To the extent the two principles conflict, a compromise must be found. Mass unemployment is a solution that one-sidedly accommodates consumer choice at the expense of workers' opportunity. Moreover, while upholding consumer choice it sacrifices GNP size. We may be better off accepting a slightly different product mix in return for a larger national product and more and better work.

To be sure, in a democracy which largely relies on market allocation, consumer preferences or tastes, once and as long as they exist, should be accommodated, if possible. Yet it must be recognized that tastes are not immutable. They are the product of the cultural and economic environment, the latter heavily shaped by government intervention. At times, tastes change as soon as people try out alternatives. Tastes can be, and continuously are, simultaneously respected *and* influenced. For instance, tobacco and alcohol are available on the market place even while their consumption is being discouraged through taxation and public information campaigns. The experimental provision of certain public services may open up a new "market," a process well-known from industrial marketing campaigns. The charge was first made by John Kenneth Galbraith that the practices of industrial marketing, having no counterpart in the realm of government services, has resulted in the biased composition of demand in favor of the private at the expense of the government sector. Fulfillment of needs for public services suffers from another handicap: The nonidentity of taxpayer and beneficiary. For instance, the existence of thousands of reluctantly fired but urgently needed municipal employees reveals the public preference for the services of a number of the present-day unemployed. The fact that these needs are not translated into effective demand has to do with the peculiar fragmentation of government services across municipalities and states in the United States. Federally supported public employment would be a move toward the goal, widely

considered legitimate, of equal provision of government services to all people regardless of their location and economic status.

As to allocative *efficiency*, are we not advocating a misallocation of resources, diverted from those sectors with higher efficiency to those with lower efficiency, thus thwarting economic growth?

First, a generous publicly supported employment program, rather than reallocating resources from one use to another, would focus on utilizing unused resources. Underemployment is the pinnacle of misallocation. Second, there are highly innovative labor-intensive lines of production within the manufacturing sector that would be able to profit from strategies favoring the use of labor. For instance, information technology, communications, computers, and control based on solid state electronics. These technologies are not material or energy intensive. Their breathtaking progress can be attributed to human rather than physical capital.

Yet the program as outlined here would have to face the issue of alleged or actual low efficiency of government operations. Given the experience of the war economy, the space program, and the social security administration, as well as the increasing supply of well-trained managerial talent, there is little a priori reason to negate the possibility of efficiently run public or publicly financed enterprises. The preceding examples, not accidentally, name programs that have well-defined and often measurable criteria for success. There are more severe organizational, managerial and political obstacles in the way of efficiently running decentralized services, particularly personal services. It would be hazardous in our context to chart any specific strategies toward improving the efficiency of these services, given the dimensions of the problem and the dearth of applicable knowledge in this area. Yet it seems inappropriate to assume the existing state of affairs as unchangeable. The very backwardness of part of the service sector makes possible substantial economies through the application of advanced technologies and economies of scale. In addition, the continuously tight budget situation of the public economy creates built-in political pressure for higher productivity and "accountability."

The most general point to be made in defense of a favorable allocative effect of an employment program as outlined has to do with "externalities"—costs and benefits accruing to others than the participants in a market transaction, be it third persons of society as a whole. To the extent a buyer of throughput-intensive goods places demands on commodities in rigidly limited supply, he bids up the price and hurts other (potential) buyers; he also contributes to inflation. For instance, it has correctly been observed that the rising meat consumption of industrial nations leads to rising world market prices for grain and places a heavy burden on countries dependent on food imports. Conversely, final demand incorporating added amounts of underemployed labor relieves the community of the burden of income maintenance, not to mention less easily quantifiable individual and social benefits of reduced unemployment such as preventing the obsolescence of skills, loss of self-esteem, and alienation. Even after the conventionally recognized externalities (pollution, noise) have been fully "internalized" in the price of the product, there remains a strong rationale for intervention designed to favor the utilization of (un-

employed) labor over those materials to which the above assumptions apply.

While the number of those who believe there is a trade-off between inflation and unemployment is rapidly diminishing, there are still many who hold that a massive public employment program would be inflationary. In the implicit model issued here, the additional net income earned in excess of transfer payments by the formerly unemployed, would indeed increase aggregate demand. Inasmuch as this demand will be directed toward full-employed markets or industries, demand-pull inflation can only be avoided by reducing aggregate purchasing power, possibly through increased taxation.

Increased rates of taxation must be seen in the perspective of the additional availability of government services provided free of charge outside of the market; and the moderate difference between unemployment/welfare benefits and net incomes of those rehired.

The presented alternative vision of the American economy and economic policy cannot be complete without assessing the potential public acceptance of more ambitious government strategies toward full employment. Can a policy be popular that defies what are considered by many the technological imperatives of an economy that bases its expansion on materials? It is neither within the purpose nor the possibilities of this paper to predict the popular support of concrete pieces of legislation. Yet survey data collected over several years on economic expectations and orientations toward government intervention indicate that along with disenchantment with government policies, even grave fears with regard to all matters economic, there is growing ferment favoring a reorientation from a laissez-faire to an activist government stance. Let us briefly review these data.

INDEX OF CONSUMER SENTIMENT

February 1966 = 100

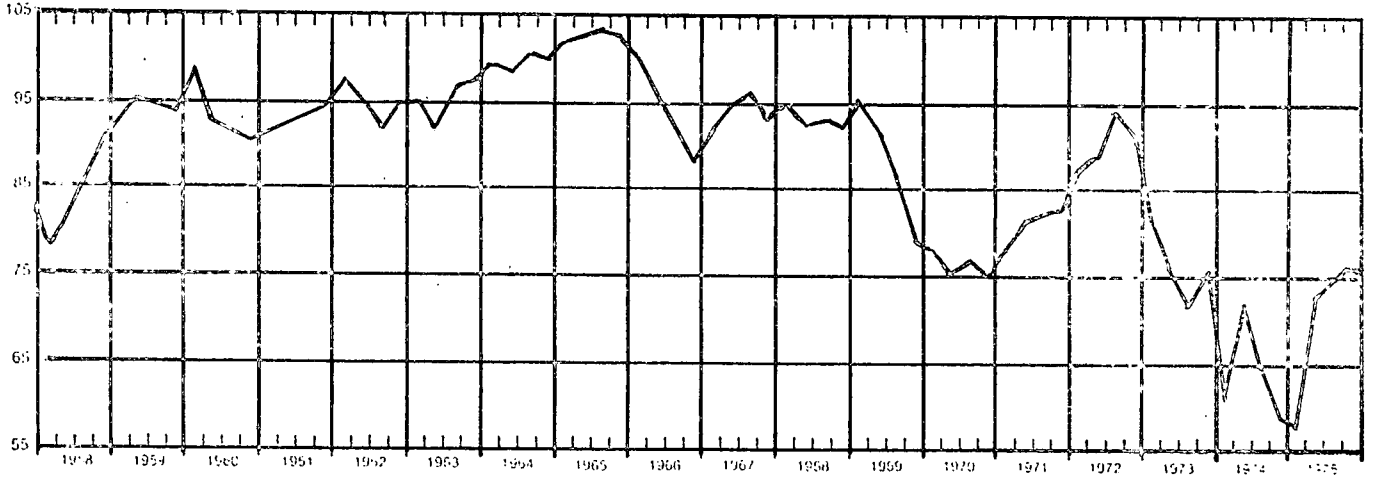

CHART 1

The index is based on answers to the following five questions:

1. "We are interested in how people are getting along financially these days. Would you say that you and your family are better off or worse off financially than you were a year ago?"

2. "Now looking ahead—do you think that a year from now you people will be better off financially, or worse off, or just about the same as now?"

3. "Now turning to business conditions in the country as a whole—do you think that during the next twelve months we'll have good times financially, or bad times, or what?"

4. "Looking ahead, which would you say is more likely—that in the country as a whole we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?"

5. "About the big things people buy for their homes—such as furniture, house furnishings, refrigerator, stove, television, and things like that. For people in general, do you think now is a good time to buy major household items?"

To construct the Index, a relative score is calculated for each question, separately, by taking the percentage giving favorable or optimistic answers, subtracting the percentage giving unfavorable answers, and adding 100. (It will be noted that this procedure is equivalent to assigning a value of 2 to favorable responses, of 1 to "same" or "don't know" responses, and of 0 to unfavorable answers.) An average is then taken over the five relative scores, and the result is adjusted to the base (February 1966=100).

TABLE 3

ASSESSMENT OF GOVERNMENT ECONOMIC POLICIES, AND LONG-TERM CRISIS EXPECTATIONS

	Annual percent averages of unfavorable orientations	
	Government is doing a poor job	Will have periods of widespread unemployment
Year:		
1969	(1)	30
1970	(1)	44
1971	24	37
1972	21	37
1973	37	48
1974	43	57
1975	39	55

[1] Not ascertained.

The wording of the questions:

"As to the economic policy of the government—I mean steps taken in regard to inflation and unemployment—would you say the government is doing a good job, only fair, or a poor job?"

"Looking ahead, which would you say is more likely—that in the country as a whole we'll have continuous good times during the next 5 years or so, or that we will have periods of widespread unemployment or depression, or what?"

(Source: Survey Research Center, The University of Michigan, Surveys of Consumer Attitudes.)

Percentages are based on the answers of 3000 to 6000 randomly selected adult respondents representing the United States population.

TABLE 4

Powerlessness and preferences for Government intervention

Question: "There are differences in opinion about how much control a person has today over what happens to him during his lifetime. This card lists some of the more common problems and needs that people may have one time or another.

"For *each* one, tell me whether you as an individual, feel you have a great deal of control over what happens, some control, or very little control.

"Now let's go through the list once again. This time, for *each* problem or need, tell me which you yourself feel the government should *do more* about than it now does, which you think the government *should not get involved in* at all, and which you think the government is now *doing just about enough.*"

	Percent feeling a great deal of individual control			Percent feeling government should do more		
	1968	1973	1975	1968	1973	1975
Improving the availability and quality of medical care	17	10	13	49	62	65
Providing for your children's college education	63	52	51	35	30	43
Accumulating funds for your retirement	58	44	46	52	64	71
Improving the neighborhood you live in	38	23	22	28	42	36
Buying your own home	69	NA	52	20	NA	21
Getting a better paying job	44	37	34	54	64	72

Note: Sample—The data are based on nationwide attitude surveys of people aged 18 and over, conducted in 1968, 1973, and 1975, sponsored by the Institute of Life Insurance. Sample size was 3,023 in 1968, 2,007 in 1973, and 1,404 in 1975. The area probability sampling method was used in all 3 surveys.

Source: Demands on Institutions and Perceived Personal Control. A Working Draft for Conference Discussion presented at the Institute of Life Insurance Family Economic Behavior Conference, January 1976; Mathew Greenwald and Harris T. Schrank. In 1968 and 1973 the data were collected by Daniel Yankelovich, Inc., and in 1975 by Research 100.

Chart I presents the changes over more than 15 years in the Index of Consumer Sentiment, developed by George Katona. This indicator

covers the evaluation of the personal economic situation as well as of the economy as a whole. Its changes are dominated by short-term expectations about the future, and therefore it can be viewed as a proxy for the confidence/uncertainty dimension. Table 3 deals with long-term expectations for the economy and satisfaction with government economic policies. The first three columns of Table 4 follow up the sense of individual control or powerlessness in a number of economic and welfare concerns between 1968 and 1975.

One conclusion emerges clearly: In the United States, several years of slow or negative economic growth have brought a severe decline in the sense of well-being, fate control, optimism, and approval of government economic policies. The situation in 1973/75 differed from earlier recessions by the depth of the decline in sentiment. In the past, the public had considered deterioration a temporary cyclical phenomenon. Expectations about the future of the economy and society had not been affected strongly. This time, a sense of gloom is prevalent. For instance, between 1946 and 1970 an economic crisis during the next 5 years was never anticipated by more than 28 percent of the respondents. This time, crisis expectations soared up to 57 percent. Even the sense of individual fate control has decreased. Society and/or anonymous forces are now seen as more powerful than before, as wielding increasing influence over the individual's situation, as shown in Table 4.

These same data suggest that, contrary to journalistic impressions disseminated by some mass media, malaise and declining trust in government are not being translated into apathy or preferences for "small government." Rather, the demands for government involvement or government spending (Table 4) have increased. We know from other evidence [20] that these demands by and large are accompanied by an expression of personal willingness to pay more taxes for purposes that people approve of. Four areas of public wants stand out: (1) Reduced inflation, (2) income maintenance, (3) education, health care, and community services, and (4) employment. The first two areas are traditional and undisputed preoccupations of government. The latter two complement each other in supporting the case for a combined employment/public service program.

In sum, an increasing proportion of Americans is longing for a credible commitment by government to deal actively and effectively with trouble spots, be they unemployment, health care, or municipal services. Refusing to act on ideological grounds, or waiting for the "self-healing forces" of the economy while dispensing explicit or implicit subsidies to private business, would undoubtedly reinforce the still prevailing mood of pessimism, even cynicism. The majority of Americans are aware that there are urgent needs for both additional employment and public services. They could be convinced that the government should take the initiative in servicing these needs and finance those programs provided this is done efficiently, the needs for services are convincingly revealed through market or other mechanisms, and very many people demonstrably profit from the services.

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[20] George Katona, Psychological Economics, New York; Elsevier 1975, Chapter 22; and Richard T. Curtin and Charles D. Cowan, Public Attitudes Towards Fiscal Programs, in: Burkhard Strumpel and others, Surveys of Consumers 1972–73: Contributions to Behavioral Economics, Ann Arbor: Institute for Social Research, 1975, p. 69.

These popular preferences are easy to understand if we remind ourselves that our society is able and willing to provide a minimum of needs satisfaction to any individual regardless of his productive contribution. In the past decades, welfare policies have been defined primarily in terms of safeguarding minimum levels of education, health, and consumption. They were concerned with correcting the distribution of outcomes. As I have argued above, these policies have prevented any catastrophic effect of high unemployment on consumption. Rising unemployment has, however, created and reinforced grave inequalities of opportunities: labor force entrants, unemployed, recent college graduates, women who plan to reenter the labor force, younger people in the middle of their career development have to bear the brunt of the costs through sharply reduced wages offered and unfavorable career and employment opportunities. In contrast, most workers who have held jobs for a long period, find their status maintained. Prevailing informal job arrangements usually safeguard the status quo and immunize them against the market. This makes it inevitable, however, that the market hits with full force those hardest who most want to change their arrangements. This is in contrast to the strong expansion of the postwar years that has provided oportunities to almost everyone and career advancement to many. There is now a generation gap in opportunities as indicated for instance in the dramatic decline of salaries of recent college graduates. The latter tend to take the jobs that could have been filled by high school graduates: Underemployment trickles down. This strangulation of opportunities must weigh heavily on Americans who, unlike Europeans, are entering the labor force in growing proportions, in spite of adverse market conditions. It is then for considerations related to both economic growth and distributional justice that reestablishing a reasonable level of job opportunities and career chances rather than induced investment deserves highest priority on the agenda of structural economic reform.

CAPITAL REQUIREMENTS FOR ECONOMIC GROWTH

By MASON GAFFNEY*

SUMMARY

This study begins with a postulate that there is unemployed and underemployed labor. "Growth" is a desirable goal because there are people seeking more and better work. There is no question that we have an untapped labor potential. There is a question about whether the supplies of capital and natural resources are adequate. The thrust of the study is that we solve this problem by lowering the capital and resource coefficients per worker and consumer. There are six basic points in the argument.

1. The resource and capital coefficients of labor are not fixed. They vary in response to relative costs.

2. Relative costs are much affected by institutional bias. They are the products of public policy as well as the market, and may be changed by changing public policy.

3. It is clear what it means to use less resources per worker: fewer acres, less energy, water, timber, sand and gravel, iron ore, and so on. But there is an uncertainty about the meaning of using less capital per man. This is because labor helps produce capital, which is stored-up labor. To resolve the uncertainty we view the production process as vertically integrated, and the relationship of capital to the labor that produces it, rather than just the labor it complements or displaces "in parallel" (as opposed to "in series").

Capital finances payroll. The share of capital in the final service flow of the product varies with the time financing continues, i.e., how long capital is tied up before being recovered. The way, therefore, to use less capital per worker is to produce things that pay out faster. Then capital is tied up a shorter time with each dose of labor, and returns to finance another payroll. "Pay out", in the overall economy, means of course delivery to consumers, not to other capitalists who must also finance the unfinished or intermediate product. Faster social payout results from moving labor downstream nearer to final consumers, shortening the steps between hand and mouth. Using field labor in lieu of more farm machines, for example, does more than replace factory workers with field workers: it obviates financing the machines and releases capital for other uses.

Once the basic idea is clear, there are many dimensions to speeding payout, and no end of examples. Shifting consumer demand toward labor-intensive products is a dimension. Another is shifting input mixes away from capital-hungry materials like heavy lumber from big logs needing 100 years to mature. Another dimension is substitut-

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ing operation, repair and maintenance outlays for initial cost of buildings and machines.

All that leads to the insight that the capital requirement of growth is not a fund of capital, but a flow of gross investment derived from the fund. The nation's capital is a Great Revolving Fund. It finances production and payroll each time it revolves or turns over. The flow of gross investment is the fund multiplied by its turnover. The fund grows only slowly by net capital formation. Turnover, however, is variable quickly and over a wide range, amply wide enough to adjust to soak up the unemployed. Here is the point of leverage for public policy.

The microeconomic substitution of labor for capital is also a macroeconomic process, creating investment flows to soak up idle labor.

4. Orthodox macro-economics stresses a need for investment outlets to keep the wheels turning. This premise, if true, would argue against any reduction of capital needs. The study demonstrates that gross investment consisting largely of *re*investment creates payrolls, and increasing reinvestment is the key to sustaining needed gross investment flows. Orthodox macro-economics is criticized for overemphasizing money flows and neglecting real flows of goods and services.

5. Inflation need not accompany high employment, either as cause or effect. A high flow of reinvestment corresponds to an equally high matching flow of ripe goods delivered to consumers.

6. There is a misplaced presumption that high capital turnover implies increased materials flows, residuals generation, and waste. High turnover of capital *value* is different from flow of concrete material. Moving labor downstream entails reduced materials flows. This issue is a red herring that should not divert us.

The study indicates where may be found the institutional biases that want correcting, and goes into some detail on tax policy, which currently tends to encourage the substitution of capital and land for labor. To remove the bias calls essentially for reducing taxes on payrolls, and increasing the tax costs of holding land and capital. It also calls for removing the capital-intensive bias from federal spending programs, and regulatory policies.

This paper addresses the problem of how much capital is needed to assure full employment for the present and future labor forces. The coefficients of capital, materials and land used per worker and per consumer have risen in our times to very high levels. Are these high coefficients necessary? If so, future growth and employment depend on uncommonly high future capital formation, and appalling future drafts on nature. These assumptions, indeed, are commonly made and are implicit in most policy debates today. If not, let us learn how to lower the coefficients so the supplies of capital and materials will go around to match the number of workers, and employ the unemployed. Then jobs and GNP can grow without necessarily using more land, and without being limited by the growth of capital.

With labor suffering from high unemployment rates, and capital and land being dearly priced and in too short supply for full employment, the needed adjustment is evident: lower the use of land

and capital per person. But is that possible? There are several alleged obstacles which I will list, and then treat in turn:

1. The obstacle that capital and land coefficients are fixed or predestined to grow for technological and efficiency reasons.
2. The obstacle that labor is overpriced by unions and politics.
3. The obstacle that labor produces capital.
4. The obstacle that more investment outlets are required to prime the flow of spending.
5. The obstacle of inflation associated with high employment.
6. The obstacle of a resource ceiling on throughput.

1. The Obstacle That Capital and Land Coefficients Are Fixed, or Predestined To Grow, for Technological and Efficiency Reasons

The possibilities for reducing resource coefficients of work and consumption are far greater than most people have any idea. We know that change is possible, for change is what got us here from there and what man hath wrought, man can unwork. But we need not go backward. We only need look to realize that the man/land ratio varies over a wide range all around us today.

Here, for example, are some data on farm land use on the east side of the San Joaquin Valley, California. The data refer to neighboring lands, generally of comparable quality and in the same markets. The differences therefore display that factor mix is sensitive to shadings of input prices so slight that they are not equalized by the market—differences internal to families and firms such as result from credit ratings, tax positions, political connections and other institutional biases. For example, an immigrant with many children goes heavier on labor, a speculator with friends in the banks and the Capitol favors lands, with a doctor with income to shelter might invest heavily in depreciable capital.

In the San Joaquin Valley, east side, land is versatile among many competing uses. These range from dryland grazing up to citrus, fresh tomatoes, and berries. Dryland grazing might gross $15 per acre per year; berries might gross $1,500 a year, 100 times as much. The specific prices are subject to secular and cyclical and inflationary change, but the basic principle is not: the same land yields a little or a lot, depending on what you do with it. Table 1 is a crop report gathered by the United States Bureau of Reclamation from its Friant-Kern Canal Service Area. Not all the land is versatile among all the options, but a close study of the area has shown that the margins between the uses are ragged.[1] Almost every area has several options, and many of them are choices between the highest and the lowest gross. To get high yields, of course, requires more labor per acre.

Labor's share of gross rises with intensity, defined here simply as nonland inputs ÷ output. For grazing, this is on the order of $6/$15=40 percent. Grazing is land-intensive. For berries it is more like $1,400/$1,500=93 percent. Berries are labor-intensive. (Grazing

[1] Mason Gaffney, "Diseconomies Inherent in Western Water Laws", in Economic Analysis of Multiple Use, Proceedings of Western Agricultural Economics Research Council, Range and Water Section, 1961, pp. 55–82, 77ff. See also Irvin H. Althouse, "Water Requirements of Tulare County," Report to Tulare County Board of Supervisors, January, 1942, (mimeo) map in back pocket.

and other unirrigated uses are not shown in Table 1, which shows the high variation of yields on irrigated land only.)

TABLE 1.—CROP PRODUCTION, FRIANT-KERN CANAL SERVICE

Crop	Acres	Value per acre
Barley	15,686	$51.09
Corn	10,490	96.68
Rice	907	167.66
Sorghums	17,279	74.77
Wheat	3,176	87.85
Alfalfa hay	63,460	144.11
Irrigated pasture	17,388	77.66
Beans, dry and edible	4,293	107.14
Cotton, lint (Upland)	108,928	352.80
Asparagus	1,383	418.70
Beans (processing)	27	900.00
Beans (fresh market)	75	975.33
Corn, sweet (fresh market)	254	205.91
Lettuce	423	336.51
Cantaloupes, etc	507	547.02
Onions, dry	686	495.70
Potatoes, early	12,711	366.04
Tomatoes (fresh market)	1,343	881.16
Alfalfa	1,279	151.79
Berries (all kinds)	80	1,215.60
Oranges and tangerines	24,952	915.51
Grapes, table	43,795	545.24
Olives	7,172	327.45
Peaches	6,371	644.38
Prunes and plums	3,288	674.00
Walnuts	1,374	338.14

Source: Sacramento Office, U.S. Bureau of Reclamation, 1958. Minor crops omitted. Data refer to irrigated land only.

Of course the return to land crops like berries or tomatoes is highly leveraged and volatile, as a shortrun gamble, but that is not our concern here. Averaging out the good years and the bad, the return to land from truck crops is very sensitive to wage rates and other costs of hiring like payroll taxes. A slight rise of 7 percent nearly wipes out the rent; a drop of 7 percent nearly doubles it. But the same wage changes would change the returns to land from grazing very little. Thus a slight drop of labor costs applies great pressure to shift land to berries and tomatoes and other high-yield, labor-intensive crops, making a very elastic demand for labor.

The scope for this kind of change is manifest in the fact that most of California's prodigious farm output comes from a fraction of her good farm land, that which is used intensively. For example, of the several million acres of irrigable land in California very little is used intensively: there are only about 21,000 acres in plums, 36,000 in freestones, and 65,000 in navel oranges.[2] Most California farm land is used at lower intensities, using little labor to yield barley, alfalfa, forage pasture, hay, sorghum, safflower, rice or cotton.

In irrigated farming water is an indirect land input, since a water right is the right to the water yield of a vast watershed. One might then think the truck crops really use a lot of land in the form of irrigation water. But in fact the high-grossing crops such as tomatoes, citrus, peaches and berries are modest users of water. Pasture, alfalfa, and rice are the heavy drinkers, and they yield only $50–$200 per acre, not one-tenth of the high yielders.

[2] G. W. Dean and Chester O. McCorkle, Trends for Major California Fruit Crops, California A.E.S., Extension Service Circular 488, 1960. The source has extensive data on other crop averages.

The high-grossing crops use more labor per acre not just in the fields, but in the packing houses, the railroads, the stores and the kitchens. A $1,500 berry crop will use more labor at every step to the consumer than a $15 weight gain on a calf, do it sooner, and much more often. Thus a higher use of labor in the field, raising yields, increases demand for labor beyond the field.[3] Reciprocally, lower costs between consumer and farmer, raising field prices by say 7 percent, would (in our example) double land returns from berries and increase demand for labor on the farm.

For another and briefer example in Iowa, a more uniform state, Shrader and Landgren have calculated that if all farmers followed the standards already practiced by the most advanced farmers, Iowa alone could supply the nation's output of feed grain.[4]

Turning to other industries (sectors), we find even greater dispersion of resource coefficients. Table 2 shows value added per kilowatt-hour (or equivalent energy) in various industries. The numbers speak for themselves.

TABLE 2.—*The production multiplier of energy measured by dollars of value-added per kilowatt-hour (VA/KWH)*[1 2] *for selected industrial groups*

Cookies and crackers	.91
Book printing	.50
Millwork plants	.36
Wood furniture	.28
Fluid milk	.13
Frozen fruits, vegetables	.12
Yarn mills	.12
Sawmills	.083
Wool weaving mills	.048
Aluminum rolling and drawing	.048
Blast furnaces and steel mills	.033
Primary copper	.020
Paving mixtures	.018
Paper mills	.016
Pulp mills	.015
Petroleum refining	.012
Beet sugar	.010
Brick	.008
Primary aluminum	.007
Cement, hydraulic	.006
Lime	.004

[1] KWH equivalents are used where relevant.
[2] U.S. Census of Manufacturers, 1967, (cited in letter from Dr. John Wilson to Dwayne Chapman, Jan. 16, 1974). Invented by writer.

It only requires a little imagination to see what these facts imply about possible factor substitution. We can change the consumption mix, using less of the resource and capital-intensive things, and modifying all products. In addition we can modify the processes we use to produce any given thing. Among other evidence, years of research at Resources for the Future, Inc., has demonstrated the high elasticity of factor substitution when the process and the product are both treated as

[3] Field labor may also be used to substitute for offsite labor, as when field labor reduces needs for buying machinery or pesticides, herbicides, chemical fertilizers, water, etc., with constant yields. The point here is that higher yields are the raw material for further labor in packing, sorting, storing, moving, distributing, exchanging, retailing, preparing, serving, and disposing of residuals.
[4] William Shrader and N. Landgren, "Land Use Implications of Agricultural Production Potential," in L. Fischer, ed., Shifts in Land Use. Nebraska Agricultural Economics Service 1964.

variables.[5] But most of us need only review our own consumption history to have all the evidence we need of how we can and do modify resource demands in response to relative input costs and to income and wealth. Some housing is land-intensive—Beverly Hills makes a good example. Some is capital-intensive, like a new high-rise. Most old housing becomes labor-intensive as costs of operation and upkeep rise to eat up most of the cash flow or service flow. So even in the production of something as universal and basic as shelter there are no fixed resource coefficients but a wide range of choices.

Another important variable is size of firm. E. F. Schumacher has struck a responsive chord with "Small is Beautiful." Schumacher's theme is that smaller firms are more labor-intensive. Although size is only one factor involved, the data bear him out. The use of labor per unit of property tends to decline with increasing size of firm. For example, the U.S. Census of Agriculture ranks farms by gross sales. "Class I" farms, those grossing $25,000 or more per year, had 22 percent of the land in farms but only 7 percent of the labor in 1950. The application of labor to property on this pattern may be styled "regressive," a term I will use.

Turning to "industrial" corporations, the regressive use of labor on property may be inferred from data in Fortune magazine's yearly report on the largest 500. I tested the thesis by ranking them by "net worth."

TABLE 3.—PROFITS PER EMPLOYEE, LARGE AND SMALL INDUSTRIAL FIRMS, RANKED BY NET WORTH [1]

Group	Net worth [2] (millions)	Profit after taxes (millions)	Employees (thousands)	Profits per employee
Top 10	$40,090	$5,470	1,662	$3,291
All 500	133,660	14,839	9,966	1,489
Lowest 10	116	8.826	29.687	297

[1] See appendix.
[2] Capital stock, surplus, and retained earnings. "Fortune" uses net worth and invested capital interchangeably. Their data on gross worth are labelled "assets".

Source: Calculated from data in "The Fortune Directory", (New York: August 1964).

Turning to "industrial" corporations, the regressive use of labor on property may be inferred from data in Fortune magazine's yearly report on the largest 500. I tested the thesis by ranking them by "net worth," and calculating profits (after taxes) per employee. Table 3 shows the broad results. The choice of profits/employee to test the case is premised on the proposition that profits in general are the realized earnings of and some index of the owned assets of a firm. In fact, if the larger firms use their property less intensively (as this and other evidence suggest) then their realized profits as an index understate the assets of larger firms compared to smaller ones.

It seems likely from this that smaller business characteristically combines property with more labor than big business, whether by its choice of products or processes (and in fact both). As we modify consumption mixes and products and processes we can also modify firm sizes. For increasing labor-intensity, small is beautiful indeed.

[5] Allen V. Kneese and Blair Bower, *Managing Water Quality* (Baltimore: The Johns Hopkins Press, 1968); Allen V. Kneese, Robert U. Ayres, and Ralph C. D'Arge, *Economics and the Environment* (Baltimore: The Johns Hopkins Press, 1970).

But how about productivity and efficiency? Is not maximum output per worker the goal of economic organization and the index of success? No, it is not. Many economists have for decades now seriously misled themselves and others by speaking loosely of "productivity" as output per worker, even though their own elementary theory textbooks taught better. Defining efficiency as output per worker is a perverse concept with a built-in bias against employment. Only recently with new studies of energy-efficiency and more sophisticated ones of "total factor productivity" is most economic discourse (in my observation) beginning to escape this single-minded preoccupation with economizing on labor.[6]

Substituting capital and land excessively for labor raises "efficiency" only by wasting capital and land and unemployed labor, and only seems efficient in unrealistic models where land and capital are underpriced and unemployment is ignored. High labor-efficiency then means low land-efficiency and low capital-efficiency, either directly or at one remove in the form of low energy-efficiency, low water-efficiency, low feed-grain efficiency, etc. Capital is not free—saving is a sacrifice, too. Land is not free to a nation—past and present military outlays attest to that. And unemployment is not to be confused with voluntary leisure. The time and talent of the unhappy idle is wasted and worse, used to make trouble for others.

Misled by the goal of labor "productivity" we have exalted high output per man employed as a symbol and measure of economic performance, and accepted an extreme substitution of capital and resources for labor. The well-known displacement of farm labor is not an exception, but more like the rule. John Kendrick calculated that the ratio of capital to labor for a large group of industries in the United States rose at an average annual rate of 1.3 percent from 1899–1953.[7] That means a 100 percent increase over that 54-year period. More recently, the United States Department of Commerce studied nonfinancial corporations, 1948–1971. It found capital inputs growing at 4 percent yearly compounded and labor at 1.2 percent.[8] That means there was 2.5 times as much capital in 1971, with 1.3 times as much labor, or 1.9 times as much capital per worker in 1971. Thus the rate of substitution seems to be increasing.

And that's not really the half of it. These studies omitted the public sector, the infrastructure into which we have poured so much public treasure at low interest rates. They omitted housing, which soaks up so much capital per job created. They omitted the recreation boom which requires so much more land and equipment per consumer hour, and per measure of personal joy, than the quiet pleasures of yesteryear. And they omit the swing of consumers toward goods and services like electric power and natural gas whose production is capital-intensive, and whose prices fall relative to labor-intensive products when the capital input is subsidized. Producers as well as consumers use much more of these as inputs. A primary metal like aluminum will

[6] Predictably, the energy crisis produced a crop of energy fundamentalists who would measure all values in energy and economize only on energy. Their work is not worth citing here. There is some sophisticated work by E. R. Berndt and D. O. Wood. "Technology, Prices, and the Derived Demand for Energy," *Rev. of Ecs. and Stat.*, August, 1975. 259–68. See also the Jorgenson-Hudson Report cited in *Business Week*, June 1, 1974, 69–70.

[7] John Kendrick, Productivity Trends in the U.S. (Princeton: Princeton University Press, 1961) pp. 148–149, Table 39.

[8] Cited in "The Push to get More from Men and Machines" Business Week, Sept. 9, 1972, pp. 80–81.

consume 135 kwh per dollar of value-added, compared to 10–20 in a normal manufacturing operation. It is energy-inefficient and thrives only on underpriced energy, thanks to which it is cheap relative to competing materials. For years we have been substituting capital and energy for labor and calling it progress and efficiency, only to find that capital and energy are scarce, and labor surplus. The route of true efficiency obviously is to use less of what is scarce and more of what is surplus.

There is a long, if intermittent, tradition, with mystic overtones, that has super-machines predestined to crowd out people and make labor obsolete. Karl Marx boosted it along. It peaked again in the under-consumptionism of Keynes, and again thirty years after in the beat generation of the sixties. In this scenario an anti-Puritan ethic is called for which downgrades work and apotheosizes consumption and leisure. Robert Theobald, Donald Michael and W. H. Ferry were among the spokesmen. "Cybernation: The Silent Conquest" appealed compellingly to science-fiction buffs. The insidious super-machines have already taken us from within; better relax and enjoy it.

While formal statements of this position have not fared very well, the undercurrents are everywhere and keep breaking through and affecting the thinking of many. It seems to take something shocking like the energy crisis, the capital shortage, or widespread famine to drive this vision away. The science-fiction world of super-cybernation is energy-intensive, capital-intensive, and counter-ecological. Now that these shocks of resource scarcity have occurred it is obvious, yet still worth underscoring, that there is no technological imperative compelling progress always to substitute capital and resources for labor. It depends on relative factor abundance and costs now as it always has and will. Proper care and conservation of the earth and of our treasure of capital will always call for the full measure of human effort.

2. The Obstacle That Labor Is Overpriced by Unions and Politics

The whole problem, in one view, is that unions overprice their labor and minimum wage laws overprice non-union labor. Welfare cheques subsidize the holdout of labor, making unemployment half voluntary. The market solution is a free labor market where wage rates drop to an equilibrium, market-clearing level. This would cause employers to substitute labor for capital and land, soaking up the unemployed.

There is enough truth in that one-sided view of things so we cannot laugh it off. So many economists are constantly making this particular case, however, that I will not supererogate. What is needed is rather to temper and balance. The evils of high, ratcheting wage rates are conventionally overstressed relative to other kinds of institutional bias that block the use of more labor. If we first took out these other biases we could proceed with clean hands against union abuses, girded with more righteousness and armed with more consistency than today. If we could create a strong reliable demand for labor, labor would enjoy needed security without having to submit to the unwelcome restraints and counterproductive rules imposed by many unions.

The tax system adds to the cost of hiring labor relative to the cost of using land and capital. The U.S. social security payroll tax in 1975

raised $73 billion, a sixfold increase since 1960, and 25 percent of all federal receipts. The personal income tax raised $128 billion, or 44 percent of receipts. But the personal income tax has become primarily another payroll tax, thanks to generous loopholes for property income and niggardly ones for wage income. To the large federal exactions we must add substantial sums taken by state income taxes.

These taxes are a big factor, obviously, in overpricing labor. This part of the price is not exacted by labor but by the Treasury. It is hard to study the tax code without inferring that legislators regard giving and receiving work to be some kind of public nuisance, to be penalized and suppressed by all means not inconsistent with the rights of property.

The employee finally gets his take-home pay in cash. To convert cash to real values, however, he is taxed again on retail sales. Many kinds of property income, on the other hand, avoid or defer sales taxes—a good example is the imputed income from residential and recreational property.

When it comes to holding land, the tax system presents a smiling and sympathetic face. The income tax code is geared to share the costs and magnify the rewards. I have treated this matter in an earlier submission to this Committee.[9] The basic preferences for land may be summarized as follows:

1. Covert write-off of undepreciated and appreciated land value (as by allocating part of it to an old building);
2. Exemptions of imputed income of homes and resorts, coupled with deduction of interest and property taxes; exemptions of unrealized appreciation; of gain at death; of bequests; of gain realized by "non-profit" owners;
3. Deferral of tax on gain until realized by sale, coupled with expensing of carrying costs;
4. Capital gains exemption for realized gains, coupled with ordinary offset of holding costs and (some) losses;
5. Possible further deferral of tax beyond date of sale; and
6. Deferral of land-use income where there is intertemporal interdependence of income.

The result of all that is a highly inflated incentive to buy more land than under a neutral tax system, sooner, and to hang onto it longer. This in turn results in spreading people and capital out thin over much more land than otherwise needed. And the last, finally, necessitates pumping billions of dollars of capital into stretched-out roads, pipes, lines, wires, and other linkages that tie the fragile web of society and economy together. Localities attract large capital resources to sink into extensions of low productivity, high risk, and deferred or imagined benefits by mortgaging the tax power to general obligation bonds. State and federal governments pour in additional capital, as by the highway trust fund. None of this public capital is subject to any property tax, and he would be an eccentric public accountant who added a shadow tax to the capital to show its real social cost. Thus the substitution of land for labor converts itself into an inflated demand for roads and utilities, all of which are highly capital-intensive. Net result: substituting land for labor on private land causes substitution of capital for labor as well.

[9] Economic Analysis and the Efficiency of Government, 1970, pp. 405–15.

Turning to the tax treatment of capital, it, too comes off well compared to labor. A major exception to this might seem to be the property tax, but the appearance is deceiving. To begin, half or more of all capital is either exempt or else underassessed and undertaxed. Public capital is exempt. Timber is preferentially underassessed. Most cattle and mobile capital are exempt; many jurisdictions exempt machinery and equipment; and so on.

Buildings bear most of the property tax. This would seem to constitute a bias against use of capital, and it certainly is a bias against improving land. But the effect on the individual building is reversed because the property tax is levied locally and local governments use zoning and other controls to protect and fortify their tax bases. The thrust of local zoning, building codes, subdivision controls, occupancy limits, condemnation power, and "sewer power" is to raise the capital requirements of residing in a town. The net result is doubly bad. We get more sprawl, raising infrastructure capital needs, and more capital per dwelling unit on the land that is used.

Turning to the income tax, it contains many loopholes and abatements for capital, and these generally are geared to favor capital of longer life. (We will be seeing that longer life is identical with greater capital-intensiveness.) I have treated this matter at length elsewhere,[10] and will merely summarize my position here. It is useful to distinguish growing capital like cattle, which yield a lump of value at end of life, from "flowing" capital like machines which yield a flow of cash or service over life.

Flowing capital receives the following preferences:

Fast write-off and expensing of outlays for durable capital;
Double-depreciation of capital when resold, inadequately offset by capital gains treatment of recapture;
Exemption of imputed income of consumer capital;
Expensing of interest and property tax; and
Investment tax credit.

In addition the abatements are biased among forms of capital, favoring the longer-lived. Capital turning over in less than a year is treated harshly. Cost and recovery are reported on the same tax return—there is no interest-free loan from the Treasury, as durable capital enjoys when it gets a fast write-off. There is no gain in straddling the yearends, either, deducting costs in one year and declaring income a year later. The I.R.S. guards against this by ruling that the cost of goods not sold is not deductible at all.

Growing capital is treated even better. The basic preference is deferral of tax to date of sale. Congress couples this with a high propensity to grant the expensing privilege to outlays for growing capital. A farmer for example may expense outlays that actually go into or are part of a final salable product: feed, seed, stud fees, costs of raising livestock, and starting orchards and vinyards. He may not expense machinery and building improvements. In either case he writes off interest and any property taxes in the year paid, regardless of deferral of tax liability.

The result of this sort of tax bias is a set of false price signals broadcast in the factor markets. The signals overprice labor and underprice

[10] M. Gaffney, "Toward Full Employment with Limited Land and Capital" in Arthur Lynn, Jr. (ed.), Property Taxation, Land Use and Public Policy (Madison: Univ. of Wisconsin Press, 1975), pp. 99–166, at pp. 128–136. These pages are submitted as App. 1.

property. The signals make us respond to a shortage of labor when in fact there is a glut, and waste capital and land when we should be sparing them.

If tax bias were the only institution to favor wealth over labor we could say it may offset other biases. But in fact there are reinforcing biases, which I will merely list: subsidies which take the form of loans at low rates of interest, such as housing loans made or insured by the panoply of Federal housing agencies; the capital-intensive bias that is inherent in allowing regulated industries a rate of return based on their total invested capital, regardless of low marginal productivity (this is called the Averch-Johnson Effect); licensing laws for the disposal of natural resources which impose heavy capital or front-money requirements—for example, western water laws which often in effect divide waters in proportion to the diversion capacity of rival appropriators, and fishing bag limits which are in proportion to numbers of boats; use of low interest rates in planning public works; ignoring opportunity costs of public land; logrolling, overcommitment, and resulting stretchout of public works; the Highway Trust Fund; the failure to provide any police or administrator-enforced abatement of pollution, leaving the citizen no recourse but the larger lot, farther out; and the price-umbrella effect that builds excess capacity into cartels. There are more, and I know of no comparable set of biases favoring inputs of labor.

3. The Obstacle That Labor Produces Capital

All right, so efficiency as well as full employment call for increasing the labor coefficient of land and capital. How do we do that? Anyone can see what it means to use more workers per acre—no problem there. Anyone can see, too, what it means to use more men per crew, or use more shifts with given plant, machinery and equipment. Ah, it should be so simple. But who then produces the plant, machinery and equipment—who but labor? There is the problem. Capital is stored-up labor. If we use less stored-up labor per worker, are we not just substituting labor for labor? What is the difference; where the net gain of jobs?

Shop A may equip each of its workers with a smaller or less sophisticated machine, and use more workers. Then Shop B, which produces the machines, needs fewer workers. And Shop A itself may produce cement, the capital for Shops C, D, . . . Z, capital whose obviation would close Shop A. It is tempting to gloss over all that by saying if every shop and farm, mill and mine, office and store, firm and agency, gang and crew, squad and corps, family and kitchen, all up and down the line from the earth to the mouth just used less capital per worker it would all work out. Maybe it would, but maybe is not good enough. If we hadn't enough doubts of our own, modern macro-economics which dominates this field would force us to analyze how capital formation makes jobs.

Modern macro-economics has made much of the fact that labor finds work producing capital, only with the emphasis on the obverse: investment employs labor (to produce capital, of course). Indeed it goes much farther. Investment not only makes some jobs, it is a prime mover, a First Cause that moves independently and exerts enormous leverage over other income-creating flows, which respond dependently.

There is a mechanical relation such that aggregate income rises and falls by multiples of changes in investment. Such is the stuff of which macro-economic models are built. Investment is more important than other flows of equal value because it is autonomous and determining, they are reactive and determinate. It is fickle and must be wooed, they tag along and may be slighted. The key to full employment is finding investment opportunities and outlets to absorb the flow of savings. In such a model, reducing capital coefficients to make jobs is dangerous and self-defeating.

Right or wrong, the orthodox macro-economic model and paradigm, in whose grooves and patterns most thought has become channeled, is vertically integrated. The emphasis is on investment employing labor, not on the capital coefficient at a given time. It sees the relations of capital and labor in sequence, rather than in parallel; labor producing capital, rather than using it or competing against it. This perception is far too dominant to be ignored or brushed aside. If we would give and receive signals in macro-economics we must make the same switch, and think vertically. What is the relationship between labor and the capital which it produces? What does it mean to use less capital per worker? How do we accomplish it?

The quantity of labor input, worker-hours, is a product of workers and time. Similarly the capital input is a product of capital and time, say "dollar-fears." Although capital takes as many forms as Brahma, the basic idea or transcendental essence is simple enough: capital is something of value produced but not yet fully consumed by users and recovered by investors. The more years elapse between production and recovery the more dollar-years of service are rendered by capital. Unrecovered capital is said to be "tied-up" or in service.[11]

How to use less dollar-years of capital per worker is now evident: *recover it faster.* We can't cut down on the dollars; they have to cover the payroll. We can cut down the dollar-years of capital combined with payroll by cutting down the years. We accomplish the goal of reducing capital coefficients by modifying the capital stock so capital returns home faster to the investor.[12] The capital financing each payroll is tied up a shorter time with it. The short phrase for it is, make capital that turns over faster.

At the same time we can use larger crews to operate and maintain each plant of given value, which is the horizontally integrated perception of substituting labor for capital. In pure logic this second idea is implied by the first, but there is no harm in stating it separately (so long as we don't later lead ourselves into double counting). The idea is to shorten the pipeline between work and use, to move labor downstream closer to the consumer. That implies, at every step, using more warm labor with the frozen labor in machines, materials, plant and equipment.

Take as an example farm machinery. A farmer substitutes labor for capital when he invests in a lighter, cheaper machine that returns its cost to him in fewer years. He is reducing the dollar-years of his

[11] In addition, often capital income goes unpaid. Then it is plowed back and becomes additional capital which claims compound interest. In this case the capital input grows more than in proportion to time. All the needed mathematics has been worked out for centuries and may be found in any HP–80.

[12] Fast tax write-off is a travesty of this principle that does not accomplish the social end. Fast write-off lets the private investor recover *his* capital faster only by his getting an advance from the Treasury, i.e. from other taxpayers. True capital recovery only occurs when ripe goods are delivered to consumers, thus unlocking the value stored up in the goods.

capital which he combined with the factory labor in the machine. In addition he can use more field labor, and fewer, smaller machines, Now he is substituting field labor for factory labor. But the field labor is a step nearer the consumer, obviating the investment of capital in farm machines (and all the capital required to produce steel, fuel, rubber, paint and other machine inputs and components). Moving labor downstream reduces capital needs.

Lowering the capital coefficient per worker is, to many people, a structural or allocative question, in a box called "micro economics." But when we understand it from the vertically integrated viewpoint it becomes a macro-economic effect of the most central kind. Turnover means sale and reinvestment. Sale means supply to consumers; reinvestment means payrolls and incomes. Added supply prevents inflation, added payrolls mean more jobs.

"Capital is kept in existence from age to age not by preservation but by perpetual reproduction" (J. S. Mill). Labor consumes capital in return for reproducing capital. The flow of payback from capital sold as goods and services is reinvested continually in payrolls in a steady ongoing process, to create new capital. Investment makes payrolls, but most investment is reinvestment, the recycling of past accumulations. The faster capital recycles, the greater is the flow of labor putting value into the pool of capital, and volume of goods and services flowing out. Faster recycling is capital "quickening." The quicker the capital, the higher rises the flow-to-fund ratio. That means the more employment and production are financed with any given fund of capital, so long as there is idle labor to soak up.

That leads to a major proposition: "Turnover limits national income." Otherwise put, "Paybacks deferred are payrolls denied." Capital that investors recover quickly is "quick capital." Quicker capital flows through and delivers value to consumers sooner. Sales mean payback. Payback means money recovered to finance new payrolls. Payrolls mean aggregate demand to match the added sales. It all balances out, but at a higher volume.

Some examples of slow capital are the following. Timber may tie up capital for over 100 years before there is *any* payout (although the cutting cycle is highly variable and can be greatly shortened). Subeconomic highway extensions *never* pay out, either in cash or any other way—non-recovery is the slowest of all, of course. Housing may not pay out completely for fifty years, varying with particulars, (but unlike timber it begins to pay out from an early date). Minerals' prospecting gets years ahead of payout. And so on.

To quicken a nation's capital we need reduce such uses and put more into other goods and services like the following: retail inventories and well-trained clerks; monitoring, measuring and scheduling equipment to get more use out of heavy capital items; swing and graveyard shifts; maintenance, operating and repair personnel; growing crops; bus service; retraining programs; craftsmanship; personal service; home delivery; cleanup, collection and recycling; rehabilitating and remodeling sound old buildings; conserving water and energy in lieu of developing more; and so on.

Investment employs labor, yes. But almost all of gross investment is *re*investment of funds recovered from turnover and amortization of existing capital, (including inventories). There is no imperative that says we must accelerate the growth of capital coefficients in

order to sustain the flow of income-creating investment. Reinvestment does just as well, and is much more weighty overall.

Net investment and savings each year are a small fraction of total income-creating spending, well under 10 percent (and not really known precisely when you look at the data sources). The massive bulk of income-creating spending has to be reinvestment of funds recaptured from sales to consumers. A terribly careless and misleading convention obtains of treating short investments of under one year as non-investment, and limiting the word to longer lived assets, but this convention has no intellectual substance and is not used here.

The nation's total capital stock is a Great Revolving Fund, a fund whose value is variously (and imperfectly) estimated to be around three times national output. A slight percentage increase in the rotation of this enormous mass of real value will have major effects. We need not make an issue whether capital turnover or capital formation is preferable, for they are not alternatives: we can raise both, so long as there is more labor to employ. But raising turnover is much the more potent.

The upshot is that the process of substituting labor for capital creates the very macro-economic flows required to employ the extra labor. Micro- and macro- are unified. Solve the problem one way and we solve it the other way in the same stroke. Circulate capital faster, thus matching the given fund of capital with more labor, and generating added investment flows to hire it. One wants to shout such goods news in the forum.

4. The Obstacle of Inadequate Investment Outlets

Macro-economics is a quest for the bottlenecks of the economy—what keeps us from employing everyone? Turnover is clearly a potential bottleneck. One firm can invest in excess of capital recovery, but only by tapping others. An economy cannot tap others. It is a closed system with a zero sum of capital transfers. The only source of investment funds other than capital recovery is net saving, but net saving is very small next to capital recovery. Essentially labor finds work pouring value into the pool of capital, and sustenance taking it out again. The flow through the pool is virtually the national income (less a few fringes small enough to leave as secondary matters). The flow is capital (K) times its turnover (T) or $K \times T$.

Dominant macro-economists have not much inquired into the role of restricted turnover as a bottleneck. Their focus has been on another possible bottleneck which is the recycling of money. Capital was pictured (if one thought of it at all) as a pile of finished goods seeking buyers, always ready for delivery, only wanting the trigger of consumer spending to release the flow. Spending controlled turnover, so much so that one need never think it had other controls, much less be a prime mover, as it is, which itself control spending. The prevailing tendency is to bury the question by implicitly assuming automatic replacement of goods and service flows consumed, so in macro-economic models "consumption" creates income.

The question rarely arises explicitly because if it does the answer is built into the assumptions and would run like this. The cycle of spending has a fatal tendency to run down because of an excessive propensity to save from income, higher than there are investment out-

lets to absorb. The problem is always to find outlets which are scarce and to be treasured. The goal of policy is to increase investment opportunities (as by tax loopholes for investors, or public works). Recovering funds from sale of goods adds to gross saving, but saving, net or gross, is not a limit on autonomous investment. There is always a bottomless cornucopia of funds available to invest.[13] Gross saving just adds to the problem—more leakage from the spending stream that has to be offset by using the precious rare investment outlets.

On the positive side, in the Keynesian picture, sale of goods leaves an empty slot to refill, and this is an investment outlet. To the pessimist, however, this is uncertain, since there is an excess of goods anyway. Only the gross saving is certain. It is preferable to sequester capital in very hard, heavy, remote goods from which the payback is slow. Delivery to consumers is also slow, but there is an excess of goods seeking sale anyway so that is no problem. On the contrary, deferring deliveries helps offset the basic depressing imperative of our dying economy to sink into morbid deflation and choke on its own surplus of final goods wanting buyers.

Happily, we can now discard the idea that spending or recycling money is a bottleneck limiting national income. It does not at all square with the facts today, if it ever did. Instead of running down, the turnover of demand deposits has risen rapidly for many years now, even as the money supply does, and banks press on their reserve requirements to meet the demand for loans. Instead of a fatal deflationary imperative, there have been years of violent inflation which failed to solve the fatal unemployment problem. New Economists have mastered all too well the arts of creating and spending money. Delivering the goods is where they fail, and it is real goods ready to consume that turn play money into real money.

Instead of a glut of loanable funds and a shortage of investment outlets there is a capital shortage. Instead of a glut of goods there are shortages, an energy crisis, materials scarcities, limited selections in inventory, delivery delays, islands of famine and fears of world hunger. Labor may be in long supply. Money undoubtedly is. It is land, materials, commodities and investment funds that are short.

There is no need to trump up investment outlets. The true benefit of fast turnover is not the decay of capital, not the drawing down of stocks, not the creation of empty niches for new investment to refill. Planned obsolescence is not a macro-economic benefit. The true benefit of fast turnover is the delivery of value to consumers and the recovery and recycling of capital by investors. The gain is not from wasting, as implied in Keynesian models; the gain is in saving capital, by untying it quicker.

Unhappily, the concerns that prevailed when the twig of the New Economics was bent are built into its axioms, laws, models, circuitry and conditioned reflexes. In addition they drew upon deep springs in the cultural subconscious. "New" Economics was always a misleading name. It was more of a regression. . . . "There is not an opinion more general among mankind than this, that the unproductive expenditure of the rich is necessary to the employment of the poor. Before Adam Smith the doctrine had hardly been questioned; . . . if

[13] There is a backing away from the infinite liquidity trap in current neo-Keynesian orthodoxy, but primarily at the textbook level. In my observation it is the operating assumption in practice.

consumers were to save . . . the extra accumulation would be merely so much waste, since there would be no market for the commodities . . ." (J. S. Mill). Now everything is different but this mode of thinking which prevails at the top of the economics profession and leads us ever deeper into error and trouble. Only now it is the unproductive consumption of the military and the welfare dependents on which we rely. "Every cutback of a dollar in defense will cut two dollars from overall GNP and drag down a lot of jobs . . ." is the statement of Lawrence Klein.[14] Reporter Ernest Volkman quotes one Pentagon budget expert, ". . . at least 20 percent of this budget amounts to a federal work-relief program to stimulate the economy. Defense contracts, especially the big ones, have an immense ripple effect." Ironic, is it not, that the study of economics, that niggardly art of scrimping with limited resources inverts so easily into an exaltation of the God of Waste. Military waste is the last refuge of a bankrupt philosophy. We must do better—and we can. We can do it by realizing it is the real circulation of real capital, not the circulation of play money that makes the big wheel turn.

New Economists have sharply attacked, rejected and even ridiculed the optimistic J. B. Say for proclaiming that there can be no general overproduction because "Supply creates its own demand." Yet today supply seems to do that and then some. Today one often hears a concern lest increased payrolls just cause inflation. Whether they do depends on where the money comes from. If it is new money why yes, of course. But when the added flow of investible funds has its source in delivery of finished goods to buyers then no, of course not. There is a matching added flow of supply to answer the added demand. Supply and demand still meet but at higher volume. Added flows are synchronized at both ends of the pipeline. The pipeline itself in this metaphor is shortened to speed the throughput and widened to carry more volume.

Keynesian pessimism sees supply overwhelming demand. Inflationary pessimism sees demand overwhelming supply. A confirmed pessimist sees both calamities at once, and there are those who do. Yet each calamity is the counterpart to and solution of the other. Calamity results from neither, but from restrictive and braking policies of other kinds adopted or tolerated by pessimists who believe or proclaim that they must forestall these imagined problems. These are the real macroeconomic bottlenecks, the real limits to growth.

5. The Obstacle of Inflation Associated With High Employment

There is a fatalistic notion abroad that high employment has to go with inflation, either as cause or effect. The notion receives high-level aid and comfort from the dominant Phillips Curve school of macroeconomists. The foregoing analysis refutes the idea, but I will recapitulate briefly.

The idea underlying most modern analysis is that spending gradually leaks out of the system into savings. Government can raise employment by spending to offset this, injecting new spending by borrowing, usually coupled with some creation of new demand deposits, or money. But wage rates rise before everyone has a job. To

[14] "The Impacts of cuts in defense spending," Business Week, Jan. 19, 1976, pp. 51–52.

beat this, government must keep a step ahead by injecting more new spending than expected. Result: inflation.

Now it is true, if government seeks to initiate a real increase of demand by printing money, inflation results. The present proposal is different. Increase the flow of investment spending by quickening the recovery of funds from existing capital. The funds are recovered quicker because the value in the capital is delivered quicker to consumers. Thus the flow of real goods to consumers rises just so as to match and meet the rise of payrolls. The flow of capital to consumers is what backs the higher payrolls and prevents inflation.

Nothing is more common than public works spending to make jobs. This indeed creates payrolls without goods and invites inflation. Public works soak up a maximum of capital per job created, and yield a minimum of subsistence to advance to labor for the next job. Public works to make jobs are one of history's great self-defeating self-deluding tragic ironies. There is only a one-shot payroll, after which the capital stops recycling for a long time, often forever. One of the great stupidities of all time, surely, was the English effort to relieve the Irish potato famine of 1845–49 by hiring Irishmen to build roads. 570,000 men, a large fraction of the working population, toiled for the Board of Works while food prices took off like a bird and while half the people died of starvation.[15] The people needed subsistence for tomorrow morning, while public policy directed their effort to the next century.

The potato famine fallacy has never died. Governments still build monuments and sub-economic works of slow or negative return while the basic necessities of life rise in price. But a policy of directing investment into quick capital of fast results would make jobs and hold down prices at the same time.

6. The Obstacle of a Resource Ceiling on Throughput

Some writers regard materials flow as a limit on growth. They regard durability very highly, and fast replacement as inherently wasteful of materials and of our limited capacity to dispose of wastes.

The proposal to quicken capital is not a proposal to waste materials. The idea is to shorten investment cycles, so value is shorter in transit from maker to user. And then must the residuals return to foul the earth? It is false to presume so. An "investment cycle" is a different animal from a materials cycle. "Dust Thou art to dust returnest" was not spoken of the soul, and value is the soul of capital.

There is a world of difference between economic flows and materials flows; between economic service life and carcass life. Maintenance, recycling, rehabilitating, remodeling, rebuilding, timber stand improvement, retrofitting, veterinary medicine, salvaging, renewing, reclaiming, scavenging, reassembling, repair, and the like are all investments that extend the useful lives of old carcasses and slow down materials throughput. But they are investments of fairly short payoff and economic life, as a rule, that tie up capital and value a short time and speed up value throughput. It is possible and indeed normal and common to append many short investment cycles in repairs onto the tail end of a longer carcass cycle.

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[15] Cecil Woodham-Smith, The Great Hunger (New York: A Signet Book, 1964) pp. 137–160, et passim.

I have already noted that the shelter afforded by old houses is labor-intensive. When you think about it, that says a lot about materials flows. The old carcass dates 'way back, but the economically valuable services are more current. Each little outlay for repair, upkeep, maintenance, cleaning and remodeling is an investment of short life and fast payback. The advanced age of the old carcass is irrelevant. Again and again people wrongly assume that shortening investment cycles means tearing down old buildings and scrapping old cars. It is the other way around.

Even outright demolition, scrapping and replacement of a subsystem often extends the usefulness of the whole, like pulling a sick tooth. Replace the battery and save the car; replace old buildings and save a neighborhood and a city. Thus short investment cycles in no way imply short materials cycles.

There are other examples where the two kinds of cycles do vary together. But the shorter investment cycle may be less taxing to the environment. Many cities short of water have to choose between water meters to save water, or new dams to develop virgin water. The dams will outlast the meters, but who now would think the dams were the environmentally sounder choice? Again, beef takes longer to grow than turnips, but turnips certainly return vastly more food value per acre than beef while improving instead of exploiting the soil. And again, 12″ by 12″ timbers outlast 1″ by 1″ lumber and particle board and cardboard and veneer, but should we then high-grade the forests, leave all the smaller logs on the ground, and burn all the chips? The more you look at examples, the less tenable is any generalization that short investment cycles must always increase materials flow and generate residuals.

Examples may disprove one rule without proving another. It is clear, though, that as we move labor downstream nearer the consumer, we need less material overall. Indeed a good deal of labor gets all the way downstream into service industry requiring no materials at all. At the other extreme producing raw materials from the earth, especially heavy ones, is as far from the consumer as you can get, and the net thrust of policies pushing labor downstream is probably to reduce materials' use. People have difficulty with abstract ideas and seek concrete counterparts.

That is understandable enough, but the search must be guided by a correct grasp of the concept. Equating materials flow and economic flow is a misapprehension of the concept, a materialistic fallacy. Value is not just material, it is labor imprinted on material, with labor adding the larger share of value, as a rule. To shorten investment cycles we must lock and unlock the labor with material quicker by moving labor downstream. In the work of Mishan, Kneese, Boulding, et al., materials flow has been elevated to a major issue; correlated, if not identified, with economic flows; and made into a limit on growth and an argument against turnover. It is none of those, and should not divert us.

Conclusion

The capital requirement of economic growth is not a fund of capital but a flow of gross investment, a flow that grows with the national payroll which it finances. The flow is the product of the fund times its turnover rate. Faced as we are today with massive capital needs

beyond our means, and surplus labor, the way to go is obvious: speed up turnover. The price system will do it for us if we stop jamming its signals with faulty institutions like bias in taxation.

The land requirement of economic growth is the land we already have, or less if need be. After we've made two blades of grass grow where one grew before, we switch over to corn, then vines, then perhaps food markets. Beware of endless lateral expansion—the world is round.

Subsidies to tap frontiers make land artificially abundant. This is supposed to help make outlets for labor, and in some ways does. But frontiering taps new land at the cost of sequestering capital. Frontiers soak up scarce capital and hold it so it stops cycling and creating payrolls. Abundant land can still be badly used, and centuries of Caucasian expansion in the new world in a futile flight from unemployment have shown frontiers are not enough. Labor doesn't need great reservoirs of underused land so much as pressure to use the land we already have, and working capital to help labor use it.

Is it not retrogressive to reduce the capital used per man? We have seen that that is what quicker turnover implies and accomplishes. But we have also seen that progress in technology is to save what is most scarce, and today this is energy, land and capital. And there is more. Saving capital has the beautiful by-product of quickening the application of progress, because each reinvestment presents a chance to embody new ideas in new things. We would not be so far ahead if the first generations of computers lasted sixty years. In all the furor over planned obsolescence (a travesty which I do not condone) it is too easy to forget the fundamental rule that real obsolescence occurs as fast as people think. I am sure that people think faster, too, when their thoughts are used.

Finally, what about the distribution of wealth and income? Must a labor-intensive economy be a coolie economy? Not if we create it the right way. We can make labor cheaper, not by beating down wages but by lightening the tax burden on labor. We can make capital dearer not by raising the income of capital but by taxing it as heavily as we do labor. The same holds for land, only that the case is much stronger. Since labor income is distributed much more evenly than property, the result is not a coolie economy but a more egalitarian one than America has known for a long time. Longfellow dreamed of Acadia:

> Neither locks had they to their doors,
> nor bars to their windows:
> But their dwellings were open as day
> and the hearts of the owners;
> There the richest was poor, and the
> poorest lived in abundance.

The rich need not be poor, we are far beyond this. But it is quite feasible for most of the poor to become working poor, and for the working poor to live in abundance. We have the capital we need, if we have the compassion, the vision, and the good sense.

Appendix. Construction of Table 3

Like any data, these might be massaged a good deal more. In particular I surmise that adding unrealized appreciation to profits would raise the profits per employee more for the top ten than for the others, since six of the top ten are

oil companies, and all ten are major mineral owners. But this information is not available.

The lowest ten include one net loser, without which the profts per employee would be $690 instead of $297. However, negative profts are also relevant, and there are twelve firms in the 500 with net losses. Most of these are in the lowest 100, so it is representative to find one loser among any group of ten. Therefore $297 seems more accurate than $690.

Net worth was used for ranking in order to reduce the bias of regression fallacy. (Had I ranked by profits, the top ten would not have changed much but the lowest ten would have been firms with negative profits.) Although it is only partly successful in that, the trends shown are strong enough to survive further purification.

Future researchers will want to rank also by gross wealth; by current appraised value of assets; and other suitable measures that add more dimensions to what this line of inquiry reveals. The present data, however, show a relationship so strong and unambiguous it is unlikely to be reversed by modifying details.

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