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"THE LIMITS TO GROWTH" REVISITED

Remarks by

**Henry C. Wallich
Member, Board of Governors of the Federal Reserve System**

in the

Manville Public Policy Lecture Series

Rockford College

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Ten years have gone by since the great debate that was unleashed, in March 1972, by a small book of less than 200 pages, under the title The Limits to Growth^{1/}. The book, which caused a tremendous stir, made some very dire predictions. The world was in danger of running out of resources. Unless course was changed drastically within the decade of the 1970's, the world would be launched on a path that could only end in collapse, some time during the second half of the 21st century if not earlier. At existing growth rates of population and resource use, catastrophe threatened through exhaustion of raw materials, and if not of raw materials, then of food, and if not of food, then of the entire environment through pollution. Ten years have gone by. How do these doomsday predictions look today?

^{1/} Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, issued under the auspices of an organization that called itself the "Club of Rome."

A lot has happened during these ten years. Two oil shocks have raised the price of oil more than tenfold. Bad crops and food shortages have driven up the price of food. Inflation has accelerated worldwide. Are events like these an indication that the thesis of "Limits" is correct and that indeed the world is on the road to catastrophe? Given the importance of the topic, second in gravity only to the threat of nuclear war, the question is well worth pondering.

The question comes in two parts. The first is whether economic growth must come to an end or whether it can go on indefinitely. The second is whether, if growth must come to an end, it must do so through collapse instead of asymptotically, with a soft landing.

Must Growth Come to an End?

Economists, of course, have expressed views on both questions for many years. In 1798 the Reverend Malthus broadly took the side of "Limits." Population would outrun food, growth would be limited by starvation. At a theoretical level, economists have always expressed great interest in a condition known as the "stationary state," in which nothing changes and there is no growth. However, it is not easy to visualize a condition of zero growth. Even if population stopped growing, saving and investment need not stop and per capita output would grow faster than before because all of the investment could be concentrated on the existing labor force. Conceivably, net saving might come to an end if the government were to absorb all saving for current expenditures. But so long as technological

progress occurred, the turnover of a constant capital stock would permit incorporation of new techniques that would sustain a slow rate of growth. All these sources would have to come to an end before growth could end. Moreover, in this scenario there is nothing to indicate that growth must end in collapse. It might simply end in what today we might call stagnation. As to when, if ever, this condition would be reached, economics had no plausible prediction.

It is true, on the other hand, that any limits to growth that might be discerned were rather spectacularly flouted by the growth models that became fashionable among economic theorists during the 1960's. Those models translated the "stationary state" into a stably and indefinitely growing state. Only labor and manmade capital played a role in this process. If the authors were of the opinion that food and natural resources could indefinitely be multiplied or substituted with the help of capital and technology, they might at least have noted the limits imposed by land or the prospect that the rent of this one limited factor would have to rise indefinitely. That, in any event, had been the opinion of the Reverend Malthus' contemporary David Ricardo, who viewed resources as unlimited but rising in price.

Must the End be Collapse?

On the second question, whether growth, if it must end, must do so by collapse, orthodox economics does have a fairly firm message. There are adjustment mechanisms built into the economy that, if they function properly, will make for a soft landing at a stable standard of living instead of collapse. These mechanisms all, in one way or another, are based on the response of economic agents to prices. Scarcity of any

particular resource will lead to conservation and increased production. The development of adverse conditions such as pollution or overcrowding will lead to corrective action. The growth of population will be slowed or stopped by the diminishing return and rising cost of rearing a large family. There can be disagreement, of course, about how effectively these mechanisms function and whether they are adequate to their jobs. The last ten years, with their various shocks to the world economy, have taught us something about the functioning and adequacy of some of these adjustment mechanisms. That is what I now proceed to examine.

Energy

Events in the energy area undoubtedly provide the most enlightening commentary on the thesis of the "Limit." This is true both in a positive and a negative sense. The first rise in the price of oil, from \$3.50 in 1972 to \$13.50 in 1974 seemed to be timed almost too well as a confirmation of "Limit's" warnings. The second oil shock, lifting the price from \$13.50 to \$34.00, seemed to make the point that the world had failed to respond adequately to the first shock. A closer look at the situation, however, requires one to take a more balanced and, on the whole, more optimistic position.

First, it must be acknowledged that even the first oil shock substantially slowed, or substantially contributed to a slowing of, world economic growth. This was particularly the case in industrial countries, but also in developing countries although they in good part compensated for higher oil prices by borrowing abroad. However, the oil shock did not have

its effect through serious shortages. Rather it worked by reducing purchasing power in the oil-importing countries and raising rates of inflation which, in turn, required restraining policies.

The principal questions to be asked are whether the response to higher oil prices came mostly through government action or through the market, and whether it came on the supply side or on the demand side. There was a good deal of talk on the side of governments, including on international action, but with very modest results. A program for energy independence in the United States remained mostly rhetoric. In the market, the supply responses to the first and even the second oil shock were either modest or very slow in materializing. Oil and gas did not spurt out of the ground as prices were deregulated, although there was some improvement. Substitute sources like shale, tar-sands, syn-fuels, and solar energy, proved uneconomic or excessively anti-environmental, even at very high energy prices. Nuclear power became a disaster, at least in the United States.

Demand, on the other hand, showed itself surprisingly price elastic. Industry quickly responded to higher energy prices, and consumers, particularly after the second oil shock, also reacted strongly. Energy consumption per unit of GNP has declined by 22 percent since 1976. Oil consumption in the United States has fallen over 15 percent in the last three years. In fact, world demand has fallen so rapidly that oil prices have dropped more than 10 percent since mid-1981.

In the United States, there was, of course, more room for energy conservation than in most other countries. The price of energy had been low and nonincreasing in real terms for many years. Moreover, price controls or

relatively low taxation kept the price of oil and natural gas in the United States far below comparable prices in most industrial countries even after the oil shocks.

In the light of this relatively good performance of the private sector, it probably would not be fair to fault government for not contributing more to adjustment to higher energy prices. Reliance on the effectiveness of the price mechanism in the private sector turned out to be justified. Even better results no doubt could have been achieved by total removal of price controls accompanied by more severe taxation of energy.

The question remains how far a supply shock produced by a cartel can be taken as a proper test of the functioning of the price mechanism. To encourage a smooth adjustment, the price of oil should have been rising for years before the shock, instead of remaining flat or declining in real terms during most of the 1960's. The market may be exonerated on the grounds that it could not reasonably have been expected to anticipate the circumstances that made OPEC effective. However, it has since become plausible that, even in the absence of a cartel, supply limitations would have been encountered during the 1970's and would have caused oil prices to rise. This evidently the market, which in any event was not a competitive one, did not adequately foresee.

The correct pricing of a resource such as Middle-Eastern oil is extremely difficult. Based on cost of production, the price prevailing during the 1960's was more than adequate. Based on a correct projection of future demand and supply, the price was much too low. A price more in line with future market balance, however, would have yielded enormous profits to the

producers. The U.S. government, in confronting the same issue in the regulation of natural gas prices, took the view that price should be based on cost, not on future supply and demand. In retrospect, the policy of maintaining a low natural gas price has been revealed as wasteful and uneconomic. The same incidentally must be said of the government's policy of limiting the importation of abundant Middle-Eastern oil since 1954 and so encouraging the using up of U.S. domestic oil resources. Thus, if the market did not do a very good pricing job, the government did even worse. The conclusion might be drawn that in this instance the price mechanism has worked less precisely and promptly than one might wish, but that over a period of years it did work quite adequately.

Food

The first oil shock coincided with a food price shock, seeming to lend further support to the "Limits" thesis. Both the United States and Soviet Russia had bad crops. Running out of food has been the classical fear of people concerned about limits to growth since Malthus. From time to time, there has been starvation in the world. At all times probably a considerable fraction of humanity has gone hungry. In a world with reasonably good storage and transportation, however, the two phenomena are far from identical. Hungry people are hungry because they are poor, not because there is no food. Indeed, most of the time world hunger seems to coincide with manifestations of excess food supply such as government accumulation of surpluses, output restrictions, and price stabilization schemes. It may be true that half or more of the world's arable land is already being farmed, at least until some economic

method of desalinating sea water is developed. But most of it is being farmed very badly. The fact that the United States is able to export 33 percent of its agricultural output while maintaining diverse restraints on this output, and can do this by the work of four percent of its labor force, shows what an efficient agriculture can do.

One of the facts that differentiates food from oil or coal or other sources of energy is that there is no substitute for food. People can shift from oil to natural gas or coal or even to solar energy. They cannot shift away from food. However, there are substitutions within the food sector, and the United States has just gone through a major substitution. As a result of price changes, the consumption of meat has dropped from 195 pounds in 1976 to 181 pounds in 1979 per capita. As in the case of oil, the price elasticity of demand for particular kinds of food has proved high. If the price of animal products should continue to rise, no doubt man would shift increasingly to direct consumption of vegetable products. Feeding animals to feed people is a roundabout and expensive process. If food problems ever were to become serious for the United States, substantial substitution would be possible.

This is not true, of course, for poor developing countries where people eat relatively cheap food. For the most part, however, developing countries have been improving their food situation by improving their farming. China, with approximately 22 percent of the world's population, is reasonably self-sufficient. India, with twice as much arable land per capita as China, has become an occasional food exporter. Pakistan and Indonesia are other large LDCs whose food problems are manageable.



What may not be manageable is the situation of some African countries. Great backwardness combined with very high population growth and in some cases an inhospitable environment seem to be the reason. One should not make a world food crisis out of the plight of these particular countries, since other countries could with little sacrifice take care of those needs were they so minded. I shall revert to this question in connection with population.

Primary Products in General

An exercise guaranteed to arouse public alarm is to demonstrate that over some predictable period we shall be running out of some particular raw material, particularly if its principal source is located in some vulnerable or less than friendly country. Manganese, platinum, chrome, bauxite, and cobalt are among the examples. For many years, a rise in the price of these and many other primary products has been predicted, pointing to a severe worsening of the terms of trade for the industrial countries. In fact, however, such shifts of a general sort have not occurred. On the contrary, the problems affecting most commodities, as their producers keep telling us, continue to be inadequate prices and unstable markets.

Within this group of primary products, substitution, of course, is relatively easy. It is hard to believe that the world's development would have been very different had the world's crust not contained such substances as cobalt, lead, or even copper. Moreover, a Ricardian rather than Malthusian view of the supply of such commodities suggests that there is no absolute limit to supply, but an unlimited supply at ever rising costs. Some

substances, to be sure, could be priced out of the market. But the fear which arose after the first oil shock that some commodities, such as bauxite and copper, might be successfully cartelized by their LDC producers seems to be put at rest by the possibilities of substitution, aside from the apparent inability of the producers to form an effective cartel.

Are the market mechanisms in place that should warn us of an impending shortage if, contrary to expectations, some critical shortage should be in the offing? The pricing of nonrenewable natural resources is a difficult matter, as I already have noted in connection with oil. Since mining properties and the like are bought and sold among large producing firms, one should think that the best available foresight is being brought to bear on the valuation of such assets. Anybody who believes that, over the next ten or twenty years, some metal or mineral will do what oil, gold, and silver have done, has an opportunity to become wealthy if he can back his judgment with money. Of course, there are risks. They relate to political events, affecting both the potential supply and the possibility of establishing a dependable claim to such resources. That, however, has nothing to do with worldwide availability over time.

Land

Land is needed not only for farming, but for people. One of the concomitants of economic growth, both per capita and aggregate, has been a greater conglomeration of people in cities. One of the concomitants of conglomeration has been crowding, social tensions, violence and crime, and pollution. Some of these conditions can become a serious threat to growth in an orderly society.

Crowding, however, is not a necessary condition of growth. Nor does crowding necessarily lead to the evils it has produced in many places. Japan is an example of a country with little space and considerable crowding which nevertheless maintains a very orderly society. The United States is an example of a large empty country with high local concentrations of people which has allowed its cities to deteriorate. Mexico City reportedly is expected to have 30 million inhabitants by the end of the century, a good part of whom will in effect be out of touch with the normal processes of government and the infrastructure of the city.

Evidently the mechanisms that one might expect to operate to forestall or correct such developments are not fully operative. Nevertheless, they exist. In the United States, the movement of population is by no means all into the cities. A substantial outward movement is going on which in some cities already is leading to net outmigration. The economic forces at work are, on the side of immigration, the attraction of jobs, higher pay, and city life. On the side of outmigration they are the high cost of city living, its inconvenience and risks, and the growing possibilities of making a good living outside the cities without becoming a farmer.

Technology, it would seem, is mostly now on the side of dispersal. Prospective improvements in transportation into and within the city seem to be few. The communications technology that would make it unnecessary for large numbers of white-collar workers to come together under one roof seems to be expanding rapidly. Most major industrial operations have long abandoned the cities.

These corrective mechanisms do not work with adequate strength because most of the negative effects of crowding are externalities. That is to say, the individual who comes to the city does not bear the full burden of the addition that he makes to the city's problems. Most of the burden, from increased apartment rents to crowded sidewalks, is upon those already there. Needed is a device to internalize these externalities that the newcomer inflicts upon others. It is not easy to conceive of a tax, of course, that might be paid by newcomers but not by old residents, but something with the effect of such a tax would weight the scales in the right direction. So would a subsidy to those who would outmigrate, although its political viability is equally questionable. There is room here for innovative social engineering. In any event, I find it difficult to argue that a country like the United States should limit either the growth of its economy or of its population in order to deal with the problem of crowding of cities. There are other countries where this advice would be more appropriate.

Pollution

In the computer runs of "Limits," pollution is always the ultimate source of catastrophe if the problems of energy, resources, and food are somehow solved. Since the appearance of "Limits," we have learned something about pollution, just as we have learned something about energy. Government action against pollution has been one of the more effective approaches of the government to problems associated with growth. One reason for this may be that the actions taken have been politically popular because typically they have been, or at least have been perceived as, directed against

producers rather than consumers. As a result, substantial success has been attained in cleaning up air and water.

Considerable resources have been invested, and the cost of these undoubtedly has helped to limit productive investment and has contributed to the marked slowing of productivity gains in the American economy, from an earlier 2-3 percent per year to practically zero in recent years. The disappearance of productivity gains, in turn, has aggravated the problem of inflation, given the habituation of the labor force to continuous real-wage increases of 2 or 3 percent. Inflation, again, has contributed to unemployment directly and indirectly. The total cost of controlling pollution, therefore, is higher than its direct cost. But by no means all of the slowdown in productivity can be charged to pollution control, in view of the fact that other countries have also made progress in that direction and have nevertheless maintained some, although a reduced, rate of productivity gains.

The control of pollution has not been done by the most economical means. The naive response to the presence of pollution -- simply to prohibit it -- has been the typical response. Only of late has attention been given to economic costs. Little progress has been made with the internalization of pollution damage, i.e., with tax and other devices that would throw upon the polluter the cost of his pollution and give him an incentive to remedy it. More could be done than we have at lesser cost if more sophisticated techniques were employed.

Overall, the experience of pollution control over the last ten years seems to suggest that we can deal with many forms of pollution. There are some forms of such cosmic magnitude that it has not even been possible to make sure how they work, let alone come to grips with them. There are those who believe that high-flying planes, or aerosol cans, or whatever, will cause a hothouse effect by trapping heat permanently in our atmosphere. They see the ice caps melting and the continents inundated. Others observe mechanisms that cause the rays of the sun to be reflected by the atmosphere, leading to a cooling off and perhaps a new ice age.

At this point, the well-meaning but not very focussed and rational character of doomsaying becomes very apparent. It is not essential whether the citizen is threatened with a new deluge or a new ice age as a result of economic growth. The main thing is that he be scared and carry away some predisposition against growth. By the same token, if one supposed road to disaster, say the depletion of resources, is plausibly shown not to lead there, another readily can be put in its place. Thus, as it became increasingly less plausible that depletion of resources will ensure trouble, emphasis has been placed on environmental factors. And as these increasingly come to be seen as controllable, the arguments shift to social tensions. Instead of starting with the premise that growth is bad and then finding the arguments to prove it, why not assume that it is good unless there is compelling evidence of damage?

Population

The question about the limits of economic growth is a question, of course, as to the level of population that the world can sustain. If world

population tapers off at a moderate level (it is now 4.3 billion), the problems of food, crowding, and pollution will be more readily solvable than if it tends toward a higher level. "Limits" sees world population overshooting the support capabilities of our planet and then diminishing drastically in starvation, pollution, disease, or war. This leads to the necessarily extremely speculative examination of the outlook for world population growth. But first two points should be made. First, the problem of nonrenewable resources would not be resolved permanently by the lower world population. Only the time when these resources ran out would be postponed. Second, a reduction in world population does not have to be associated with visions of disaster. To be sure, the world has seen such disasters -- in the fourteenth century, the Black Death reduced the population of England by perhaps one-half. But a much more humane reduction of numbers is conceivable also. If the average number of children per family were to drop progressively from present levels, population would soon begin to decline.

Estimates of world population by the year 2000 run from 5.7 billion to 6.35 billion. Beyond that, they diverge even more imaginatively. Global 2000 estimates of a minimum of 10 billion by 2030 and a maximum of 30 billion by the end of the 21st century have been cited. Once more, the question is what mechanisms are in place to cope with tendencies toward excessive growth. The simplest mechanism, of course, is that described by Malthusians for many years and spelled out in greater detail by "Limits": People die off because survival is impossible. This mechanism has not been validated in general

although it seems to have operated in some cases. Growth patterns have been well defined for many countries that have reached approximate population stability or at least a slow rate of growth. The population cycle begins with declining death rates, thanks to better health, food, and general sustainability of life. For a while population explodes. Then birth rates begin to come down and eventually population slows or levels off altogether. The outcome depends on how quickly birth rates follow death rates.

A reasonably good correlation has been observed, across nations, between per capita income and birth rates. This relationship can be used to derive population estimates from income growth estimates, within a very wide margin. This is one technique by which some estimates of future population levels have been made. There can be no assurance, of course, that the past negative relation between birth rates and per capita income will be stable hereafter.

There is, however, a discernible mechanism that tends to drive the birth rate. In low-income societies, which means predominantly farming societies, children are assets. Economically speaking, procreation is an investment in a producer good. As people leave the farm and the society becomes increasingly urban, children cease to be earning assets to their parents. Economically speaking, they in effect become consumer goods, born for the enjoyment of their loving parents. As the costs of child rearing and education rise, and, in some cases, the problems of family life multiply, parents tend to reduce the number of children. In countries without primogeniture, or where stable family fortunes of a financial sort are significant,

the desirability of avoiding a fragmentation of the inheritance becomes another driving force for family limitation.

Are these mechanisms likely to operate as effectively in developing countries as they have in present-day industrial societies? In many countries, the matter is complicated by religious factors. Government policy can play an important role. China, for example, has achieved a level of population growth of 1.6 percent which for its per capita income is remarkably low. In a democracy, things are less easy. Information rather than propaganda may be the key. Power politics between developed and developing countries can also play a role, although it is obvious even now that within two generations the people of today's industrialized countries will represent a small minority, perhaps 1.3-1.4 billion, out of a much larger world population.

Conclusion

Let me summarize the conclusions at which I believe we have arrived. The course of events following the publication of Limits to Growth has superficially seemed to bear out the predictions of the book with remarkable speed. Actually, events have provided some test cases that allow a better evaluation of these predictions. What we have observed so far is that the pressures generated by growth and the problems resulting from them are real. But we have seen also that, at some cost, it has been possible to overcome them. We have also found that there are mechanisms at work that should produce a soft landing, if the limits to growth are ever reached, as they may be. Some of these mechanisms require strengthening. The means to do

that are at hand also. Given expected private behavior and sensible public policy, therefore, no catastrophe seems to loom in the distant future. We can be even more confident today, after ten more years of experience, than we had reason to be in 1972, that these problems can be solved.

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