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Steady State Economy at Optimal Population Size

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Abstract

This paper reviews briefly the idea of a steady state economy from the ancient times to the present. It discusses some of the suggestions made by H. Daly in his model of a steady state economy and particularly the idea of a stable population. It suggests that population must be stable at a level that is compatible with ecological equilibrium. That level is about three billion people and therefore the world population must be reduced drastically. This can be achieved if each family is allowed to have less than two children. To achieve this reduction of population this paper proposes the creation of an international market for human reproduction rights.

Introduction

In his *General Theory of Employment, Interest and Money* Keynes (1960) writes in the final concluding note at the end of his book:

Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their

frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians and even agitators apply to current events are not likely to be the newest. But, soon or late, it is ideas, not vested interests, which are dangerous for good or evil (p.383).

If Keynes was right, then, those in authority during the last fifty years (presidents, prime ministers, religious leaders, heads of international organizations etc.) should have been totally unfamiliar with the ideas of Plato, Aristotle, Malthus, Huxley, Paul Ehrlich, and the report of the Club of Rome. Indeed, this conclusion appears to follow from the fact that few of such people have shown any interest in the unprecedented growth of world population in the last half century in spite of the warnings of the writers mentioned above and many other modern scientists regarding the dangers of overpopulation either for some countries or for the entire planet.

More relevant to the problem of overpopulation, another quotation from Keynes (1963) is interesting. He says:

I draw the conclusion that, assuming no important wars and no important increase in population, the economic problem may be solved, or be at least within sight of solution, within a 100 years. This means that the economic problem is not -if we look into the future- the permanent problem of the human race.

Unfortunately, neither of the two conditions was met and the economic problem seems to be permanent. In addition, the increase in wasteful consumption after World War II and the growing income disparities worldwide make the solution of the economic problem a "mission impossible". In fact, the alarming growing gap between our ecological footprint and the globe's biocapacity means that our prime concern now is not just to solve the economic problem but to save our planet and its population from tragic prospects.

What does it mean “To Solve the Economic Problem”?

The economic problem exists because an economy's resources are limited while human wants are unlimited. Utopias like the Garden of Eden have no economic problem. But, in modern human societies, the attempts to solve the economic problem are based on efficiency: efficient production, efficient allocation of resources and efficient technologies. People are free to satisfy their wants as best they can. No one in modern times has ever suggested imposing a limit on the level of wants satisfaction because that would be against the freedom of choice. Thus, for the modern economist and also for the modern individual, the economic problem can be solved by maximizing production to satisfy wants as much and as many as possible.

Human wants are unlimited for two reasons. First, wants have the property of being insatiable in the sense that the typical individual would like to have more of everything if they could afford it. Under normal circumstances, the marginal utility of an additional unit of an item would always be positive. Second, human wants are multiplied by the rate at which population increases. Prior to the emergence of contemporary environmental concern, during the modern economic era no one except Malthus and John Stuart Mill, (indirectly and a little later) considered the possibility of population growth to the point that it would become a major problem.

In ancient times, it was suggested by philosophers that the solution of the economic problem should be looked for not on the side of supply, i.e. not in increasing the available resources or in using them more efficiently in order to maximize production, but rather on the demand side, i.e. in constraining consumption and population size within limits. These limits were determined by reference to human wants. The cynic philosophers introduced the idea of suppressing wants to needs. We should consume not what we want but what we need for simple life. Diogenes, a leading figure of this school of philosophy, once saw a boy drinking water from a fountain using his hands, and then he threw away his cup because he understood that he did not really need a cup - he said: “A child surpassed me in plain living” (Diogenes Laertius, p. 131). Of course, Diogenes had no intention to solve the economic problem as we understand it today but rather to give an answer to the question put by Socrates, namely “How to live”.

Between the typical modern economist, who sees the solution of the economic problem in maximum utility, and Diogenes who is the champion of the simple life by minimizing utility to a level corresponding to the satisfaction of real needs, stands Aristotle whose ideas are as timely as ever. The fundamental idea in Aristotle's economics (and ethics) is that of the "best life" (Politics, book VII). This is a life in which the individual has enough material wealth by which he/she can live with comfort and generosity but not luxuriously and wastefully. Happiness (*eudemonia*) means acting with virtue and this requires external goods, i.e. material wealth. Thus, according to Aristotle, to solve the economic problem means to produce enough so that everyone can live comfortably but not waste resources through luxurious consumption.

How is the Economic Problem Actually Solved?

An unbiased observer would certainly agree that, historically, human societies have been successful in partly solving the economic problem by increasing production and thus allowing higher consumption levels. Thus, today in perhaps all countries of the world, most people enjoy a higher standard of living than in any other period in the history of humankind. The sciences, technological changes (embodied and disembodied), and institutional changes are the prime powers that have led to an amazing growth of world production.

However, the unbiased observer should also agree that people act under a veil of myopia or indifference, in the sense that they do not see all of the real consequences of their actions or they do not care about them. This is evident from the effect that the last half century's economic growth has had on the ecosystem: during this period humanity's ecological footprint has exceeded the biocapacity of the Earth. In 2014, the planet's biocapacity was estimated at 12,221 million hectares and the ecological footprint 20,602 million hectares (Global Footprint Network). Thus, the solution of the economic problem worldwide has resulted in a huge ecological deficit. According to the Global Footprint Network, in 2018 the "ecological year" ended on August 1st. To sustain current levels of consumption would require 1.7 Earths.

Thus, the world economy has "solved" the economic problem in the same way as many countries do when they create huge external public debts that future generations are expected to pay. Or like the lumberjack who cuts down trees at a

rate faster than the forest can reproduce itself. In such cases, a deficit is created that future generations will be forced to cover in ways that may be painful. In this sense, so far, the economic problem is being solved in a myopic way.

Why is it so Difficult to Solve the Economic Problem?

In one of the quotations given in the introduction, Keynes mentioned two factors that make the solution of the economic problem extremely difficult, namely wars and population growth. Wars absorb huge amounts of resources that could be used for the production of consumption goods. Natural catastrophes and other human activities that do not result in production of consumer goods would have the same negative economic effects as wars.

During the period after World War II, a third factor has appeared that absorbs very considerable amounts of the available resources: namely overconsumption by the general population in the wealthy nations, but also of the rich in less developed countries. Of course, orthodox economic theory does not recognize the term "overconsumption" because each individual is free to choose the type of commodities they like and buy as many as they wish and can afford. However, it is hard to shake the feeling that there is something wrong in a society where a small family has a huge house and a swimming pool next to a sandy beach, where people travel with private jets and private yachts, where wealthy women buy luxury dresses that they will wear only once, where simple people have five watches when they need only one, etc. I do not wish (and I do not have the knowledge) to enter into a discussion about the ethics of consumption, but simply to point out that the misuse of scarce resources is so great that one cannot be criticized for speaking about overconsumption as a factor contributing to the ecological deficit.

Is the Earth Overpopulated?

A region, a country, or the entire Earth can be said to be overpopulated if it can be shown that its population exceeds a certain level determined by a relevant criterion. With respect to our planet, there are several different and independent studies that show that Earth is heavily overpopulated.

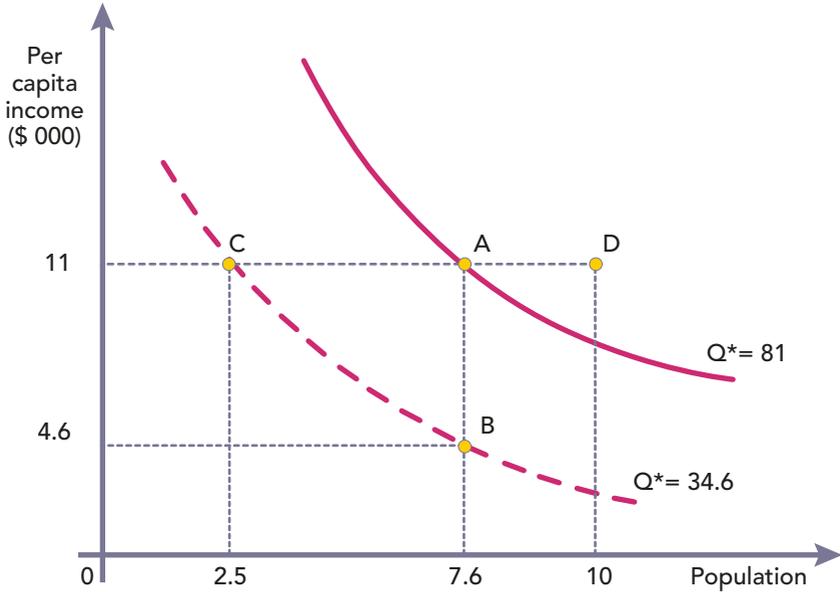
In 1994, Daily, Ehrlich, and Ehrlich (1994) conducted a thought experiment to calculate the optimum population size based on an estimate of the maximum

total world energy production “at which ecosystems and resources seemed to be holding their own”. Assuming a 50% margin of error, the authors postulated that at 6 TW total energy production (6,000,000,000,000 watts) and a level of consumption of just 3 kW per person would lead to an optimum population of 2 billion. The same year, Pimentel et al. (1994), based on the estimate that 0.5 ha per capita is needed to supply food and assuming a program of soil conservation, estimated that a world population of 3 billion people could be sustained. More recently, Pimentel et al. (2010) estimated that under certain reasonable assumptions regarding land inputs, a European standard of living for everyone with sustainable use of natural resources results in a carrying capacity of the Earth of 2 billion people. In a more recent study, Lianos (2013) estimated that, assuming a per capita income of \$11,000, ecological equilibrium (defined as equality of ecological footprint with biocapacity) can be maintained if the world population is 2.5 billion or less. If the population size is bigger, ecological equilibrium requires lower standards of living.

Clearly, even allowing for a margin of error of 100%, the above estimates show that the present (October 2018) population size of 7,659 million people exceeds by far the carrying capacity of our planet. The fact that all of the above estimates result from different methods of estimation and do not differ substantially is a strong indication that our planet is heavily overpopulated.

The exact meaning of overpopulation can be shown with the help of Figure 1. It is estimated (Lianos and Pseiridis, 2015) that the maximum value of world GDP that corresponds to ecological equilibrium is $Q^* = 34.6$ trillion dollars. According to the World Bank, the world GDP in 2017 was approximately 81 trillion dollars and with 7.6 billion people the per capita GDP is about 11 thousand dollars. This pair of values is shown as point A in Figure 1. However, with $Q^* = 34.6$ and 7.6 billion people per capita GDP should be 4.6 thousand dollars as shown at point B. If we wish to have a per capita income of 11 thousand ecological equilibrium requires a reduction of population to 2.5 as shown at point C.

Figure 1. The trade-off between standard of living and population at ecological equilibrium.



Thus, it becomes clear that the meaning of overpopulation is relative to the desired standard of living given the availability of resources with ecological equilibrium. In terms of Figure 1, all pairs of population and GDP per capita that can be shown by points to the right of the dotted curve Q^* , such as point A, reveal overpopulation. Therefore, those who argue that the world population can increase to 10 or more billion should also specify the standard of living to be enjoyed by those billions of people.

The curve Q^* in Figure 1 has been drawn to correspond to the maximum world GDP of 34.6 trillion on the condition of ecological balance. Technological innovations, institutional changes, and better management of resources may shift the Q^* curve to the right thus allowing for higher per capita incomes at given levels of population. It seems unlikely that Q^* can be 81 trillion with ecological balance in the foreseeable future; but even if it does, population would have also increased in the same time period so that a point like D is likely to occur. Thus,

arguing that technology can solve the problem of ecological disequilibrium is the same thing as arguing that one can step out of their shadow.

Why is Overpopulation a Problem?

There are people who argue that overpopulation, or rather increases in population, do not create a problem. The basis of this argument is that increases in population mean an increase in total utility as long as every individual has a positive level of utility. Thus, adding one individual with a positive level of utility to the population, other things remaining equal, will result in an increase in total utility. Therefore, a large increase in population instead of being a problem is actually a positive development. However, such a conclusion is clearly false and unacceptable. It is false because the mere addition of people violates the "other things remaining equal" condition. New people need resources and, since resources are limited, the satisfaction of their needs will reduce the resources available to those who were born before. The argument is unacceptable because it leads to Parfit's (1984) "repugnant conclusion" that a huge population with each individual having a utility level just above zero is better than a small population with each individual enjoying a high standard of living.

That overpopulation is a problem is clearly indicated by the existence of ecological deficit and the estimates of the population size that can be sustained assuming ecological balance. Resource depletion, water shortages, climate change, loss of biodiversity, soil depletion, overcrowding, lack of space for various uses, sordid slums and poverty are some of the issues associated with overpopulation. Some researchers are very pessimistic and speak of "painful population crash" (Schade and Pimentel, 2010), "increased social and political instability in many parts of the world" (Pimentel, 2012) and even suggest that the human race will be extinct within a hundred years because of population explosion and "unbridled consumption" (Frank Fenner, reported by Firth, 2010).

The above discussion is suggestive of only one solution to the economic problem, namely that of reducing the size of world population to a level that would be in congruence with ecological balance. This is a defining property of a steady state economy.

STEADY STATE ECONOMY

1. The ancient philosophers

The idea of a steady state economy is very old. In the 4th century BC, Plato and Aristotle both developed the idea of a steady state by specifying the proper relationship between land and population that is necessary for a just and happy state.

Plato's treatment in the *Laws* (book V) is very brief but Aristotle's analysis is more thorough. In his *Politics* (book VII), Aristotle constructs a comprehensive model of a steady state economy based on his idea of the "best life" or a life of happiness, namely "life conjoined with virtue furnished with sufficient means for taking part in virtuous action" (1323b40 – 1324a2). In Aristotle, this means a comfortable but not a luxurious and wasteful lifestyle. The elements of his model are private land (property), public land, and population. These elements can be properly combined to produce enough wealth for all individuals that possess land, and sufficient proceeds from public land to take care of the poor and cover the costs of administration.

Aristotle believes that there is no limit to the growth of population if it is left uncontrolled. Therefore, the optimum land-population combination cannot be sustained unless population controls are introduced (for a detailed analysis see Lianos, 2016).

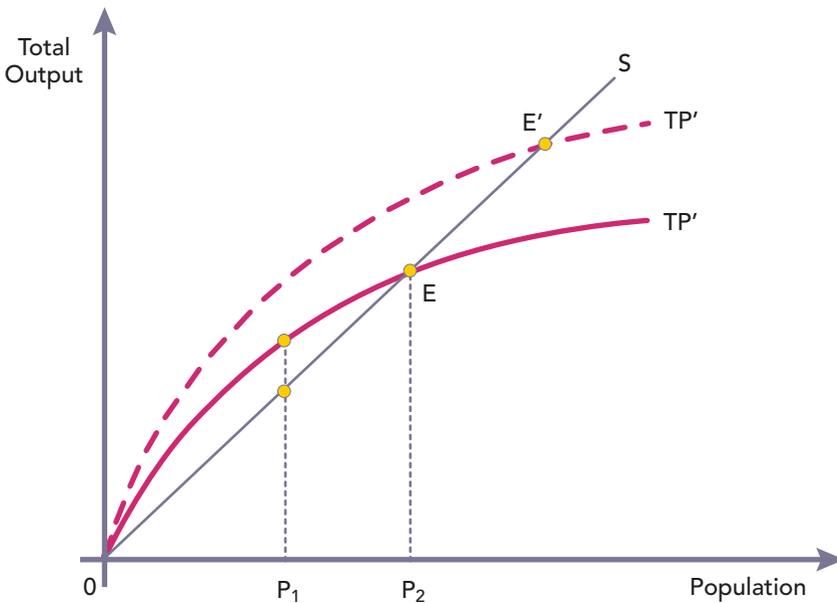
2. The Classical view

During the 18th and 19th centuries many of the classical economists, including Smith and Ricardo, thought it inevitable that the economy would tend toward a steady state. However, John Stuart Mill was possibly the first to argue that a steady state "would be, on the whole, a very considerable improvement on our present condition" (Mill, 1970, p. 113). For Mill, a steady state is a stationary state of capital and wealth.

The view of steady state economy held by the classical economists, including Mill, is epitomized by Baumol's (1951) "magnificent dynamics" presented in Figure 2. Curve TP shows total product (or output) for each level of population (or labor force). This is the aggregate production function and displays diminishing

returns to labor. Line S shows the amount of product that is necessary for the subsistence of the labor force. The real wage rate is shown by the slope of line S. At population level P_1 the difference between TP and S represents profits which motivate investment, increase in employment, higher wages, and improvement of the condition of the labor force and thus increase of population. This process will be terminated at point E when population increases to P_2 . At point E the stationary state is reached with zero profits. Improvements in the production process that raise the total product curve to TP' will motivate investment again and the new process will bring the economy to a new stationary state at point E'.

Figure 2. The magnificent dynamics.



The question often raised by several writers, e.g. Blauwhof (2012), Binswanger (2009), Gordon and Rosenthal (2003), is if a capitalist economy can really stay at a steady state position with zero profits? The answer given by the classical economists is in the affirmative.

3. The Marxist View

A steady state economy in the Marxian sense is supposedly described in his theory of simple reproduction outlined in chapter XXIII of Volume One of *Capital* (ch.23). The case of simple reproduction can be a steady state economy only if at every period capitalists consume the surplus value acquired as revenue that year. For some (e.g. Blauwhof, 2012) this is in fact a steady-state economy. However, this equilibrium position will not be sustained because in capitalism only a small part of surplus is consumed and the rest is invested. Thus, the economy always follows the expanded reproduction path, although crises will not be avoided.

The Marxian steady-state is not the simple reproduction scheme. It is, rather, the higher phase of communist society, very briefly mentioned in the Critique of the Gotha Program (part I). As is well known from Marx's brief description, at that higher phase the economy will have greatly developed its productive powers, work will have become an integral part of living, not just a means to live, and each member of society would offer to production what they can and take what they need. This situation can be said to be a steady state in the sense that further economic growth is meaningless. According to Marx, human history ends at that phase of the truly communist society where the word "scarcity" is removed from society's vocabulary.

Given the circumstances prevailing today, namely a world population of 7.6 billion and a huge ecological deficit, Marx's vision of a communist affluent society is purely utopian. Therefore, it is inaccurate to talk about steady-state in Marx's economics in the same sense as in the classical tradition or in contemporary accounts such as Herman Daly's.

4. Daly's Steady-State Economy and De-growth

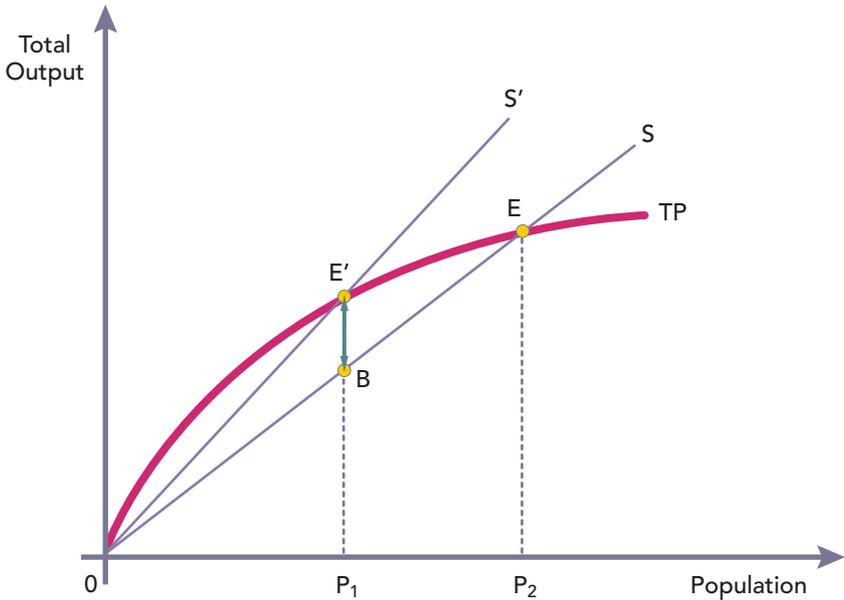
Daly's steady-state economy (SSE) is sometimes discussed together with economic de-growth (e.g. Kerschner, 2010). This is probably because of Georgescu-Roegen's rejection of the steady-state economy proposed by Daly and also because of Daly's (1997) criticism of Solow and Stiglitz on the basis of Georgescu-Roegen's arguments. However, Daly's steady-state economy and de-growth are two different concepts at least for economic policy purposes.

According to Latouche (2009), de-growth is a political slogan primarily designed to make clear that exponential growth must be abandoned. Growth serves the

interests of capitalists and has disastrous implications for the environment, and consequently for the world as a whole. Although Daly and Latouche share some common concerns, they should not be discussed together as they have very different agendas. Daly's steady-state economy and his policies for achieving a satisfactory state are of immediate practical importance. In his many writings, Daly defines the steady-state economy as:

... an economy with constant population and constant stock of capital, maintained by a low rate of throughput that is within the regenerative and assimilative capacities of the ecosystem. This means low birth equal to low death rates, and low production equal to low depreciation rates. [...] Alternatively, and more operationally, we might define the SSE in terms of a constant flow of throughput at a sustainable (low) level, with population and capital stock free to adjust to whatever size can be maintained by the constant throughput that begins with depletion of low-entropy resources and ends with pollution by high-entropy wastes. (Daly, 2008, p. 4)

The long run equilibrium position of Daly's steady-state economy can be presented in a diagram like that of the classical model. The equilibrium position of the latter is based on the stability of the subsistence wage and on the Ricardian mechanism of the labor market. If the real money wage determined in the labor market exceeds the subsistence wage, population will increase. In the opposite case population will decline. Thus, deviations from point E of Figure 3 will be temporary. Now, suppose that the economy is at point E' with population at P_1 . Since by definition population is stable, point E cannot be reached. The equilibrium position will now be at point E' with higher wages indicated by the higher slope of the S' line. The gap of BE' will be closed not by a movement to E but by an increase of the wage rate. The horizontal supply of labor curve implied in the Ricardian model is now replaced by a vertical labor supply curve because of constant population.

Figure 3. Equilibrium with stable population.

In the same paper, Daly gives a ten point policy summary. Daly's definition and his suggested policies raise a number of issues, one of which is a vague reference to the stability of population. Economic policy requires setting quantitative targets. It is not sufficient to say that population should be stabilized by equating birth rates with death rates. This leaves the SSE undetermined. It is necessary to specify the size at which population should be stabilized. This target should be, according to Daly and other writers, at the level where there is a sustainable constant flow of throughput. Since a given level of throughput corresponds to a given level of total output (assuming constant technology), the size of population should be stabilized at a level dictated by the sustainable level of total product. The studies we have already referred to have found that level to be between two and three billion people.

Although the burden of overpopulation on the resources of the planet is obvious and recognized by the majority of researchers, it seems that Daly is not willing

to specify the optimal size of population and, like many others, he avoids the challenge of raising the issue of population control. Population control is still a taboo.

Also, Daly seems to believe that a SSE will necessarily suffer from unemployment. This follows from his question "If we must stop aggregate growth because it is uneconomic, then how do we deal with poverty in the SSE?" (Daly, 2008, p. 4). His answer is redistribution by setting limits to minimum and maximum incomes. However, as we have indicated earlier, if population is constant there is no need for growth for the purpose of absorbing the increasing labor force. There is no economic argument on the basis of which a SSE will suffer from unemployment just because it is a steady-state. However, unemployment may result from changes in technology or in consumers' tastes that change the structure of demand and require transfers of labor and resources from one industry to the other. Also, the type of redistribution suggested by Daly is questionable. A limit on maximum income would create problems of economic motivation and of bureaucracy. It would also keep the minimum limit low. Redistribution of income can take place through a system of taxes and subsidies and other means depending on the inventiveness of the government.

One major item in Daly's ten point policy summary is that "the SSE could benefit from a move away from our fractional reserve banking system toward 100% reserve requirements." His slogan is "Nationalize money, not banks" (2017). This can be achieved by treating demand deposits differently from time deposits. For demand deposits the reserve requirements would be 100%. In this case, however, consumers and business would deposit money only for security and for their transactions. Also, banks would need to charge a fee as this would be their only source of revenue from accepting and handling demand deposits and this may discourage people from depositing. In the case of time deposits (savings accounts), according to Daly, there would be no required reserve and all savings can be loaned to potential borrowers. The banks will profit from the difference between the interest rate paid by borrowers and that received by savers. Now, banks would bring together savers and borrowers but they cannot change the money supply and the risk of financial crisis disappears. This suggestion is not without problems. There are two important cases where Daly's suggestion appears to be too restrictive. One case has to do with the time structure of time deposits

that may not coincide with that of the demand from borrowers. In this case, the banking system will leave borrowers unsatisfied while time deposits are resting within the banks. The other important case is the inability of the system to finance new firms. In a capitalist steady-state economy there will certainly be changes in consumer tastes, new products will be introduced, and new technologies will be applied to production. Therefore, new firms will be created and old ones will disappear. A banking system with 100% reserve requirement will make difficult the financing of new firms. The stability of the financial system can be protected by other means without sacrificing the advantages of fractional reserves.

Daly offers a few other policy suggestions that might improve the existing situation in many countries. However, they do not define a steady-state economy. The heart of the matter is the size of population which needs to be determined at a level that would be in harmony with ecological balance.

5. Population and Steady State Economy

As was pointed out earlier, it is not enough to say that in a steady-state economy population should be stabilized. The actual size of population should also be known. For example, with the present population of 7.6 billion the economy cannot be sustained at its present level because of the ecological deficit that we experience at the present time. The choices we have were presented on Figure 1. The curve Q^* shows the combinations between population and per capita income compatible with ecological balance. This means that there are many positions that a steady-state economy can occupy along the Q^* curve. The decisive factor that will determine the size of population is our choice of the standard of living that we wish to enjoy.

The sad truth is that in the not very distant future a steady-state economy with a population much smaller than the one we have today will become necessary. It will occur either by voluntary birth rate reduction or by imposed population controls (as for example in China) or the hard ways to which the present unsustainable situation leads, namely poverty if not starvation, conflicts, and wars.

At the theoretical level, a steady-state economy requires three fundamental elements. First, population must be stable at a size that would be compatible with ecological equilibrium, or less. If technological advances make possible more

efficient use of resources and total product can increase, population and/or per capita consumption may also increase. Second, as has been repeatedly said by Daly and others, externalities must be internalized so that prices reflect real costs in terms of resource use. Third, the prices of products and of factors of production should be flexible so that changes in technology and/or in tastes would not result in permanent market deficits or surpluses.

Price flexibility is very important because of its implications. For example, it implies that labor unions should not have the power to determine wages and thus give rise to the insiders-outsiders phenomenon that has resulted in higher unemployment in many European countries. However, labor unions would have a role in a steady-state economy as for example in representing workers in a bargaining process. Also, there should not be subsidized products (like bread, for instance). Problems of poverty should be solved by other means of income redistribution. Monopolies and other privileges should be abolished. Natural monopolies should be under the control of the community or of the government. Commodities and factors of production should be allowed to move freely.

There may be differences of opinion regarding the institutional arrangements in a steady-state economy. But it is undeniable that the size of population should be determined by the scarcity of resources and the need for ecological balance. If population is fixed at a certain level, everything else will be adjusted relative to that level.

Economists and policy makers in modern economies have been unjustly accused for "growthmania" since the end of World War II. Growth was necessary not only for improving the standard of living but also for accommodating the exploding population. The driving force for economic growth has been the explosion of population. Stability of population will make growth unnecessary although it could take place when technological and other production improvements raise the biocapacity of the Earth.

6. The Role of the State in a Steady-State Economy

It should be emphasized that "a steady-state economy is not a failed growth economy" (Daly, 2008, p. 4). It is not an economy in stagnation. All the things that happen in a free economy would also happen in a steady-state economy.

In the words of Mill “There would be as much scope as ever for all kinds of mental culture, and moral and social progress” (1970, p. 116). However, such an economy would not be free of the problems that constantly appear in a free economy.

Scientific discoveries, new technological applications, changing consumer preferences, new products, and new methods of production and management would constantly change the structure of demand and therefore adjustments in production would be necessary. Unless prices are perfectly flexible and adjust automatically, which is rather unrealistic to expect, it would be necessary for the state to intervene. Also, public schools and public health systems would require the intervention of the state. Finally, natural disasters, such as earthquakes and floods, would make intervention necessary. Generally speaking, the frictions of the capitalist system and the myopia of many individuals in providing for the future would make it necessary for the state to play a corrective role.

It is certainly premature to discuss what the role of the state should be in a steady-state economy and what concrete measures it should take as this depends on the nature of the problems that are likely to appear. What is urgent today is to discuss and think of ways to reduce the size of world population.

REDUCING POPULATION

The current world population is close to 7.7 billion people and it is projected to increase in the decades to come. Every day a new city of approximately 250 thousand people is born.

According to a recent study from the International Institute for Applied Systems Analysis (Lutz et al., 2014a, 2014b) world population is likely to peak at 9.4 billion around 2070 and then decline to about 9 billion by the end of the century. According to a United Nations study (Gerland et al., 2014), the world population can be expected to grow to 9.6 billion in 2050 and to 10.9 billion in 2100. Despite their differences, both studies predict a 30% increase in world population in the next forty to fifty years.

If we accept that the Earth is overpopulated then the population must be reduced to preserve the natural powers of the planet in a condition conducive to human

life. At various times several ways have been suggested for population control including moral abstinence, guidance to the young, delaying marriages, availability of contraceptives, abortions by consent, voluntary sterilization, coercion, and economic incentives and disincentives. The fact is, however, that these methods, to the extent they were applied, have not given the expected results. Actually, in some countries incentives have been given for population growth rather than reduction. It is often suggested (e.g. Conly, 2016) that education and economic incentives may be effective. Thus, it is interesting to discuss briefly the likely effects of economic incentives.

1. Economic incentives and disincentives

Given that stability of population requires 2.1 children per family on average, incentives in the form of money or other equivalent rewards should be given to families that agree to have no more than one child so that the average number becomes less than 2.1. Such a policy is not without problems. First, families that have no intention or desire for more than one child would also be rewarded and will raise the cost of the program. Second, it is unknown what size of monetary reward (in cash or kind) would be sufficient to convince the family to have only one child. For example, would covering all the educational expenses of the only child up to university be sufficient or would subsidies be required equal to the total income that the second child is expected to bring to the family? One can think of other types of financial incentives as, for example, free social security benefits when the parents reach a certain age. Third, those families that would be willing to participate in such a program would certainly be among the poorest and thus in effect such a program would be discriminatory.

A policy of economic disincentives should involve economic punishment for those families that decide to have two or more children. The punishment can be something like a progressive tax for each child after the first, high enough to make the marginal utility of the money paid higher than the utility of the additional child. To the extent that such policy is successful it is also discriminatory against the poor and it is certain that it will meet strong opposition.

In general, although economic incentives and disincentives seem to be, at least in theory, a good idea, in practice they will be very costly and very unpopular.

2. Creating a Market for Human Reproduction Rights

Another way for reducing world population is by monetizing the problem and creating a market for human reproduction rights¹. One model for implementing such a program can be described as follows.

- (i) Every couple is given three shares by the government, with each share giving the right to give birth to half a child. Each share represents the right of the couple to participate in the creation of the next generation and all couples have the same rights.

- (ii) These rights are tradable in the world market. Thus, a couple in Canada that wishes to have two children can buy one share from a couple in China. Similarly, a couple that wishes to have three children would have to buy three shares etc. If all couples wish to have two children, no trade will take place and therefore the one-and-a-half policy becomes in practice a one-child policy. However, it is certain that there will be people in all countries that would be willing to buy and others than would willing to sell shares. Thus, the one-and-a-half child program will at the same time become a program of income transfers, probably from relatively rich people to relatively poor, within each country and between countries.

- (iii) This policy can be applied to each individual country that suffers from overpopulation, e.g. China, India, Indonesia, etc. However, since the population problem is universal, the full impact will be seen if its application is global. Thus, it is desirable that it has the support of all governments and also of various institutions, e.g. the Church and other social organizations. It is very likely that some governments that favour the large family model would prefer not to adopt the one-and-a-half children policy. However, if the international demand for shares is high and a substantial sum of money is received by those who sell one or more of their shares, the popular demand for the adoption of the plan in those countries would be strong.

1. A reviewer's comment led me to a search in the relevant literature where I found that a similar plan with transferable birth licence was proposed by Boulding (1964) and presented later by Daly (1990). The plan presented in this paper was developed independently.

(iv) In addition to reducing world population, some other positive side effects are also possible. For example, the black markets for adoption of children that exist in some (perhaps many) countries would practically disappear since there would be not many children for sale. Also, the adoption of orphans will be much easier. In addition, very substantial money flows would be directed from rich families and countries to poor ones. Of course, negative side effects are certain to appear as in the case of unintended pregnancies of married women who have sold their shares.

Variations of the basic idea are possible. For example, some people may argue that the right to give birth to children should be given to individuals and not to couples since there are many people who wish to have children but not get married. In other words, the right to give birth to a child is an individual right, separate from the way couples decide to live. Also, instead of each share corresponding to half-a-child, different values may be given, e.g. 0.6 or 0.4, depending on the desired rate of decline of population.

To facilitate exchanges of reproduction rights an international stock exchange can be established where reproductive rights would easily, and with a minimum cost, be sold and bought. Thus, a couple in one geographical region can very easily buy (or sell) a reproduction share from (or to) another couple living in a very distant place.

Needless to say, such a scheme of population reduction will often be violated, at least at the beginning. Problems of non-compliance will certainly arise and no easy treatment is available. However, fines and other measures of an administrative nature can be used so that compliance is encouraged and non-compliance discouraged. Information about the problem of overpopulation and moral suasion can contribute to the acceptance by the public of the proposed solution.

This plan has two advantages and one important disadvantage. The advantages are that essentially it would be cost-free and it treats everybody equally². The disadvantage is that it is coercive. Of course, controlling the family size in this

2. Of course, it would be easier for wealthy couples to buy shares, but this is true for all items for which a market exists.

way violates a basic human right. Many people would be very skeptical about introducing laws that force families to reduce the number of our offspring. For example, Conly (2016) rejects the claim that people have a fundamental right to have as many children as they want but refuses to accept enforcements on the number of people that a family may have. However, the offence of this violation should be weighed against the alternatives. There is, also, an intergenerational social justice issue involved in this discussion. Forcing people to have fewer children than they might want to have will certainly reduce the level of utility (happiness) they enjoy. However, if they are allowed to have as many children as they want, the level of utility of the future generations will be much lower given the limited resources that would be available to them just because the present generation contributes to overpopulation. In a real sense, the present generation by its numbers and its consumption habits is using resources that will be lost for the future generations. This is no different from the act of a thief who steals corn from the barn of a neighbor. Although freedom is a fundamental right the thief is imprisoned. One might say that the comparison is not valid because the present generation has no intention of stealing resources from the future generations and therefore there is no deceit involved. This defense is not convincing because it is difficult to find people that are not aware of the critical situation to which the Earth has been brought because of overpopulation. Finally, it should be pointed out that a policy or a rule, if applied generally, is not conceived by the public as a coercive restriction. We do not feel that our freedom of choice is violated when we are required by law to enroll our children in school or to drive on one side of the road or even fight in a war.

In defense of this plan I would like to quote J. S. Mill's "very simple principle" that "the sole end for which mankind are warranted individually or collectively in interfering with the liberty of action of any other member is self-protection. That the only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others" (Mill, 1961, p. 263).

It is clear from the analysis presented in this paper that the primary purpose of the one-and-a-half child policy is to prevent the present generation from harming the next ones.

In the history of the world, social problems have been solved or were limited to manageable proportions by command rules, by economic incentives, and by a combination of both. Of course, monetizing a problem will not necessarily lead to the best solution, but a second best solution is often better than letting things run their own course. My suggestion of the one-and-a-half child policy is a combination of command and economics that also allows some choice.

Reducing population is not without problems, at least in the short run. A reduction in population worldwide will be followed by a general fall in demand for goods and services and a period of deflation and unemployment at least at the first stages. It is unlikely that price flexibility would be an adequate remedy for the waves of demand reduction. Some rigidities will always exist. Thus, very active government policies of demand and of income redistribution will be necessary. However, the problem may not be very serious because incomes previously spent for the needs of children will now be spent on other items and therefore the decline of aggregate demand need not be so great.

3. Ecological Renaissance

If such a plan is generally adopted, the world population would be halved in three to four generations, i.e. in about one century. At the same time and despite initial passive or active resistance to such a plan, it is very likely that important changes for the better will take place in the ways people see themselves in relation to the environment and to each other. During the transition period towards the steady state something like a modern ecological renaissance may occur and free humankind from the narrow anthropocentrism that may be a factor in preventing environmental sustainability and more socially fulfilling lives (Samways 2016).

Comments

It was pointed out that a steady-state economy is not a stationary economy in the sense of "a failed growth economy". It should also be said that it is not necessarily an affluent economy as long as population remains above the optimal size. Population must be stabilized at a level much lower than the present level of 7.7 billion. If population fails to be stabilized at a level at which the ecological deficit is maintained, society will, in the long run, suffer from problems of inadequate resources to support that population size. Consequently, in addition to the serious ecological problem that we are already facing, poverty will result. Thus, it

is important that the steady-state economy be defined as one with population at a level compatible with ecological equilibrium as well as comfortable lifestyles.

Also, the steady-state economy will suffer from some of the problems that capitalist societies presently have, e.g. problems related to changing tastes, new technologies, risks, natural disasters, etc. Therefore, state policies that facilitate economic and social adjustments would be necessary.

Finally, I have emphasized the need for birth controls even if that means some violation of human reproduction rights to some extent. The justification for such violations is that they are less onerous than poverty, starvation, social unrest, and wars that result from overpopulation. In analyzing population issues it is useful to keep in mind that "The real crux of the population question is the quality of people's lives: the ability of people to participate in what it means to be human; to work, to play, and die with dignity; and to have some sense that one's life has meaning and is connected with other people's lives" (Cohen, 2017 p. 42).

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