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ABSTRACT

In this booklet, one of a series intended to apply economic principles to major social and political issues of the day, it is argued that although doomsayers claim that world population growth is threatening the ability of the world to feed itself and that drastic measures should be taken to curb population growth, the world population situation is not that bad. By using simple economics to analyze what determines the level and rate of growth of the population, one can show that the rate of population growth is the result of, among other things, economic factors. Given that, it is likely that the economics of population will in time dictate a slower rate of population growth. A look at the world's nations reveals that there is no relation between the income per capita of a country and that country's population per square kilometer. However, the rate of growth of the population of a country and that country's per capita income are related, in that high income countries have low rates of population growth and that low income countries have high rates of population growth. It is concluded that the major determinant in such growth concerns the cost and benefits of having children, and that as countries become more industrialized, the returns from large families, and hence the desire to have them, will decrease. (LH)

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Introduction

Predictions of dreadful things to come surround us. Some say the earth is being overrun with people, and soon Earth's ability to supply food will not be sufficient to support its growing population. Even sooner we will have exhausted our energy resources or spoiled our atmosphere. Sounds like the end is near; but is it? Are we in fact doomed to experience a planet overrun with people all fighting over the ever decreasing supply of food and energy? It seems reasonable to wonder if there is any way out of this predicament. Is the only solution one of limiting individual families' decisions concerning the number of children they would like to raise?

To answer this question we will use some simple economics to analyze what determines the level and rate of growth of the population. By looking at systematic relations (causes of population growth) we can show that the rate of population growth is not given, but is the result of, among other things, economic factors. Given that, we might suggest that well before doom sets in, the economics of population will dictate a slower rate of population growth.

There are two ways to discuss the population question. First, there is the total number of people in a nation or in the world. Second, there is the rate at which a given population is growing. These two aspects of population are related in that a faster rate of population growth will eventually lead to a larger population, but at any given time vast differences may exist between levels of population and population growth rates. Some nations have large populations with small rates of population growth while others have small populations and large rates of population growth.

As we shall show, a look across the nations of the world reveals that there is no relation between the income per-capita of a country and that country's population per square kilometer. Thus, population density and the income of the population seem to be unrelated. But we shall also see that the rate of growth of the population of a country and that country's per-capita income are related, that high income countries have low rates of population growth, and that low income countries have high rates of population growth.

I. Some Demographic Facts

The nations of the world differ in many ways. One of these differences is in the per-capita income of their residents. We are all aware that there are rich nations and poor nations. In Table 1, we have ranked the major countries of the world by income per inhabitant, a common measure of the well-being of the people of a country. In column 2 of the table we show the number of people per square kilometer in each of the countries.

As you can see by comparing columns 1 and 2, some rich countries are densely populated (Japan, Great Britain, and West Germany) and some poor countries are sparsely populated (Bolivia, Chile, and Mexico). Obviously nations are not poor simply because they are overpopulated. We have also drawn a line across the table. This line separates those countries that have per-capita incomes of less than $1,500 (the less developed countries—called LDCs) from the remainder (the so-called developed countries).

Table 1
Income, Population Density and Growth Rates By Country

Country	Income Per Capita	Population Per Square KM	Population Growth Rate
Sweden	9,029	18.0	0.40
Canada	8,410	20.0	1.20
United States	7,912	23.0	0.80
West Germany	7,249	247.0	0.20
France	6,552	97.0	0.70
Japan	4,937	303.0	1.30
Great Britain	3,936	229.0	0.20
Argentina	1,920	9.0	1.30
Mexico	1,270	32.0	3.50
Chile	744	14.0	1.80
Korea	707	237.0	2.10
Nigeria	399	70.0	2.70
Bolivia	383	5.0	2.70
Thailand	379	84.0	2.80
India	144	186.0	3.60
Ethiopia	95	23.0	2.30

In column 3 of the table we show the rate of growth of population for each country. As you scan the population growth rates you will notice that the countries below the line (the LDCs) have larger rates of population growth than those above the line (the developed countries). The average population growth rate for the developed countries is 0.76 percent while for the LDCs population is growing at an annual rate of 2.69 percent.

The fact that the LDCs have faster population growth than the developed countries has led many observers to argue that these countries are their own worst enemies. They create new people faster than they create output, thus being doomed to poverty unless they can do something about population growth. Such arguments have prevailed in many nations, such as India, and extensive measures have been taken to induce the public to engage in some form of contraception. In India, men who have fathered two children are paid to have vasectomies.

Surprisingly, while concern for population is not new, measures such as those taken in India have been rare. In fact, there have been many more examples of subsidies for having children than of subsidies for not having them. For example, in Nazi Germany parents were paid a fixed sum of money per child and even today in Canada there is a monthly payment per child. Historically, nations have felt the need to expand their populations far more often than the need to reduce them. Also, many religions encourage their members to have large families.

Given all these differences across countries, a theory of population has much to explain. Such a theory must be able to explain why the rates of growth in population are larger in the nations with lower income per-capita. The theory must also be able to explain the decline in the rate of population growth in the developed world over the past three decades. In section III we tackle some of these problems, but before we do, two other related issues will be discussed: the poulation doom prophets and theories of population for the lower animals.

II. Past Theories of Population

As we indicated above, predictions of doom resulting from uncontrolled population growth are not new. For example, the original economics prophet of population doom was Thomas Robert Malthus, who lived in the eighteenth century. Malthus believed that man's ability to increase the productivity of land in the growing of crops could only progress at an arithmetic rate. Population, on the other hand, would grow at a geometric rate. The eventual outcome would be that the world's population would outpace its ability to feed that population.

Let us examine this proposition of Malthus' a little more deeply. First, an arithmetic rate of growth is one that increases as the progression 1,2,3,4,5,...etc.. A geometric progression, on the other hand,

increases as 1,2,4,8,16, . . . etc.. That population increases in a geometric progression is not surprising to anyone that has raised rabbits or gerbils. That is, you start out with a pair of gerbils and before you know it you have a house full.

The two assumptions made by Malthus concerning man's abi 'y to raise food and control population have not been borne out by the [illegible] of the two centuries since his work was published. First, modern [illegible] tural methods have resulted in significant improvements in our [illegible] raise crops so that Malthus' assertion that the productivity of land will increase at only an arithmetic rate is open to serious question. Second, man is not a gerbil, so we do not have to accept the assumed geometric growth in population suggested by Malthus.

Where did Malthus develop the ideas that population was uncontrollable? Looking at the economics of population in the animal kingdom will assist us in answering this question. What determines, for example, the population of lions in the bush? First, the population of game that lions feed upon. Second, the rate at which lions reproduce. Third, the incidence of diseases and other factors that kill off the lion population.

Why do these three factors affect the lion population? Not because lions all sit around and vote on limiting population, that's for sure. These factors determine the population of lions in spite of the efforts of the lions to overcome them. Essentially, as more and more lions are born, each must work harder to survive, because the bush (like the rest of the world) contains only limited resources. These limited resources and the resulting increased work load makes the lions more susceptible to disease and less able to reproduce. Some even starve to death. Nature controls the lion population.

Can we expect similar forces to be at work regarding the human population? Well, Malthus did. He argued that man was doomed to live at a subsistence level in the long run. The mechanism of Mathus' argument was similar to the above analysis of the lion population. Malthus argued that if the real earnings per person rose above subsistence, then the rate of population growth would rise. A larger population would increase the supply of labor and drive real wages back down to subsistence levels. In addition, both pestilence and famine would contribute to the control of the population.

This whole approach of Malthus, that the human population is not out of control but rather is in a controlled state of hopelessness, is depressing at best. However, the experience of the past two hundred years in the developed countries of the world seems to prove Malthus wrong. In fact, not only have we been able to increase the output of food faster than the population has grown, but the increase in real wages has been accompanied by a reduction in the rate of growth of the population. These facts suggest that something more complex than Malthus' simple subsistence arguments are needed to explain population growth.

III. The Demand and Supply of Children

Ultimately, the control of population through the free decisions of the members of society depends on the number of children that families have. Thus, the answer we seek revolves around whether or not the economics of family decisions concerning numbers of children will prevent the growth of the population from getting out of hand. If so, are there systematic differences between the LDCs and the more developed countries that imply that as the LDCs become more developed, they too will experience a slower rate of population growth? To answer, our approach will be to treat children as we would any other commodity, in the hopes of learning something about population growth.

Historically, children have performed a dual function. The components of this dual function are consumption and production. A little thought will let you see the truth of this statement. First, children are clearly consumption goods, you only have to watch adults enjoying play with their children to see this side of children. But children have also been production goods for the major part of man's history. They have worked in sweat shops and on the farm to name two of the tasks allocated to them (other tasks include mowing the lawn and doing the dishes!). We want to devote some thought to these two aspects of children in the hopes of shedding light on the population issue.

A. Children As Consumption Goods—If children can be viewed as consumption goods, then they compete with other goods for the resources of their parents. Many couples have decided not to have children, not because they hate them, but because of the cost of raising them. This suggests that the cost of raising children relative to the costs of other consumer durables (such as automobiles, house, appliances, etc.), and non-durables for that matter, is a relevant factor in the decision of how many children, if any, to have.

Another relevant factor is the income of the prospective parents. Assuming that children are a **normal** good (a normal good is a good the demand for which increases when income increases), then increases in income will result in an increase in the number of children per family. But we know that the developed countries have lower population growth than the LDCs and that in the United States family size is lower for high income families than it is for low income families. Are children then what economists call **inferior** goods? We will address this question shortly, but first, let us finish a categorization of some other factors in the decision to have children.

Clearly an important factor in the children decision is what economists refer to as tastes and preferences. In a way this description simply begs the question, but in a very real way it helps us to limit our analysis. What we assume is that the tastes and preferences of human beings for

children change very slowly, if at all. What does change often, and by large amounts, is the alternative to having children, or as economists would put it, the alternative cost of children. This alternative cost consists of the goods and services you give up when you have a child.

Consider children as a consumption good. Clearly there is more to the consumption of children than just numbers; quality also matters: One way of looking at children that captures both their quantity and quality aspects is to consider that what is being consumed by the parents is actually the services of children. On what factors do the total services of children depend? First, on the number of children. At least for reasonable numbers of children an increase in the number of children, increases the flow of children services.

A second and perhaps more important component in the total services of children is the quality of children. How does one improve the quality of a child? Why, the same way we improve the quality of anything else: by investing resources such as our time and money in them. We invest in our children by spending time with them, giving them music lessons, teaching them athletic skills, or even teaching them academic skills. Finally, the third component in determining the services of children is the inherent talent of the children.

Taking these three components together we can imagine a form of production function for the services of children. Essentially a production function for children services shows the quantity of children services available with a given number of children and a given investment per child for children of given talent. For example, you give me the number of children you want to have and the amount in terms of time and money you intend to invest in each child. Given the talent of the children, the children services production function tells you your total amount of children services.

Each of the components affects the total consumption services generated by children in a unique way. An increase in the number of children will increase the consumption services of children. An increase in the investment in children for a given number of children will also increase the total consumption services of children. Finally, an increase in the talents of children for a given number of children and dollar investment will increase the total available consumption services of children.

For the sake of argument let us assume that each family chooses the number of children and the dollar investment per child so that, for the given talents of their children, the cost of acquiring any given amount of children services is as small as possible. What the children services production function says is that any desired quantity of children consumption services can be acquired either with a larger number of children and a small investment per child, or with a few children and a large investment per child. Thus, depending on whether numbers of

children or dollar investment in children is cheaper, the number of children chosen by a particular family may be large or small.

What makes larger numbers of children expensive relative to investment in children? The expense of children to any family depends in a significant way on the value of the time of the individual family members. The greater the wages of the father and mother, the greater the cost of having a child. But as we have pointed out, this expense can be offset by having fewer children and investing more in each child. Thus, as family income rises, families increase their consumption of children services but do so by having fewer, more capital intensive children (that is, they invest more per child).

We have then, an explanation for the observed relation between the number of children and income per family. The data for the developed world indicates that higher income families have fewer children. But the services of children can still be a normal good, beause higher income families invest more in their children. We also have at least a partial explanation for the differences in the rate of population growth in the LDCs and the more developed countries. The cost of adding to the number of children relative to investing in children is lower in the LDCs than in the developed world. Accordingly, families in the LDCs have more children and invest less in them than families in the developed countries.

B. Children as Production Goods—One of the most important aspects of children from a historical perspective is their use as a production good by their families, tribes, or nations. We are going to concentrate on the production value of children to the family only, as we are trying to explain the economic factors that affect the rate of population growth, given that families are free to make their own decisions. This means that we are going to ignore, for the moment, the efforts of various nations to increase or decrease their populations.

We can classify the productive aspects of children into two categories. First, we have the family labor motive, wherein the family captures the labor income of the child. In this category we have the use of children as laborers on the farm or in family businesses. In the past, and even now in many LDCs, children can be sent to work outside the home and their wages delivered to the parents. Second, we have the family retirement motive. In this category children are used to provide retirement income for their parents and they in turn will receive similar benefits from their children. Economists refer to this form of retirement plan as a consumption loan. Thus, we refer to this aspect of the productivity of children as the consumption-loan motive.

In the past the consumption-loan motive was particularly important since, for most families, the only guarantee of an income that parents

had for their old age was their children. In effect, we had the equivalent of a contract between parents and children. The parents raise the children, feed and clothe them during the unproductive childhood years. The children, in turn, feed and clothe the parents when the parents useful work life is over. This form of social contract was very consistent with the idea of the extended family. In the extended family no one had an incentive to break the contract because if a child broke the contract then his children could be expected to break their contract with him.

IV. The Decline in the Value of Children

If we are to understand the relation between the rate of growth of population and the per-capita incomes of the countries of the world, we must be able to explain why children have become less valuable in the developed countries over the past century. This explanation must be in terms of the motives for having children as we have outlined them above. If, by using these simple motives for having children and the changes that have occurred in the costs and benefits of children over the past century, we can explain the trend in the rate of population growth, then we have come a considerable way toward understanding the population problem.

The strength of the two motives, the consumption and production motives, depends on the costs of raising children and on their returns as investments compared to alternative forms of investment. Over the past century, in the developed countries, several factors have contributed to the reduction in the value of children as investment goods. These factors are especially relevant when one compares the LDCs and the developed world. The changes in the world during the past two hundred years and particularly during the past fifty years, have served to greatly reduce the value of children as productive goods in the developed world.

The most significant factor in the value of a child as a productive good, is the parents' ability to capture the flow of income generated by the child. In nations where the extended family is important, where the opportunities for children to leave their homes or communities are few, parents have a better chance of enforcing the consumption-loan agreement. Slavery, of course, is the ultimate in the ability of parents to capture the productive capability of their children.

It is clear that in the developed world, parents have difficulty capturing the income earned by their children. This is especially true for the non-agricultural parts of any developed country. Most, if not all, of the developed nations have child labor laws that prohibit children under a specified age from working. By the time a child becomes old enough to

work in these countries, the child is old enough to leave home. In addition the increase in technology has resulted in an increase in the knowledge required to perform productive work, making children less useful as instruments for earning income. Notably, the agricultural sector is exempt from child labor laws so that agricultural parents can use even young children for farm work.

Parents in the developed countries may appear to be at a significant disadvantage in providing for their old age as compared to parents in the LDCs. True enough these parents cannot force their children to provide them with old age assistance, but the developed countries have alternatives to children for the provision of retirement income. These alternatives are in the form of ownership of financial assets that are easily accessible to all in that they are bought and sold in established markets. In addition, the developed countries have various social retirement programs. These forms of old age provision reduce the necessity of parents forming informal and possibly unenforceable consumption-loan agreements with their children in order to provide for retirement. So we see that significant differences exist between the LDCs and the developed countries that would lead one to expect that the rate of population growth would be greater in the LDCs. Also we have seen changes in the environment as a country develops that reduce the value of children as production goods for their parents.

It is not surprising from the standpoint of the demand for children as production goods that we see fewer children per family in the developed world than in the LDCs. Some additional evidence is that in the United States, agricultural families have larger families than do urban families of similar income levels. We would expect rural families to have more children than urban families because children are more productive in the rural setting for all of the reasons pointed out above. Moreover, there is a net migration of children from the farm to the city. This net migration of people from the farm to the city suggests that the agricultural sector exports both crops and children to the cities.

Finally, we have the fact that from the point of view of the consumption of children services, numbers of children have become more costly relative to investing in children as a means of increasing the services of children. Thus, it has become cheaper to consume any given quantity of the services of children by having fewer children and investing more in each child. Moreover, the greater the value of the parents' time, the more expensive an additional child is relative to increasing investment in existing children. As the opportunities for women in the labor force continue to increase, further decreases in the number of children per family seems likely.

Thus, both from the point of view of children as consumption goods and as production goods, children are more expensive in the developed countries than in the LDCs. Within a given country as per-capita income

rises, the value of children as productive goods falls if the rise in income is the result of the introduction of technology that requires skilled workers. Even if this is not the case, increases in per-capita income increase the cost of consuming children services through numbers versus investing in the quality of children. Our theory then explains the differences in the rate of growth in the population both across countries and within a country.

V. Prospects for the Future

Perhaps now that we have discussed some of the economic determinants of the rate of population growth, we need not fear the future quite so much as before. That is not to say that the importance of the possibility of overcrowding is diminished, but only that the simple analysis that extrapolates the trends of the past cannot forecast the future. Just as in the physical sciences, social trends have causes, and in order to understand and to predict the future we must account for the changes in the causes of the things we are trying to predict.

We believe that our analysis has shown that poor countries are not poor because they have large populations. One cannot expect to reduce population and have the nation's total income stay the same. The real issue is by how much would a 10 percent reduction in the population of a poor country reduce that country's national income. If a 10 percent population reduction reduces national income by less than 10 percent then the average citizen will be better off. But we must remember that labor is a productive resource, and that labor's productivity is the underlying reason for the larger family size in the poorer countries.

Clearly, other factors are at work in determining the rate of population growth. The two factors that have changed the most during the past three decades, especially for the LDCs, are infant mortality rate and death rate. Even with significant reductions in the birth rates in these countries, increases in the rate of growth of their populations would have occurred. In fact, the largest contributor to the increase in the rate of growth in the population of the LDCs has been the eradication of malaria and other diseases that plagued these countries.

In Table 2 we show the trend in life expectancy in the LDCs for the post World War II period. The magnitude of the improvement is startling. The table also shows the infant mortality rate for these countries. Clearly, these two improvements in the general health of the LDCs has resulted in significant increases in the rate of population growth. However, once the effects of these changes have worked their way through the system, the rate of population growth will be reduced to that generated by the general birth and death rates in the LDCs.

Table 2
Infant Mortality and Expected life Span in the LDCs 1950 to 1975

Country	Infant Mortality Rate (Per 1,000 births)		Per Cent Change	Life Expectancy (years)		Per Cent Change
	1950	1975		1950	1975	
Bolivia	116.7	77.3	33.76%	49.71	50.75	2.11%
Chile	153.2	56.4	63.19%	51.87	64.45	24.25%
Ethiopia	84.2*		—	38.50	39.05	1.43%
India	127.1	122.0	4.01%	32.96	45.60	42.23%
Korea	115.6	47.0	59.34%	52.43	65.89	25.67%
Mexico	96.2	49.7	48.34%	38.86	64.67	66.42%
Nigeria	90.8*	—	—	36.95+		—
Thailand	68.2	26.3	61.44%	50.30	60.60	20.48%

Data for infant mortality and life expectancy are from the United Nations, *Statistial Yearbook* and the *Demographic Yearbook* respectively. The actual figures were not always reported for 1950 and 1975. When a particular date was not available the closest date available was reported.

* Only a single year's data was available for Ethiopia (approximately 1963) and for Nigeria (approximately 1950).

\+ Life expectancy data for Nigeria was only available for 1965.

In addition to the general improvement in the health standards of the LDCs, the availability of inexpensive contraceptive devices may well change the future rate of population growth in these countries. We must stress, however, that if family size is primarily the result of individuals making optimizing decisions, then reducing the cost of contraception will have little effect on population growth.

What will be most important in determining the rate of population growth in the LDCs is what happens to the costs and benefits from having children. As the LDCs become more industrialized, the returns from large families will be diminished. As the earnings of the average citizen increase, they will find it less expensive to consume the services of children by investing more intensely in a smaller number of children. Thus, the problem is somewhat self solving.

So as to avoid sounding like Dr. Pangloss from Voltaire's Candide, in suggesting that all is well in this "best of all possible worlds", let us close this paper by mentioning some problems that may be important. We have shown above that given tastes and preferences for children, economic factors are significant in determining the rate of population

growth. But, is it not possible that these tastes and preferences are such that they will, even with economic constraints, generate a population too large? A population so large that we will suffer the fate forecast by such prophets of doom as the Club of Rome?

We have to answer this question with a possible yes. All we have shown is that as the problems of scarcity of space and other resources become more intense, individuals will find it more expensive to have children. Accordingly, they will have smaller families. But they will be basing their decisions on only their individual situations, and not considering the effect of more people on society as a whole. This is what we refer to as an externality, and externalities can be troublesome. They can result in problems such as those predicted by the prophets of doom. We can be confident that the economic factors will slow the process but possibly not prevent the disaster.

This still leaves room for the education of the public as to the full costs of large families. Once all are educated, they should be free to make their own decisions unless we have very strong evidence that these individual decisions will result in disaster for the rest of us. But then who would you put in charge? Is it at all clear that some government agency will, or can, do the job better than individuals freely making their own choices? We leave this decision up to you. After all, it is you who will have to live with the solution.

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Thomas R. Saving is a professor of economics at Texas A&M University. He is the author of numerous journal articles and of two books, Money, Wealth and Economic Theory, *and* Foundations of Money and Banking. *He is past president of both the Western Economics Association and the Southern Economics Association.*

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