

**GLOBAL DEMOGRAPHIC CHANGE:  
DIMENSIONS AND ECONOMIC  
SIGNIFICANCE**



**David Bloom**  
Harvard School of Public Health

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## **Foreword**

I am pleased to make available for wider dissemination the lecture on ‘Global Demographic Change: Dimensions and Economic Significance’ delivered by Professor David Bloom, Clarence James Gamble Professor of Economics and Demography, Department of Population and International Health, Harvard School of Public Health. The lecture was held at ICRIER on December 22, 2004.

Prof. Bloom’s focus, as explained by him, is on new research at the intersection of three very longstanding areas of social science: demographic change, population health, and economic growth. The lecture examines linkages between health and economic growth and analyses the demographic factors and the various channels (of labor supply, savings, and education) through which these factors may affect economic growth. It also emphasizes on the effect of population health and age structure on economic growth. Prof. Bloom advocates the role that market and non-market institutions can play in future, at both the national and global levels, in allowing economies to cushion adverse macroeconomic impacts of demographic changes and to magnify and capture the beneficial impacts.

**Arvind Virmani**  
Director & Chief Executive  
ICRIER

My talk today focuses on new research at the intersection of three very longstanding areas of social science: demographic change, population health, and economic growth. One exciting new line of research has to do with the effects of demographic change on economic growth, and another is examining the effect of population health on economic growth. I have pursued this work with a variety of co-authors, with my Harvard colleague David Canning being my principal collaborator.

My plan is to divide this talk into five central parts. The first is about the links between health and economic well being. Then I will speak on the effect of demographic change on aggregate economic performance. I'd like to go on from there to what the results I will share with you say, as well as try to be very clear about what they don't say. Then I will turn my attention to the results, in particular to the demographic results, to try to understand the economic performance and prospects of our world's two population superpowers – namely, India and China. Finally, I'd like to comment on the emerging place of health, both general health and reproductive health, in the process of development.

Let me start by taking note of what is certainly one of the oldest and the most persistent questions in the whole field of economics, namely: Why are some countries richer than other countries? For instance, why is per capita income in Chile three times what it is in Egypt? Or why is the per capita income in Singapore 30 times higher than it is in Azerbaijan? Or why is income in Norway 130 times higher than in Nigeria?

This question of why some countries are rich and other countries are poor was first posed by Adam Smith more than 2 centuries ago in his seminal book 'The Wealth of Nations'. Economists have been chipping away at the answer ever since. The basic view, which has dominated the field of economics for most of the past few centuries, is that income disparities between countries are due to corresponding differences in these countries' stocks of physical capital and technologies. In other words, it takes physical capital and technology to create output. It stands to reason that some countries have more output or more income than other countries because they have more physical capital and better technologies than those of the other countries. And that is basically what Adam Smith's view was. When I talk about capital, I am talking about tools; I am talking about equipment and infrastructure, like harbors and irrigation systems, and communication networks. I would also include natural resources: oil, minerals, what have you.

According to this classic view of economic growth, national income increases because of capital accumulation and also because of technological change, and the benefits of income growth essentially trickle down to the poor.

It turns out that for many years, as economists worked on this, they discovered that income differences across countries were very large, relative to the differences in the capital stock and technologies across countries. So although it seems clear that capital stock and technology have something to do with explaining income differences across countries, there must be some other piece of this

explanation missing. In the late 1950s, the notion of capital was augmented to include the concept of human capital, mainly education and skills. T.W. Schultz, a professor of Economics at University of Chicago, was awarded the Nobel Prize in Economics for introducing this notion. What I refer to here as 'capital plus' is essentially physical capital stock, including infrastructure and natural resources, and also human capital stock.

The period when this idea was introduced coincided with the period in which the income inequality between countries exploded. This is one of the dominant features of the world economy over the last 50 years. While Schultz's notion -- that we should view capital in a much more general way, to take into account not just physical but also human capital -- gave us a more complete explanation of the income differences across countries, it was still not enough. It was clear even then that there must be something else going on.

So about 20 years ago, economists -- I apologize for simplifying 200+ years of research, but I think this captures the gist of what took place -- added an arrow to the diagram that comes back from income to the capital stock. They gave it fancy name. They called it an endogenous growth model. Basically, it is a feedback effect that reflects the idea that high-income countries invest more in the education of their young, and that they invest more in the development of their infrastructure and the rest of their capital stock and more in research and development.

So you have the capital stock feed into income and income feed back into the capital stock. It is a very powerful idea because you can have a situation where a small initial difference in the capital stock can lead to a small initial difference in income. That difference feeds back and generates an increase in the difference in the capital stock. This results in a process of cumulative causality. The small initial difference in the capital stock ends up, when all the dust settles, resulting in a large income difference, in this case across countries.

Whether these models can provide an adequate answer to Adam Smith's question depends on the magnitude or the strength of the arrow that points back from income to capital. What we've learned over the past two decades is that yes, there is indeed the arrow that comes back, but it is just not big enough in the end to account for the gigantic income differences across countries. 130 to 1 is the ratio of income in Norway to income in Nigeria, as I mentioned a moment ago.

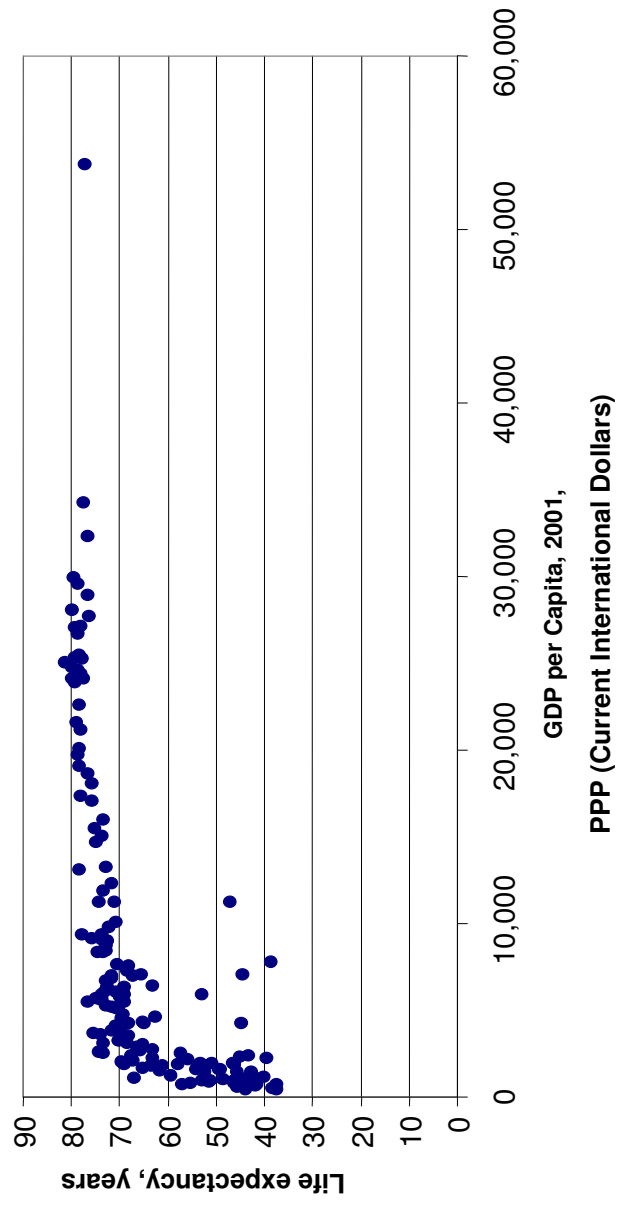
Now, I think a very important point to note here is that population health doesn't figure at all in this paradigm. It has not been viewed traditionally as a cause of income growth, it has not been viewed as a cause of capital accumulation, and it has not even been regarded as an aspect of human capital, in the way that education has, for example. That means that public-health spending could not be justified as an instrument of economic growth. It could only be justified on a traditional basis – on moral, ethical, and humanitarian grounds and on grounds of social equity.

I will have little bit more to say about that in a few moments.

At any rate, that picture, I think, captured the scene as of 5, 6, 7 years ago. Our macro-economists were continuing to search for a fuller explanation of the income differences across countries, and they were also continuing to ignore population health. Now, I think it is natural to ask why it is that macro-economists were so narrow in their views, by and large. And as far as I can tell, one main reason for that is actually this chart (see Figure 1). This chart documents what one would describe as one of the best-established patterns in the whole field of International Health. And that is the positive association between health and income, or, because it rhymes, we often say between health and wealth.



**Figure 1: Life expectancy & income in 2001**



On the bottom axis we have income per capita -- this is for 2001 -- and along the y axis we have life expectancy as a measure of health. Each of the dots represents a country. I understand that there are some exceptions, but by and large the countries that have higher income per capita also have better health, as measured by life expectancy.

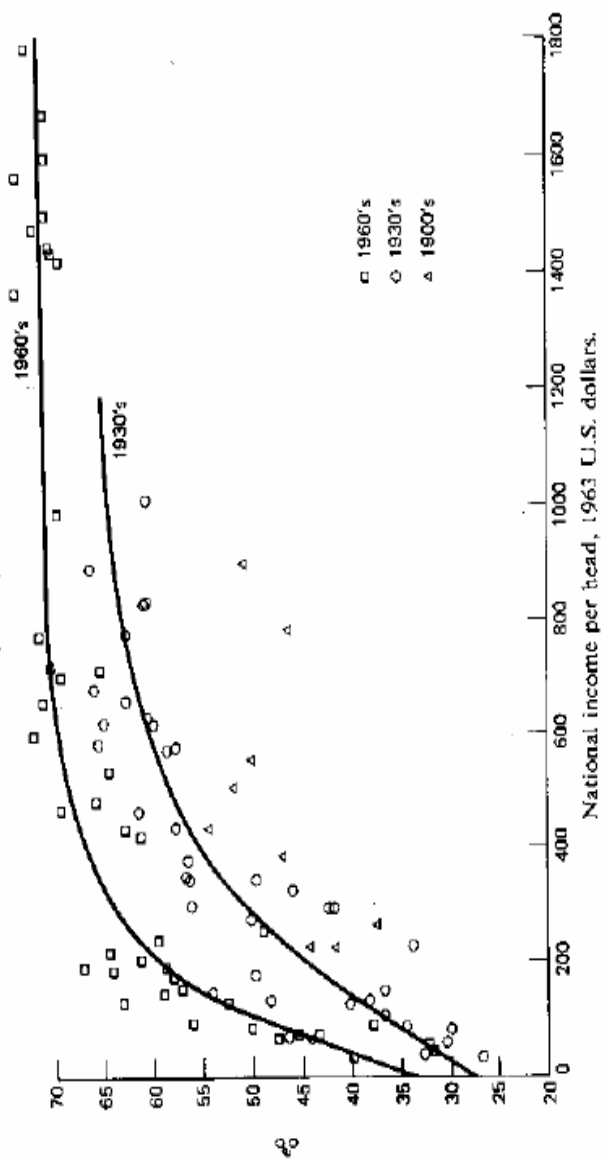
Furthermore, you get the same basic pattern whether you measure income in PPP dollars or exchange-rate dollars, or if you use dollar-per-day or two-dollar-per-day poverty. And if, instead of life expectancy, you put on the health axis the infant mortality rate or child mortality rate, you will get the same pattern.

Now, the key feature of this chart is that income has been placed on the x-axis and health on the y-axis. Thinking back to high school geometry classes, normally the horizontal axis is what we think of as the independent variable. What we think of as the dependent variable is what you put on the Y-axis. So when we draw the diagram this way, there is some implied causality. What is implicit in this diagram is that the causality runs from income to health.

This chart has a name: the Preston Curve (see Figure 2). It was introduced almost three decades ago in an article published in 'Population Studies' by one of the very best demographers in the world, Sam Preston, in an article titled 'The Changing Relation between Mortality and Level of Economic Development'.

Figure 2: The Preston Curve

Scatter-diagram of relations between life expectancy at birth ( $e_0^*$ ) and national income per head for nations in the 1900s, 1930s, and 1960s.



I can show you the chart as he had it. What he did is go back and get as many observations as he could from the early 1900s, the 1930s, and the 1960s, plotting observations on income per capita along the x-axis and life expectancy on the y-axis. He didn't have enough points to fit a curve back to 1900, but there were points to fit data for the 1930s and 1960s. What Preston was interested in was whether or not life expectancy increased over the 1900s because of income growth. If in fact it is because of income growth, you would see a movement along the curve. As income goes up, countries experience higher life expectancy. But it is quite clear from the lines that fit the data that we also have a shift of the curve.

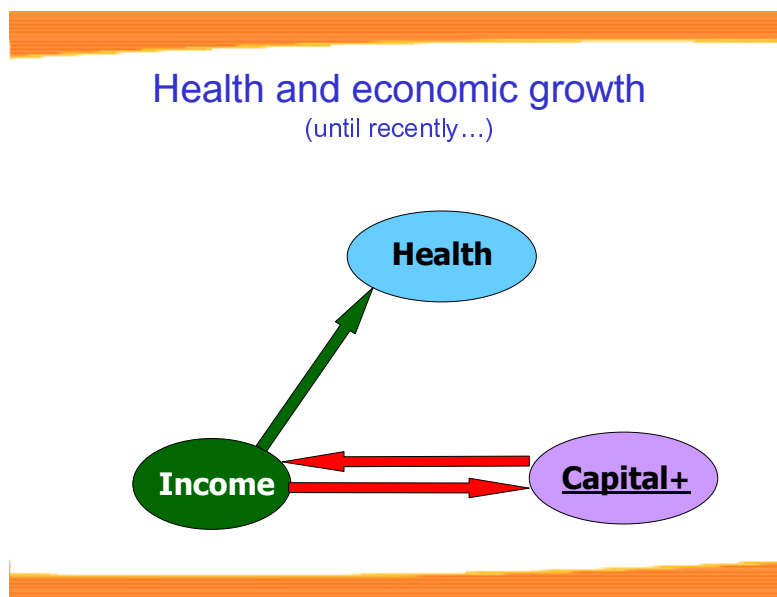
In other words: in the 1930s, for a given amount of income, you had one level of health, but in the 1960s, that same income level translates into a higher level of health. What Preston concluded was that income growth accounts for about a fourth of the increase in life expectancy during the last century, and the rest is due to improvements in health technology and also in public health practices.

One bit of more recent work is associated with an article that was authored by Lant Pritchett and Larry Summers, who is now President of Harvard University. They wrote an article in 1996 entitled 'Wealthier is Healthier'. The basic story that they tell – consistent with Preston's diagram – is that causality runs from income to health. Now, it is not a crazy idea by any means to say that causality runs from income to health. For example, when countries have higher incomes, people have better nutrition. They have better access to safe water, better access to sanitation, better

access to more and better medical care, better psycho-social resources, etc. It is certainly plausible to think that there is causality that runs from income to health. And this notion that wealthier means healthier was their attempt to explain Preston's diagram, and to explain why we have a positive association across countries between income and health.

If we just make a little aside to take stock of where we are at the moment – I think it is sometimes helpful to combine these various ideas into one diagram (Figure WW). Here we see that with respect to national income, all the action takes place at the bottom of this figure.

**Figure WW**



The causality runs from capital to income and from income back to capital. That is how the income is determined. In the classical economics framework of a few years ago, health was very much an afterthought. It was conceived of as an afterthought in the process of economic development. This was the traditional macroeconomic notion – that higher income leads to better health, but that population health is a consequence and not a cause of the development. In this framework, it doesn't effect economic growth.

I think it's a little bit embarrassing that it appears that over two centuries, and certainly in the last thirty years since the Preston diagram, economists have forgotten that the scatter plot only really shows an association. It does not prove causality. It could be the case that there is causality that goes from income to health. It could equally well be the case that there is causality that goes from health to income. Or neither could be true: there could be some other variable out there that affects both health and income, and it induces this correlation that we see.

What I'd like to do now is bring us up to date and really focus on the work that was begun in academia and came to the fore through the World Health Organisation's Commission on Macroeconomics and Health. And that is the idea that there is also an arrow that runs from health to income. In other words, it is not that the arrow that goes from income to health is wrong, but that it is not the whole story. A great deal of research has been going on at universities and think tanks around the world for several years. It has been a very exciting time for people working

in the area of international health economics. New work seems to be suggesting – just for now, I'll discuss conceptually but I will speak a little bit more about the data analysis and empirical work in a few moments – that there are a number of plausible reasons to think that, yes, there is an arrow that goes from health to income.

First of all, I'll try to classify the different lines of literatures that have been developing. The first is that a healthy work force is more productive. People have more energy and they have good mental health. There is less absenteeism when people are healthier. And there is also a term that has been coined quite recently called presenteeism. Presenteeism is what happens when people who are ill, fatigued, or distracted show up to work anyway, when you'd rather that they stayed at home. It is actually the title of an article in a recent issue of 'Harvard Business Review'. I think it is certainly reasonable to think that labour productivity is greater when you have a healthier work force.

The second argument that has been offered has to do with education. Essentially, the way that economists think about the education is as an investment. You pay tuition and fees today and forego certain earnings while you are in school as opposed to working, in the hope of getting higher wages later in life. Well, a healthy population is a population that lives longer, and if people live longer then there is longer horizon over which people can recoup the benefits of their investment in education. They have less absenteeism due to sickness in disease, but also they work more years – instead of working into their 50s, they might

work into their 60s, for example. If it is the case that people work longer and get higher wages for more years in the work force, then it is also the case that the rate of return on this investment in education will be higher. We normally think that when the rate of return on something is higher, people invest more in it. And of course if people invest more in education, then that is going to contribute more to economic growth. Indeed, I think it is generally accepted that education is a powerful engine of economic growth.

A healthier population not only promotes income growth as people go to school and go for longer, but healthier children also get more out of each day they spend in school. It's actually fairly well established that children's cognitive development proceeds faster when they are healthier. So not only do you get more years of human capital accumulation, but you accumulate more human capital each year.

The third argument is investment – the idea here is that when a population expects to live longer than did earlier generations, they need to save more now for a longer period of retirement. If you think that you will live to 55 or 60 years, then you probably think that you are going to work until you die. But if you think you are going to live to be 75 to 80 years old, then you probably expect a certain number of years where you are not going to be working, and you need to save now for the future. In economics, savings translate into investment capital accumulation and that is the whole capital-income link that is at the core of the economic growth literature.



There is also the idea – Jeffrey Sachs originally offered this conjecture but it’s now been demonstrated empirically – that healthy populations are also magnets for attracting FDI. There is actually evidence of how healthy populations can attract investment from abroad, and with investment comes creation of jobs and technology, etc., which is another form of capital accumulation in the country.

Finally, the last of these notions has to do with demographics, and I am going to say more about this in a few moments. For now, let me suggest that health improvements trigger a process of demographic change that promotes an age distribution that is increasingly favourable to economic growth. That has the name “demographic dividend”. We’ll come back to that.

The empirical work that has been done on these mechanisms includes work on labour productivity, education, investment, and demographics. The first three of these, as it turns out, seem to add up to quite a lot. They are important individually and also collectively. As a summary, I’d say maybe 60 studies have been done in this area over the past five to seven years. As a rough rule-of-thumb guide, a ten-year gain in life expectancy, which is well within the reach of developing countries today as judged by historical example, translates to as much as one additional percentage point of income growth per capita per year. That is extra and of course we know about the cumulative effect of compounding an extra percentage point every year, year in and year out.

As I said, roughly 60 studies have been done on it, and they have used many different data sets, many different control variables, different econometric techniques, and different instrumental variables. If we cut right to the chase, the bottom line here seems to be the new finding that emerged and that really got into the bright light as a result of the work of the Commission of Macro Economics and Health – that population health is an exceedingly robust and powerful predictor of economic growth. We can imagine two countries that are identical in all aspects that are important for economic growth, except that the people in one country are healthier than the people in the other country. This new finding tells us that the country with the healthier population will grow its average income and reduce its poverty rate faster than the other country.

I now turn back to the demographic channel of this population health idea, so let us focus on that. I thought we could start the discussion with a bit of background on the links between population size and economic well being. Table 1 shows the milestone years in which it is estimated the world population reached each successive billion.

**Table 1**

<b>World population in billions</b>	
<i><b>Population and year</b></i>	<i><b>Time taken to add a billion</b></i>
1 billion in 1804	1,001,804 years
2 billion in 1927	123 years
3 billion in 1960	33 years
4 billion in 1974	14 years
5 billion in 1987	13 years
6 billion in 1999	12 years
7 billion in 2012	13 years
8 billion in 2026	14 years
8.9 billion in 2050	26+ years

It supposedly took more than 99% of human history to reach a world population of 1 billion around the year 1804. For the past four decades, and at least for the next two, you can see we're adding another billion people every 12-14 years. Just in historical terms, population growth is taking place on a scale now that is really quite unprecedented.

Now, concerns about the effects of rapid population growth on economic well being go back a long way, not quite as far as Adam Smith, but at least to that general era, to the work of Thomas Malthus. Malthus took note of the 'irrepressible passion between the sexes' and its implications for human misery. The population would expand at an exponential rate, whereas the food supply

would only expand arithmetically. Population would basically outstrip us, pun intended, and food supply scarcity, famine and disease, and widespread suffering would be the result. Malthus was the original population pessimist and he had this dim view of the prospects for humanity.

It turns out that there is a different view that is very optimistic about population growth. It's the view that necessity is the mother of invention, or that necessity is the mother of adoption, and that population growth would act as a spur to technological and institutional innovation. Technological and institutional innovation would increase the carrying capacity of the earth, food supply in particular. That view is associated with some work done by Esther Boserup at Berkeley, by Julian Simon, and also by Simon Kuznets, another Nobel Prize winner in Economics.

So demographers have these two very different views. We have extreme population pessimism on the one hand, and, on the other extreme, we have the view that rapid population growth is a good thing.

According to one expression of the latter view – the so-called genius theory – the more people born, the more geniuses there will be. Supposedly, one in about every 100,000 to one million people is a true genius. It's the absolute number of geniuses that is important for global prospects, and not the relative number. That theory has come into some disfavour in recent years because people have increasingly recognized that when geniuses are malnourished, they do not do their best work.

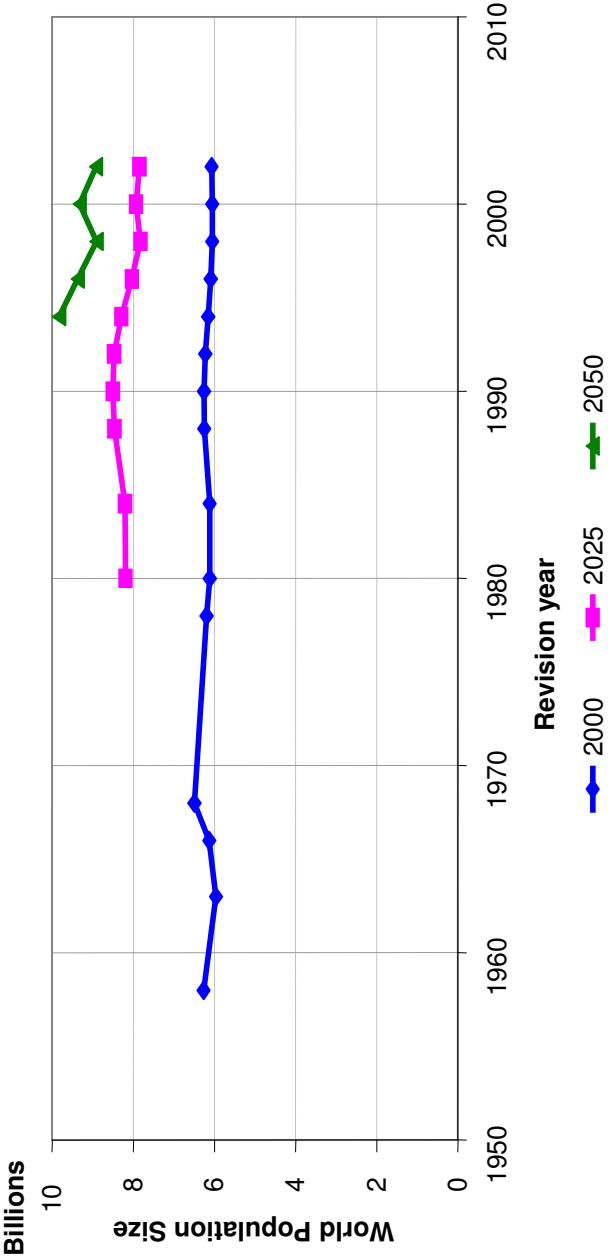
Nevertheless, we have two views, pessimistic and optimistic. Midway through the 1980s, a different view began to emerge and that view came to be known as population neutralism. It was canonized in a 1986 report published by the National Academy of Sciences in the US. This report showed that when you actually look at the evidence, there are many examples of countries in the world in which population has grown rapidly. Economic studies of these show such a wide range of experience that it is really difficult to extract a signal indicating that rapid population growth actually impedes economic growth. In other words, population growth seems to be neutral in its impact on economic growth, which is exactly what the US delegation to the Mexico City conference in 1984 said.

I think the real question here is whether the academic research is actually what had the impact on what was said or whether the ideologies associated with the Reagan administration did. I think that probably ideology was driving the belief at that time. Most likely, the academic study was used as window dressing, but the idea was essentially a result of a conservative reactionary ideology. At any rate, the result was that academic research in population and reproductive health basically slid off the radar screen in many influential donor agencies. Research that has been done in the last six to seven years now reveals a major defect in the conclusion that was reached by the National Academy of Sciences.

That defect has to do with a pre-occupation of economists when they talk about demographics. It is almost an obsession: population growth as the sole important

indicator of demographic change. But what people have pointed out in the last two years is that equally important, and perhaps more important, is population age structure. That has quite surely been neglected. The population division of the UN produces projections of world population (see Figure 3) and for a long time, they have projected up to the year 2000. And in the last few years they have also produced projections for 2020-25 and now up to 2050. In 1994 the UN Population Division was projecting that world population by the year 2050 would be 10 billion. They have since steadily revised that downwards. So the 2002 UN projection of global population in 2050 is now down to 9 billion – really 8.9 billion – as a result of a fertility decline that has been faster in many countries than they had anticipated, and also as a result of AIDS mortality.

Figure 3: Projected World Population by UN Revision



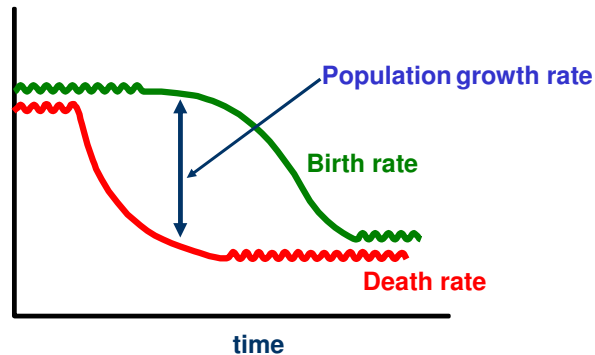
As a result of these declines in the projected population, many people have been arguing in the last two years that the world no longer has a population problem. And I want to suggest that, to some extent, it may be true that the very explosive character of the world population has somewhat abated. I also think that we should not lose sight of the fact that the world population is a little over 6 billion now and will be almost 9 billion by the year 2050. That means adding three billion more people over a century. That is a lot of people, almost three times the size of India's population. I don't think it is a trivial test by any mean to take up the challenge of absorbing three billion additional people into the world population and providing for them. I find it hard to conclude that the world doesn't have a population problem when we are growing at that pace.

Now, we are talking about population growth, and whenever demographers think about population growth, there is one model that naturally springs up. It's like when you ask an economist a question and they automatically resort to supply and demand. When you ask demographers about population growth, this is what most of us first think about. This model is known as the demographic transition model (see Figure 4). It refers to the transition from high rates of fertility and mortality to low rates of fertility and mortality. The transition takes place in an interesting way, because the changes in fertility and mortality are not synchronized: mortality tends to decline first and fertility declines afterwards.



**Figure 4: The Demographic Transition**

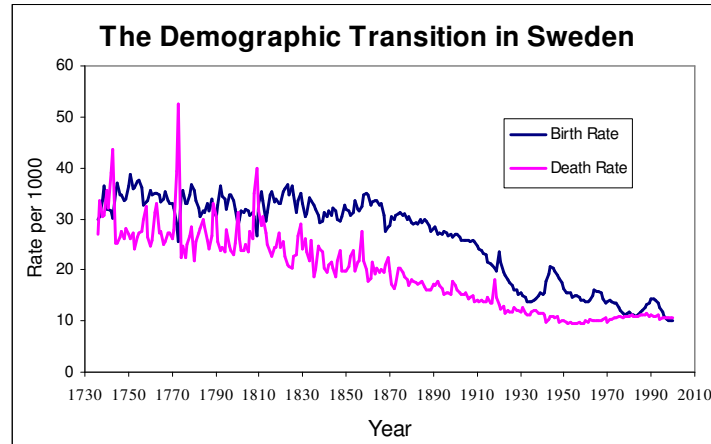
### The Demographic Transition



In a closed population – we can keep migration aside for the moment – the difference between the birth rate and death rate is the rate of population growth. That is why demographers think about this diagram: it is a tool to understand population growth. The demographic transition reflects a decline in mortality before a decline in fertility. You start out with a low rate of population growth and very little difference between birth and the death rates. You advance to high rates of population growth and then transition back to low rates of population growth. Now, if you actually look at the data, they will never look as neat as that, but, by and large, this is a reasonably good explanation of many countries' experiences.

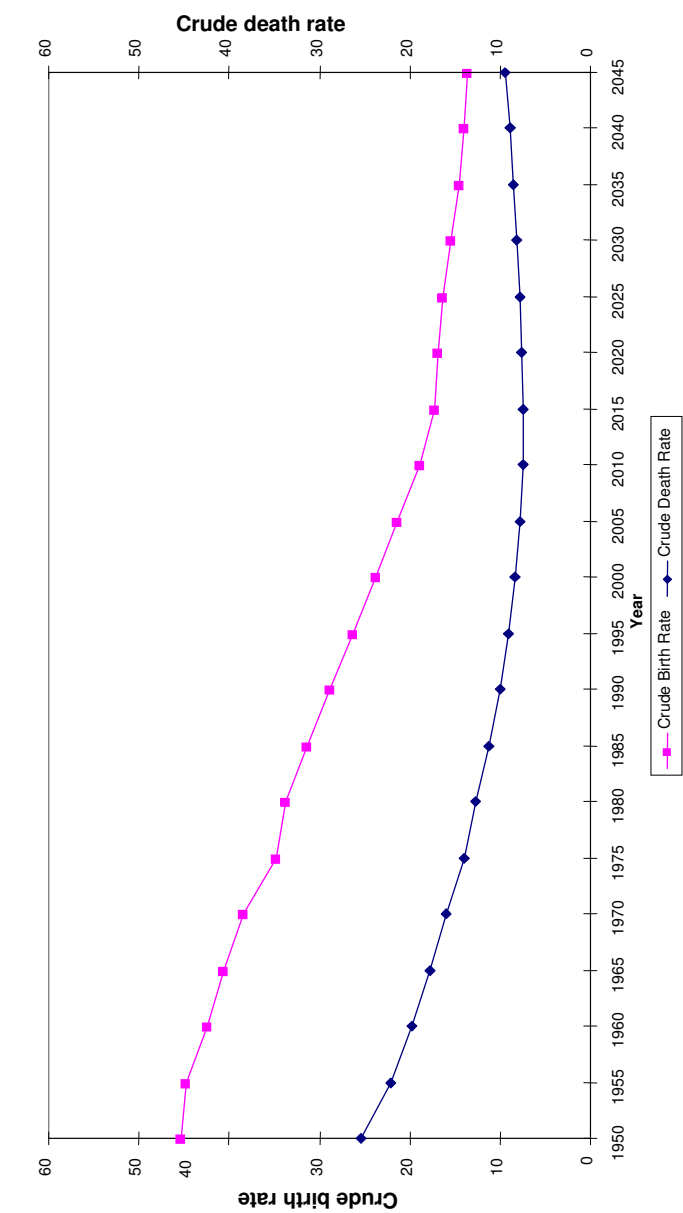
I want to share with you some data from Sweden (see Figure BB). Sweden is very valuable for demographers, because it is one of the few countries in the world for which we have very long, fairly good, time series demographic data. Let us first look at the death rate. Before the year 1800, the death rate in Sweden was consistently high. There were periodic spikes caused by epidemics, disease, famines, etc., but starting around 1820 there was a long-term decline in the death rate. There were some spikes in the death rate afterwards as well; one major spike was associated with the flu epidemic of 1918-1919. For the most part, however, the spikes are considerably attenuated after 1820. This decline in the death rate took place prior to the germ theory of disease and prior to the widespread provision of clean water and sanitation systems in cities. Those didn't come along until the second half of the 19<sup>th</sup> century. Historically, you also have a very high crude birth rate in Sweden, but starting around 1870, i.e., 50 years after the decline in the death rate – the point I was making about the asynchronous changes in fertility and mortality – there was a large decline in fertility rates throughout western Europe and also in Sweden. Of course, in the interim you have population growth.

**Figure BB**



India also seems to subscribe to this general pattern of demographic transition. In 1950 – the first year for which we have UN population data – you have a crude birth rate of about 45 and a crude death rate of around 25, a difference of 20 (see Figure 5). That difference widens over the next 15-20 years, and it's actually shrunk down again in more recent years. This diagram serves as a lead-in to a very important feature in the demographic transition, which is that population growth is not the only consequence of the demographic transition. Societies also experience changes in the structure of their population.

Figure 5: Crude birth and death rates, India



Why do we get changes in the age structure of the population? Well, one thing demographers know -- and this is another part of our basic training -- is that when a population has high mortality and this mortality rate declines, those declines occur disproportionately among infants and children. Because infants and children are initially the greatest beneficiaries of improvements in the mortality, what that decline really does is create a baby boom. However, it is not the usual kind of baby boom we are used to. The usual baby boom is one where more babies are born. This is a baby boom created not because more babies are born but because more of the babies that are born survive. Eventually the baby boom ends. Fertility rates come down sometime after the baby boom as couples realize that they can achieve their desired fertility with fewer births, because the survival rate is higher or because their desire for children is moderated.

I don't want to give the impression that all population growth and all changes in the age structure of the population are associated with the demographic transition. There are also bona fide baby booms, where more babies are born, and echo effects of baby booms. If you look at the data for Japan, you see a bump around 1970. It turns out that Japan had a baby boom following World War 2. It was a very short, five-year baby boom, from 1946-51. Actually, we have recently been advised by Bob Wyman, a biologist from Yale University, that the reason the baby boom ended abruptly in Japan was that in 1951 abortion was legalized in Japan. The indication of the data that has been shared with us is that the rate of pregnancy stayed the same afterwards,

but the rate of abortion went up, resulting in fewer births. That bump in 1970 would be the echo of the earlier baby boom in Japan.

Following the flu epidemic in 1918-1919, there was an increase in fertility. During World War II, there was the postponement of child bearing because of spouse separation. And again, there was a postponement prior to World War 2 when the world was in economic depression, as many people postponed child bearing due to uncertainty and economic hardships. A period of postponement is often followed by a baby boom.

The unfolding of the baby boom over time has a name, the 'Pig in the Python' phenomenon, or the PPP. When a python swallows an animal, over the course of several days you see a bump move through the animal slowly as the animal is digested. By analogy, what happens in a baby boom is in the early years there are lots of children. Because every time a year goes by the age of the group goes up by one, as the boom ages through the working ages and into the older ages, you get a bulge in the age distribution that moves through the population curve like a wave.

Now this potentially has economic consequences for the following reasons. Initially, when you have lots of babies, you have to take care of them. That means you have to divert resources from other uses. We have to feed, to clothe, and to house these children, and we have to provide medical care and education, etc. That means we are not building as many bridges, digging as many harbours, or

creating as many ports. In other words, the resources that are normally put into building up the economy -- the infrastructure both public and private -- are being used to raise children.

One might think that during the years when you have many children, measured economic growth is lower. Eventually, however, those children are going to reach the prime working years. If they have been equipped with the right health care and education, what will happen when they reach the working years is that the productive capacity of the economy will expand on a per-capita basis. There will be more workers per capita, essentially. Eventually, on their reaching old age, there is the question of whether they will actually drag down the economy, and we will come to that in a few moments.

Now, there are a couple of things potentially operating in this situation. One is that when children reach the working age, there is a pure accounting effect. You have the potential for rapid economic growth if those children end up in productive employment. You also have another accounting effect because those years tend to be high-savings years. Children by and large don't save. Life cycle theory also suggests that the elderly tend not to save, but that is another discussion, because they seem to save in fact a lot more than economists ever imagined. The prime years in which people save tend to be 30s, 40s, and 50s. So if you have more people, and a bigger share of the population is at those ages, you can expect higher savings. Higher savings rates tend to translate into higher human capital and

physical capital accumulation. And that is one of the engines of economic growth.

But this story is not just about accounting; there are also behavioural effects. When women begin having fewer children as a result of the end of the baby boom, you might expect that women of a given age will be more likely to go to work. So the labour force participation rate of women will tend to increase. Also, for the arguments mentioned before, you might expect that people save more as longevity increases, as people try to increase their wealth. So there are some accounting effects and also some behavioural effects, at least in principle.

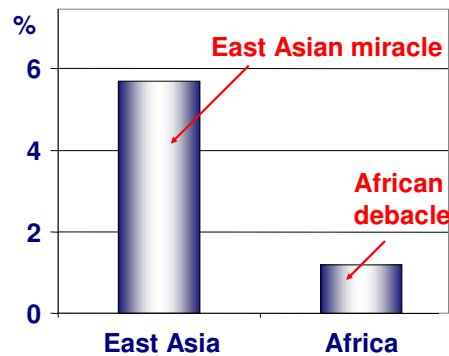
So far, this is all at the level of hypothesis and conjecture. What I'd like to share now are a few facts and some related evidence. The easiest way to get into this whole empirical literature is to focus attention on the two regions of the world that are most extreme, both with respect to economic performance and also with respect to demography. Those two regions would be East Asia and Africa among the low- and middle-income countries.

These two bars (see Figure 6) reflect the growth rate of income per capita in these regions during the years 1965-1990. That first bar has a name and it's the 'East Asian miracle'. It refers to the fact that never before in history has such a large group of countries grown their income per capita at such a high rate for such a long period of time as East Asia during this period.



**Figure 6: Growth rate of GDP per capita,  
1965-1990**

Growth rate of GDP per capita,  
1965-1990



When the World Bank tried to account for these high growth rates in mid 1990s, they found that they actually couldn't. And so what did they do? They called it a miracle. I think it was meant in a lot of ways as a confession of ignorance. At the other extreme, we have economic performance in sub-Saharan Africa, which was on the order of 1% per year growth of income per capita. Almost 6% to around 1% -- that is the range of global experience during those years.

I said that these are the most economically and demographically extreme regions. The basic pattern of

death and birth rates in East Asia does not look exactly like the demographic transition diagram, but it does have the main features. The mortality rates came down while the fertility rates were essentially still flat, and then eventually fertility rates came down. This gave rise to population growth and I will show in just a moment the changes in the age structure of the population as well.

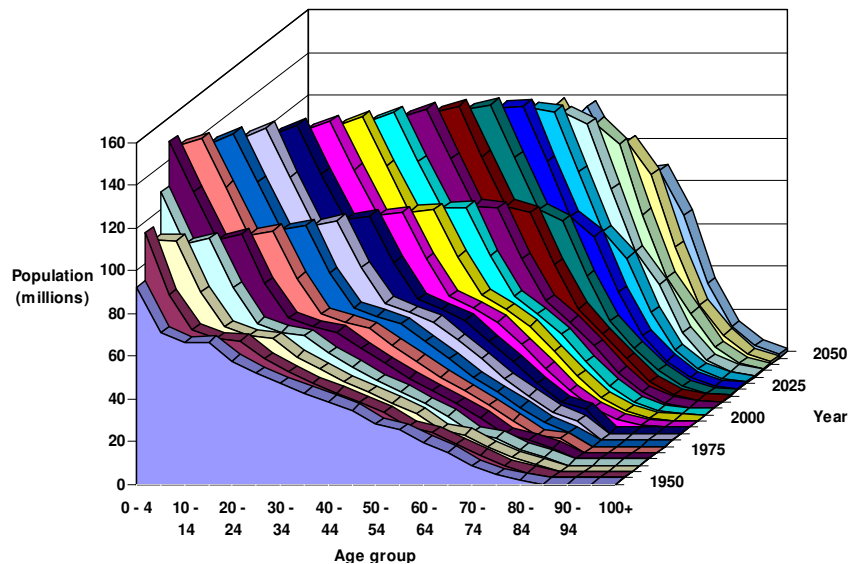
By contrast, the numbers and the trajectories in Sub-Saharan Africa show a decline in death rates while fertility remained essentially flat. It is a very sluggish response of fertility to the decline in death rates. Actually, the difference between crude birth rates and crude death rates in the year 2000 was larger than in the year 1950. So Sub-Saharan Africa really is only mid way through its demographic transition, unlike East Asia, which had the most rapid demographic transition on record. There are reasons for this kind of pattern and I will come back to this in a moment.

I'll briefly point out that there is actually much less cross-country variation in the timing of the mortality declines than there is variation in the timing of fertility declines. That suggests that perhaps there is a common cause of the health improvements in different countries. It turns out that if you look at medical history, this period is known as 'the golden age' in the development of antibiotics and other agents against disease.

Figure 7 is a three-dimensional variation of the demographers' favourite diagram, the population pyramid. In each slide, I put together a pyramid for a different year,

and the first shows the population pyramid in 1950 for East Asia (and the basic features of the picture change only a little if China is not included in the data). The second is the population pyramid in 1955 and then in 1960, etc. Each diagonal ridge represents one age cohort of people over time. Every time five years go by, that group of people will be five years older. What is most salient about the diagram are these ridges along the diagonals. Those ridges are the Pigs in the Python and the echo effects of the Pig in the Python.

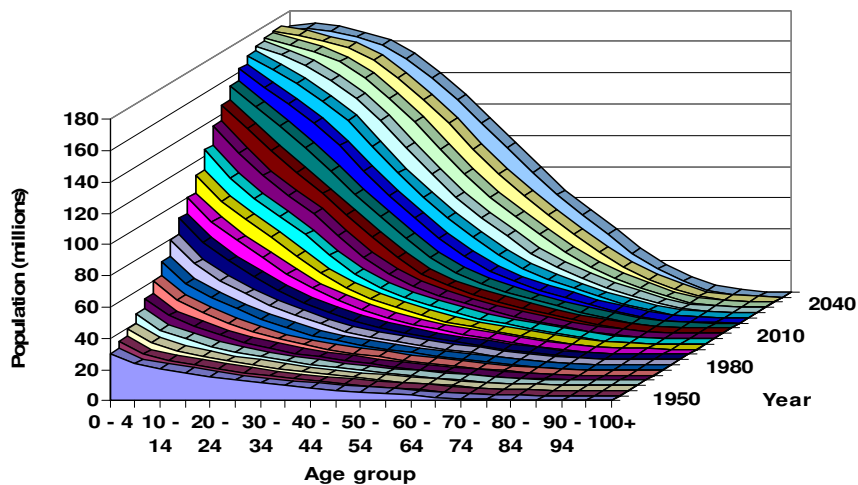
**Figure 7: East Asia's population**



*Source: UN, World Population Prospects: The 2000 Revision*

So East Asia had a very rapid demographic transition. The changes in the age structure of the population are very pronounced and they show up in a diagram like this. By contrast, in Sub-Saharan Africa, which has had a very sluggish demographic transition, there are no ridges in the diagram (see Figure 8). All you see is a large, growing population that is getting younger and younger.

**Figure 8: Sub-Saharan Africa's population**



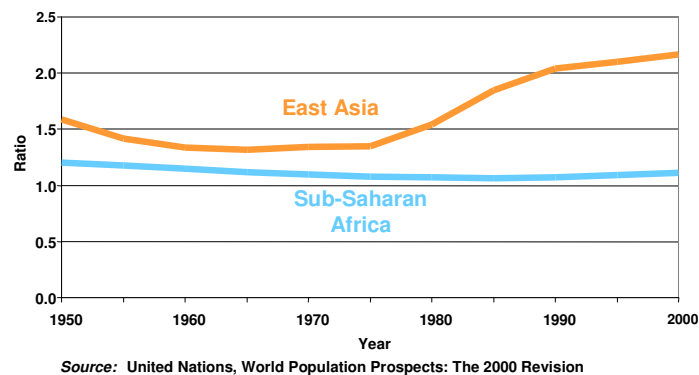
*Source: UN, World Population Prospects: The 2000 Revision*

Another way to look at these numbers is not in three dimensions but in two dimensions. What is shown in Figure 8a is the ratio of the working age to the non-working age population. The working age population is 15-64 and the non-working population consists of those less than age 15

or age 65 and over. There are a few things to note. First of all, in Sub-Saharan Africa, the number of workers to non-workers has been lower through this entire 50-year period than it has been in East Asia. Second, in East Asia there was an initial decline in that ratio. That is because of the baby boom, which occurred as mortality rates were declining. In other words, because there was a baby boom with more children surviving, the denominator for the non-working-age population started to go up.

**Figure 8a**

Ratio of working-age to non-working-age people  
in Sub-Saharan Africa has been stable



So at first the ratio came down, but as the Pig in the Python moved through the age distribution, there was a

very sharp and substantial rise in the ratio of workers to non-workers in East Asia.

Now think about this in a household instead. If you have one worker for every non-worker, that is essentially the situation in Sub-Saharan Africa. Let's say that you increase to more than two workers per non-worker. It shouldn't be a big surprise that the income per capita – the standard of living -- in that household is going to increase significantly. Because instead of one supporting the other, you now have two people supporting one other person. This carries over to the population level as well.

One last way to appreciate these changes is to look at the numbers themselves. What you see is that from 1950 – 2000 the working-age population in East Asia grew 1.8% per year versus 1.2% for the dependent population. That differential between 1.8% and 1.2% per year meant that year in and year out for 50 years, East Asia added more workers -- more people of working age -- than non-workers. I am going to suggest that it's no great surprise that its economy took off during those years. In fact, it has something important to do with this, but we will come to those results in a moment. Looking again at the numbers, by contrast to East Asia, in Sub-Saharan Africa you find essentially the opposite pattern. You have the dependent population growing slightly faster than the working-age population. You have very high rates of population growth overall.

What we have to understand is how to marry this idea about the possible importance of age distribution to the

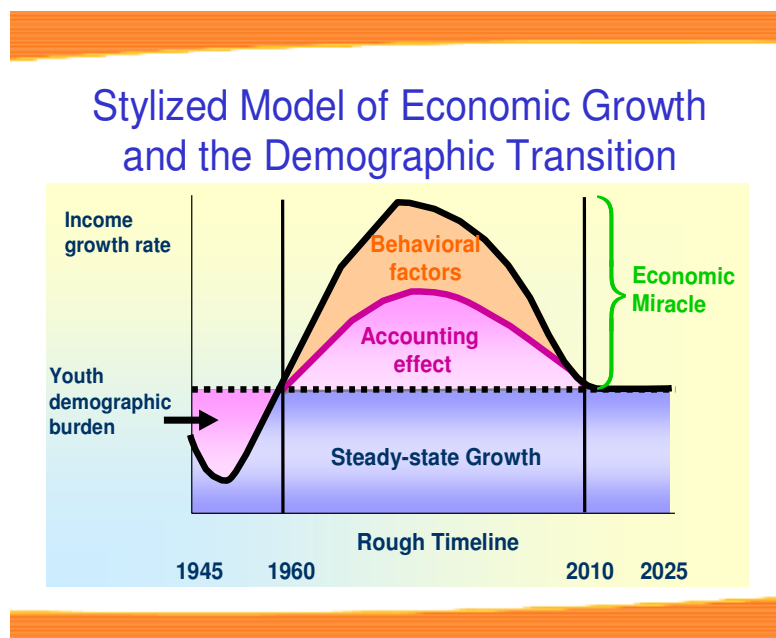
modern models of macroeconomics and economic growth. What my many colleagues and I have figured out turned out to be amazingly simple in terms of the mathematical formulation. We wrote to macroeconomists, and we said: Can you please send us your data? Can you send us your data and can you send us your lists of the variables that you think are important to explain economic growth? Can you send us your computer programs? All we wanted to do was to try one little twist. We put in the age structure of a population. It turned out that with this included, population growth rate was no longer neutral. It looked like population growth was in fact an impediment to economic growth. It also looked like age structure was really important.

So we started to complain to macroeconomists that their models were okay if you assume that every person in the population is a worker, but, of course, that is not true. We have children and we have the elderly, and their numbers are growing at very different rates when you have the demographic transition. When we began to take account of that, what we found was that this is highly significant and very robust. No matter what you put into these equations, those results don't go away. They are not fragile results. I would just note that results related to the role of education in economic growth, for example, are not as robust, somewhat to the chagrin of macroeconomists around the world.

The story is summarized in this picture (see Figure 9). Let us assume we have an economy that is growing at 2 or 3% per year. We call that steady-state growth. The story here is that the demographic transition creates a youth

demographic burden initially. In the first phase of the demographic transition, we have a baby boom. That baby boom drags down measured economic growth a bit, but when the baby boom children reach their prime working years, you have the accounting and behavioural effects -- more savers and more workers and also higher labour force participation rates and more people earning to save because they think they are going to live longer. That can lead to a big bump in the economic growth rate.

**Figure 9: Stylized Model of Economic Growth and the Demographic Transition**





That bump abates when people reach older age. So the demographic cycle induces an economic cycle, and that's essentially the idea. When we drew this diagram originally, we also had a dip when people reach older age, but it turns out that the data didn't support that. So we were surprised and I think it merits further work, but it certainly doesn't seem to be the case that the elderly are a drag on the economy in the same way that children are a drag on the economy. It's presumably because many people in the 65 and over crowd still work. Many of them still save even if they are not working, and they may be enabling their sons, son-in-laws, daughters, and daughter-in-laws to go to work by watching their grandchildren. They have human capital and may also be imparting it to other generations to make them more productive. That is why the diagram is drawn this way.

The bottom line here on the demographic transition is that about a third of the East Asian miracle growth rate of 6% can be attributed to changes in the age structure of the population associated with the demographic transition. That is a demographic effect above and beyond the general health effect on economic growth noted earlier.

Demographics and health together can give a gigantic boost to an economy. I just briefly want to mention another country, lest you think that we're basing this only on the example of East Asia. It turns out, somewhat ironically, that Ireland is also a very interesting example of exactly the same phenomenon. We have all heard about the Celtic Tiger or the Celtic economic miracle, and there is a great deal of literature trying to account for economic growth in

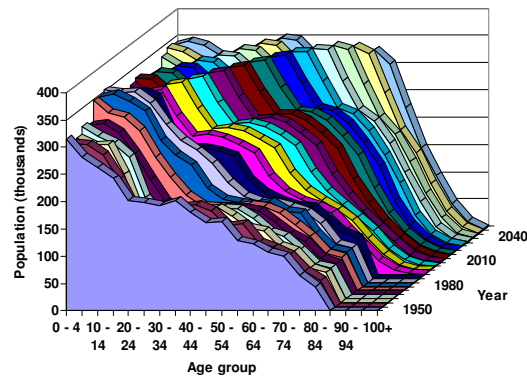
Ireland. In fact, 'The Economist' three weeks ago had a special on Ireland. There's a whole list of reasons in the literature and in popular discussion that try to account for why Ireland did so well economically.

We think that the literature so far has overlooked something. If you look at the history of family planning in Ireland, you find a new rationale for the Celtic economic miracle. Contraception was illegal until 1979. Further liberalization took place in the mid-1980s. It's no surprise, but if you look at the birth rates in Ireland, you see that immediately after contraception was legalized – within the next ten years – the birth rate dropped by a third. This is a very pure form of age structure effect because death rates were already low in Ireland.

Without the initial drop in death rates, you don't have a baby boom that slows the economy down. You just get all the effects of fertility decline immediately. If you look at the three dimensional population pyramid for Ireland (Figure AA), I'd suggest that it looks more like the East Asia pyramid than the one for Sub-Saharan Africa.

**Figure AA**

### Ireland's population

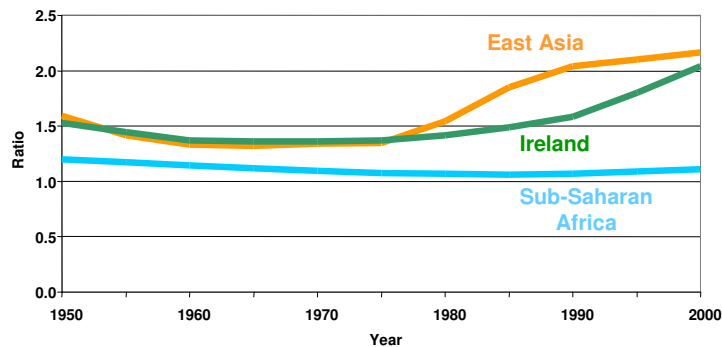


Source: UN, World Population Prospects: The 2000 Revision

If you look at the two-dimensional numbers (see Figure ZZ), you see Ireland tracks East Asia quite closely and then diverges while contraception is still illegal. But then it catches up.

**Figure ZZ**

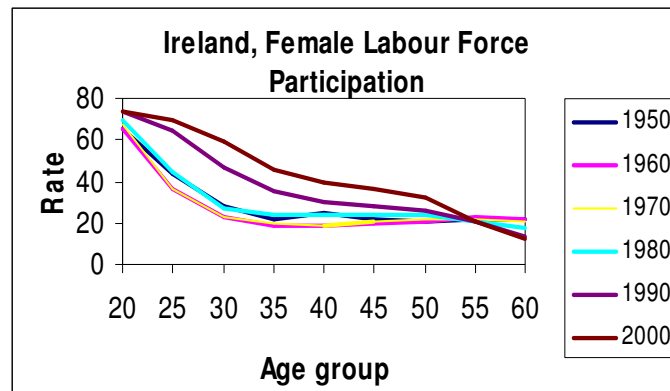
Ratio of working-age to non-working-age population  
in Ireland resembles that in East Asia



Source: United Nations, World Population Prospects: The 2000 Revision

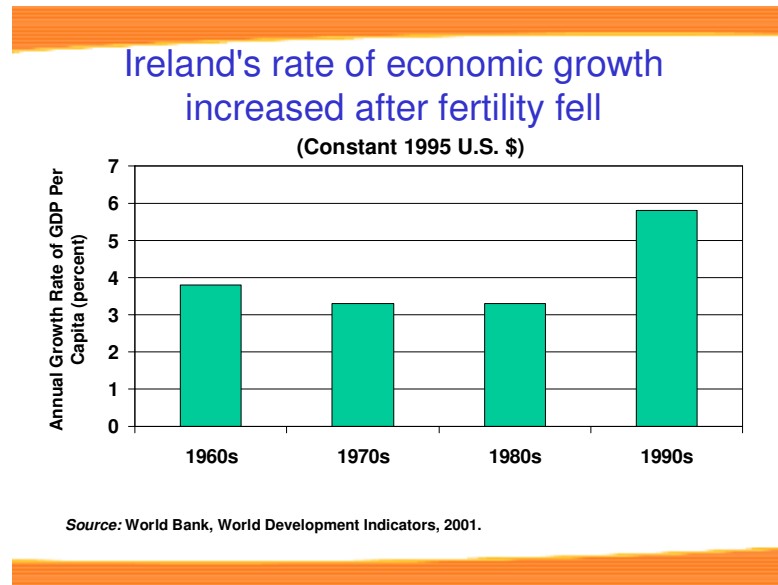
And that is potentially quite important. I would note, however, just in support of this idea, that it is not just the accounting effects but also the behavioural effects here as well. If you look at the age pattern of women's labour market participation in Ireland (see Figure XX) what you see are those lower three or four lines corresponding to 1950, 1960, 1970 and 1980. They all bunch together. Women's labour force participation was very similar and was very stable over time until contraception became legal. Then fertility dropped and suddenly there is an expansion of women's labour force participation in 1990 and 2000.

**Figure XX**



And so the real test of our idea is to see what happened to patterns of economic growth in Ireland. In the 1960s, 1970s, and 1980s, income per capita grew a little bit over 3% per year. Then in the 1990s, which is when in the demographic argument you expect the Irish economy to start taking off, Ireland achieves almost identical rates of economic growth to those seen in East Asia. See Figure YY. Now I am showing you stylized facts to make this point, but if you use more elaborate statistical models to see how well Ireland's economic performance is tracked by demographics, you will see it tracks remarkably well.

**Figure YY**



So the fact that Ireland enjoyed the demographic dividend gives some further support to this view.

Let me reflect a little bit on what this means. One thing that is important to note is that a world in which income gains can promote health and in which health gains can then feed back to income presents the possibility of a virtuous spiral of income gains and health gains. You can have a rapid spiral upwards in both of these, and you can affect the way the world works.

However, it is a risky world, and the spiral can also go down fast, and that is what many people have worried about with respect to the HIV/AIDS epidemic, or even with respect to SARS a year or so ago. The idea is that some sort

of adverse health shock can trigger a negative chain reaction in income, living standards, and health. That's something to be kept in mind also.

Second, I'm not saying that health is destiny or that demography is destiny. I really don't think that they are. I don't think it is true that health improvements or age structure changes automatically or mechanically lead to improvement in economic growth. I think this evidence seems to suggest that population health improvements can lead the development process forward by creating the potential for income growth and poverty reduction. The question then becomes, 'What is it that translates that potential for economic growth into actual economic growth?'

I think the evidence seems to indicate that the policy environment is very important. You can imagine lots of people flooding the labour market, ready to work and well equipped in terms of their education and training. But very powerful unions, or minimum wages that are astronomically high and are enforced are the kinds of policies that can really choke off a labour market, so that a country doesn't get to take advantage of a healthy work force and a relatively large working-age population. What the evidence seems to indicate is that openness to trade, good governance, and good macro-economic management seem to be very important to realising the demographic dividend.

When we think about the policy environment, there are actually three classes of policies that are important. One is for those countries in the world that have not yet experienced

the demographic transition or are at the very early stages. These countries need policies that will act on or help to catalyze that transition. Those policies are typically public-health investment oriented, addressing things like infant mortality rates and child mortality rates through primary health care, safe water, sanitation, vaccines, and drugs.

Then there are a number of countries in the world, many more countries, that are actually midway through the demographic transition. Their mortality has come down and fertility is showing signs of abating. For those countries, the real question is how to speed up the fertility transition. These policies include family planning, reproductive health programmes, girls' education, provision of job opportunities, and liberalizing specific laws – for example liberalizing laws on inheritance.

Then finally we have the last set of policies, which has to do with capturing the benefits of demographic transition once it is occurring. That is where things like good governance and open trade policy are important. This was discovered when, in contrast with the situations in East Asia and Sub-Saharan Africa, one considered Latin America during this time frame. The numbers show that in terms of its income performance Latin America looks a lot more like Sub-Saharan Africa than East Asia during this period, whereas in terms of demographics, it looks more like East Asia. Latin America was a real puzzle for quite some time. Ultimately, that's how it came to be realized that the policy environment was really the problem in Latin America. You can imagine that the hyper-inflation in 1980s wreaked havoc on incentives -- on savings, for example. There is really a lot

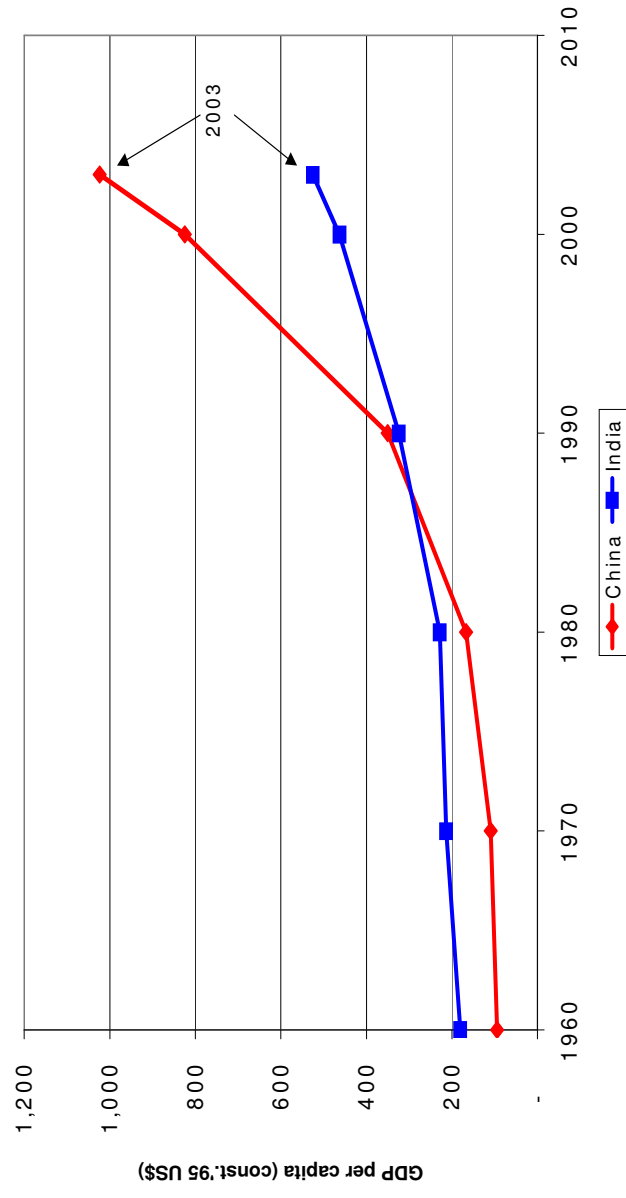


at stake in getting the right policy mix and that is an important point.

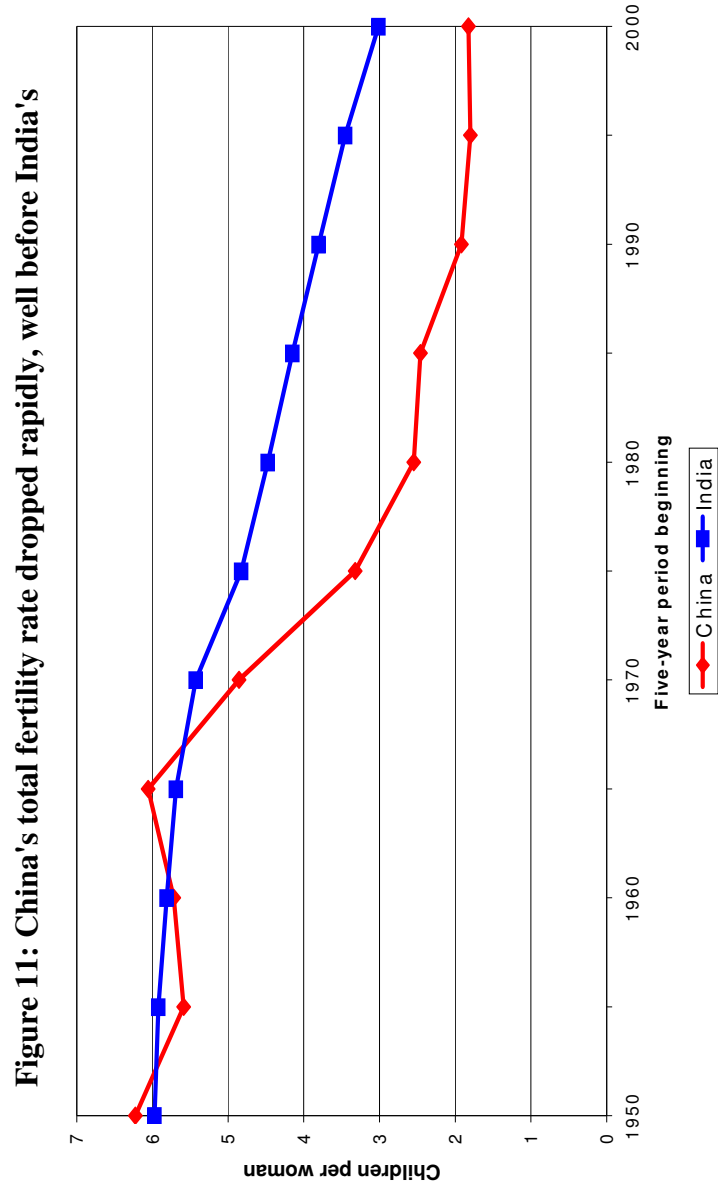
The next point is that these effects are all transitional. When you see the Finance Ministers from East Asia walking around and feeling good about themselves, it is because they think that it was their policies, wise and judicious, that led to the remarkable economic growth. Well, it may be partly that, but it was also something I think rather out of their control, which was the demographic change. That will not operate in favour of East Asia in the years to come. East Asia's working-age population grew substantially faster than its dependent population in the last 50 years. The projection for the next few years has the working-age population actually declining slightly on average per year and the dependent population – mostly elderly dependents – increasing. According to the population projections from the UN, the situation is very much the opposite in Sub-Saharan Africa.

Now I will talk about the two bona fide population superpowers in the world, India and China. Together, they have 40% of the world population and they are competing head to head in many sectors, like textiles, software engineering, back room office service, and they are also competing very vigorously for FDI. I guess one point of departure here is that income per capita was actually higher in India than it was in China in 1960, 1970, and most of the 1980s. Another point of departure is that China surged ahead of India during 1990s (see Figure 10) and income per capita in China is now about double what it is in India.

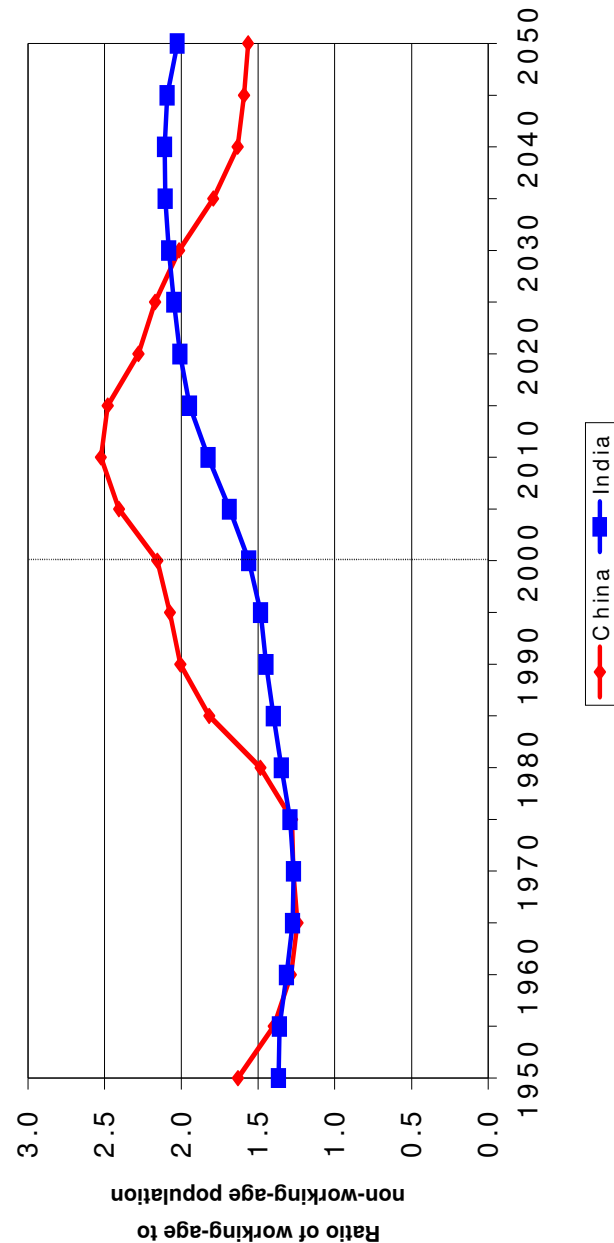
**Figure 10: GDP per Capita: China started behind but has surged ahead**



The point I want to delve into here is the idea of the decisive economic surpassing of India by China. I want to look at that from the perspective of demographics. India had the first National Family Planning program in the world and China had the second. But their demographics are really very different. Through the 1960s, the fertility rates in India and China mirrored one another quite closely. Between 1965 and 1990, the total fertility rate in China absolutely plummeted from 6 to about 2 (see Figure 11), whereas in India it declined much more modestly, from about 6 to about 4. Along the line of fertility changes reflecting themselves in age structure of the population, this is what the ratio of the working age and non-working age population looks like in the two countries (see Figure 12). They tracked each other very closely through the mid-1970s, but since about 1985, there has been a notable difference between India and China. The growth rate of the working-age population in China was much higher than the growth rate of the dependent population, much higher in absolute terms and also relative to the situation in India.



**Figure 12: Ratio of working-age to non-working-age population China will peak, and the tide will turn.**



Some rough calculations will give you an idea what this might translate into. They suggest about three-quarters of a percentage point advantage in favour of China, year-in and year-out, over the past 25 years as a result of differential demographics. What is interesting about these demographic changes is that they are very much transitional. China had its transition before India, but India is now starting to accelerate in terms of its transition. We have a situation where, looking at the future, the tide seems to be starting to turn. Over the next 25 years, the working-age and the overall dependent population in China are going to grow at identical rates. China is already well into the period of economic benefits from the demographic transition. But in India, that demographic dividend is going to swell. That should account for an advantage in the next 25 years, in favour of India, on the order of between a half and three-quarters of a percentage point.

If you observe that China had a three-quarter percentage point advantage for the last 25 years, now perhaps they have a three quarter percentage point disadvantage. That's a big swing of one and half percentage points. Again, over a long periods of time, this can amount to quite a lot.

I want to suggest a map of the development process, and it's different from the standard economists' map. When we started with Adam Smith, there was just one arrow going from physical capital to income. This map has on it now demography and health, and this is not just an argument or reasoning but is based on empirical evidence that we see. Demography and health have earned a place on the development map.

It does seem to be the case that health matters. If I summarize and extract a few messages from this hour, the first would be that health matters to the pace and the process of economic growth and development. The second message I would suggest is that population also matters to the pace and the process of development, largely through the age structure of the population. The third message is that health and population matter a lot. They have a lot of oomph, in that they really seem to drive the data. Sometimes when you do an empirical or statistical analysis, you identify a variable that is statistically significant, which means you have a precise estimate of it, but it is small in magnitude. Here we have different situation. Here we have a statistically significant effect of something that also looks to be a really big number. As far as we can tell, it is not possible to find any other variable in the long list of variables that macroeconomists think are important that outplays demography and health. These two just seem to move the data more than anything and there is not even a close second, as far as we can tell.

What is also interesting and probably the reason that macroeconomists have not rebelled against us is that introducing demography and health into the framework has not knocked out many of their variables. Their variables are still there, still significant, and they have the same magnitude as before. So, it just looks like it's an add on. The so-called East Asian miracle – which many macroeconomists interpreted as a statistically significant East Asian region effect in economic growth frameworks – as well as the so-called economic debacle in sub-Saharan Africa – which was apparently a statistically significant negative effect of being

an African country – go away. You don't have those when you introduce demographics and health into the framework.

What many economists are trying to do now is first understand all these arrows individually. And second, they are trying to get a better sense of how it all operates as a system, and of the natural entry points into this system. It might be that the best way to improve health systems is through medical interventions, like sanitation or safe water, or it might be through non-medical health interventions like education. There are many entry points into this system, and they connect to the rest of the system.

My final point is that we are starting to see and hear that economic leaders are getting this point. They are getting it quickly. With the kind of questions that you see and hear them asking, it is apparent that they understand that population health is important to economic growth and poverty reduction, and they are asking what to do to improve population health.

My sense is that that is where the field of public health needs to be for the next 10-15 years. We need to deal with issues of management, implementation, and scaling up. We have lots of good work that has been done for implementation, but we don't have a field called implementation studies. We know a lot about interventions, but we don't have a field called intervention science. Those fields need to be created. My sense is that is really where the rubber will finally meet the road. And it will be quite welcome.

Thank you.



## About the Author

**Prof. David Bloom** is presently the Clarence James Gamble Professor of Economics and Demography Department of Population and International Health at Harvard School of Public Health.

Prof. Bloom has published over eighty articles and books in the fields of economics and demography. He has been honored with a number of distinctions, including an Alfred P. Sloan Research Fellowship and the Galbraith Award for quality teaching in economics. He was also a Fulbright Scholar in India, and a scholar in residence at the Russell Sage Foundation during the academic year 1989-1990.

Prof. Bloom's current research interests include labor economics, health, demography, and the environment. He has written extensively on the linkages between health status and economic growth; the effects of population change on economic development; the determinants of wages, fringe benefits, and total family income; the adjudication of labor disputes; the measurement of discrimination; the emerging world labor market; the effects of rapid population growth; the economics of municipal solid waste; the sociology and economics of marriage and fertility; and the global spread and economic impacts of HIV and AIDS.

Prof. Bloom has served as a consultant to the United Nations Development Programme, the World Bank, the World Health Organization, the International Labor Organization, the National Academy of Sciences, and the Asian Development Bank. In addition, he is a member of the American Arbitration Association's Labor Arbitration Panel, and a faculty research associate at the National Bureau of Economic Research, where he participates in the programs on labor studies, health economics, and aging.

Prof. Bloom has been a contributing editor of *American Demographics* and an associate editor of the *Review of Economics and Statistics*. He has served as a referee for over fifty journals and publishing houses, and has been a member of the Board of Reviewing Editors of *Science* magazine since August 1991. From 1990 to 1993, Bloom served as the Chairman of the Department of Economics at Columbia University, and from 1996 to 1999, he served as Deputy Director of the Harvard Institute for International Development.