

## Review Essay

# The causes and consequences of demographic transition

David Canning

Harvard School of Public Health

*Population and Development: The Demographic Transition*. 2010. By TIM DYSON. London: Zed Books. Pp. xv + 268. £16.99 or US\$28.95, paperback. ISBN: 978-1-84277-960-6.

### Introduction

Tim Dyson has given us a short book on a big subject. The last 300 years have seen three remarkable changes in human society. One was demographic transition in much of the world: substantial reductions in mortality rates set off a population explosion, followed by reductions in fertility that are leading to stable, and in some cases declining, population numbers. A second was economic growth, the emergence for the first time in history of sustained increases in income per head. The third was an increase in social and political equality, particularly between men and women, with the adoption of democracy and universal adult franchise in many countries. This book asks what causes demographic transition and what are its consequences for social, political, and economic development, which is essentially the question of how we explain these three fundamental changes and the links between them.

Most academic work, both by individuals and within disciplines, is narrow, focusing on particular mechanisms and with a tendency to shy away from statements about the big questions. To its credit, the book does not do this but rather addresses these questions directly by integrating insights from different disciplines to produce a coherent view of population and development.

It is easy to criticize the individual mechanisms postulated to lie behind the theory. Each of these has its own literature, with established and dissenting views, and in every case more could be said than can be said in this short book. I do discuss a few of these mechanisms, where I feel there is evidence for larger

effects than are reflected in the book. However, the key issue is whether the ‘big picture’ of demographic transition and its relationship to development put forward by the book is correct. This means tackling the central thesis of the book, which is that demographic transition is a largely self-contained process that proceeds independently of social and economic development. The argument is that mortality transition occurs exogenously and is the cause of a subsequent decline in fertility and rise in urbanization. This exogenous demographic process plays out over time, and has effects on economic, social, and political development.

To argue for the complete independence of demographic processes would be absurd. There are clear examples of cases, such as civil wars, when economic, social, or political circumstances have affected population numbers. While acknowledging this, and discussing the complex mechanisms that affect demographic processes, the thesis of the book is that by and large demographic processes are relatively independent and that, as a first approximation, they are exogenous and lead to changes in the rate of socio-economic development. One key issue is, therefore, whether there are important mechanisms that flow the other way, from development to demography, which might have substantial effects and would undermine this view.

A second question is how important demographic transition has been for the economic and political changes we have seen. The book’s case is that demographic transition makes a substantial contribution to these processes but the author does not address the question of whether the transition is necessary—could the economic and political changes

we have seen have taken place without the transition? I deal with these two central questions in detail below.

The book defines a population by its fertility, mortality, sex, age structure, and urbanization. This focus on the number of people and where they live is the standard approach in demography but one that misses a key element—the *quality* of people. A discussion in the book suggests that reductions in mortality are probably accompanied by improvements in population health leading to social and economic benefits, but the mechanisms of these improvements in quality are not investigated in the same way as the quantity mechanisms.

Dyson's view of population and development can be contrasted with an alternative view, the 'unified growth theory' as expounded by Galor (2011). The major theme of the latter is that there are two epochs in development. The first is characterized by a Malthusian trap, with any improvement in living standards inevitably leading to pressure on agriculture and starvation. This epoch is followed by an epoch of sustained economic growth following escape from the trap. Dyson focuses essentially on the modern epoch after we have escaped the trap, but the issue of how we did this is a fundamental question in development.

## **Causes of the transition**

### *Mortality*

The book documents the large decreases in mortality over the last 300 years and argues that they have mainly been due to advances in health knowledge that led to the prevention and treatment of infectious diseases. The key argument here is that of the Preston Curve (Preston 1975), which shows that while life expectancy is higher in high-income countries, most health gains come from the curve moving up over time with gains in life expectancy at all income levels. The contribution of rising incomes to improved health, while real (Pritchett and Summers 1996), is modest in comparison. This picture is true both across countries and within developed countries (Canning and Bowser 2010), though in developed countries there is likely to be a contribution from the treatment of non-infectious disease (Cutler et al. 2006).

Even the poorest less developed countries today have seen rapid improvements in health over the last 50 years. The caveat to this, of course, is the HIV/AIDS epidemic, which has led to sharp

reductions in life expectancy in many countries in sub-Saharan Africa. While this picture of health improvements being largely exogenous seems true today, this may not have been the case for health improvements in the eighteenth and nineteenth centuries. The extent to which the improvements were exogenous for historical improvements in mortality is linked to the debate about the relative importance of nutrition, which is endogenous and income-dependent, and public health measures made possible by exogenous advances in health knowledge. It is clear that the mortality transition first started in richer countries and spread to poorer countries over time. It is also the case that the implementation of basic public health measures requires both that public health is a policy goal and that at least rudimentary infrastructure is in place for the delivery of public health services. These facts, together with Sen's argument (1991) that democracy plays an important role in ensuring the provision of basic nutrition and public health services, suggest that historically the timing of the start of the mortality transition in each country was dependent on its level of political development. However, while this may have been true before 1950, since then all countries have started the mortality transition. To some extent, this is simply a process of technological diffusion but it has been aided by the fact that expertise and funding is available from international organizations to support public health measures. The effects of this aid support Dyson's argument that, at least in the modern era, mortality transition is largely exogenous.

While mortality transition has had important consequences for economic and social development, it is important to realize that longer healthy lifespans are themselves a gain in human welfare. If we measure the value of these health gains relative to gains in income, we find that the two have been roughly equal as sources of welfare gains over the last century (Becker et al. 2005).

### *Fertility*

A key argument in the book is that while fertility is influenced by government policy, contraceptive availability, education, ideation, and culture, the central underlying cause of the fertility transition is the mortality transition that precedes it. The strongest evidence for this is the fact that fertility decline always follows the decline in mortality. On the other hand, counting against the argument that

the relationship is automatic are the facts that the initial response to the start of the mortality decline is usually a *rise* in fertility, and that the fertility transition in some countries in recent years has been very rapid relative to historical episodes. There is undoubtedly an effect of lower child mortality on desired fertility: the increase in child survival rates reduces the fertility required to achieve a desired number of surviving children. An alternative explanation of fertility decline is the economic model, in which fertility decisions are seen as being the result of a quantity–quality trade-off. Key factors here are the returns to education and other forms of human capital. If technological progress raises the returns to schooling, families may decide to have fewer children but invest more in each child. A third candidate in explaining fertility decline is that advances in contraceptive technologies have played a key role in allowing the reduction in fertility.

It is difficult to decide between these theories using household-level data. The impact of replacement births as a direct response to child deaths is fairly low. The more important issue is the size of the effect on fertility of the perceived prospective risk of child mortality. Similarly, the issue for returns from education is the expectation of earnings over the child's future lifetime. Neither the perception of mortality risks nor earning expectations are usually measured directly in household surveys. However, there is clear evidence that while household-level characteristics do affect fertility, most of the fertility change observed during fertility transition is not due to changes in these characteristics. Rather, all women move towards lower fertility without large changes in household-level socio-economic variables. Changes in a population's fertility behaviour are more like a change in a social norm than a reflection of decisions to change made independently by individuals, and are probably the outcome of common, community-wide factors, such as changes in expectations about mortality or earnings. The book also argues that while mortality transition may be the underlying cause of fertility transition, the former may work through intermediate factors, making causality even more difficult to determine. For example, reductions in infant mortality may lead to large family sizes, with negative consequences, and it is the observation of these large families in their communities that may prompt women to decide to have fewer children without considering mortality rates.

The availability of contraception and abortion clearly affects fertility rates, but may not be decisive in allowing fertility to decline. In Ireland, despite contraception and abortion being illegal, total fertility had declined to four by 1979, which was very high by European standards of the time. After 1979 and the legalization of abortion, fertility fell quite quickly to replacement levels with consequent effects on females' labour supply, age structure, and economic growth. My view is that it is very difficult to see how a country could achieve replacement fertility without access to contraceptives or abortion. However, since all countries now seem to allow access to some form of contraception, in practice this is no longer a key issue. The mix of different contraceptive methods, sterilization, and abortion used to control fertility varies enormously across countries, suggesting that access to at least one method has a large effect while the availability of some methods and not others may have a smaller impact.

In many countries fertility transition occurred after mortality decline but before substantial gains in income per head; for example, both India and China saw large fertility declines before their surges in economic growth. However, the continuing decline in fertility to replacement level and below usually occurs in conjunction with rapid growth, making it difficult to establish causality. While the aggregate-level data are consistent with the idea that mortality transition drives fertility transition, my own view is that the question is still open on the importance of the returns to human capital and the quality–quantity trade-off. Today this is a central issue for development in sub-Saharan Africa (Eastwood and Lipton 2011). Will the substantial declines in child mortality we have seen be sufficient to induce large declines in fertility without economic growth or will fertility decline stall?

### *Urbanization*

Before demographic transition, high mortality in cities tends to give them an excess of deaths over births and their populations are sustained only by rural to urban migration. As mortality declines, the death rates in cities fall below the death rate in rural areas. The urban population becomes self-sustaining through urbanization, meaning that the increasing proportion of people in urban areas requires continuing rural to urban migration.

The economic theory of urbanization holds that migration equalizes the net advantages of living in different settings; these net advantages take all factors into account, including earnings, living space, health, and social contact (Glaeser 2011). Cities tend to have higher wages on average than rural areas but housing prices are higher and crowding may make cities more or less attractive than the countryside. The rise in rural population that follows mortality decline means more workers per acre of land and lower agricultural wages owing to diminishing returns—the classical Malthusian argument. Production in the manufacturing and service sector in cities does not have a fixed factor and does not suffer from decreasing returns; in fact, we see higher productivity in larger and denser cities.

From the point of view of a single country with international trade, population pressure will therefore tend to produce urbanization. However, on a worldwide basis, the larger population still needs to be fed. In a Malthusian setting, this requires ever increasing labour inputs into farming with diminishing gains in output. In fact, in the modern era we see increased productivity in agriculture attributable to both technology and increased intensity of capital investment. Technological progress and increased capital tend to reduce the demand for labour in agriculture and increase the demand for labour in industry. A striking feature of the modern era has been the reduction of the absolute numbers of workers in agriculture and the reduction in land area devoted to agricultural production—technological progress and the mechanization of farming have essentially removed the Malthusian check. A similar process is now occurring in a second transition from manufacturing to services, with technological advances and increasing intensity of capital investment reducing the demand for labour in industry and being accompanied by a shift of labour into services.

My view until quite recently was that urbanization was a combination of push factors from the countryside and pull factors from the city, with excess labour in the rural area producing a push and industrialization and high wages in the cities providing a strong pull. The problem with this view is that, as pointed out by Dyson, urbanization in Africa over the last 50 years has proceeded in step with that of Asia (Bloom et al. 2008), which is difficult to explain given Asia's more rapid productivity gains in agriculture and industry. Dyson's conclusion is that urbanization is the inevitable

result of demographic transition. The excess population in the rural areas tends to move to the cities largely independently of economic considerations, partly because cities are more attractive places to live for non-economic reasons. For example, mortality rates are now often lower in urban than in rural areas, even among people of low socio-economic status, and cities may have cultural and social advantages not found in rural settings.

My current view is that large-scale urbanization requires technological progress and increased intensity of capital investment in agriculture to allow sufficient food production for the growing population, with a declining agricultural workforce. The similarity of the urbanization rates in Asia and Africa means that the pull factors of industrialization and high urban wages may not be of central importance.

### *The quality of people*

A remarkable feature of the modern era is the increase in the 'quality' as well as quantity of people. In economics, the quality of people or human capital has been taken to be synonymous with education, but we should think of the quality of people in a broader sense. Over the last 100 years we have seen substantial increases in the physical and cognitive development of children, as evidenced by gains in adult height (Fogel and Costa 1997) and IQ score (Neisser 1998), even in the component of the increases not associated with education. These gains have been due to improvements in nutrition and health in the first few years of life (Akachi and Canning 2007): the mortality transition that sets off demographic transition is also usually a health transition that is associated with better nutrition and a lower burden of disease. In addition, the onset of disability and physical and cognitive decline in old age is occurring later in life—the compression of morbidity (Mor 2005). These improvements in physical and cognitive ability—improvements in the quality of people—have played a large role in economic and social development. I would argue that including these improvements in population quality, in addition to population quantity, as measures of demographic change provides a richer basis for thinking about the link between population and development. In my view, the economic and social effects of these quality changes have been fundamental in

promoting economic growth. One reason for a higher return to education is the increase in healthy lifespan people now expect, with an attendant increase in the time horizon for the returns to education.

## Consequences of the transition

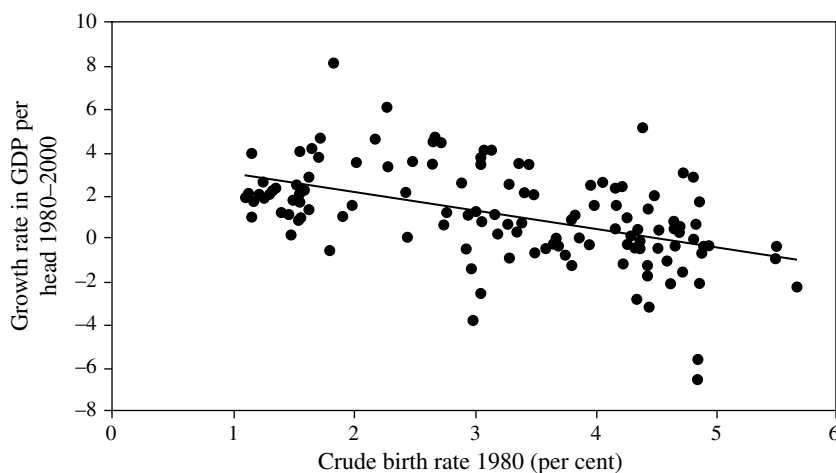
### *Economic consequences*

Surprisingly, the original Malthusian argument that larger populations are associated with lower incomes, because of population pressure on agriculture and food leading to impoverishment, is not a central issue in the book, perhaps because the author has discussed this issue previously (Dyson 1996). I agree with the argument there that productivity gains and mechanization have meant that food production has not proved a fundamental barrier to economic growth, though the case for the Malthusian argument in the African context has been undergoing something of a revival (Young 2005). Newer versions of the argument hold that larger population numbers will lead to impoverishment in the future because of pressure on other scarce resources, such as energy, or because of global warming, to which it will contribute. I believe these possible negative consequences can be addressed through incentive mechanisms, such as the pricing of carbon emissions, and do not fundamentally require population control, but it would be helpful to have at least some discussion of these issues.

The fundamental point, however, is that in practice we have escaped the Malthusian trap. Because mortality decline precedes fertility decline, a demo-

graphic transition leads from a four-fold to a ten-fold increase in population numbers. In the Malthusian world, this would put pressure on agriculture, leading to starvation, and the death rate would rise to return the population to its equilibrium size. We have avoided this outcome by massive gains in agricultural productivity. These gains are a necessary condition for demographic transition to occur—without them any mortality gains would be short-term and would be reversed by starvation. This consideration undermines the argument for the pure exogeneity of the mortality transition.

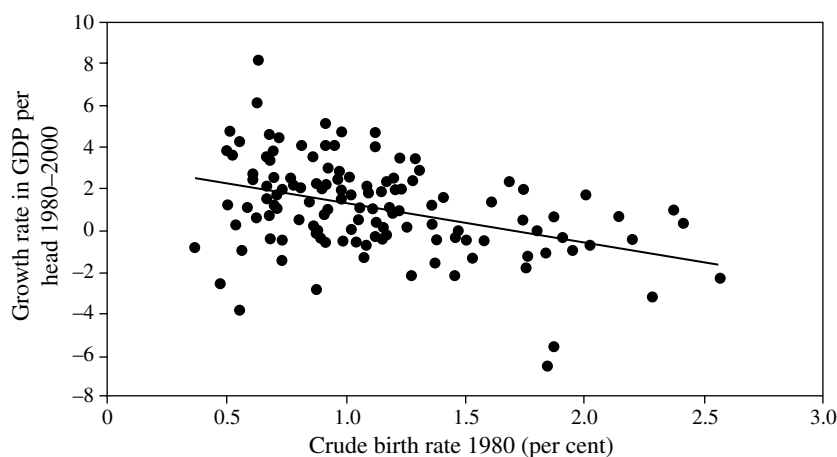
Even when we escape the agricultural Malthusian trap, the Solow growth model (1970) predicts a negative association between population growth and economic growth because the growth in the workforce dilutes the capital stock per worker in industry. There is some discussion of this negative relationship using recent data in the book, but studying this relationship can be misleading. In practice the economic effects of population growth depend fundamentally on whether it is due to a high birth rate or a low death rate (Bloom and Freeman 1988; Kelley and Schmidt 1995). Adding these two components together and expecting the same effects on growth independently of the source of the population growth is not feasible. If population growth has negative consequences for economic growth, we would expect to see a negative association between the birth rate and economic growth. Figure 1 shows just this expected negative relationship between the birth rate in 1980 and growth in real GDP per head (adjusted for purchasing power parity) over the period 1980–2000 for 127 countries, using data from the World Bank (2011). On the other hand, we would expect to see a positive



**Figure 1** Birth rate in 1980 and the rate of economic growth 1980–2000 in 127 countries

*Note:* GDP per head is measured at purchasing power parity and the growth rate is the annual average percentage change over the period.

*Source:* World Bank 2011.



**Figure 2** Death rate in 1980 and the rate of economic growth 1980–2000 in 127 countries

*Note:* GDP per head is measured at purchasing power parity and the growth rate is the annual average percentage change over the period.

*Source:* World Bank 2011.

relationship between the death rate and economic growth if high death rates ease population pressure. In fact, the relationship between death rate and economic growth shown in Figure 2 for the same sample is negative, indicating that countries with higher death rates have lower rates of economic growth. Thus, the effects of birth and death rates are not equal and opposite as would be required for population growth to be a meaningful summary statistic.

The book does discuss some reasons why birth and death rates have effects over and above their impact on population growth. The first reason is that they have different effects on age structure, which can give rise to a demographic dividend: the working-age share of the population rises when the baby boom, brought about by falling infant mortality, is followed by a decline in fertility. More importantly, the decline in death rates leads to a longer lifespan, which can increase the incentive to invest in human capital. Declining mortality is usually accompanied by declining morbidity. There is increasing evidence that improvements in health and nutrition in early childhood lead to improved educational outcomes and labour market productivity.

Fewer children allow greater participation by females in the labour market (Bloom et al. 2009). In addition, smaller numbers of children can allow a trade-off, with each child receiving a larger investment in health and education. While the book makes all these points, there is a difficulty in establishing the magnitude of the effects since the associations seen in the data may not be causal. However, there is recent evidence of large causal effects on education and earnings of eradicating malaria and improving

childhood nutrition (Hoddinott et al. 2008; Bleakley 2010). There is also emerging evidence of causal effects of the reduction in fertility on investments in children (Joshi and Schultz 2007). While everyone seems to agree on the negative effects of high fertility, there is still a debate about whether the quality effects of improvements in health outweigh the negative effects of additional population numbers when mortality declines (Bloom et al. 2004; Acemoglu and Johnson 2007; Ashraf et al. 2007).

### *Social and political consequences*

The social and political consequences of demographic transition are perhaps the most difficult to establish. Though transition undoubtedly has such consequences, its magnitude relative to other forces is difficult to determine. In the Malthusian world we have high returns to land and excess labour at subsistence wages, which favour a political system under the control of those who own the land. The very high death rates and decline in population attributable to the Black Death in fourteenth-century Europe appear to have caused a shortage of labour, leading to a rise in wages and the breakdown of the feudal labour system (Herlihy and Kohn 1997), but this was due to a temporary rise in mortality, not the declines we see as part of demographic transition.

Demographic transition and population growth would lead us to expect a world of labour surpluses, with high economic rents and political power for the owners of land and capital. This has not happened. Rather, the wages and the political power of workers

have risen relative to those of other classes. The key force behind the rise in labour productivity and wages was the Industrial Revolution and the rise of industry. The new means of production increased the power of workers, particularly skilled workers. In my view, it was this rising economic power, rather than demographic transition that led to the progressive expansion of the franchise among men in several countries during the eighteenth and nineteenth centuries.

Where the book may be on much stronger ground is in its linking of fertility decline to the decline in gender-specific roles in society, the decline in the popularity of marriage, and the economic and political empowerment of women. Part of this political empowerment has been the extension of the franchise to women. The emphasis on psychosocial as opposed to purely economic mechanisms of these changes also seems plausible. As always, however, we have the problem of reverse causality: these economic and social changes may have influenced fertility as well as being influenced by it.

### **Unified growth theory**

In unified growth theory, we begin in a Malthusian world in which improvements in technology can raise living standard temporarily, reducing death rates. Population growth then puts pressure on agriculture, which leads to starvation until equilibrium is re-established, with wages at subsistence level and with a larger population. Improvements in health technology and reductions in mortality similarly raise population numbers and lead to starvation, raising the death rate back to its old level. In such a world, economic growth in per-head terms is impossible. However, technological progress does raise agricultural productivity and allows for a larger population to be sustained—all technological progress goes into population numbers not income per head.

As population numbers increase, the rate of technological progress increases: a large population produces more new innovations than a small population. Technological progress becomes sustained and cumulative; it becomes geometric rather than arithmetic. Improvements in agricultural techniques and the mechanization of agriculture make the fixed factor, land, less important and less of a constraint. More importantly, this technological progress leads to new methods of production, and new research methods for producing new

technologies, which increase the returns to education. This leads to a quality–quantity trade-off: families choose to have fewer children in order to allow investments in education that will make these children better off. This reduction in fertility means population growth is limited to a rate that can be covered by technological advances and that allows sustained economic growth. Economic growth is also assisted by improvements in health.

In Dyson's view, the central driving force is improvements in mortality that induce lower fertility. Unified growth theory gives pride of place to technological improvements in production and increased returns to education that produce the quantity–quality trade-off and induce fertility decline.

### **Conclusion**

Dyson puts forward a coherent theory in which a largely exogenous demographic transition, fundamentally driven by reductions in death rates from advances in public health, has major effects on economic, social, and political development. When I first read the book I was surprised by the argument for the exogeneity of demographic transition. My own view is that the mortality transition is initiated by public health advances, but for it to be sustained we require productivity gains in agriculture that allow the larger population to be fed and to prevent the mortality gains from being reversed through starvation. I would also put more emphasis on the argument that a major underlying cause of fertility decline is technological progress that raises the return to education and induces a reduction in the number of children and greater investments in each child's schooling—the quality–quantity trade-off. I would also emphasize the role of economic forces in determining urbanization, rather than seeing it as an inevitable consequence of demographic transition. Dyson has an arguable case that in practice mortality transition has inevitably been followed by fertility decline and urbanization, and that while other forces such as technological advances in agriculture play a part, they have not proved decisive. However, I think demographic change is a more organic part of the modern development that has been in part a consequence as well as a cause of the process. It may be that the issues are more about timing than about eventual outcomes. The process described by Dyson—demographic transition and associated economic and political changes—is inevitable but the speed at which this process occurs may

differ greatly depending on feedbacks to mortality and fertility. While sub-Saharan Africa will probably follow a process of development similar to that already seen in other countries, this process may take 50 years, or it may take 200 years; the difference between these in terms of human welfare is enormous.

While the book's case is that demographic transition has contributed to economic growth and political change, a key question is whether it is necessary and sufficient for modern development. Unified growth theory identifies the fundamental source of growth as technological progress in production with a contribution from improved population health as mortality declines. The theory predicts that in the absence of fertility reduction, the economy is in a Malthusian trap; technological gains lead to growth in population numbers rather than income levels. While technological gains are the driving force, in order to turn these into higher income and escape the Malthusian trap, we need reductions in fertility. I think these reductions in fertility were central in allowing developed countries to escape this trap.

Technological advances in health, and the improvement in health and human capital, have played a major role in spurring economic growth. I would go further than Dyson in emphasizing that the health improvements that reduce mortality and increase population numbers also improve population quality in the form of health and human capital and that these quality gains help fuel economic growth.

The story of the modern world is often told as a story of the Industrial Revolution driven by technological advances in manufacturing. To this we should add technological advances in public health that have allowed enormous gains in life expectancy. The modern world has seen both an industrial revolution and a health revolution. In addition to both of these we have the remarkable achievement of having escaped the Malthusian trap of population pressure leading to food shortages. This escape has been driven in part by technological advances and mechanization in the agricultural sector, but mainly by a decline in fertility.

## Note

1 Professor David Canning is at the Department of Global Health and Population, Harvard School of Public Health, 665 Huntington Avenue, SPH I 1211, 12th Floor, Boston, MA 02115, USA. E-mail: dcanning@hsph.harvard.edu

## References

- Acemoglu, D. and S. Johnson. 2007. Disease and development: the effect of life expectancy on economic growth, *Journal of Political Economy* 115(6): 925–985.
- Akachi, Y. and D. Canning. 2007. The height of women in sub-Saharan Africa: the role of health, nutrition, and income in childhood, *Annals of Human Biology* 34(4): 397–410.
- Ashraf, Q. H., A. Lester, and D. N. Weil. 2007. Would curing malaria raise Zambian per capita GDP? Mimeo Brown University.
- Becker, G. S., T. J. Philipson, and R. R. Soares. 2005. The quantity and quality of life and the evolution of world inequality, *The American Economic Review* 95(1): 277–291.
- Bleakley, H. 2010. Malaria eradication in the Americas: a retrospective analysis of childhood exposure, *American Economic Journal: Applied Economics* 2(2): 1–45.
- Bloom, D. E., D. Canning, and J. Sevilla. 2004. The effect of health on economic growth: a production function approach, *World Development* 32(1): 1–13.
- Bloom, D. E., D. Canning, and G. Fink. 2008. Urbanization and the wealth of nations, *Science* 319(5864): 772–775.
- Bloom, D. E., D. Canning, G. Fink, and J. E. Finlay. 2009. Fertility, female labor force participation, and the demographic dividend, *Journal of Economic Growth* 14(2): 79–101.
- Bloom, D. E., R. B. Freeman, and S. D. Korenman. 1988. The labour-market consequences of generational crowding, *European Journal of Population* 3(2): 131–176.
- Canning, D. and D. Bowser. 2010. Investing in health to improve the wellbeing of the disadvantaged: reversing the argument of fair society, healthy lives (The Marmot Review), *Social Science and Medicine* 71(7): 1223–1226.
- Cutler, D., A. Deaton, and A. Lleras-Muney. 2006. The determinants of mortality, *Journal of Economic Perspectives* 20(3): 97–120.
- Dyson, T. 1996. *Population and Food: Global Trends and Future Prospects*. London: Routledge.
- Eastwood, Robert and Michael Lipton. 2011. Demographic transition in sub-Saharan Africa: how big will the economic dividend be? *Population Studies* 65(1): 9–35.
- Fogel, R. W. and D. L. Costa. 1997. A theory of technophysio evolution, with some implications for forecasting population, health care costs, and pension costs, *Demography* 34(1): 49–66.
- Galor, O. 2011. *Unified Growth Theory*. Princeton, NJ: Princeton University Press.
- Glaeser, E. L. 2011. *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*. New York: The Penguin Press.



- Herlihy, D. and S. K. Kohn, Jr. 1997. *The Black Death and the Transformation of the West*. Cambridge MA: Harvard University Press.
- Hoddinott, J., J. Maluccio, J. Behrman, R. Flores, and R. Martorell. 2008. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults, *Lancet* 371(9610): 411–416.
- Joshi, S. and T. P. Schultz. 2007. Family planning as an investment in development: evaluation of a program's consequences in Matlab, Bangladesh. Yale University Economic Growth Center Discussion Paper No. 951.
- Kelley, A. C. and R.M. Schmidt. 1995. Aggregate population and economic growth correlations: The role of the components of demographic change, *Demography* 32(4): 543–555.
- Mor, V. 2005. The compression of morbidity hypothesis: a review of research and prospects for the future, *Journal of the American Geriatrics Society* 53(9S): S308–S309.
- Neisser, U. (Ed.). 1998. *The Rising Curve: Long-Term Gains in IQ and Related Measures*. Washington, DC: American Psychological Association.
- Preston, S. H. 1975. The changing relation between mortality and level of economic development, *Population Studies* 29(2): 231–248.
- Pritchett, L. and L. H. Summers. 1996. Wealthier is healthier, *Journal of Human Resources* 31(4): 841–868.
- Sen, A. 1991. Public action to remedy hunger, *Interdisciplinary Science Reviews* 16(4): 324–336.
- Solow, R. M. 1970. *Growth Theory: An Exposition*. Oxford: Oxford University Press.
- World Bank. 2011. *World Development Indicators 2011*. Washington, DC: World Bank.
- Young, A. 2005. The gift of the dying: the tragedy of AIDS and the welfare of future African generations, *Quarterly Journal of Economics* 120(2): 423–466.

Copyright of Population Studies is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.