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The Demographic Transition¹

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The evolution of economies over most of human history was marked by Malthusian stagnation. Technological progress and population growth were miniscule by modern standards and the average growth rate of income per capita was even slower due to the offsetting effect of population growth on the expansion of resources per capita. In the past two centuries, however, the pace of technological progress increased significantly in association with the process of industrialization. Various regions of the world departed from the Malthusian trap and experienced a considerable rise in the growth rates of income per capita and population. The increasing role of human capital in the production process in the second phase of the Industrial Revolution triggered a demographic transition, liberating the gains in productivity from the counterbalancing effects of population growth. The decline in population growth and the associated advancement in technological progress and human capital formation paved the way for the emergence of the modern state of sustained economic growth.

The growth of world population was sluggish during the Malthusian epoch, creeping at an average annual rate of about 0.1% over the years 0-1820 (Maddison, 2001). The Western European take-off along with that of the Western Offshoots (i.e., United States, Canada, Australia and New Zealand) brought about a sharp increase in population growth in these regions. The world annual average rate of population growth increased gradually reaching 0.8% in the years 1870-1913. The take-off of less developed regions and the significant increase in their income per capita generated a further increase in the world rate of population growth, despite the decline in population growth in Western Europe and the Western Offshoots, reaching a high level of 1.92% per year in the period 1950-1973. Ultimately, the onset of the demographic transition in less developed economies in the second half of the 20th century, reduced population growth to an average rate of 1.63% per year in the period 1973-1998.

The demographic transition in Western Europe occurred towards the turn of the 19th century. A sharp reduction in fertility took place simultaneously in several countries in the 1870s, resulting in about 30% decline in fertility rates within a 50-year period. Over the period 1875-1920, Crude Birth Rates declined by 44% in England, 37% in Germany, and 32% in Sweden and Finland. A decline in mortality rates preceded the decline in fertility rates in most Western Europe. The decline in fertility outpaced the decline in mortality and brought about a decline in the number of children who survived to their reproduction age. A similar pattern has characterized mortality and fertility decline in less developed regions. Total Fertility Rate over the period 1960-1999

plummeted from 6 to 2.7 in Latin America, from 6.14 to 3.14 in Asia, and declined moderately from 6.55 to 5.0 in Africa, along with sharp declines in infant mortality rates.

The Decline in Infant and Child Mortality

The decline in infant and child mortality that preceded the decline in fertility in many developed countries, with the notable exceptions of France and the US, has been demographers' favorite explanation for the onset of the decline in fertility. Nevertheless, this viewpoint appears inconsistent with historical evidence. While it is highly plausible that mortality rates were among the factors that affected the *level* of fertility along human history, historical evidence does not lend credence to the argument that the decline in mortality accounts for the *reversal* of the positive historical trend between income and fertility.

The mortality decline in Western Europe started nearly a century prior to the decline in fertility and was associated initially with increasing fertility rates in some countries. In particular, the decline in mortality started in England in the 1730s and was accompanied by a steady increase in fertility until the 1820s. The significant rise in income per capita apparently increased the desirable number of surviving offspring and thus, despite the decline in mortality rates, fertility increased significantly. The decline in fertility during the demographic transition occurred in a period in which this pattern of increased income per capita (and its potential effect on fertility) was intensified, while the pattern of declining mortality (and its adverse effect on fertility) maintained its course in the 140 years that preceded the decline in fertility. The reversal in the fertility patterns in Western European countries in the 1870s suggests therefore that the demographic transition was prompted by a different universal force.

Furthermore, most relevant from an economic point of view is the cause of the reduction in net fertility (i.e. the number of children reaching adulthood). The decline in the number of surviving offspring that was observed during the demographic transition is unlikely to follow from mortality decline. Mortality decline would have led to a reduction in the number of surviving offspring if implausibly individuals were risk averse with respect to the number of surviving offspring more than with respect to their own consumption, and if sequential fertility were modest.

The Rise in the Level of Income Per Capita

The rise in income prior to the demographic transition has led researchers to argue that the demographic transition was triggered by its asymmetric effects on households' income and on the opportunity cost of raising children. Becker (1981) argues that the rise in income induced a fertility decline because the positive income effect on fertility was dominated by the negative substitution effect that was brought about by the rising opportunity cost of children. Similarly, he argues that the income elasticity with respect to child quality is greater than that with respect to child quantity, and hence a rise in income led to a decline in fertility along with a rise in the investment in each child.

This theory suggests that the timing of the demographic transition across countries in similar stages of development would reflect differences in income per capita. However, the decline in fertility occurred in the same decade across Western European countries that differed significantly in their income per capita. In particular, in 1870, on the eve of the demographic transition, income per capita in Germany, Sweden, and Finland was only 57%, 48%, 36%, respectively, of that in England -- the richest country in the Western Europe (Maddison, 2001). The simultaneity of the demographic transition across Western European countries that differed significantly in their income per capita suggests that the high level of income reached by Western Europeans countries in the Post-Malthusian regime had a limited role in the demographic transition.

The Rise in the Demand for Human Capital

The gradual rise in the demand for human capital in the second phase of industrialization, and its close association with the timing of the demographic transitions, has led researchers to argue that the increasing role of human capital in the production process induced households to increase investment in the human capital of their offspring, leading to the onset of the demographic transition. Galor and Weil (1999, 2000) and Galor and Moav (2002) argue that the acceleration in the rate of technological progress increased the demand for human capital in the second phase of the Industrial Revolution, inducing parents to invest in the human capital of their offspring. The increase in the demand for human capital brought about two effects on population growth. On the one hand, the rise in income eased households' budget constraints and provided more resources for the quality as well as the quantity of children. On the other hand, it induced a reallocation of

these increased resources toward child quality. In the early stages of the transition from the Malthusian regime, the effect of technological progress on parental income dominated, and the population growth rate as well as the average quality increased. Ultimately, further increases in the demand for human capital induced a reduction in fertility, generating a decline in population growth along with an increase in the average level of education.

This theory suggests that a universal acceleration in technological progress raised the demand for human capital in the second phase of the Industrial Revolution and generated a simultaneous increase in educational attainment and a fertility decline across Western European countries that differed significantly in their levels of income per capita. The effect of the rise in the demand for human capital on the reduction in the desirable number of surviving offspring was magnified via its adverse effect on the desirability of child labor. Moreover it was reinforced by improvements in health and life expectancy and their positive effect on the return to investments in children's human capital. Interestingly, international trade and its differential effects on the demand for human capital in developed and less developed countries had an asymmetric effect of the timing of the demographic transition across these regions, expediting the transition in developed countries and delaying it in LDCs (Galor and Mountford, 2006).

Consistent with the theory, the growth rates of income per capita among these Western European countries were rather similar during their demographic transition, ranging from 1.9% per year over the period 1870-1913 in the UK, 2.1% in Norway, 2.2% in Sweden, to 2.9% in Germany. Moreover, the demographic transition was associated with a significant increase in schooling.

The Decline in the Gender Gap.

The rise in the demand for human capital and its impact on the decline in the gender gap in the last two centuries could have reinforced a demographic transition and human capital formation. Galor and Weil (1996, 1999) argue that technological progress and capital accumulation complemented mental-intensive tasks and substituted for physical-intensive tasks in industrial production. In light of the comparative physiological advantage of men in physical-intensive tasks and women in mental-intensive tasks, the demand for women's labor input gradually increased in the industrial sector, decreasing monotonically the wage differential between men and women. In early stages of industrialization, wages of men and women increased, but the rise

in female's relative wages was insufficient to induce a significant increase in women's labor force participation. Fertility, therefore, increased due to the income effect that was generated by the rise in men's absolute wages. Ultimately, however, the rise in women's relative wages was sufficient to induce a significant increase in labor force participation. It increased the cost of child rearing proportionally more than households' income, generating a decline in fertility and a shift from stagnation to growth.

The Old-Age Security Hypothesis

The old-age security hypothesis (Caldwell, 1976) has been proposed as an additional mechanism for the onset of the demographic transition. It suggests that in the absence of capital markets that permit intertemporal lending and borrowing, children serve as an asset that permit parents to transfer income to old-age. The process of development and the establishment of capital markets reduce this motivation for rearing children, contributing to the demographic transition. However, evidence that show that in the pre-demographic transition era wealthier individuals, that presumably had a better access to credit markets, had a larger number of surviving offspring (Clark and Hamilton, 2006), raises some doubts about the significance of this mechanism.

Concluding Remarks

The demographic transition has been a prime force in the transition from stagnation to growth. The rise in the demand for human capital in the second phase of industrialization brought about significant reductions in population growth, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita.

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