THE DEMOGRAPHIC TRANSITION AND THE EMERGENCE OF SUSTAINED ECONOMIC GROWTH

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Abstract
The demographic transition that swept the world in the course of the last century has been identified as one of the prime forces in the transition from stagnation to growth. The unprecedented increase in population growth during the early stages of industrialization was ultimately reversed and the demographic transition brought about a significant reduction in fertility rates and population growth in various regions of the world, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita. This paper examines various mechanisms that have been proposed as possible triggers for the demographic transition, assessing their empirical validity, and their potential role in the transition from stagnation to growth. (JEL: O11, O14, O33, O40, J11, J13)

1. Introduction

The transition from stagnation to growth has been the subject of intensive research in recent years. The inconsistency of exogenous and endogenous growth models with some of the most fundamental features of process of development induced growth theorists to advance a unified growth theory that captures in a single framework the epoch of Malthusian stagnation, the contemporary era of sustained economic growth, and the fundamental driving forces of the recent transition between these distinct regimes.

The understanding of the contemporary growth process would be fragile and incomplete unless growth theory would be based on proper microfoundations that reflect the qualitative aspects of the growth process and its central driving forces over most of human existence. Moreover, a comprehensive understanding of the hurdles faced by less-developed economies in reaching a state of sustained economic growth would be futile unless the factors that prompted the transition of the currently developed economies into a state of sustained economic growth

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would be identified and their implications modified to account for the differences in the growth structure of less developed economies in an interdependent world.

Unified growth theory, first advanced by Galor and Weil (1999, 2000), suggests that the transition from stagnation to growth is an inevitable by-product of the inherent Malthusian interaction between population and technology, and its ultimate impact on the demand for human capital and thereby on the onset of the demographic transition. Variations in the timing of the transition across countries and regions reflect initial differences in geographical factors and historical accidents and their manifestation in variations in institutional, demographic, and cultural factors, trade patterns, colonial status, and public policy.

The demographic transition that swept the world in the course of the last century has been identified as one of the prime forces in the movement from an epoch of stagnation to a state of sustained economic growth. It brought about a significant reduction in fertility rates and population growth in various regions of the world, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita.

2. Historical Evidence

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, in contrast, 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 initially experienced a considerable rise in the growth rates of income per capita and population. Unlike episodes of technological progress in the pre-Industrial Revolution era that failed to generate sustained economic growth, the increasing role of human capital in the production process in the second phase of the Industrial Revolution ultimately prompted 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 evolution of population growth in the world economy has been nonmonotonic. 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 2003). The Western European take-off along with that of the Western Offshoots (i.e., the 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

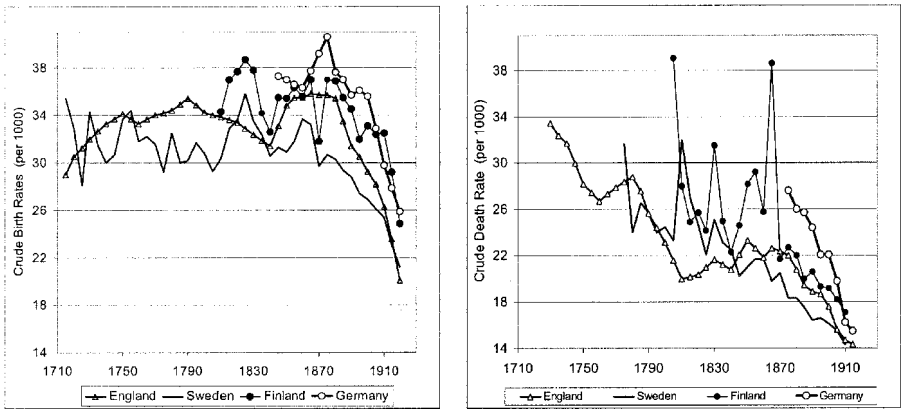

FIGURE 1. The decline in fertility and mortality in western Europe. Source: Andorka (1978).

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 1973–1998 period.

The timing of the demographic transition differed significantly across regions. The reduction in population growth occurred in Western Europe, the Western Offshoots, and Eastern Europe towards the end of the 19th century and in the beginning of the 20th century, whereas Latin America and Asia experienced a decline in the rate of population growth only in the last decades of the 20th century. Africa's population growth, in contrast, has been rising steadily, although this pattern is likely to reverse in the near future due to the decline in fertility rates in this region since the 1980s.

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, and resulted in a more than a 30% decline in fertility rates within a 50-year period. As depicted in Figure 1, 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. It began in England nearly 140 years prior to the decline in fertility and in Sweden and Finland approximately 100 years prior to the decline in fertility. The decline in fertility outpaced the decline in mortality rates and brought about a decline in the number of children who survived to their reproduction age.

A similar pattern characterizes 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 a sharp decline in infant mortality rates.

3. Assessment of Theories of the Demographic Transition

This section examines various mechanisms that have been proposed as possible triggers for the demographic transition, assessing their empirical validity, and their potential role in the transition from stagnation to growth.

3.1. The Decline in Infant and Child Mortality

The decline in infant and child mortality rates that preceded the decline in fertility rates in many developed countries, with the notable exceptions of France and the United States, 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 rates accounts for the reversal of the positive historical trend between income and fertility.

As demonstrated in Figure 1, 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 and nondecreasing fertility rates in others. In particular, as depicted in Figure 2, the decline in mortality started in England in the 1730s and was accompanied by a steady increase in fertility rates until 1820. The significant rise in income per capita in the Post-Malthusian Regime apparently increased the desirable number of surviving offspring and thus, despite the decline in mortality rates, fertility increased significantly so as to reach this higher desirable level. 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 the trend that existed in the 140 years that preceded the demographic transition.[1] The reversal in the fertility patterns in England as well as other Western European countries in the 1870s suggests therefore that the demographic transition was prompted by a different universal force than the decline in infant and child mortality.[2]

1. The argument that the decline in mortality was not internalized into the decision of households is highly implausible given the fact that in England mortality declined monotonically for nearly 140 years prior to the demographic transition.

2. The insignificance of the mortality decline for the decline in fertility during the demographic transition is established in the quantitative analysis Doepke (forthcoming) and Fernandez-Vilaverde (2004).

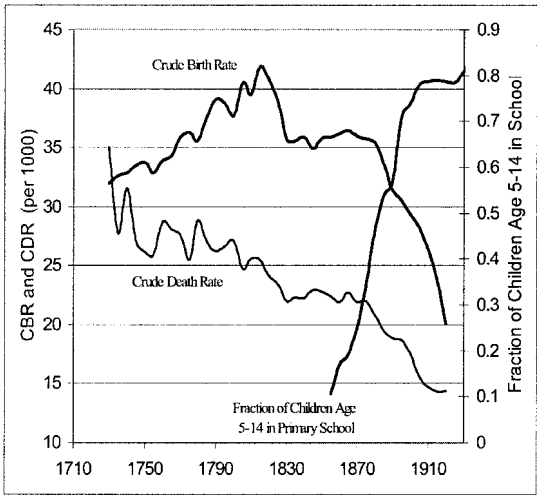

FIGURE 2. Sources of the demographic transition: England 1720–1930. Sources: Wrigley and Schofield (1981), Flora et al. (1983), and Andorka (1978).

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 the following implausible conditions would be met: (i) There exists a significant precautionary demand for children, i.e., individuals are significantly risk averse with respect to their expected number of surviving offspring. (Highly improbable from an evolutionary perspective); (ii) Risk aversion with respect to consumption is smaller than risk aversion with respect to fertility. (Evolutionary theory would suggest the opposite); (iii) Sequential fertility (i.e., replacement of nonsurviving children) is modest; and (iv) Parental resources saved from the reduction in the number of children that do not survive to adulthood are not channeled towards child-rearing.

3.2. The Rise in the Level of Income Per Capita

The rise in income per capita prior to the demographic transition has led some researches to argue that the demographic transition was triggered by the asymmetric effects of the rise in income per capita on household 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 insatisfactory theory, which is based on an innate bias against child quantity at high levels of income, appears counterfactual.[3] It suggests that the timing of the demographic transition across countries in similar stages of development would reflect differences in income per capita. However, remarkably, as depicted in Figure 1, the decline in fertility occurred in the same decade across Western European countries that differed significantly in their income per capita. In 1870, on the eve of the demographic transition, England was the richest country in the world, with a GDP per capita of $3191.[4] In contrast, Germany that experienced the decline in fertility in the same years as England, had in 1870 a GDP per capita of only $1821 (i.e., 57% of that of England). Sweden's GDP per capita of $1664 in 1870 was 48% of that of England, and Finland's GDP per capita of $1140 in 1870 was only 36% of that of England, but their demographic transitions occurred in the same decade as well. 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 that was reached by Western Europeans countries in the Post-Malthusian regime had a very limited role in the demographic transition.[5]

3.3. The Rise in the Demand for Human Capital: Main Mechanism

The gradual rise in the demand for human capital in the second phase of the Industrial Revolution (as well as in the process of industrialization of less developed economies) 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, ultimately leading to the onset of the demographic transition.

Galor and Weil (1999, 2000), argue that the acceleration in the rate of technological progress gradually 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 rate of technological progress and the

3. For instance, a quantitative analysis of the demographic transition in England, conducted by Fernandez-Villaverde (2004), demonstrates that in contrast to Becker's theory, a rise in income would have resulted in an increase in fertility rates, rather than in the observed decline in fertility.

4. Source: Maddison (2003). GDP per capita is measured in 1990 international dollars.

5. Furthermore, cross-section evidence within countries suggest that the elasticity of the number of surviving offspring with respect to wage income was positive prior to the demographic transition (e.g., Clark and Hamilton 2003), in contrast to Becker's argument that would require a negative elasticity at higher levels of income.

associated increase in the demand for human capital brought about two effects on population growth. On the one hand, improved technology eased household's 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 rate of technological progress that were stimulated by human capital accumulation induced a reduction in fertility rates, generating a demographic transition in which the rate of population growth declined along with an increase in the average level of education. Thus, consistent with historical evidence, the theory suggests that prior to the demographic transition, population growth increased along with investment in human capital, whereas the demographic transition brought about a decline in population growth along with a further increase in human capital formation.[6]

Galor and Weil's 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 demographic transition across Western European countries that differed significantly in their levels of income per capita. Consistent with the theory, the growth rates (as opposed to the levels) 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 United Kingdom, 2.12% in Norway, 2.17% in Sweden, to 2.87% in Germany. Moreover, as depicted in Figure 2, the demographic transition in England was associated with a significant increase in the investment in child quality as reflected by years of schooling.

Evidence about the evolution of the return to human capital over this period are scarce and controversial. They do not indicate that the skill premium increased markedly in Europe over the course of the 19th century. One can argue that the lack of clear evidence about the increase in the return to human capital over this period is an indication for the absence of a significant increase in the demand for human capital. This partial equilibrium argument, however, is flawed. The return to human capital is affected both by the demand and the supply of human capital. Technological progress in the second phase of the Industrial Revolution brought about an increase in the demand for human capital, and indeed, in the absence of a supply response, one would have expected an increase in the return to human capital. However, the significant increase in schooling in the 19th century, and in particular the introduction of public education that lowered the cost of education, generated a significant increase in the supply of educated workers. Some of this supply response was a direct reaction of the increase in the demand for human

6. Quantitative evidence provided by Greenwood and Seshadri (2002) is supportive of the role of the rise in the demand for skilled labor (via faster technological progress in an industrial, skilled-intensive, sector) in the demographic transition in the US.

capital, and thus may only operate to partially offset the increase in the return to human capital. However, the removal of the adverse effect of credit constraints on the acquisition of human capital (e.g., Galor and Zeira 1993), as reflected by the introduction of public education, generated an additional force that increased the supply of educated labor and operated towards a reduction in the return to human capital.[7]

3.4. The Rise in the Demand for Human Capital: Reinforcing Mechanisms

The Decline in Child Labor. 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 child labor. It gradually increased the wage differential between parental labor and child labor, inducing parents to reduce the number of their children and to further invest in their quality (Hazan and Berdugo 2002). Moreover, the rise in the importance of human capital in the production process induced industrialists to support education reforms (Galor and Moav 2003) and thus laws that abolish child labor (Doepke 2004; Doepke and Zilibotti 2004), reducing child labor and thus fertility.

The Rise in Life Expectancy. The impact of the increase in the demand for human capital on the decline in the desirable number of surviving offspring may have been reinforced by the rise in life expectancy. Despite the gradual rise in life expectancy prior to the demographic transition, investment in human capital was rather insignificant as long as a technological demand for human capital had not emerged. The technologically based rise in the demand for human capital during the second phase of the Industrial Revolution and the rise in the expected length of productive life has increased the potential rate of return to investments in children's human capital, reinforcing the inducement for investment in education and the associated reduction in fertility rates (Galor and Weil 1999; Hazan and Zoabi 2004; Lagerloaf 2003a; Moav 2005; Soares (forthcoming)).

Natural Selection and the Evolution of Preference for Offsprings's Quality. The impact of the increase in the demand for human capital on the decline in the desirable number of surviving offspring may have been magnified by cultural or genetic evolution in the attitude of individuals toward child quality. Galor and Moav (2002) propose that during the epoch of Malthusian stagnation that characterized most of human existence, individuals with a higher valuation for offspring quality (in the context of the quantity-quality survival strategies) gained an evolutionary advantage and their representation in the population gradually increased. The agricultural revolution facilitated the division of labor and fostered trade

7. This argument is supported indirectly by contemporary evidence about a higher rate of return to human capital in less-developed economies, reflecting the greater prevalence of barriers for the acquisition of skills.

relationships across individuals and communities, enhancing the complexity of human interaction and raising the return to human capital. Moreover, the evolution of the human brain in the transition to Homo sapiens and the complementarity between brain capacity and the reward for human capital has increased the evolutionary optimal investment in the quality of offspring. The distribution of valuation for quality lagged behind the evolutionary optimal level and individuals with traits of higher valuation for their offspring's quality generated higher income and, in the Malthusian epoch when income was positively associated with aggregate resources allocated to child rearing, a larger number of offspring. Thus, the trait of higher valuation for quality gained the evolutionary advantage. This evolutionary process was reinforced by its interaction with economic forces. As the fraction of individuals with high valuation for quality increased, technological progress intensified, raising the rate of return to human capital. The increase in the rate of return to human capital, along with the increase in the bias towards quality in the population, reinforced the substitution towards child quality, setting the stage for a more rapid decline in fertility along with a significant increase in investment in human capital. This hypothesis is consistent with the observed rise in literacy rates prior to the increase in the demand for human capital in the second phase of industrialization.

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 deferential 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 household income, generating a decline in fertility and a shift from stagnation to growth. (See Lagerloef 2003b as well.)

3.5. Other Theories

The Old-Age Security Hypothesis. The old-age security hypothesis has been proposed as an additional mechanism for the onset of the demographic transition

(Caldwell 1976). It suggests that in the absence of capital markets that permit intertemporal lending and borrowing, children are assets that permit parents to smooth consumption over their lifetime. The process of development and the establishment of capital markets reduce this motivation for rearing children, contributing to the demographic transition. The significance of the decline in the role of children as assets in the onset of the demographic transition is questionable.[8] The rise in fertility rates prior to the demographic transition, in a period of improvements in the credit markets, raises doubts about the significance of the mechanism. Furthermore, cross-section evidence in the predemographic transition era indicates that wealthier individuals, that presumably had a better access to credit markets, had a larger number of surviving offspring (e.g., Clark and Hamilton 2003).

Exogenous Shocks—Luck. Becker, Murphy, and Tamura (1990) underlines the role of luck in the determination of the timing of the demographic transition and the wealth of nations. They argue that a major shock shifted economies from a low-output, high-fertility steady-state equilibrium towards a high-output, low-fertility steady-state equilibrium, triggering a demographic transition. This theory suffers from critical deficiencies in the microstructure.[9] Moreover, in contrast to existing evidence that shows that the process of industrialization was accompanied initially by sharp increase in the population growth, in their setting a major shock generates, counterfactually, a monotonic decline in fertility rates along with a simultaneous rise in income per capita.

4. Concluding Remarks

This paper argues that the increasing role of human capital in the production process in the second phase of industrialization was the central force behind the demographic transition that swept the world in the course of the last century. The onset of the demographic transition liberated the gains in productivity from the counterbalancing effects of population growth, paving the way for human capital formation and the emergence of the modern state of sustained economic growth.

8. There are rare examples in nature for offspring that support their parents in old age. Thus old-age support could not be the prime motivation for child rearing.

9. Multiplicity of equilibria is generated by the implausible assumption that the return to education increases with the aggregate level of education in society. Moreover, their "Malthusian" steady-state has none of the features of a Malthusian equilibrium: (a) in the absence of technological change population growth rate is not at the reproduction level, (b) counterfactually population growth in their "Malthusian" steady-state is higher than the that in the beginning of the demographic transition, and (c) a small positive shock to income in the "Malthusian" steady-state initially decreases fertility.

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