Economic Growth in the Very Long Run

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Abstract

The evolution of economies during the major portion of human history was marked by Malthusian Stagnation. The transition from an epoch of stagnation to a state of sustained economic growth has shaped the contemporary world economy and has led to the Great Divergence in income per capita across the globe in the past two centuries. This entry examines the process of development over the course of human history and its implications from comparative development in light of recent advances in Unified Growth Theory.

JEL classification Numbers: O11, O14, O33, O40, J11, J13.

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Introduction

The evolution of economies during the major portion of human history was marked by Malthusian Stagnation. Technological progress and population growth were miniscule by modern standards and the average growth rates of income per capita in various regions of the world were even slower due to the offsetting effect of population growth on the expansion of resources per capita.

In the past two centuries 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. 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 industrialization ultimately prompted a demographic transition, liberating the gains in productivity from the counterbalancing effects of population growth. The decline in the growth rate of population and the enhancement of human capital formation and technological progress paved the way for the emergence of the modern state of sustained economic growth. Variations in the timing of the transitions from a Malthusian epoch to a state of sustained economic growth across countries lead to a considerable rise in the ratio of GDP per capita between the richest and the poorest regions of the world from 3:1 in 1820 to 18:1 in 2000.

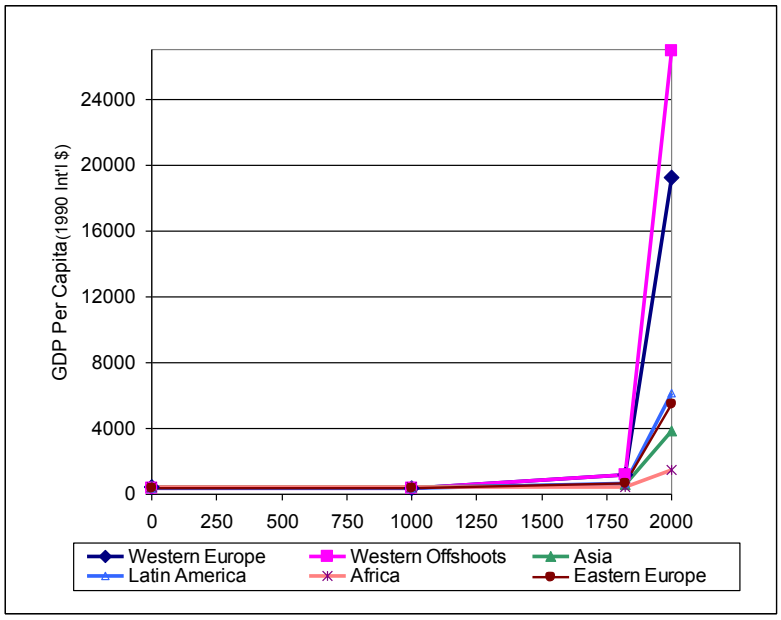

Figure 1. The Evolution of Regional Income per Capita 1 - 2000

The transition from stagnation to growth and the associated phenomenon of the Great Divergence have been the subject of intensive research in the growth literature in recent years. [Galor and Weil, 1999, 2000; Galor and Moav, 2002; Lucas, 2002; Hansen and Prescott, 2002; Jones, 2001; Hazan and Berdugo, 2002; Doepke, 2004; Lagerlof, 2003, 2006; Fernandez-Villaverde, 2005; Galor and Mountford, 2003, 2006]. The inconsistency of exogenous and endogenous growth models with some of the most fundamental features of the process of development, has led to a search for a unified theory that would unveil the underlying micro-foundations of the growth process in its entirety, and would capture in a single framework the epoch of Malthusian stagnation that characterized most of human history, the contemporary era of modern economic growth, and the driving forces that triggered the recent transition between these regimes.

The advancement of unified growth theory was fueled by the conviction that the understanding of the contemporary growth process would be fragile and incomplete unless growth theory would be based on

proper micro-foundations that reflect the various qualitative aspects of the growth process and their central driving forces. Moreover, it has become apparent that a comprehensive understanding of the hurdles faced by less developed economies in reaching a state of sustained economic growth would remain obscure unless the factors that prompted the transition of the currently developed economies into a state of sustained economic growth could be identified and modified to account for the differences in the growth structure of less developed economies in an interdependent world.

Unified growth theory explores the fundamental factors that generated the remarkable escape from the Malthusian epoch and their significance in understanding the contemporary growth process of developed and less developed economies. Moreover, it sheds light on the perplexing phenomenon of the Great Divergence in income per capita across regions of the world in the past two centuries. It suggests that the transition from stagnation to growth is an inevitable outcome of the process of development. The inherent Malthusian interaction between the level of technology and the size and the composition of the population accelerated the pace of technological progress and ultimately raised the importance of human capital in the production process. The rise in the demand for human capital in the second phase of industrialization and its impact on the formation of human capital as well as on the onset of the demographic transition brought about significant technological advancements along with a reduction in fertility rates and population growth, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita, and paving the way for the emergence of sustained economic growth.

Differences in the timing of the take-off from stagnation to growth across countries (e.g., England's earlier industrialization in comparison to China) contributed significantly to the Great Divergence and to the emergence of convergence clubs. These timing differences have 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. In particular, once a technologically-driven demand for human capital emerged in the second phase of industrialization, the prevalence of human capital promoting institutions determined the extensiveness of human capital formation, the timing of the demographic transition, and the pace of the transition from stagnation to growth. Thus, unified growth theory provides the natural framework of analysis in which variations in the economic performance across countries and regions could be examined based on the effect of variations in educational, institutional, geographical, and cultural factors on the pace of the transition from stagnation to growth.

The Process of Development

The process of economic development has been characterized by of three fundamental regimes: the Malthusian Epoch, the Post-Malthusian Regime, and the Sustained Growth Regime.

A. The Malthusian Epoch

During the Malthusian epoch that had characterized most of human history, humans were subjected to a persistent struggle for existence. Resources generated by technological progress and land expansion were channeled primarily towards an increase in the size of the population, with a minor long-run effect on income per capita. Improvements in the technological environment or in the availability of land generated temporary gains in income per capita, leading eventually to a larger but not richer population. Technologically superior countries ultimately had denser populations but their standard of living did not reflect the degree of their technological advancement.

During the Malthusian epoch the average growth rate of output per capita was negligible and the standard of living did not differ greatly across countries. The average level of income per capita in the world during the first millennium fluctuated around $450 per year (in 1990 international dollars) and the average growth rate of output per capita was nearly zero. (Maddison, 2001). This state of Malthusian stagnation persisted until the end of the 18th century. In the years 1000-1820, the average level of income per capita in the world economy was below $670 per year and the average growth rate of the world income per capita was miniscule, creeping at a rate of about 0.05% per year. Nevertheless, income per capita fluctuated

significantly within regions, deviating from their sluggish long-run trend over decades and sometimes centuries.

Population growth over this era followed the Malthusian pattern as well. The gradual increase in income per capita during the Malthusian epoch was associated with a monotonic increase in the average rate of growth of world population. The slow pace of resource expansion in the first millennium was reflected in a modest increase in the population of the world from 231 million people in 1 CE to 268 million in 1000 CE; a miniscule average growth rate of 0.02% per year. The more rapid (but still very slow) expansion of resources in the period 1000-1500, permitted the world population to increase by 63%, from 268 million in 1000 to 438 million in 1500; a slow 0.1% average growth rate per year. Resource expansion over the period 1500-1820 had a more significant impact on the world population, which grew 138% from 438 million in 1500 to 1041 million in 1820; an average pace of 0.27% per year.

Variations in population density across countries during the Malthusian epoch reflected primarily cross country differences in technology and land productivity. Due to the positive adjustment of the population to an increase in income per capita, differences in technology or in land productivity across countries resulted in variations in population density rather than in the standard of living. For instance, China's technological advancement in the period 1500-1820 permitted its share of world population to increase from 23.5% to 36.6%, while its income per capita in the beginning and the end of this time interval remained approximately $600 per year.

B. The Post-Malthusian Regime

During the Post Malthusian Regime, the pace of technological progress markedly increased in association with the process of industrialization, triggering a take-off from the Malthusian trap. The growth rate of income per capita increased significantly but the positive Malthusian effect of income per capita on population growth was still maintained, generating a sizeable increase in population growth that offset some of the potential gains in income per capita.

The take-off of developed regions from the Malthusian Regime occurred at the beginning of the 19th century and was associated with the Industrial Revolution, whereas the take-off of less developed regions occurred towards the beginning of the 20th century and was delayed in some countries well into the 20th century. During the Post-Malthusian Regime the average growth rate of output per capita increased significantly and the standard of living began to differ considerably across countries. The average growth rate of output per capita in the world soared from 0.05% per year during the period 1500-1820 to 0.53% per year in the years 1820-1870, and 1.3% per year during the period 1870-1913. The timing of the take-off and its magnitude differed across regions. The take-off from the Malthusian Epoch and the transition to the Post-Malthusian Regime occurred in Western Europe, the Western Offshoots (i.e., the United States, Canada, Australia and New Zealand), and Eastern Europe at the beginning of the 19th century, whereas in Latin America, Asia (excluding China) and Africa it occurred towards the beginning of the 20th century.

The rapid increase in income per capita in the Post-Malthusian Regime was channeled partly towards an increase in the size of the population. During this period, the Malthusian mechanism linking higher income to higher population growth continued to function. However, the effect of higher population on the dilution of resources per capita was counteracted by accelerated technological progress and capital accumulation, allowing income per capita to rise despite the offsetting effects of population growth.

The Western European take-off along with that of the Western Offshoots brought about a sharp increase in population growth in these regions and consequently a modest rise in population growth in the world as a whole. The subsequent take-off of less developed regions, and the associated increase in their rates of population growth, brought about a significant rise in population growth in the world. The rate of population growth in the world increased from an average rate of 0.27% per year in the period 1500-1820 to 0.4% per year in the years 1820-1870, and to 0.8% per year in the time interval 1870-1913. Despite the decline in population growth in Western Europe and the Western Offshoots towards the end of the 19th century and the beginning of the 20th century, the delayed take-off of less developed regions, and the significant increase in their income per capita prior to their demographic transitions, generated a further

increase in the rate of population growth in the world to 0.93% per year in the period 1913-1950, and 1.92% per year in the period 1950-1973. Ultimately, the onset of the demographic transition in less developed economies during the second half of the 20th century gradually reduced population growth rates to 1.66% per year in the 1973-1998 period (Maddison, 2001).

It appears that the significant rise in income per capita in the Post-Malthusian Regime increased the desired number of surviving offspring and thus, despite the decline in mortality rates, fertility increased significantly so as to enable households to reach this higher desired level of surviving offspring. Fertility was controlled during this period, despite the absence of modern contraceptive methods, partly via adjustment in marriage rates. Increased fertility was achieved by earlier female's age of marriage, and a decline in fertility by a delay in the marriage age.

The take-off in the developed regions was accompanied by a rapid process of industrialization. Per-capita Level of Industrialization (measuring per capita volume of industrial production) increased significantly in the United Kingdom, rising 50% over the 1750-1800 period, quadrupling in the years 1800-1860, and nearly doubling in the time period 1860-1913. Similarly per-capita level of industrialization accelerated in the United States, doubling in the 1750-1800 as well as 1800-1860 periods, and increasing six-fold in the years 1860-1913. A similar pattern was experienced in Germany, France, Sweden, Switzerland, Belgium, and Canada. The take-off of less developed economies in the 20th century was associated with increased industrialization as well. However, during the 19th century these economies experienced a decline in per capita industrialization, reflecting the adverse effect of the sizable increase in population on the level of industrial production per capita as well as the forces of globalization and colonialism, that induced less developed economies to specialize in the production of raw materials.

The acceleration in technological progress during the Post-Malthusian Regime and the associated increase in income per capita stimulated the accumulation of human capital in the form of literacy rates, schooling, and health. The increase in the investment in human capital was induced by the rise in income per capita, as well as by qualitative changes in the economic environment that increased the demand for human capital and induced households to invest in the education of their offspring.

In the first phase of the Industrial Revolution, human capital had a limited role in the production process. Education was motivated by a variety of reasons, such as religion, enlightenment, social control, moral conformity, sociopolitical stability, social and national cohesion, and military efficiency. The extensiveness of public education was therefore not necessarily correlated with industrial development and it differed across countries due to political, cultural, social, historical and institutional factors. In the second phase of the Industrial Revolution, however, the demand for education increased, reflecting the increasing skill requirements in the process of industrialization. The economic interests of capitalists were a significant driving force behind the implementation of educational reforms (Galor and Moav, 2006). The process of industrialization has been characterized by a gradual increase in the relative importance of human capital in less developed economies as well. Educational attainment increased significantly across all less developed regions in the Post-Malthusian regime.

C. The Sustained Growth Regime

The acceleration in the rate of technological progress in the second phase of industrialization, and its interaction with human capital formation, triggered a demographic transition, paving the way to a transition to an era of sustained economic growth. In the post demographic-transition period, the rise in aggregate income due to technological progress and factor accumulation was no longer counterbalanced by population growth, permitting sustained growth in income per capita in regions that experienced sustained technological progress and factor accumulation.

The transition of the developed regions of Western Europe and the Western Offshoots to the state of sustained economic growth occurred towards the end of the 19th century and their income per capita in the last century has advanced at a stable rate of about two percent per year. The transition of some less developed countries in Asia and Latin America occurred towards the end of the 20th century. Africa, in contrast, is still struggling to make this transition.

The transition to a state of sustained economic growth was characterized by a gradual increase in the importance of the accumulation of human capital relative to physical capital as well as with a sharp decline in fertility rates. In the first phase of the Industrial Revolution (1760-1830), capital accumulation as a fraction of GDP significantly increased whereas literacy rates remained largely unchanged. Skills and literacy requirements were minimal, the state devoted virtually no resources to raise the level of literacy of the masses, and workers developed skills primarily through on-the-job training (Green, 1990; Mokyr, 1993). Consequently, literacy rates did not increase during the period 1750-1830 (Sanderson, 1995).

In the second phase of the Industrial Revolution, however, the pace of capital accumulation subsided, the education of the labor force markedly increased and skills became necessary for production. The investment ratio in the UK which increased from six percent in 1760 to 11.7% in 1831, remained at around 11% on average in the years 1856-1913 (Crafts, 1985). In contrast, the average years of schooling of male in the labor force that did not change significantly until the 1830s tripled by the beginning of the 20th century. The drastic rise in the level of income per capita in England as of 1865 was associated with an increase in school enrollment of 10 years old children from 40% in 1870 to 100% in 1900. Moreover, Total Fertility Rates in England sharply declined over this period from about five in 1875, to nearly two in 1925.

C.1 The Demographic Transition

The demographic transition swept the world in the course of the last century. The unprecedented increase in population growth during the Post-Malthusian Regime was 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. The demographic transition enhanced the growth process via three channels: (a) reductions in the dilution of the stock of capital and land, (b) enhancements in human capital formation, and (c) changes in the age distribution of the population, temporarily increasing the size of the labor force relative to the population as a whole.

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.

C.2 Human Capital Formation

The process of industrialization was characterized by a gradual increase in the relative importance of human capital in the production process. The acceleration in the rate of technological progress gradually increased the demand for human capital, inducing individuals to invest in education, and stimulating further technological advancement. Moreover, in developed as well as less developed regions, the onset of the process of human capital accumulation preceded the onset of the demographic transition, suggesting that the rise in the demand for human capital in the process of industrialization and the subsequent accumulation of human capital played a significant role in the demographic transition and the shift to a state of sustained economic growth.

Notably, the reversal of the Malthusian relation between income and population growth during the demographic transition, corresponded to an increase in the level of resources invested in each child. For example, in England literacy rate among men, which was stable at around 65% in the first phase of the Industrial Revolution, increased significantly during the second phase, reaching nearly 100% at the end of the 19th century. In addition, the proportion of children aged five to 14 in primary schools increased from 11% in 1855 to 74% in 1900. A similar pattern is observed in other European societies. (Flora et al., 1983).

The process of industrialization was characterized by a gradual increase in the relative importance of human capital in less developed economies as well. Educational attainment increased significantly across all less developed regions. Moreover, in line with the pattern that emerged among developed economies in the 19th century, the increase in educational attainment preceded or occurred simultaneously with the decline in total fertility rates.

D. The Great Divergence

The differential timing of the take-off from stagnation to growth across countries and the corresponding variations in the timing of the demographic transition led to a great divergence in income per capita as well as population growth. Inequality in the world economy was negligible till the 19th century. The ratio of GDP per capita between the richest region and the poorest region in the world was only 1.1:1 in 1000, 2:1 in 1500 and 3:1 in 1820. In the past two centuries, however, the ratio of GDP per capita between the richest group (Western offshoots) and the poorest region (Africa) has widened considerably from a modest 3:1 ratio in 1820, to 5:1 ratio in 1870, 9:1 ratio in 1913, 15:1 in 1950, and 18:1 ratio in 2001.

An equally momentous transformation occurred in the distribution of world population across regions. The earlier take-off of Western European countries increased the amount of resources that could be devoted for the increase in family size, permitting a 16% increase in the share of their population in the world from 12.8% in 1820 to 14.8% in 1870. However, the early onset in the Western European demographic transition and the long delay in the demographic transition of less developed regions, well into the 2nd half of the 20th century led to a decline in the share of Western European population in the world, from 14.8% in 1870 to 6.6% in 1998. In contrast, the prolongation of the Post-Malthusian period among less developed regions, in association with the delay in their demographic transition well into the second half of 20th century, channeled their increased resources towards a significant increase in their population. Africa's share of world population increased from 7% in 1913 to 12.9% in 1998, Asia's share of world population increased from 51.7% in 1913 to 57.4% in 1998, and Latin American countries increased their share in world population from two percent in 1820 to 8.6% in 1998.

Unified Growth Theory

Galor and Weil (2000) advanced a unified growth theory that captures the three regimes that have characterized the process of development as well as the fundamental driving forces that generated the transition from an epoch of Malthusian stagnation to a state of sustained economic growth. The theory replicates the observed time paths of population, income per capita, and human capital, generating: (a) the Malthusian oscillations in population and output per capita during the Malthusian epoch, (b) an endogenous take-off from Malthusian stagnation that is associated with an acceleration in technological progress and is accompanied initially by a rapid increase in population growth, and (c) a rise in the demand for human capital, followed by a demographic transition and sustained economic growth. This qualitative patterns are confirmed in the calibrated of the theory by Lagerlof (2006).

The theory proposes that in early stages of development economies were in the proximity of a stable Malthusian equilibrium. Technology advanced rather slowly, and generated proportional increases in output and population. The inherent positive interaction between population and technology in this epoch, however, gradually increased the pace of technological progress, and due to the delayed adjustment of population, output per capita advanced at a miniscule rate. The slow pace of technological progress in the Malthusian epoch provided a limited scope for human capital in the production process and parents, therefore, had no incentive to reallocate resources towards human capital formation of their offspring.

The Malthusian interaction between technology and population accelerated the pace of technological progress and permitted a take-off to the Post-Malthusian Regime. The expansion of resources was partially counterbalanced by the enlargement of population and the economy was characterized by rapid growth rates of income per capita and population. The acceleration in technological progress eventually increased the demand for human capital, generating two opposing effects on population growth. On the one hand, it eased households' budget constraints, allowing the allocation of more resources for raising children. On the other hand, it induced a reallocation of resources toward child quality. In the Post-Malthusian Regime, due

to the modest demand for human capital, the first effect dominated and the rise in real income permitted households to increase the number as well the quality of their children.

As investment in human capital took place, the Malthusian steady-state equilibrium vanished and the economy started to be attracted by the gravitational forces of the Modern-Growth Regime. The interaction between investment in human capital and technological progress generated a virtuous circle: human capital generated faster technological progress, which in turn further raised the demand for human capital, inducing further investment in child quality, and eventually triggering the onset of the demographic transition and the emergence of a state of sustained economic growth.

The theory suggests that the transition from stagnation to growth is an inevitable outcome of the process of development. The inherent Malthusian interaction between the level of technology and the size of the population accelerated the pace of technological progress, and ultimately raised the importance of human capital in the production process. The rise in the demand for human capital in the second phase of the Industrial Revolution and its impact on the formation of human capital as well as on the onset of the demographic transition brought about significant technological advancements along with a reduction in fertility rates and population growth, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita, and paving the way for the emergence of sustained economic growth. Quantitative analysis of unified growth theories (Doepke, 2004); Fernandez-Villaverde, 2005; Lagerlof, 2006) indeed suggest that the rise in the demand for human capital was a significant force behind the demographic transition and the emergence of a state of sustained economic growth.

Variations in the timing of the transition from stagnation to growth and thus in economic performance across countries 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. In particular, once a technologically-driven demand for human capital emerged in the second phase of industrialization, the prevalence of human capital promoting institutions determined the extensiveness of human capital formation, the timing of the demographic transition, and the pace of the transition from stagnation to growth.

The theory proposes that the growth process is characterized by stages of development and it evolves non-linearly. Technological leaders experienced a monotonic increase in the growth rates of their income per capita. Their growth was rather slow in early stages of development, it increased rapidly during the take-off from the Malthusian epoch, and it continued to rise, often stabilizing at higher levels. In contrast, technological followers that made the transition to sustained economic growth experienced a non-monotonic increase in the growth rates of their income per capita. Their growth rates was rather slow in early stages of development, it increased rapidly in the early stages of the take-off from the Malthusian epoch, boosted by the adoption of technologies from the existing technological frontier. However, once these economies reached the technological frontier, their growth rates dropped to the level of the technological leaders. Hence, consistently with contemporary evidence about the existence of multiple growth regimes (Durlauf and Quah, 1999), the differential timing of the take-off from stagnation to growth across economies generated convergence clubs characterized by a group of poor countries in the vicinity of the Malthusian equilibrium, a group of rich countries in the vicinity of the sustained growth equilibrium, and a third group in the transition from one club to another.

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