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Unified Growth Theory: An Insight

*Faustine Perrin**

Abstract: *»Ein Einblick in die Unified Growth Theory«*. The Unified Growth Theory is receiving increasing attention from growth theorists since the seminal work of Galor and Weil (1999, 2000). These authors emphasize the need for a unified theory of growth that could account for the transition from Malthusian Stagnation to the Modern Growth Regime (1999). This interest is motivated by the lack of explanation and knowledge regarding the historical evolution of the relationship among population growth, technological change and the standard of living. This paper gives an overview of the Unified Growth Theory, its determinants and its implications.

Keywords: economic growth, Malthusian stagnation, great divergence, demographic transition.

1. Introduction

Human history can be clearly divided into two distinct eras, separated by a transitional period¹. Before the Industrial Revolution all societies were characterized by a very long period of stagnation in per capita income with high fertility rates and the dominance of physical over human capital (Clark, 2005). Since this fateful period, Western countries observed a complete reversal with a high sustained income per capita, low fertility and human capital as an important source of income. The trends upheaval strongly suggests the existence of an interaction between the decline in fertility, the rise of human capital and the onset of sustained growth.

Figure 1 illustrates the variation in timing of the transition to a state of sustained economic growth across different regions of the world and that lead to a spectacular rise in the GDP per capita.

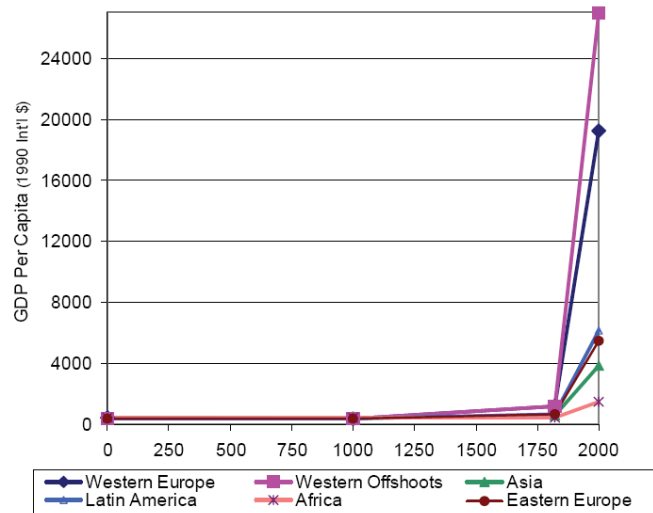
For a long time, theories which aim to explain the development and economic growth found their inspiration in Malthusian and Neoclassical conceptions. In his essay on the principle of population (1798), Malthus defends a “pessimistic” vision of the impact of population on the long run economic development (coherent with the world economic history prior to the Industrial Revolution). In opposition to Malthus’ approach, the Solow model considers demographic behaviors independent from wages, incomes or prices. Thereafter, growth theorists exploring mechanisms by which fertility and growth are re-

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¹ See Annexe for a better understanding of the full time span of human economic history.

lated focused for the most part on the modern era (Barro and Becker, 1989; Barro and Sala-i-Martin, 1995; Becker et al., 1990; Moav, 2005; Tamura, 1994, 1996). The so-called endogenous growth theory, taking into account family behavior, was able to explain empirical regularities that characterized the growth process of developed countries over the last hundred years.

Figure 1: Evolution of Regional GDP per Capita, 1-2001



Source: Galor² (2004).

Nevertheless, both exogenous and endogenous models remain inconsistent with the pattern of development over the very long run. They fail either to capture the recent negative relationship between population growth and income per capita or to comprehend the positive effect of income per capita on population growth and the economic factors that triggered the demographic transition. This left the door open for a new generation of growth theorists (Galor and Weil, 2000; Galor and Moav, 2002; Hansen and Prescott, 2002; Strulik and Weisdorf, 2008) to face the challenge of developing a theory consistent with the entire process of development. Advanced first by Galor and Weil (1999, 2000), the Unified Growth Theory intends to capture in a single framework the main characteristics of the transition from the Malthusian era to the modern era, as well as the associated phenomenon of Great Divergence and Demographic Transition. The theory suggests that:

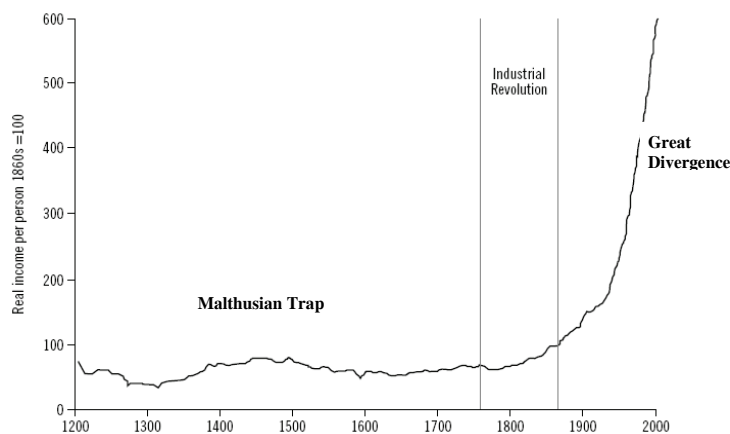
² Using Maddison data (2003) – Western Offshoots consists of United-States, Canada, Australia and New-Zealand.

[...] 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. Oded Galor (2004)

2. Historical Evidence: The Process of Development

Several important features stand out from the data (Maddison, 2001; Clark) for selected countries and regions of the world. Human history can be clearly divided in two distinct eras: the pre-industrial phase for all countries before 1800 and a period of sustained economic growth for Western countries. This evidence is supported by Figure 2 taken from Clark (2007). It represents the real income per capita in England from 1200 to the present. Prior to the Industrial Revolution real income evolved horizontally around a subsistence level and increased exponentially after the 1860-70s.

Figure 2: Real Income per Person, 1200-2004



Source: From Clark (2007).

Stagnation: The Malthusian Era

Stagnation characterized human history for thousands of years. At this stage, population growth was positively affected by the level of income per capita. From this period marked by the absence of significant changes in the level of technology it resulted in a proportional increase in output and population. Income per capita was trapped around a subsistence level and population size remained relatively stable.

As depicted by Maddison's data (2001), the average level of world per capita income fluctuated around \$450 per year over the period 1-1000 and around

\$670 per year then until the end of the 18th century (Figure 3). The monotonic increase in income per capita during the Malthusian era was associated with such a uniform evolution of the average population growth rate in the world (0.01% per year in the first millennium; 0.1% per year in the years 1000-1500; 0.27% per year over the period 1500-1820) while it did not result in variations in the standard of living.

Take-off: The Post-Malthusian Regime

In the beginning of the 19th century, Western countries experienced a take-off from Malthusian stagnation. This shift took place with the increase in the pace of technological progress in association with the process of industrialization, presumably stimulated by the accumulation of human capital³. During this period, income and population growth are still positively correlated. It resulted in a significant increase in the growth rate of output per capita generating an unprecedented increase in population growth, (but in a minor proportion?).

Based on Maddison's data, the world average growth rate of output per capita increased from 0.05% per year for the period 1500-1820 to 0.54% per year during the period 1820-1870, and reached 1.3% per year in the years 1870-1913. Similarly, the average rate of population growth in the world increased from 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 interval 1870-1913. The timing of the take-off differs across regions. In less developed countries⁴, the take-off occurred progressively with a one-century delay, from the beginning of the 20th century. The decline in population growth marked the end of the so-called Post-Malthusian Regime towards the end of the 19th century in Western countries and in the second half of the century in less developed regions.

Sustained Growth: The Modern Growth Regime

The acceleration of technological progress in the second phase of industrialization, its interaction with the human capital accumulation and the reversal in the relation between income per capita and population growth signed the transition toward a state of sustained economic growth. The entrance in the Modern Growth Regime, associated with the phenomenon of demographic transition, has led to a great divergence in income per capita in the past two centuries in Western countries (Galor, 2011).

The phenomenon of demographic transition occurred in the course of the last century as countries developed along the industrialization. This process accounts for the transition from high birth and death rates to low birth and

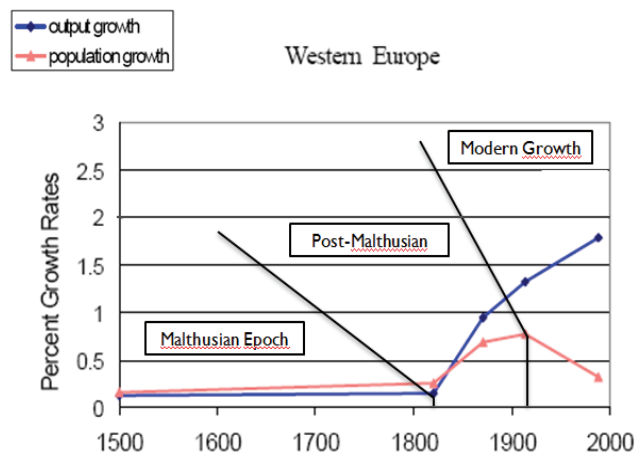
³ The demand for education increased toward the end of the period.

⁴ By developed countries, we mean Latin America, Asia and Africa.

death rates. In pre-industrial society, both death and birth rates fluctuated around a high level (depending on food supply, diseases, natural events...). During the 19th century in Western countries, mortality rates dropped rapidly while birth rates remained high, involving an increase in population. In the following stage, birth rates fell and population growth began to level off.

According to Maddison's data, a reversal in the rate of population growth occurred by the end of the 19th century-beginning of the 20th century for particular regions of the world (Western Europe, Western Offshoots and Eastern Europe). From an average of 0.77% per year in the period 1870-1913 in Western Europe, the population growth rate decreased to an average of 0.42% per year in the years 1913-1950, while it continued to grow in other parts of the world. At the same time, the world average growth rate of GDP per capita kept on increasing, reaching an average of 2.92% per year on the period 1950-1973.

Figure 3: Growth of GDP per Capita and Population, 1500-2000



Source: From Galor using Maddison's data⁵ (2004).

Figure 3 illustrates the evolution of the relationship between output and population growth over the course of history in Western Europe, characterized by three distinct eras: the stagnation, the take-off and the sustained growth.

⁵ Maddison (2001).

3. Main Challenges

The development process described in section 2 raises number of questioning and puzzles. This exacerbates the interest of researchers specialized in the field of growth and development. Unprecedented upheavals occurred during this process. The demographic transition, the transition from stagnation to growth and the phenomenon of great divergence in income per capita took place with different timings across regions of the world. Many mysteries persist. Contemporary growth theorists such as economic historians need to improve the understanding of the development process: the driving forces and underlying determinants that led to the escape from the Malthusian trap and allowed the transition to sustained growth. The main questions to answer are the following one:

- What can explain the centuries of stagnation that characterized most of human history?
- What are the driving forces that account for the sudden increase in growth rates of GDP per capita and the persistent stagnation in others?
- What conducted to the Industrial Revolution? What did this phenomenon occur first in Great Britain?
- What factors can account for the relationship between population and output growth? Why has the positive link between income and population growth reversed its course in some economies but not in others?
- What are the main forces that initiated the process of demographic transition?
- What has caused the Great Divergence in income per capita across regions of the world over the last two centuries?
- Would the transition have been possible without the demographic transition?

In other words, what are the underlying behavioral and technological structures that could simultaneously account for these distinct phases of development? Additionally, what are their implications for the contemporary growth process of developed and under-developed countries?

The fundamental challenge faced by social scientists is to provide credible answers to the questioning before-mentioned using the contributions both of economists, historians and even sociologists. The issue for growth theorists is to develop a unified theory of growth that would account for the main features of the three distinct phases that have characterized the process of development: the Malthusian era, the period of transition and the modern growth regime.

This is what has been first undertaken by Galor and Weil (1999, 2000) with the development of the Unified Growth Theory. In other words, the theory aims to give a better understanding of the driving forces that have conducted to escape the Malthusian trap and allow a transition to a state of sustained growth.

4. Toward a Unified Growth Theory

Background – Malthusian Theory

World economic history has then been dominated by the Malthusian stagnation. The Classical growth theory developed by Malthus in 1798 in *An Essay on Principle of Population* matches pretty well with the empirical evidences of the relation between income and population dynamics prior to the Industrial Revolution. According to this theory, the effect of population growth would be counterbalanced by the expansion of resources, reflecting in such a way the fluctuations of the income per capita around a subsistence level. In other words, without changes in the level of technology (resources) the population size would remain stable as well as the income per capita, while periods of technological progress (expansion of resources) would lead to an increase in population growth, triggering ultimately a decline in income per capita.

Despite the capacity of the Malthusian theory to capture the characteristics of the epoch of stagnation, its predictions appear inconsistent with the features of the post-demographic transition era as well as that of the modern growth regime.

Theories of Demographic Transition

From a theoretical point of view different factors could have triggered a demographic transition, i.e. a period of significant reduction in fertility rates and population growth following the unprecedented increase in population growth.

Theorists have examined a set of plausible explanations being at the root of the demographic transition and the reversal in the relation between income and population growth. Among these potential factors, we came across the decline in child mortality rates leading to a corresponding decrease in total fertility rates. Some researchers (Becker, 1981) argued also that the rise in per capita income had an effect on both the household's income and the opportunity cost of raising children. In both cases, historical (and empirical) evidences contradict these potentialities. First, in Western countries the decline in mortality started a century before the decline in fertility. Secondly, the demographic transition occurred simultaneously across countries that significantly differ in their income per capita.

The gradual rise in the demand for human capital along the process of industrialization has been seen by some researchers as a prime force leading to the onset of the demographic transition, specifically during the second phase of the Industrial Revolution. Galor and Weil (1999, 2000) developed the idea that the acceleration in the rate of technological progress would gradually increase the demand for human capital, inducing parents to invest in the quality of their offspring rather than in the quantity. The existence of a negative correlation between education and fertility has been demonstrated by Becker, Cinnirella

and Woessmann (2011) with new county-level evidence for Prussia in 1816. Ultimately, the process of human capital accumulation would induce a reduction in fertility rates as far as the growth rate of technological progress increase.

The decline in the gender gap is another argument advanced as a reinforcing mechanism impacting fertility rates. According to Galor and Weil (1996), technological progress and capital accumulation would positively impact the relative wages of women along the process of industrialization which would increase the opportunity cost of raising children, and ultimately lead to a reduction in fertility.

The Unified Growth Theory

The inability of exogenous and endogenous growth models to explain the process of development over the full span of human history motivated growth theorists to develop a unified theory of growth, i.e. a theory that would capture in a single analytical framework the main characteristics of the process of development.

The Unified Growth Theory integrates the main features of the Malthusian economy but within a context where the size of population and technology are linked. First, the increase in technological progress and the capital accumulation counterbalances the negative effect of population growth on income per capita highlighted by the Malthusian theory. As proposed by Galor and Weil (2000):

[...] during the Malthusian epoch, the dynamical system would have to be characterized by a stable Malthusian steady-state equilibrium, but ultimately due to the evolution of latent state variables in this epoch, the Malthusian steady-state equilibrium would vanish endogenously leaving the arena to the gravitational forces of the emerging Modern Growth Regime.

Henceforth, the theory generates the endogenous driving forces allowing the economy to experience a demographic transition and which ultimately lead to a take-off from the era of stagnation towards a state of sustained economic growth.

5. Conclusion

The unified theory of growth is developed as an alternative theory of exogenous and endogenous model that could capture in a single framework the main characteristics of the process of development. The Unified Growth Theory shed lights on the driving forces that would enable countries in a state of Malthusian stagnation to take-off towards a state of sustained economic growth.

In the Malthusian Regime, the economy remains trapped around a substantial level of output growth. During the Post-Malthusian Regime, the pace of technological progress accelerates, caused by the increase in the size of popula-

tion, and allows the economy to generate a take-off. In the Modern Growth Regime, the output per capita increases along with the rate of population growth and human-capital accumulation (Galor and Weil, 2000). Rapid technological progress, resulting from human capital accumulation, triggers a demographic transition with a constant decrease in fertility rates (Galor, 2011).

Other central determinants of the development process have been left out from the first attempts of modeling a unified theory of growth. This left the door open to social scientists and growth theorists to bring the lights on a more complete understanding of the driving forces allowing the development process in different regions of the world over the last century. A greater challenge in the construction of a Unified Growth Theory is to get a better understanding of the past in order to comprehend the future. The path dependency could then be a guide in the analysis and the implementation of economic policies.

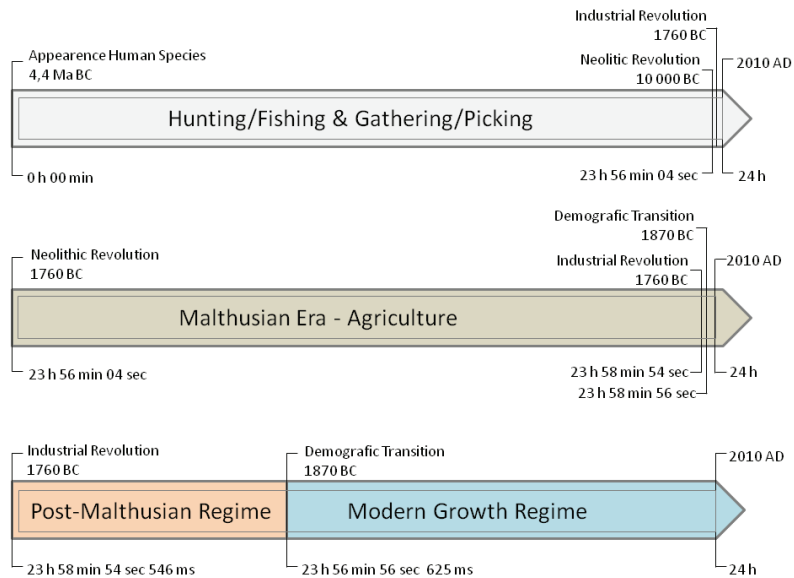
Annexe

The development process is a complex phenomenon. In order to have a better understanding of the full span of human economic history, we chose to imagine what would represent the time span of 4Ma BC-2010 AD in terms of a 24 hours-day, in the inspiration of the Snowdown's "soccer field of history" (Snowdown, 2008).

If humans appeared at 0h00 and if 24 hours have elapsed... Humans are born 3 to 5 million of years ago (depending on whether we consider Australopithecus as being Humans or only the type Homo) but let's bring back this period to 24 hours. At the beginning, at 0h00, Humans evolved in an economy of predation, divided into groups of hunters-gatherers, fishers, pickers (using available natural resources without having the control over them). At approximately 21 h 48 min 29 sec, on our one-day scale, the domestication of fire by Homo erectus marks a turning point in the Prehistory (around 450 000 BC). At about 23 h 56 min 04 sec, the Neolithic Revolution initiates the transition from hunting and gathering towards agriculture and sedentary lifestyle. The livelihood of the population is insured by the production. Then everything accelerates, it was 23 h 58 min 54 sec 546 ms when the Industrial Revolution marked the transition from a predominantly agricultural and artisanal society towards a commercial and industrial society (lagged in time and space depending on the considered countries); at 23 h 58 min 56 sec 625 ms, onset of the Demographic Transition with a multiplication by two or three of the European population.

Figure 4a illustrates the time span of human history in 24 hours. Figure 4b shows that during the last hour of the day of history (10,000 BC-2010 AD), the Malthusian Growth Regime dominated human history until the onset of the Industrial Revolution. Figure 4c represents the final 01 min 05 sec 454 ms that has witnessed the demographic transition and the emergence of the modern growth regime.

Figure 4: a-c



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