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Introduction

The movement of the production potential of the industrialized nations over long periods of time is at the center of the very latest economic debates. This preoccupation is far from new. The Classical economists were already concerned about how to increase welfare by increasing growth. The subject remained controversial after World War II with the theoretical debate on the long-term stability of market economies. However, through Solow's (1956) economic-growth model neo-classical thinking gradually exerted its power. Its reasoning is clear, and it also explains numerous aspects related to economic growth, which are summarized perfectly in Kaldor's (1963) six "stylized facts." At the same time – perhaps paradoxically – scientific interest in work on growth and economic fluctuations disappeared. There were two main reasons for this. First, the short-sightedness of economists whose attention was centered almost exclusively on the study of short-term movements and second, the comparative weakness of theoretical models unable to solve the aspects that remain unexplained by the different theories of growth. This partially explains why the post-war neoclassical models are unsatisfactory. Indeed, in the long run, they only account for economic growth by involving exogenous factors (except for Ramsey's (1928) model that was rediscovered very recently). In addition, Solow's reference model does not provide any way of explaining the divergence in growth rates at the international level. The theory of long-run equilibrium suggests that all countries should progress at identical, exogenous rates of technical progress. Similarly, it should be noted that the hypothesis of the systematic existence of a negative correlation between income level and economic growth rate is not based on any satisfactory empirical verification. Finally, nothing really corroborates the convergence hypothesis, that is to say, the transfer of capital from the richest to the poorest countries.

However, the work of Lucas (1988) and Romer (1986, 1990) attracted attention, and the 1980s marked a renaissance of the neoclassical theory of growth. The prime objective was to go beyond the weakness of the old theoretical models. The aim was also to answer new questions: What are the determinants of sustainable economic growth? Can technical progress alone increase social welfare or can capital accumulation also lead to a permanent increase in per capita income? What are the factors of production that engender sustainable economic growth: physical capital, environmental capital, human capital or technological knowledge? What are the mechanisms that guarantee growth over a long period for a market economy? And finally, what is/are the market structure/s within which economic growth can be achieved? Strengthened by its focus on these questions, the debate on the

determinants of the economic growth process has recently attracted renewed attention, both in the importance of its implications in terms of economic policy, and in the number of theoretical and empirical analyses that it engendered.

In fact, during the past two centuries, the Western world witnessed dramatic economic, demographic and cultural upheavals. This period marked a turning point in historical economic and demographic trends. Despite some variations in terms of timing and speed of changes (Galor, 2012), Western countries exhibited similar patterns of economic and demographic transition. 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 capital over human capital (Clark, 2005). Since this fateful period Western countries experienced a complete reversal with high and sustained income per capita and low fertility rates (Becker *et al.*, 2012, Klemp, 2012). Human capital became an important source of income.

The main objective of this chapter is to present the theoretical approaches attached to the understanding of the process of development and growth. Empirical regularities raise numerous questions about the potential interactions linking demographic developments and the economic transition, and about the role they have played in the transition from the stagnation to sustained growth. What are the underlying behavioral forces behind this demographic transition? What are the endogenous interactions between population and production? What accounts for the unprecedented rise in income per capita? Why has the transition to a state of sustained economic growth occurred together with the demographic transition?

This chapter that lays the theoretical foundations of cliometric analyses that aim at providing a better understanding of the long-run economic growth is organized as follows. First, we provide an overview of the stylized facts of three fundamental regimes that have characterized the process of development over the course of human history on the basis of the seminal work of Galor and Weil (2000).[1] Second, we explore existing theories offering explanations of the different stages of the process of development. We briefly examine the predictions and underlying mechanisms of the traditional theories of economic growth and development, and the theories of demographic transitions. Third, we highlight the relevance of the Unified Growth Theory to explain and capture the underlying mechanisms of the development process, and we provide an example of the unified growth model, introducing a key concept of development: the level of gender equality.

1. The Stylized Facts of the Development Process

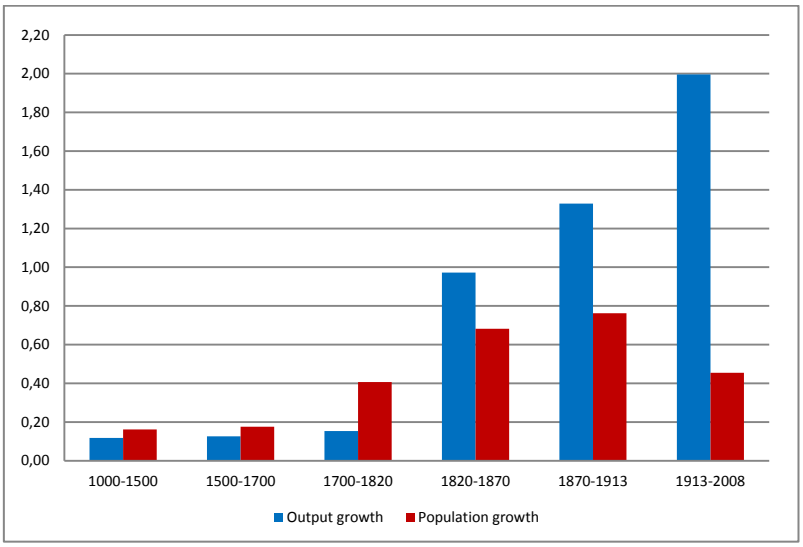
[1] The seminal work of Galor and Weil was quickly followed by new contributions, including Jones (2001), Lucas (2002), Hansen and Prescott (2002), Galor and Moav (2002), Doepke (2004), Galor (2005), Cervellati and Sunde (2005), Strulik and Weisdorf (2008), among others.

1.1. Evolution of Output and Population Growth in Western Europe

Demographic behaviors are a key underlying aspect of the process of development that occurred in Western countries over the past two hundred years. In order to have a better comprehension of the evolution of economic growth, demographic trends must be studied coincidentally with economic developments.

Figure 1 presents a broad picture of the joint evolution of output growth and population growth in Western Europe over six periods between 1000 and 2008. The first two periods, 1000-1500 and 1500-1700, are highly similar with a population growth rate slightly larger than the output growth rate (respectively around 0.16% and 0.12%). Both average annual growth rates start to increase slowly over the period 1700-1820 (respectively 0.41% and 0.15%). The wealth generated was absorbed by the rise in population growth. This positive relationship between income and population continues over the period 1820-1870 but becomes progressively narrower.

Figure 1 : GDP per Capita and Population Growth Rates in Western Europe (30 Countries)



Source: Data from Maddison (2008)

The period 1820-1870 experiences a sharp rise in economic growth. The take-off in growth rates of GDP per capita was associated with a rise in population growth as observed in all regions of the world (Galor, 2011). However, the population growth remains relatively restrained in comparison to the output increase. More precisely, the average growth rate in GDP per capita in Western Europe between 1820 and 1870 rose to an annual growth rate of 0.97% (from 0.15% during the period 1700-1820) while the average population growth rate increased to 0.68% (from 0.41% during the period 1700-1820). If we compare Western Europe with France, we note that population growth was significantly lower in France than in Western Europe, with an average annual growth rate of 0.42% over the same period. From 1870-1913 the pace of the population growth rate slowed down (0.42%)

while that of the GDP per capita increased further, to 1.11%. The last period, 1913-2008, is marked by an unprecedented reversal in the relationship between population and output growth. For the first time, the rate of population growth decreased while the growth rate of per capita GDP continued to rise. The rate of GDP per capita then grew by 2% per year while population growth rate declined to a yearly average of 0.45%. Ultimately, Western Europe experienced a demographic transition in parallel to the continuous increase in GDP per capita.

1.2. The Three Phases of the Development Process

Several important features stand out from Maddison's (2008) data. Human history can be divided into three fundamental regimes: the Malthusian Epoch, the Post-Malthusian Regime, and the Modern Growth Regime.

1.2.1. Stagnation – Malthusian Era

Maddison indicates that the average level of world per capita income fluctuated around $450 per year over the period 1-1000 and around $670 per year from then until the end of the 18th century. The monotonic increase in income per capita during the Malthusian era was associated with a uniform evolution of the average population growth rate (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), keeping living standards fairly stable. The stagnation has characterized human history for thousands of years. At that stage, population growth was positively affected by the level of income per capita. The monotonic increase in income per capita during the Malthusian era was associated with uniform growth rate of the population, which did not result in variations in the standard of living (Galor, 2011). The absence of significant changes in the level of technology trapped the income per capita around a subsistence level and population size remained relatively stable.

1.2.2. Take-off – Post-Malthusian Phase

At 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 capital.[2] Based on Maddison (2008), we note that 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. Hence, we note that this period is still marked

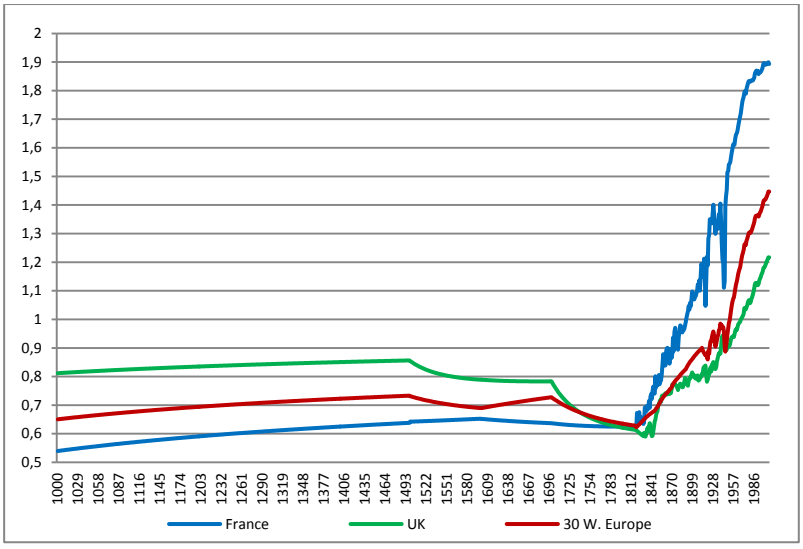
[2] The demand for education increased from the end of the period.

by a positive relation between income and population growth. The acceleration of technological progress resulted in a significant increase in the growth rate of output per capita, generating an unprecedented increase in population growth. The timing of the take-off differs across regions. In less developed countries[3] 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 by the end of the 19th century in Western countries, and by the second half of the century in less developed regions.

1.2.3. Sustained Growth – Modern Growth Regime

The acceleration of technological progress during 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, marked 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 Western countries over the past two centuries (Galor, 2011).

Figure 2 : Ratio of Output to Population Growth Rates in France, UK and Western Europe, 1000-2008



Source: Using data from Maddison (2008)

Using Maddison's data, the reversal in the rate of population growth occurred by the end of the 19th century and the 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 a peak of 2.82% per year between 1951 and 1973.

[3] By less developed countries, we mean Latin America, Asia and Africa.

Although industrialization initiated the demographic transition in most Western countries by the late 19th century, the process started nearly a century earlier in France. Figure 2 makes a comparison of the ratios of output and population growth in France, the United Kingdom, and Western Europe over the period 1000-2008. After centuries of stability in the output-to-population growth rates[4], there was a sudden and dramatic rise. France, UK and Western Europe witnessed this unprecedented increase at the same time, namely by the first decade of the 19th century.

However, while the ratio of population and output growth rates reached one in France in 1891, Western Europe reached this ratio in 1953 and the United Kingdom in 1968 only. The growth rate of GDP per capita relative to population growth has been much faster and intense in France than in the rest of Western Europe. Two main issues emerge from these findings. Why did population and output growth reverse at the same time in France and in other Western European countries? Why was the rise in the ratio between output and population growth so much faster in France than in the rest of Western Europe?

1.3. Main Challenges

As previously mentioned, the development process raises a number of questions and puzzles. This has piqued the interest of cliometricians specializing 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 at different times across regions of the world. Many mysteries persist. Contemporary growth theorists, as well as cliometricians, need to improve their understanding of the development process and of the driving forces and underlying determinants that led to the escape from the Malthusian trap and allowed for the transition to sustained growth.

The main questions addressed (Galor 2005, 2011) are the following:

- 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 led to the Industrial Revolution? Why 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?

[4] about 0.6 in France, 0.8 in UK and 0.7 in Western Europe

- What are the main forces that initiated the process of demographic transition? Why did this phenomenon occur first in France?
- What has caused the Great Divergence in income per capita across regions of the world over the last two centuries? Would this 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?

2. Toward a Unified Theory of Growth – Theoretical Background

The fundamental challenge faced by cliometricians specializing in economic growth is to provide reliable answers to the previous set of questions using the contributions of economists, historians, and sociologists. The issue for growth theorists is to develop a unified theory of growth that can account for the main features of the three distinct phases that have characterized the process of development. This was first undertaken by Galor and Weil (1999, 2000) with the development of the Unified Growth Theory.[5] This theory aims at giving a better understanding of the driving forces that triggered the escape from the Malthusian trap and the subsequent transition to a state of sustained growth.

2.1. Traditional Theories of Economic Growth

The theories and models of economic growth have evolved considerably over time. The theories of endogenous growth have emerged in response to the inability of exogenous growth models to explain the origin of technological progress. These two types of modeling have themselves borrowed some basic elements from the Classical theories of growth and stagnation.

2.1.1. The Malthusian Theory

The world of economic history has been dominated by the Malthusian stagnation. For a long time, theories aimed at explaining economic growth and development found their inspiration in Malthusian and Neoclassical conceptions. In his *Essay on the Principle of Population*, Malthus (1789) defends a "pessimistic" vision of the impact of population growth on long-run economic development, coherent with the world economic history prior to the Industrial Revolution. Malthus's thinking can be summarized by the two following postulates: *(i)* population growth is bounded by the means of subsistence; *(ii)* population increases with livelihoods in a geometric progression while production of food grows in arithmetic progression. The theory developed by Malthus matches the empirical

[5] The term was coined first by Galor (2005).

evidence of the relation between income and population dynamics prior to the Industrial Revolution fairly well. According to this theory, the effect of population growth is counterbalanced by the expansion of resources, reflecting the fluctuations of the income per capita around a subsistence level. Malthus argued that two types of barriers contributed to reduce the size of the population at the subsistence level: the "positive checks" and the "preventive checks". The "positive checks" raise the death rate through hunger, disease, or war. The "preventive checks" affect birth rates through birth control, abortion, late age of marriage, or celibacy.

Without changes in the level of technology and resources, both the population size and the income per capita would remain stable. However, periods of technological progress and expansion of resources would lead to an increase in population growth, which ultimately triggered 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 and the modern growth regime. At the end of the 19th century, liberal economists such as Leroy-Beaulieu (1913) found that the theory was contradicted by the facts. He found that the movement of population was slowing down and output growth was accelerating. As a consequence, doctrines evolved toward the idea that population growth followed different rules than output growth. Boserup (1965, 1981) notably argued that the demographic pressure would lead to a reorganization of agricultural production. According to Boserup, the size of the population drives changes in the operating modes, and not the subsistence level. Technological progress may then allow the subsistence level of production to consistently exceed population growth.

Classical economists such as Malthus (1798), Smith (1776), Ricardo (1817), and later Schumpeter (1934) have provided basic ingredients that appear in modern growth theories, such as the interplay between income per capita and the rate of population growth, the role of technological progress, and the accumulation of physical and human capital.

2.1.2. The Neoclassical Theory

Exogenous Growth Model

Contrary to the Malthusian theory that has investigated the relation between population and production prior to the demographic transition, neoclassical growth models focused largely on the growth process during the Modern Growth phase. Far from being limited to agricultural productivity, population growth is affected by complex socioeconomic-cultural phenomena related to the enrichment of society, culture, and choices of social organization that triggered families to limit their number of children. Growth models only gradually started to integrate these aspects.

In opposition to Malthus' approach, exogenous growth models, such as Solow (1956) and Swan (1956), deal with demographic growth as an exogenous variable and assume demographic behaviors to be independent of wages, incomes and prices. Without technological progress, the income per capita converges toward a stable steady-state independently of the size of the population. The Solow model is based on the assumption that the factors of production separately have diminishing returns. However, returns to scale are assumed to be constant, and factors of production are assumed to be used effectively by all countries. In an economy with more capital, the productivity of labor increases. As a consequence of diminishing returns to factors of production, economies will reach a point where any increase in production factors does not generate an increase in output per capita. In neoclassical growth models, the rate of long-run growth is determined by factors that remain unexplained (exogenous), such as the rate of technological progress in the Solow model.

New Home Economics

Parallel to the evolution of exogenous growth models, a branch of theoretical economic literature started to methodically analyze household decisions, such as consumption, savings, and labor supply. The lack of consideration of family behavior and its impact on economic models indeed led to the creation of a new stream of research, the so-called "New Home Economics."[6]. The New Home Economics extended the domain of microeconomic analysis to a wide range of behaviors and human interaction, such as demographic behavior, investments in human capital, and intergenerational transfers. The (static) modeling of household production and time allocation was notably used to explain the sexual division of labor and the market behavior of household members. Among the first publications were Becker (1960) on fertility, Mincer (1962) on women's labor supply, and Becker (1965) on the allocation of time. Key assumptions of this literature are that institutions and cultures influence decisions in the home (Folbre, 1994) and that these decisions are made by families as a unit. Manser and Brown (1980) have introduced household (two-sex) bargaining models, taking into account the separate interests of individual household members. Their framework was then extended by authors such as Chiappori (1992) and Lundberg and Pollak (1993). A decade after the creation of the New Home Economics, Nerlove (1970), Razin and Ben-Zion (1975) and Srinivasan (1988) developed models linking demographic behaviors to macroeconomic evolutions in order to analyze their implications on the general equilibrium.[7]

2.1.3. The Endogenous Growth Theory

[6] Ironically, the etymology of "economics", is derived from the Greek "*oîkos*" (house, dwelling) and "*nómos*" (law, custom) and refers to the art of properly administrating one's home.
[7] Within the framework of the neoclassical growth model with endogenous fertility, the authors attempt to determine the optimal population growth rate.

Endogenous growth models were developed in the 1980's as an extension to exogenous growth models in order to address the issue of the origin of technological progress – holding that economic growth results from endogenous (and not external) forces. The first endogenous growth model was published by Romer (1986) and was then extended by Lucas (1988), Romer (1990) and Barro (1990). These theories are constructed around the central idea that factor returns no longer decrease when it is accepted that components other than physical capital (such as human capital) exist and can display endogenous accumulation. Endogenous theorists identified four key factors of growth: returns to scale, research and innovation (Romer, 1990; Grossmann and Helpman, 1991; Aghion and Howitt, 1992), knowledge and human capital (Lucas, 1988), and state intervention (Barro, 1990). The structure of these models is identical. Endogenous growth becomes possible after the introduction of a new accumulation factor that compensates the decreasing returns of capital accumulation. According to Lucas, the source of economic growth lies in the unlimited accumulation of human capital. This boundless increase in human capital is based on major hypotheses of non-decreasing returns of technology and training, and the existence of externalities. In the models in line with Romer (1990), economic growth is a function of research and development that depends on the share of human capital allocated to the research sector. The accumulation of knowledge (innovations) is the engine of growth. Other models achieve self-maintained growth through similar mechanisms by means of hypotheses concerning the non-decreasing returns of the new factors of accumulation.

The AK Model. – The simplest version of endogenous growth models is the AK model. This formalization eliminates all the fixed factors that are not reproducible and therefore cannot be accumulated, thus making it possible to achieve endogenous growth in spite of the absence of increasing returns to scale or externalities. The essence of endogenous growth resides in the use of reproducible factors that can be accumulated. This central hypothesis makes it possible to affirm that capital returns are constant. The production function is then summarized by the following expression: $Y = AK$; where A is an exogenous scale parameter indicating the level of technology, and K describes capital, including human capital, the stock of knowledge, and financial capital. Human capital is subject to accumulation and substitutes for the labor factor – which is by nature not reproducible. Capital is therefore a composite component incorporating all the accumulation factors. The non-decreasing returns allow self-maintained growth.

Family-based Endogenous Growth Models. – Inspired by the New Home Economics literature and by endogenous growth models, growth models with explicit microeconomic foundations of family have developed progressively (Barro and Becker, 1989; Becker, Murphy and Tamura, 1990; Ehrlich and Lui, 1991; Galor and Weil, 1996; Dahan and Tsiddon, 1998; Iyigun, 2000). Growth theorists, exploring mechanisms by which fertility and growth are related, focused primarily on the modern era (Barro and Becker, 1989; Barro and Sala-i-Martin, 1997; Becker *et al.*, 1990; Moav, 2005; Tamura, 1994, 1996). The so-called endogenous growth theory, taking into account family behavior (as a single

decision-maker), is able to explain the empirical regularities that characterized the growth process of developed countries over the last hundred years. The pursued objective of these models is to provide a theoretical growth model with microeconomic foundations consistent with the stylized facts of the demographic transition.

2.2. The Theories of Demographic Transition

The demographic transition is identified as having played a key role in the process of development. From a theoretical point of view, different factors have been put forward to explain the process of demographic transition. Becker (1960) argued notably that the rise in per capita income had an effect on both households' income and opportunity cost of raising children. However, this explanation does not seem sufficient to fully explain the empirical regularities described previously. Why did demographic transitions occur simultaneously across countries that significantly differ in income per capita? Why did France experience its demographic transition prior to other countries?

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. Taking family as a single decision-maker, Becker's models manage to generate the demographic transition but do not differentiate between the behaviors of males and females. Becker *et al.* (1990) model the relationship between human capital, fertility and economic growth. In this "one sex" model with altruistic parents, higher productivity leads to higher wages and favors human capital accumulation, which in turn raises the opportunity cost of children. This feature highlights the existence of two locally stable steady-states: a Malthusian steady-state with many children and little human capital, and a steady-state with few children and high human capital.[8] In the interpretation of the model, they consider changes in female labor force as implicit. 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 county-level evidence for Prussia in 1816. Ultimately, the process of human capital accumulation would induce a reduction in fertility rates as the growth rate of technological progress increases.

The decline in the gender gap is also considered a reinforcing mechanism impacting fertility rates. Galor and Weil (1996) investigate the relationship between fertility, gender gap in wages, and economic growth by explicitly assuming that men and women have different abilities and do different kinds of work. The authors postulate that technological progress and capital accumulation positively

[8] Tamura (1994) finds the same result.

impact the relative wages of women along the process of industrialization, which increases the opportunity cost of raising children and ultimately leads to a reduction in fertility. Hence, economic growth would contribute to the closing of the gender gap in earnings, which would further lower fertility and reinforce economic growth. In a dynamic model with endogenous fertility, Iyigun and Walsh (2007) investigate how the evolution of spousal bargaining power within the couples' decision-making problem may trigger the decline in fertility.[9] Doepke and Tertilt (2009) study the opposite direction of causation. Based on a model with a quantity-quality trade-off on children, they investigate what economic forces may be at the origin of the progressive rise in women's rights throughout the process of industrialization. For Falcao and Soares (2008), it is the demographic transition that increases the supply of female labor and decreases the female-to-male wage gap. They show that gains in adult longevity increase the returns to human capital and reduce fertility. The subsequent decline in demand for household production (initially the specialization of women) increases the fraction of time spent by women in the labor market and reduces the gender earning gap. De La Croix and Vander Donckt (2010) employ the notion of intra-household bargaining power (called "welfare weight") and analyze how its variations may affect demographic and economic outcomes.

The progress of neoclassical growth models with endogenous fertility provides plausible explanations of the modern experience of economic growth in developed economies. Nonetheless, they do not provide a global understanding of the development process. They are unable to explain some of the most fundamental features of the process of development. They capture neither the recent negative relationship between population growth and income per capita, nor the positive effect of income per capita on population growth and the economic factors that triggered the demographic transition. This left the door opened to a new generation of growth theorists (Galor and Weil, 2000; Jones, 2001; Galor and Moav, 2002; Hansen and Prescott, 2002; Doepke, 2004; Strulik and Weisdorf, 2008) to face the challenge of developing a theory consistent with the entire process of development.

3. The Unified Growth Theory

Unified Growth Theories are endogenous growth theories consistent with the whole process of development – accounting for empirical evidence that has characterized the growth process over longer time horizons in developed and less developed economies.

3.1. The Building Blocks of the Theory

Advanced first by Galor and Weil (1999, 2000) and developed by Galor (2005, 2010), Unified Growth Theory intends to capture, in a single framework, the main characteristics of the transition from the

[9] In this paper, the authors do not focus on economic development and leave aside the question of how changes in gender heterogeneity may affect long-run growth.

Malthusian era to the modern era, as well as the associated phenomenon of the Great Divergence and Demographic Transition.

Unified Growth Theory integrates the main features of the Malthusian economy in a context where the size of population and technology are linked. First, the increase in technological progress and the capital accumulation counterbalance 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."*

Galor and Weil (1999, 2000) develop the idea that the acceleration in the rate of technological progress gradually increases the demand for human capital, inducing parents to invest in the quality of their offspring rather than in the quantity. Ultimately, the process of human capital accumulation induces a reduction in fertility rates in response to the increasing growth rate of technological progress. This leads to a demographic transition and sustained growth. The model, therefore, generates a transition from the Malthusian stagnation to the Modern growth regime. Later on, models incorporating new mechanisms emerge. Galor and Moav (2002) and Lagerlöf (2003) share similar intuitions by suggesting the existence of innate/inherited preferences in terms of children quality. Based on a unitary approach of the family, Lagerlöf (2003) explains how high-quality preferences may have spread over time and generate higher prosperity and lower fertility – considering changes in gender discrimination in education exogenous. In Cervellati and Sunde (2005), the authors introduce complementary mechanisms/channels based on the relations linking life expectancy, human capital and technological progress. In a simple model, Strulik and Weisdorf (2008) provide a unified theory that captures the interplay between technological progress, mortality, fertility and economic growth. Using a two-sector framework with agriculture and industry, the authors demonstrate how fertility responds differently to productivity and income growth between both sectors. Agricultural productivity and income growth make food, goods, and therefore children, relatively less expensive, while industrial productivity and income growth, on the other hand, makes them relatively more expensive. Common to all these models (and to our model) is the central role played by the quantity-quality substitution in the phase transition. Empirically, the existence of a negative correlation between education and fertility has notably been demonstrated by Becker, Cinnirella and Woessmann (2011) with county-level evidence from 1816 Prussia.

Unified Growth Theory generates the endogenous driving forces allowing the economy to experience a demographic transition that ultimately led to a take-off from the era of stagnation toward a state of sustained economic growth. As highlighted in Section1, Western countries experienced similar

patterns of economic and demographic transition. This theory, which seems to be consistent with empirical regularities, is based on the interaction between four key elements: the building aspects of the Malthusian theory, the engines of technological progress, the origin of human capital accumulation, and the triggering forces of the demographic transition. The theory suggests that the acceleration in the pace of technological progress increased the importance of human capital. The rise in the demand for human capital and its impact on the accumulation of human capital led to a decline in fertility and to a rise in living standards.

However, one paradox persists. The French-English paradox (Chesnais, 1992) raises a central question: why demographic development came so late in England and so early in France, while economic development was early in England and comparatively late in France. One underlying aspect of the development process may be missing.

3.2. Complementary Factors – The Role of Female Empowerment

Other central determinants of the development process have been left out of the first attempts at modeling a unified theory of growth. This left the door open to cliometricians and growth theorists to bring to light and explore additional and complementary mechanisms of the transition from stagnation to sustained growth. One such example is the issue of gender.

Gender related issues have become central to the field of labor economics[10] and economic history (Goldin, 2006). Empirical literature on the link between gender equality and economic development is rather abundant (Schultz, 1995; Dollar and Gatti, 1999; Klasen, 2002; Knowles, Lorgelly and Owen, 2002, among many others). However, the contributions remain rare in the field of economic growth. Few growth models explicitly consider the role played by gender on economic development. Galor and Weil (1996) – based on the assumptions of different gender abilities, Lagerlöf (2003) – taking gender differences as exogenous variables, or more recently De La Croix and Vander Donckt (2010) – focusing especially on the pathways by which improvement in gender equality may affect fertility, are among the few growth theorists who have integrated gender differentiation into their models.

Galor and Weil (1996) have engaged a first step toward a better integration of gender in growth theory by addressing the issue of the relationship between fertility, gender gap in wages, and economic growth with an inter-temporal dimension. Nevertheless, the model focuses on the modern era of economic growth and does not aim at providing a global framework of analysis for the evolution of economies over the entire course of human history. Lagerlöf (2003) sets up a model capturing gender stereotypes in which increasing gender equality can account for the important changes in growth rates of income per capita and population, in a unitary approach of the family. However, the model does not

[10] Notably the pioneering work of Jacob Mincer (1962) that contributed to the development of economic analysis of the household.

capture the notion of gender decisional empowerment, as noted by De La Croix and Vander Donckt (2010).

The role played by the rise in gender equality has been examined by Diebolt and Perrin (2013b). They argue that female empowerment has been at the origin of the demographic transition and engaged the take-off to modern economic growth. More specifically, they develop a unified cliometric growth model capturing the interplay between fertility, technology, and income per capita in the transition from stagnation to sustained growth. The model suggests that gender empowerment is a crucial factor of both demographic and economic transition. In particular, the theory points out that the acceleration of skill-biased technological progress generates a positive externality on the level of gender equality. Both wages and gender equality are key variables in the education decision process of individuals. More specifically, higher gender equality reinforces individuals' incentives to acquire skilled human capital. In turn, female choices in terms of time and quality of educational investments increase their endowment in human capital and impact positively the fraction of the subsequent generation of individuals acquiring skilled education. In other words, improvements in technological progress, gender equality, and skilled human capital reinforce each other. Ultimately, the presence of a sufficiently high fraction of skilled individuals in the population yields to sustained economic growth. In the early stage of development, the low rate of technological progress does not provide any incentive to invest in skilled education. Therefore, the fraction of skilled individuals is low and the economy remains trapped in the Malthusian steady-state equilibrium, with low education, low standard of living, and low gender equality. Technological progress is assumed to increase monotonically from generation to generation. Therefore, as technological progress grows, we observe a qualitative change, and the subsequent income effect triggers (temporarily) higher fertility rates. After sufficiently many generations, increases in the returns from investments in skilled education (productivity growth) – driven by the rise in technological progress – makes investing in skilled education more profitable so that gender equality improves. The dynamic system of skilled human capital and gender equality is therefore characterized by multiple steady-state equilibria. Since gender equality becomes high enough, a substantially larger fraction of individuals acquire skilled human capital, which triggers rapid developments and reinforces gender equality. Due to larger educational investments (in terms of time units), the opportunity cost of having children increases and average fertility declines: the demographic transition occurs along with the process of human capital accumulation. Ultimately, in later stages of development, gender equality and the fraction of skilled individuals converge toward their maximum. Thus, the economy is characterized by the Modern Growth steady-state equilibrium, where living standards are high, gender equality is high and fertility is low.

Conclusion

The unified theory of growth has been developed as an alternative theory of exogenous and endogenous models that can capture the main characteristics of the process of development in a single framework. The Unified Growth Theory sheds light on the driving forces that enable countries in a state of Malthusian stagnation to take-off toward a state of sustained economic growth. In the Malthusian Regime, the economy remains trapped around a substantial level of output. During the Post-Malthusian Regime, the pace of technological progress accelerated under the effect of the increase in the population size, and allowed economies 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. The theory of unified growth suggests that the transition from stagnation to sustained growth is an "inevitable by-product" (Galor, 2011) of the process of development.

The purpose of future cliometric research in the growth theories area is to close the gap between *Geisteswissenschaften* and *Naturwissenschaften*, i.e. to move from the historical *verstehen*, or understanding, side to the economic *erklären*, or explaining, side. Even better, mixing both approaches, facts and stylized facts, for an increased knowledge of the past, present and future economic and social development of developed and developing economies (Diebolt, 2012; Diebolt and Perrin, 2013a).

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