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An exploration of the cliometric relationship between gender equality and economic growth[1]

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Abstract: This paper develops the foundations and the implications of the mechanisms proposed as possible triggers for the demographic transition and the process of socio-economic development. In particular it examines the role played by gender equality and its significance for the understanding of the development process which allowed economies to move out of a long period of stagnation into a state of sustainable economic growth. Based on a renewed cliometric approach, the analysis suggests that the rise in gender equality was a key trigger for the transition to modern growth.

Keywords: cliometrics, demographic transition, economic growth, gender, human capital.

JEL codes: J1, N33, O11.

Introduction

The long-term evolution of the production potential of nations is at the centre of today's most pressing economic discussions. Throughout most human existence the process of economic development has been characterized by the stagnation of living standards. After a substantially flat evolution for centuries *per capita* income displayed a sudden and brutal increase. The timing of the rise in living standards varied widely across the globe. The take-off occurred first in Western countries in the early 19th century (i.e. Western Offshoots and Western Europe), followed by Eastern Europe and Latin America about a century later and by Asia in the second half of the 20th century (see Figure 1). This

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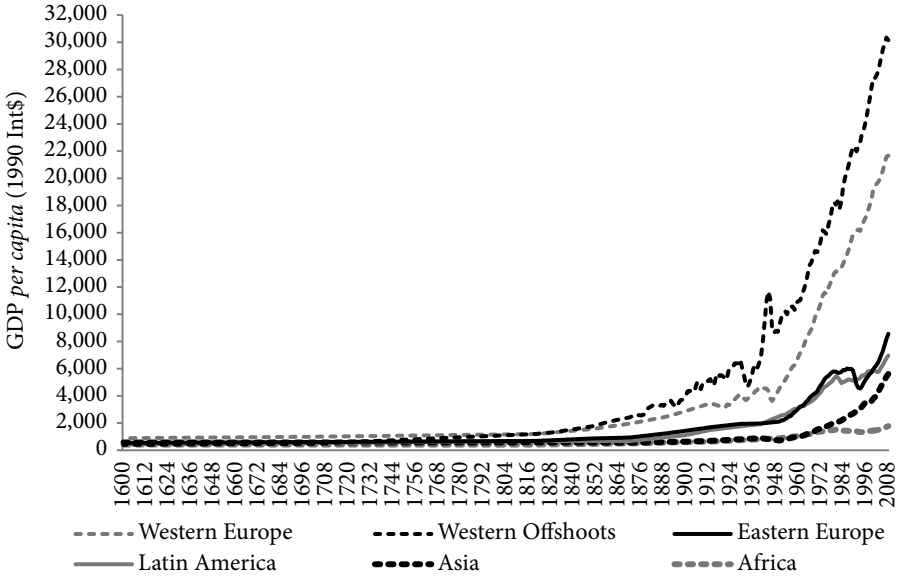


The Western Offshoots are Australia, New Zealand, Canada and the United States. The Eastern Europe gathers Albania, Bulgaria, Czecho-Slovakia, Hungary, Poland, Romania and Yugoslavia

Figure 1. Evolution of regional income *per capita*, 1600–2008

Source: Maddison [2008]

variation in the timing of the take-off generated large inequalities between the regions of the world.

What can explain the divergence at the international level between growth rates in the long run? Why do all countries not progress at the same levels exogenously of technical progress? In the same line, why do not we observe the transfer of capital from the richer towards the poorer countries as suggested by the convergence hypothesis?

Improving our understanding of economic history may help to understand today's current situation and comparative development. The discussion can be opened up to a second set of questions. What are the determinants of sustainable economic growth? Which production factors lead to sustainable economic growth? What is the role played by environmental capital, human and demographic capital, social and cultural capital? What are the dynamics that drive the accumulation of capital? Which mechanisms can provide a market economy with long term economic growth?

Theoretical background

The concern about the long-term evolution of the production potential of nations is far from being new. Classical economists were already preoccupied with the issue of how to improve the welfare and increase growth at the same time.

After World War II and the theoretical debate on long-term stability of market economies at international level the question remains a controversial topic. Lucas and Romer in the 1980's expressed a real renewal with the emergence of the theories of endogenous growth. The progress of endogenous neoclassical growth models improved the understanding of the modern experience of economic growth in developed economies and has been instrumental in highlighting the key role played by the technological progress and the accumulation of factors of production in Western countries during the 20th century.

However economic evolutions are just one aspect of the drastic changes that have characterized the evolution of Western countries over the last centuries. Profound demographic changes transformed the structure of the population. The simultaneity of economic and demographic transition led researchers to investigate the causal relationship between population and economic growth and to question the underlying forces behind economic and demographic developments. Based on the long-term relationship between population and output growth, human history can be divided into three fundamental regimes: the Malthusian Epoch, the Post-Malthusian Regime and the Modern Growth Regime [Galor and Weil 2000].

During the Malthusian Era the population growth was positively affected by the level of income *per capita*. 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 for centuries. The Post-Malthusian Regime is characterized by a significant increase in output growth, driven by technological progress, and by an unprecedented increase in population growth. Finally, the Modern Growth Regime shows a reversal of the relationship between income *per capita* and population growth which indicated a transition towards a state of sustained economic growth.[3] With the demographic transition the economy leaves the Malthusian causality between output and population growth implying a large increase in the standard of living.

Figure 2 displays the long-run relationship between output and population growth in Western and Eastern Europe. The figure shows that both regions experienced the same pattern of development. Although the timing differs the take-off in the growth rate of *per capita* income was associated with a take-off in the growth rate of population. Ultimately both Western and Eastern Europe underwent a demographic transition whilst output growth continued to progress at a sustained level.

Galor and Weil [1999, 2000] have raised the idea of a theory that could capture in a single framework the characteristics and underlying forces of the en-

[3] Western countries observed a complete reversal with high and sustained income *per capita*, low fertility [Becker, Cinnirella, and Woessmann 2012; Klemp 2012]. Despite some trans-national variations in the timing and speed of changes, Western countries experienced similar trends [Galor 2012]. Similar contemporaneous patterns can also be observed in emerging countries.

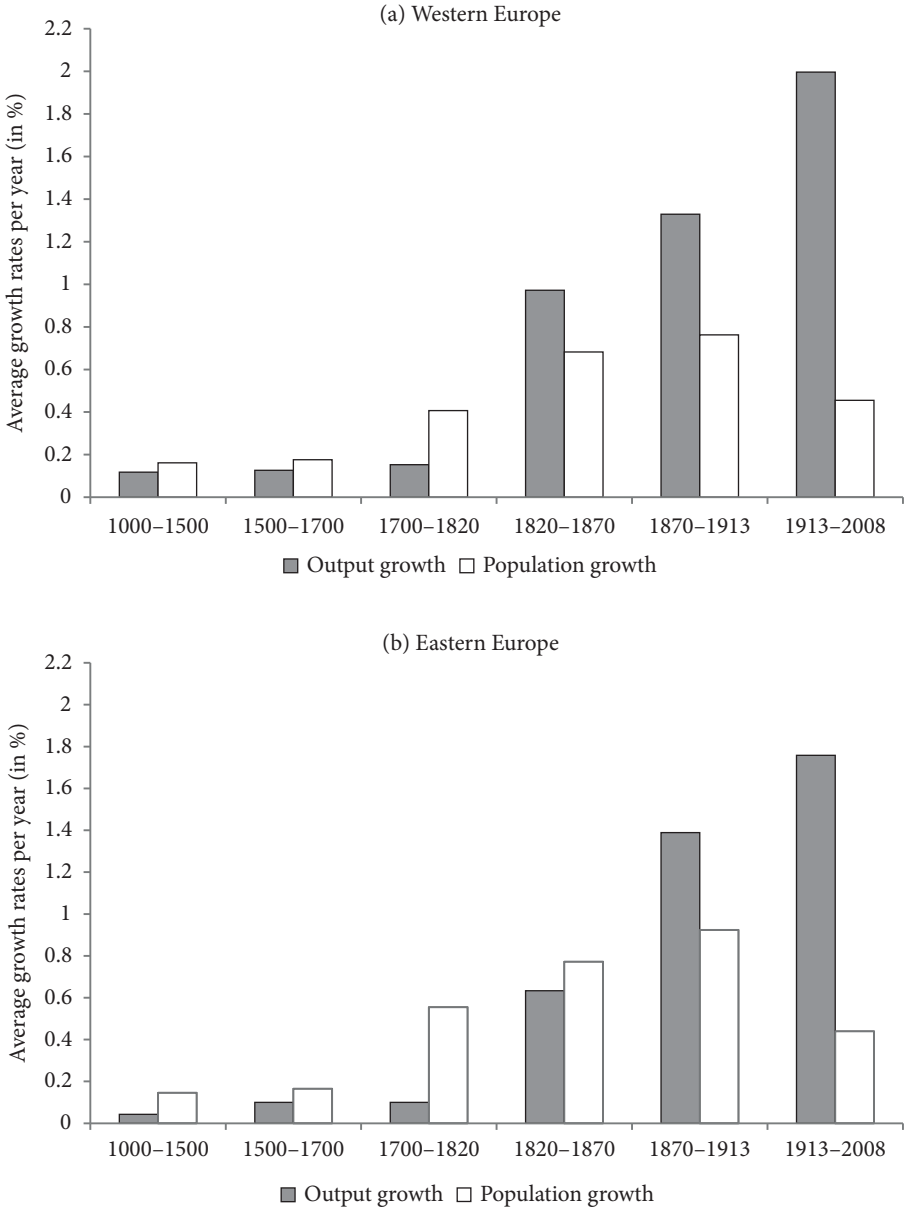


Figure 2. GDP *per capita* and population growth rates, 1000–2008

Source: Data from Maddison [2008]

tire process of development: *(i)* the epoch of Malthusian stagnation that characterized most of human history, *(ii)* the escape from the Malthusian trap, *(iii)* the emergence of human capital formation in the process of development, *(iv)* the onset of the demographic transition, *(v)* the origins of the contemporary

era of sustained economic growth, and *(vi)* the divergence in income *per capita* across countries.

The unified growth theory suggests that the transition from stagnation to sustained growth is an "inevitable by-product" [Galor 2011] of the process of development. Common to most unified models is the rise in the rate of technological progress (through the emergence of new technologies) during the process of industrialization that increased the demand for human capital and induced parents to invest more in the education of their offspring. Investing in education increased, in turn, the opportunity cost of having children and forced parents to choose between the number and the education of their children (the child quantity-quality trade-off). This process ultimately triggered the economic and demographic transitions.

Motivation and research questions

One remaining issue is the reason why individuals chose at some point to favour the quality of children to the detriment of their quantity? One aspect often neglected in the literature on economic growth is the role played by women. Understanding gender roles is difficult in that it requires a global understanding of family organization and its interaction with the marketplace. As a consequence the related literature has predominantly omitted one of the most profound changes that have affected households' behaviour, i.e. the historical process of women empowerment. Gender relations underwent slow but profound transformations over the course of economic development. The deployment of women from the home to the market place and their expanded contribution to family income marked an unprecedented transformation in women's life and family organization. Changes in gender relations have affected both demographic developments and social-economic developments through various channels (e.g. fertility decisions, human-capital formation of the following generations, or as a potential source of productive workforce).

Beyond the importance in itself of integrating gender issues in the study of long-run economic developments, additional, challenging puzzles still need to be addressed. Countries' demographic profiles are similar but they witnessed the demographic transition with different timing. Why were demographic developments so early in France comparatively to other European countries? What underlying aspects of the development process explain these various timings? The exploration of changes in gender relations may provide plausible explanations of this puzzling question and improve the understanding of the process of development and the associated phenomenon of the demographic transition.

Along the lines of Galor's work this paper seeks to dwell on the questions of understanding and explaining the mechanisms and determinants underpinning the development process which allowed economies to move out of a long period of stagnation into a state of sustainable economic growth. In particular

it questions the role played by gender equality in the demographic transition and socio-economic developments. This paper is stimulated by a twofold motivation: on the one hand, the conviction that the understanding of comparative economic development requires a global view of the entire process of development; on the other hand, the belief that the promotion of gender equality together with the economic and social empowerment of women is essential to achieve sustainable development and may contribute to the determination of the timing and space of the transition to sustained growth.

In particular the paper aims to provide preliminary insights into the following questions: To what extent and through what mechanisms does gender equality affect the process of development? This first question encompasses a broader set of underlying questions: Could changes in gender relations explain the dramatic reversal of the positive relation between income *per capita* and population? What are the underlying behavioural forces behind the process of demographic transition? What forces caused the process of human capital accumulation? What mechanisms are at the origin of the substitution of child quantity for quality? Could gender equality account for the endogenous interactions between education and fertility that resulted in the transition phase? Would the transition to sustained economic growth have been feasible without improvements in gender equality? Could female empowerment account for the observed take-off from stagnation to sustained growth in Western countries?

Satisfactory answers are difficult to provide mainly because of a lack of data and guiding theories. Based on a renewed cliometric approach the aim of this paper is to offer a preliminary reflection towards a better economic theory. Central to this paper is the consideration that the development process is linked with the changing economic role of women. I argue that the deployment of women from the home to the market place has been a necessary condition to achieve sustained economic growth. My hypothesis is that the empowerment of women has played a key and necessary role in the transition towards modern societies through the essential role it played on the accumulation of human capital and on the fertility transition.

Methodology – cliometric analysis

The purpose of this study is located at the crossroads of several areas of economic and social sciences. In order to carry out this study and deepen the analysis of social groups it is essential to rely on insights from sociologists, demographers, historians and anthropologists. My approach is therefore that of an economist specialized in cliometrics[4] with the ambition to build a bridge between economic history and other scientific communities.

[4] Literally cliometrics is defined as a projection of quantitative social sciences in the past, structured by the economic theory and informed by the statistical and econometric tools.

That cliometrics is an indispensable tool in the study of long-run economic growth is no longer a very controversial statement [Goldin 1995; Diebolt 2012]. At the theoretical level it enables the researcher to formulate problems precisely, to draw conclusions from postulates and to gain insight into workings of complicated processes. At the applied level it allows the measurement of variables, the estimation of parameters and the organization of the elaborate calculations involved in reaching empirical results. This paper, which provides preliminary hints of the role played by gender equality over long-run economic and demographic development path of industrialized countries, is an illustration of my belief in this principle. The projected innovation is twofold: first, building a bridge between the theoretical models of growth and economic history, and second, investigating the theories based on history, whilst seeking to formulate general laws. This line of research between pure empiricism and abstract theory could pave the way towards a better economic theory allowing the interpretation of economic issues taking into account the past and in so doing, to understand more deeply the economic and social historical processes [Diebolt and Perrin 2013].

The remainder of the paper is structured as follows. I first consider historical facts related to the long-run relationship between gender equality and the process of development in France. This involves the examination of the social and cultural context that forms the framework constraining individuals' behaviour. Hence I focus on the genesis of the relationship between men and women to determine in which socio-economic context the issue of gender equality emerged and evolved. In a second step, I propose possible triggers through which the improvement of equality between men and women acted as a phenomenon of demographic transition – and even more – as a process of past, present and future economic and social development of developed and developing economies.

1. Understanding the French process of development

As a field of experiment I choose the iconic case of France. This choice is motivated by: *(i)* the peculiarity of France in terms of demographic aspects – France was the most populated European country at the turn of the 19th century and the first European country to experience the demographic transition; *(ii)* the specific institutional and economic context that has followed (and preceded) the French Revolution in 1789[5]; and *(iii)* the lack of studies having been dedicated to France so far. Although gender equality may not be confidently considered as a causal factor driving economic development and the empirical regularities

[5] France was subject to huge variations in the cost of living throughout this period [Sharp and Weisdorf 2012].

question its potential long-term interaction with economic and demographic variables. The analysis of a unique collection of transversal and longitudinal data from France, ranging as far back as the mid-eighteenth century, uncovers key socio-economic, demographic, geographic and cultural patterns that have marked a turning point in economic history.[6]

1.1. The mutation of demographic and socio-economic structures

The incremental changes in the means of production impacted the society in various ways. From its original cradle in the North of France to other new hubs of industrialization the dynamics of capitalism reshaped the landscapes of the country. The industrialization caused a transition to new manufacturing processes which influenced many aspects of daily life.

Demographics

The study of long-run trends puts into perspective several important findings. Despite an overall increase in the availability of resources, the number of offspring radically declined; coupled with improvements in life expectancy both mortality and fertility rates reduced sharply within the space of a century.

Profound transformations have affected the marriage pattern in France in the course of the demographic transition. I distinguish three main stages in the evolution of marriage practices since the 18th century: *(i)* prior to the French Revolution, marriage practices were characterized by the classical features of the European Marriage Pattern: a large share of definitive celibacy, marriage at a late age and low frequency of illegitimate fertility; *(ii)* A reversal occurred after the French Revolution. The share of definitive celibacy fell sharply, the median age at marriage started on an impressive downward path and illegitimate births rose substantially; *(iii)* From the 1960–70's the median age at marriage reversed its course as did the share of single individuals (see Figure 4 in Appendix).

During a large part of the 18th century individuals have acted authentically in a very Malthusian way accepting more and more late marriage and a larger proportion of definitive celibacy in order to maintain a sustainable number of offspring (whilst the rate of infant mortality was falling). The change in marriage patterns towards larger celibacy numbers and a younger age at marriage occurred at the same time as the decline in fertility. This interesting paradox can be explained by the evolution of individuals' behaviour with regards to fertility regulation. The investigation of regional specificities in the mid-19th century shows the coexistence of two types of fertility regulation: control via

[6] Most raw data come from the *Statistique Générale de la France*; data on population, statistics of primary education and industrial statistics contain much valuable information. Other data have been collected from books, archives manuscript and a variety of additional sources.

marriage (Malthusian regulation) versus control within marriage (birth limitation). Religious practices, family structure and the system of inheritance, help the understanding of the geographical distribution and the regional dynamics of nuptiality and birth control within marriage [Perrin 2013b: 56]. Whilst the counties characterized by larger share of Catholic and Protestant were using the Malthusian regulation, secular areas were more likely to use the control of birth within marriage. The Malthusian regulation played an important role in areas with stronger religious practices until the beginning of the 20th century. The fertility transition occurred later in these areas than in the rest of France where the Malthusian regulation was early replaced by birth limitation. The difference in the family structure and the system of inheritance [see Todd 2011] also display a close link with the geographical distribution and speed of diffusion of the fertility decline. In general France can be divided into two main areas: the northern part of France characterized by a more egalitarian, nuclear family and the southern part of France more preferential and organized around the stem family.

Labour force

The exploration of the evolution of the female labour force, in particular the transformation of the female life cycle at work, helps understanding of the reasons of the changing demographic behavioural patterns. The kinds of jobs women occupied were historically limited in terms of number and of type. The study of the evolution of their labour force participation however reveals that the female labour force in paid activities increased substantially over time, both in its proportion and in its structure. Economic development leads to strong upheaval in the social structure of the workforce. The rural exodus drove agricultural workers to cities; a decline in the peasantry (craftsmen and tradespeople) occurred slowly in favour of manufacturing workers during the 19th century [Marchand and Thélot 1991].

In the North of France women entered the labour market mainly through the development of textile industries [Perrin 2013b: 105]. Women working in industry were usually young and single. However the evolution of the female labour force by marital status and age reveals a significant increase in the share of married women and women of childbearing age in the labour force. At the same time the share of women aged 15–24 in the labour force experienced considerable decline [Perrin 2013b: 83].

The variations in the female labour force suggest the evolution of gender relations on the labour market. The attention paid to the study of gender differences reveals an important decline of the gender gap in occupation and earnings over time, however the differences persist. Women did not turn towards the same types of jobs and were less likely than men to perform skilled jobs. The differences observed cannot be fully explained by economic factors and raise the question of the access to educational opportunities.

Education

The investigation of educational investments shows strong differences between boys and girls. During the 19th century women were, on average, less trained than men. Women's opportunities and access to education were limited and restricted. Additional education was often limited to specific knowledge related to housework and skills required for their future role within the household as mother and wife. The 19th century marked however deep improvements in individuals' investments in human capital. Formal education became accessible to the vast majority of the population. Whilst a huge share of the population was illiterate in the early 19th century only a small fraction of the population remained unable to read and write at the turn of the 20th century [Perrin 2013b: 128]. The feminization of education notably through the implementation of laws and decrees (e.g. Pelet 1836; Duruy 1867; Sée 1879 or Bert 1879) allowed girls to fulfill a large part of their delay in schooling. Female literacy rates caught-up with male rates at the turn of the 20th century.

Educational investments diffused across the French departments throughout the 19th century from the most industrialized areas of France to the dominantly agrarian part of the country. The massive and widespread access to education occurred gradually from primary education to secondary education and later in time (during the 20th century) from secondary education to tertiary education. Women became more and more trained. Long-run trends reveal strong improvements in the quality of the labour force that had turned in favour of women by the early 20th century [Diebolt and Perrin 2014].

Human capital is an important factor in understanding the distribution of earnings and occupations. Nonetheless the evolution of gender differences in educational investment remains insufficient to fully explain the persistence of gender differences in wages and specialization. This observation therefore questions the role played by the status of women in society, i.e. the roles, behaviours and activities socially established as being appropriate for women.

Gender roles and family organization

Economic factors and market forces cannot explain alone the gender division of labour. Inequalities between men and women seem to be rooted in the cultural, social and political systems of many countries. The evidence collected with regard to demographic behaviours, involvement in the labour market and educational investment in France emphasizes the existence of slow but profound changes in the structure of gender relations over time.

The study of family organization over time and across modes of production allows a better understanding of the evolution of the distribution of roles between members of the household. There exist three main fundamental functions that family members have to perform: *(i)* the economic function – production of goods and services within and outside the home; *(ii)* the social function – production of education and well-being, transmission of norms and values,

inheritance; *(iii)* the reproduction function – renewal of generations. These functions are shared between the members of the household.

The distribution of roles between the members of the household and the time spent performing the different tasks differ according to the historical, sociological, cultural or economic context in which a society evolves. Two extreme organizations emerged: the patriarchal organization, characterized by a sexual division of the tasks within the household, (family sphere versus professional sphere), and the dual-earning organization in which the tasks are more equally distributed between wife and husband. The investigation of family organization suggests that a gradual transition occurred from a sexual division of labour to a more egalitarian distribution of the tasks within the household. The emergence of married women into the paid workforce has contributed profoundly in the modification of gender relations and has weakened the patriarchal family organization in favour of a more egalitarian distribution of roles within the household. The position of women evolved within the family and there within the society (and conversely).

With the development of industries it became more difficult for women to combine the family and professional spheres. An important indicator of the evolution of the status of women is the joint evolution of marriage patterns and fertility behaviours, as described above. The 1851 gender gap index, built from a collection of county-level data by gender, demonstrates the degree and the amplitude of gender-based disparities in France in the mid-19th century [Perrin 2013b: 189]. The geographical distribution of the gender gap index suggests the improvement in women's status was driven by counties dedicating important effort to educational investment (more educated areas), i.e. counties located in the northeastern diagonal part of France (see Figure 5 in Appendix).

1.2. The socio-economic and demographic regional profile of France in the mid-19th century

The study of cross-sectional data sketches an interesting picture of the geography of economic activities, educational investment, demographic behaviour and gender relations. The analysis of socio-economic and demographic profiles of French counties helps to shed new light on the specificity of regional characteristics of France.

The typology of French departments (using the Principal Component and Hierarchical Cluster Analyses) enables the division of French territory into six classes based on their socio-economic and demographic characteristics [see Perrin 2013b: 197, for more details]. The analysis emphasizes the key role played by education, religion, industrialization and urbanization and the level of gender equality in the comparative economic and demographic developments of French areas. The most apparent dimensions separating French counties are the productive structure (agriculture versus industry), the educational

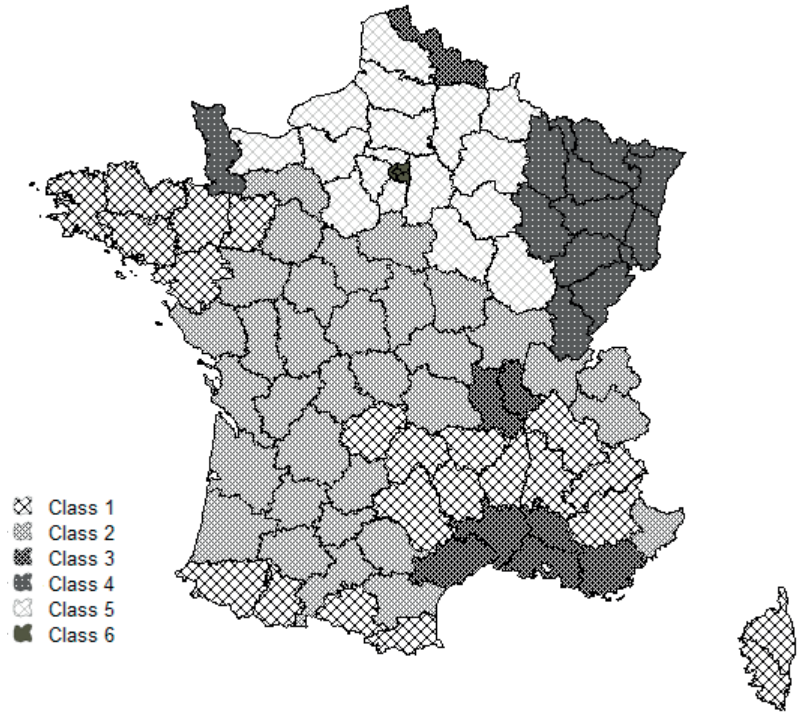


Figure 3. The Typology French Counties

Source: Perrin [2013b: 209]

structure (rural uneducated versus urban educated) and the marital-fertility structure (no birth control versus birth control within marriage). Figure 3 displays the geographical distribution of the six classes that have been determined through the analysis of socio-economic and demographic characteristics of French counties in the mid-19th century.

The class 1 groups counties oriented toward agricultural activities – activities in which women are more represented than the average of other counties. Nonetheless the class is marked by a gender gap index strongly below the national average. These departments present an age at marriage of both men and women and a share of definitive celibacy higher than the average. Despite these patterns the marital fertility rate is a lot higher than the average of all counties as the crude birth rate remains above the average. These departments are also marked by relatively higher child and infant mortality rates. In addition these departments have less reliable means of communication and display low manufacturing output. Therefore class 1 groups less developed counties, dominantly agrarian and located in remote areas. They are characterized by low gender equality, high fertility despite a control of nuptiality and a low living standard.

The class 2 is characterized by counties displaying a high share of illiterates amongst married individuals, a lack of educational infrastructure and predominantly agrarian. The industrial production is low in these districts, as are both male and female employment rates in industry. Contrary to class 1 counties a large share of the population married young and the share of definitive celibacy is below the national average, although marital fertility remains a little below the national average. Similarly to class 1 the gender gap index is low. Class 2 groups counties located in rural areas where the population is poorly educated compared to the average of other classes and so is the living standard. Fertility rates are at the national average. Individuals marry young but tend to exercise some control of their fertility within marriage.

The departments that make up class 3 clearly display a concentration of population in urban areas. These departments are industrialized and urbanized. The average wage of men and children within these departments is high – it may be driven by a larger proportion of professional as well as by a stronger industrial production. In addition we note that this class is characterized by educational infrastructures for boys below the national average. Finally these departments present high fertility rates. Class 3 groups rich and industrial counties. They present large gender inequalities with regards to education and wages and high fertility rates.

The class 4 is very interesting with regard to the educational indicators. Enrollment and literacy rates and educational structures are larger than in any other districts for both genders. Religion appears strongly devisive for these departments – closely located to Prussia and characterized by the largest share of Protestants amongst the population. Men and women in these departments married on average later than in other departments. Furthermore the departments of this class show a relatively rich industrial production, but outside urban areas. The class is also marked by a gender gap index somewhat larger than in other counties. Class 4 is then composed of counties characterized by a highly educated population of both genders. These counties are mainly rural and present high living standards. Gender equality is high and average fertility rates are close to the national average.

The departments forming class 5 are characterized by a high availability of arable land and are mostly rural. The female population of these departments is highly educated despite a low number of schools for girls. Female education and literacy is a strongly divisive indicator. Similarly the gender gap index is clearly larger than the national average. Female average wages are higher than in any other department. Men's and children's wages are also higher but to a lesser extent those of women. These departments have a dynamic industry as revealed by high employment rates in industrial activities but remain also largely rural. Finally the counties of this class present low fertility rates within marriage although women marry younger than the national average. Class 5 differs mainly from class 4 with regard to fertility. Whilst counties of class 5

limit fertility within marriage, counties of class 4, being more religious, tend to "regulate" fertility through nuptiality.

Seine (Paris) is a peculiar county and forms class 6 on its own. The population density is 29 times larger than the national average. Seine is more industrialized than any other county and the manufacturing output is five times that of the national average. The level of gender equality is close to the average. However this level hides the fact that education and literacy rates are very low for both genders. Total fertility is very high although marital fertility is lower than the national average. Individuals marry late; the share of definitive celibacy is high and the share of illegitimate births is twice the national average. At the same time the rate of child and infant mortality is the highest in France.

Two opposing profiles emerge from the French formalized facts and the analysis of the socio-economic and demographic profiles of French counties conducted. On the one hand, we find agrarian counties characterized by a poorly educated population, considerable gender inequalities, high mortality, high fertility rates and low living standards. On the other hand, we find industrialized but still rural areas putting significant emphasis on education for both genders; gender equality is high, women tend to be more integrated in the labour market, fertility rates are lower and living standards are higher. Based on these observations I emphasize the importance of considering the gender relations and family as a unit of analysis in the investigation of the mechanisms underlying the development process. My claim is therefore that the transition from stagnation to sustained economic growth occurred in parallel to the transition from a patriarchal organization of society towards a more egalitarian organization, characterized by a better distribution of the tasks between the members of the household.

2. Underlying mechanisms of the relationship between gender equality and economic growth

The research conducted on French data produces a complex story of national and regional variations. It suggests the existence of interconnected relationships between the process of the historical emancipation of women, demographic transition and economic development. The application of the theory enables transformation of this complex set of information into a more simple system with the target of improving our understanding of the mechanisms underlying the formalized facts. I propose here some possible triggers by which the improvement of equality between men and women acted as a phenomenon of demographic transition – and even more – as a process of past, present and future economic and social development of developed and developing economies.

2.1. Additional and novel mechanisms in a Unified Growth Model

The literature review on the theories of economic growth emphasizes the need for a Unified Growth Theory that could capture in a single framework the main characteristics of the process of development. However the growth models that differentiate the role of men and women in their analysis are rare considering rather the effect of household decisions on fertility. This section aims to shed light on the theoretical foundations and mechanisms through which the evolution of gender relations might have affected the development processes that have triggered the transition from a long period of stagnation to a state of sustained growth.

The intuition is that the development process occurred in parallel to the transition from a "Patriarchal" organization of the society (male-breadwinner model), characterized by a sexual division of labour based on the desire for households to maximize both their income and the number of children, towards a "Modern" organization of the society (dual-earnings model), characterized by a better distribution of duties within the household, where both men and women work on the labour market. This transition is at the core of both the process of human capital accumulation and the demographic transition experienced by developed countries.

Diebolt and Perrin [2013] developed a unified cliometric growth model that captures the interplay between technology, income *per capita*, gender equality and fertility in the transition from stagnation to sustained growth. In particular they consider a two-sex overlapping-generations framework with two types of human capital and integrating gendered aspects. The key state variables for individuals' decisions are the technological environment and the power-imbalance ratio between sexes. The first element of the model is that technological progress raises the rate of return of skilled human capital. As long as there is a clear division of the tasks between the members of the households, men who participate in the productive sphere are encouraged to invest in education. The subsequent rise in income provides the necessary resources for the members of the household to bear more children (income effect). Such an effect would explain the difference of schooling observed between boys and girls and the positive relationship between income and fertility. The second element of the model is that technological progress is skill-biased; the rise in educational investment affects positively the growth rate of technological progress. When the technological progress is low, population and output growth remain stable. Sufficiently large technological progress, however, provides the necessary resources to observe the joint rise of output and population growth. The third element of the model is the positive externality on the level of gender equality generated by the acceleration of skill-biased technological progress. The female marital bargaining power within the decision process of the household is conditional on the stock of human capital of the members of the

household. The rise in the female marital bargaining power leads to a better distribution of the tasks between the members of the household; both man and woman work on the labour market and provide a wage to the household. The rate of return of skilled human capital encouraged women to invest in skilled education. The rise in women's role in human capital is the key ingredient allowing the transition to the Modern Growth Regime. Women face a trade-off between the time they spend getting educated and working on the labour market and the amount of time necessary to have and to rear children. The rise in the time spent by women becoming educated and working on the labour market raises the opportunity cost of having children and triggers an increase in income and a decline in fertility (substitution effect). Besides, women's role in human capital is considered primordial in the educative development of children. The rise in women's educational investment impacts positively children's role in human capital. Women have fewer children but they are better educated. Higher gender equality in turn triggers the substitution of the "quantity of children" towards the "quality of children". Such an effect would be an explanation for the dramatic rise in schooling for both genders and the onset of the demographic transition that have occurred in Europe over the course of the 19th and 20th centuries.

2.2. Dynamic mechanisms of the transition to Modern Growth

In the early stage of development the low rate of technological progress does not provide an incentive to invest in skilled education. Therefore the proportion of skilled individuals is low and the economy remains trapped in Malthusian steady-state equilibrium, with low education, low living standards and low gender equality. Technological progress is assumed to increase monotonically from generation to generation. Thereby, as technological progress grows, we observe a qualitative change and the subsequent income effect triggers (temporarily) higher fertility rates. After many generations increases in the returns from investment 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 equilibriums. When gender equality becomes high enough a substantially larger proportion of individuals acquires skilled human capital which triggers rapid developments and reinforces gender equality. Due to larger educational investment the female 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 proportion of skilled individuals converge towards their maximum. Thereby the economy is characterized by a Modern Growth steady-state equilibrium, where living standards are high, gender equality is high and fertility is low.

2.3. Preliminary empirical verification of the key role of women for the development process

The trade-off between the women's role in human capital and their number of children is the crucial ingredient of the transition to Modern Growth. Greater opportunities for women to invest in education increases the opportunity cost of having children and implies that women have to face a trade-off between education and fertility, which ultimately leads to a fertility transition.

Perrin [2013a], and Becker, Cinnirella and Woessmann [2013] have tested the effect of the rise in women's human capital on fertility for France and Prussia respectively. Using a dataset of 86 county-level observations in the 19th century, Perrin [2013a] runs simple OLS tests to compare the effect of the changes in men's and women's human capital on the change in fertility. In accordance with the theory the paper shows: *(i)* the existence of a significant and negative effect of women's role in human capital on fertility during the French demographic transition, but *(ii)* no significant effect of men's role in human capital. In the same research Becker, Cinnirella and Woessmann [2013] shed light on the relationship between women's formal education, measured in terms of female school enrollment rates and their fertility. Using least-squares estimates they show that increases in women's education played a substantial role in reducing fertility already before the demographic transition in Prussia, results corroborated by the use of IV and panel models.

Conclusions

Differences between men and women have certainly existed throughout history and are still a feature of many contemporary social arrangements. The objective of this paper was to provide a first insight into the long-run relationship between gender equality and economic growth and to highlight the advantage of using the cliometric analysis for that purpose. The findings emphasize the need to consider the evolution of gender relationships in the understanding of the process of development.

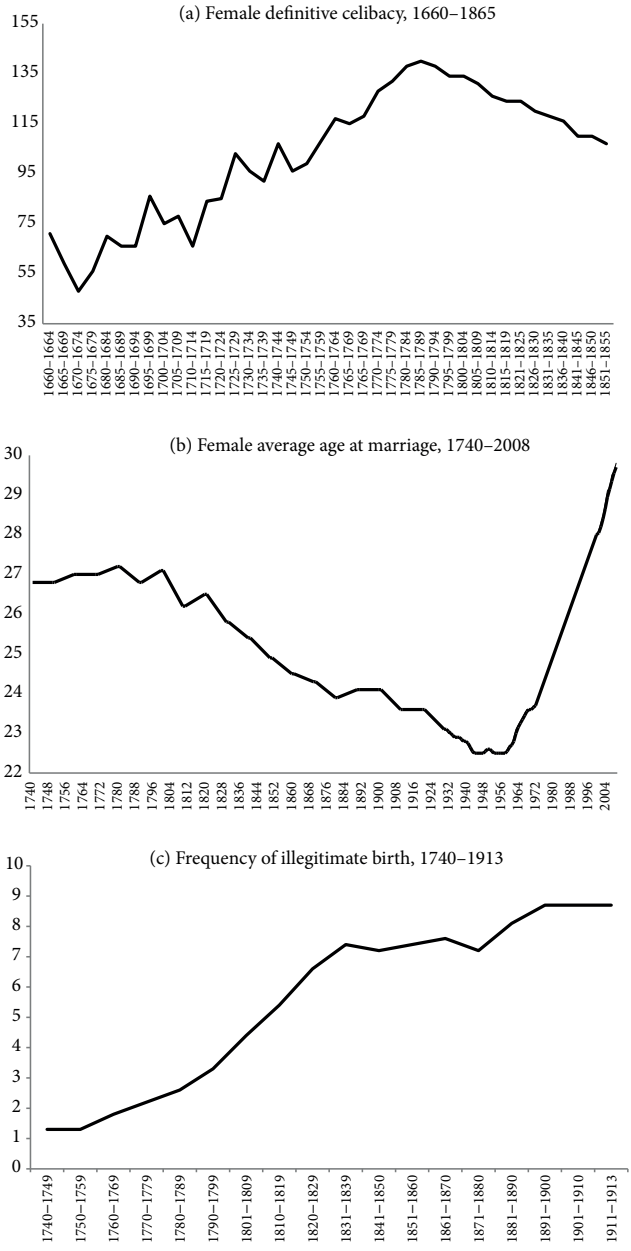
Our reflection provides a new track for the specification of this relationship. It puts into perspective the impact of female empowerment on demographic and economic transitions. It therefore appears that the particular organization of the society, and more precisely the distribution of roles within households, is an influential aspect of the contribution of gender equality to economic growth. The socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women has evolved significantly in the Western world over the past two hundred years. Changes in gender roles have affected the economic performance of Western countries and demographic behaviour in a number of ways. The participation

of women in economic life, the educational investment of girls and their increasing empowerment in these areas have been essential to strengthen their rights. It enabled women to have control over their lives and influence within the society. Improving women's status led to larger investments in the education of their children, as well as in their health and well-being. At the same time, it resulted in a voluntary reduction of fertility. Combined together they contribute to explain the origin of the process of human capital accumulation and the demographic transition that have been at the origin of the transition of Western economies towards sustained economic growth.

The underlying mechanism of the theory suggests that female empowerment has been at the origin of the demographic transition and caused the take-off that allowed economies to move from the post-Malthusian regime to modern economic growth. In line with empirical evidence the theory characterizes the conditions under which the process of human capital accumulation started. Changes in the share of population acquiring skilled human capital have substantial effects on fertility patterns. Human capital being a factor with increasing returns of scale, the reallocation of resources towards this factor sets the economy on a growing path dependency.

Through the use of an original method this paper puts into perspective evidence of the interplay between gender equality and economic development. In particular it shows that gender equality was necessary to allow economies to move from Malthusian Stagnation to Modern Economic Growth. This paper has the aim of being an original illustration of the main achievement of cliometric research in recent years. In particular it aimed at bringing together theoretical growth models and economic history in order to interpret more deeply the historical working and path of dependence of the socio-economic processes of developed and developing countries.

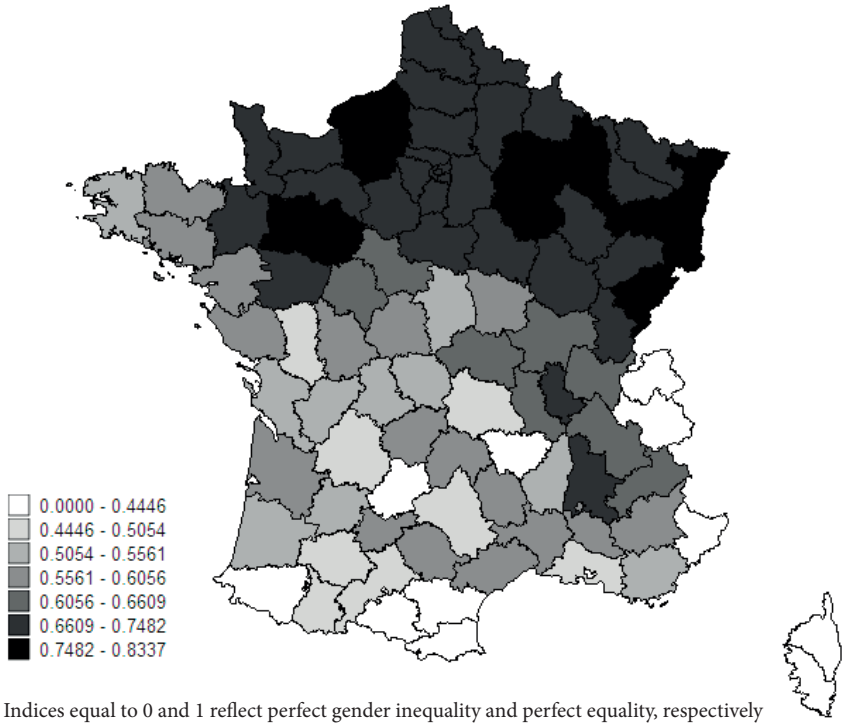
Appendix



(a) The measure of definitive celibacy is made from the study of permanent celibacy built up from the classification of deaths of each sex for periods of five years, from 1740–1744 to 1825–1829, groups of five generations and marital status

Figure 4. The transformation of the marriage patterns in France

Sources: Data from (a) Henry and Houdaille [1979]; (b) Henry and Houdaille [1979] – INSEE; (c) Segalen and Fine [1988]



Indices equal to 0 and 1 reflect perfect gender inequality and perfect equality, respectively

Figure 5. Geographical distribution of the gender gap index in France, 1851

Source: Perrin [2013b: 194]

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