

# Identifying the Origins of the Little Divergence: Rare Events, Outbreaks of Peasants' Revolts and Change in Labor Institutions in England

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## **Abstract**

The identification of the periods and the key drivers of the genesis of the economic transformation of Northwestern Europe have been one of the most intriguing and controversial issues in economic history. This paper analyzes whether the Little Divergence in Europe could have begun from a very early period, during the times of the Black Death, focusing the attention in the England. Based on times series analysis and other econometric techniques, first, the paper finds that Holland and England respectively escaped from the dynamic of the rest European economies since 1430's and 1470's. After, the paper identifies three periods of breaking points, in which the first occurred around the year of 1380; the second period from 1427 to 1484, and the third period from 1500 to 1519. The first breakpoint around of 1380 was abrupt and explosive, while the last two periods occurred at a time when some of the key drivers of growth may could have begun to operate, such as changes in marriage and fertility, or the beginning of an urban agglomeration process. The paper discuss how the peasant revolt of 1381 could have contributed to reinforce the decline of serfdom, which had already begun since the first waves of the Black Death, and could have contributed to trigger all the process of growth.

Key words: Little Divergence in Europe, Black Death, Serfdom

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## 1. Introduction

The emergence of the early economic transformation of Northwestern Europe, from the Malthusian stagnation to a modern growth regime, has been one of the most intriguing and controversial issues in economic history. This transformation has raised diverse views on the roots of the transition from feudalism to capitalism [Blum (1957); North and Thomas (1971); Domar (1970); Hilton (1973); Brenner (1976, 1982); Epstein (2000); Prak (2005); Ogilvie (2007); Dimmock (2014); Bailey (2014)]. Discussions on the early transformation of Northwestern Europe have also sparked controversy over the origin of the Industrial Revolution, the Europe's Little Divergence and the Great Divergence [Craft (1985); Jones (2001); Lucas (2004 and 2005); Broadberry and Gupta (2006); Van Zanden (2009); Allen (2011); Broadberry (2013); De Pleijt and Van Zanden (2016)].

However, the identification of the periods and the key drivers of the genesis of this economic transformation have led scholars to offer different answers. In the 1980's and 1990's, the "revolt of the early modernists", as De Vries (1994) named it, indicated that the Industrial Revolution was possible due to the structural changes that had taken place during the period from 1500 to 1800 [Van Zanden (2002)]. Recently, other scholars believe that the roots of the economic transformation in northwestern Europe are found many years earlier, during the Black Death period [Pamuk (2007); Allen (2011); Voigtländer and Voth (2013); Fochesato (2018)]. Others argue that there is no connection between the plague and the origin of that early growth process [Clark (2007, 2016); Humphries and Weisdorf (2019)]. In an extreme position, the California School believes that the origin of Europe's economic boom was a sudden process that occurred only after 1750 or 1800, just when the Industrial Revolution had begun [Pomeranz (2000); Goldstone (2008); Rosenthal and Wong (2011)]. For Galor (2005), the identification of the forces that triggered the transition from a state of stagnation to a sustained economic growth continue to be one of the most challenging issues in the field of growth.

This paper aims to contribute to the discussion about the origin of the Little Divergence and the early transformation of northwestern Europe focusing attention on England during the period from the late Middle Ages to the Early Modern Period. This paper has two objectives. First, the paper offers a study, based on times series analysis and other econometric techniques, to identify whether there was indeed an early and sustained long-term divergence in economic variables during this early period, as some economic historians have argued. This analysis considers the dynamics in the GDP per capita for some European economies. In recent years, much has been debated about the roots of the Little Divergence. Some historians point to the Black Death as the period in which economic divergence began, while others believe that the plague only produced temporary gaps in economic variables, given the population's shortage. The central idea in this paper is to analyze whether the divergence observed in this early period was persistent and sustained over the long term, in the sense that the gaps in GDP per capita among European economies not only did not return to the levels prior to the first shock of the plague in 1348, but also they transcended in the early seventeenth century, prior the of the catastrophic plague waves of 1629-1630 and 1656-1656-1657.

Second, this analysis also aims to identify those turning points, hitherto unknown, in which the early economic divergence could have begun. This analysis would allow to identify those events that occurred in England during these critical years related to these turning points, as well as to analyze how the mentioned events could have influenced to the beginning of long-term divergence in Europe. In this way, this paper discusses how some events in those critical years, such as the outbreaks of peasants revolts, in particular the Wat Tyler's Rebellion of 1381 in England, in combination to other factors, such as the state of war, could have triggered changes in labor institutions in England.

Finally, this paper offers a discussion to contribute to the explanations of the accelerated transformation of labor institutions in England. Considering the findings previously obtained on the existence of an early divergence and the identification of breakpoints in the economic variables, this paper tries to discuss whether there was a link between the transformations of labor institutions and economic divergence in Europe. This discussion is relevant considering that during this period there were significant changes in the dynamic of one of the most important labor institutions in Europe: the serfdom.

During the twelfth and thirteenth centuries, a process of serfdom transformation had begun, derived from economic expansion and population growth, in which landlords had begun to become rent receivers and to grant concessions to their peasants [Blum (1957)]. However, with the Black Death and the economic downturn, that dynamic was interrupted and the lord-peasant relation diverged between Northwest Europe and the rest of the continent. In England, since the beginning of the 15th century, or before, serfdom was in an accelerated process of extinction, moving quickly toward other institutional arrangements, such as leasehold and copyhold [Bailey (2014)]. In other areas of Europe, serfdom not only remained for a longer period but also it re-emerged and was intensified. In France, the collapse of serfdom was an intermediate case, while in Spain and Italy serfdom emerged again for a brief period in the 17th century while in Eastern Europe this medieval institution arose for many years [Blum (1957)]. In Russia, serfdom survived until the 19th century when was abolished in 1861.

The contribution of this paper is to provide an analysis, based on novel quantitative approaches of time series analysis, to explore whether the timing of those roots of the Little Divergence actually occurred during the period after the Black Death. Broadberry et al (2015) clearly identifies two cycles for England in which the highest per capita gains are observed in periods when the population declined, followed by periods characterized by a little decrease in those gains once the population recovered. The first cycle lasted from the second half of the fourteenth century to the sixteenth century while the second cycle took place during the seventeenth and the eighteenth centuries. Several historians and social scientists have focused more on the second cycle to explore the roots of economic transformation in Northern Europe [North and Thomas (1973); Clark (2005, 2007, 2016); Humphries and Weisdorf (2019)]. However, a recent literature suggests that the roots of economic transformation in this region occurred during the first cycle, from the demographic collapse caused by the Black Death [Allen (2001, 2011); Pamuk (2007)]. This paper would focus on the first cycle, from 1348 to 1629.

The identification of the key turning points during the “Golden Age of Labour” is relevant not only to understand the key drivers that led England and northwestern Europe to escape from the Malthusian dynamic and, therefore, to identify the origin of the Little Divergence. The analysis here proposed also could provide some elements about the beginning of the Great Divergence between Europe and Asia. According to Broadberry (2013), the key turning points were around 1348 and 1500, when both the European Little Divergence (Britain and Holland overtook Italy and Spain) and the Asian Little Divergence (Japan overtook China and India) occurred. Therefore, the Great Divergence occurred when there were differentiated rates of economic growth between Northern Europe, characterized by a strong dynamism, and Japan, which grew more slowly. For Broadberry (2013), the Black Death and the transatlantic expansion to the Americas and Asia, were the key shocks of the Great Divergence, together with other structural factors.

Finally, the discussion about the possible link between the early divergence of labor institutions and the beginning of an economic divergence in Europe makes more sense considering that the dynamic of labor is essential to achieve more levels of efficiency and economic growth. In this case, the transition from serfdom to labor markets is relevant taking into account that the agricultural sector represented a considerable output in England's GDP in those years, as well as in wealth and labor force [Campbell (2000, 2007); Campbell and Bartley (2006); Broadberry et al (2015)]. Also, it is relevant that in 1300 around half of all peasants and rural population were servile [Bailey (2014)]. In addition, the gains in efficiency and social welfare obtained in this transition, from an inefficient system based on labor coercion arrangements to a market system, can be significant for economic growth [Acemoglu and Wolitzky (2011)].

The analysis finds the existence of a divergence among the European economies throughout the period from 1348 to 1799. For this purpose, the analysis uses the Sigma Convergence estimator and it was applied to GDP per capita for England, Holland, Central Italy, Spain and France. Five different periods were identified. The first runs from 1348 to 1374, characterized by an economic convergence, in which the economic disorganization generated by the Black Death affected all European economies alike. The second period was from 1375 to 1454, in which the economies shown an early divergence. The third was a brief period from 1455 to 1494, in which a little convergence among economies was observed. The fourth period goes from 1495 to 1618, in which a significant divergence was observed. From 1618 to 1799, it was a period characterized by a stationary dynamics and economies keeps their divergence reached in 1618.

It is also analyzed, based on the on the Log t regression test, the period from 1348 to 1629, which is characterized by a divergence. However, the existence of heterogeneous behaviors and different transition paths among economies were found. If the absolute levels of GDP per capita are just considered, England was still far to overtake Central Italy, as Malanima (2013) observed. In any case, there are two clubs of countries that shares similar absolute levels in their GDP per capita. In the first club, with the highest

level of GDP per capita, were Italy and Holland; in the second club were England and Spain; while France is a particular case. However, focusing more in the transition trends (dynamics, acceleration or decline in GDP growth rates per capita), Holland and England respectively escaped from the club of the European economies since a very early period. From the decade of 1430's Holland took its own way while around 1470 England also took a separated trend from the club conformed by the European economies.

Subsequently, breakpoints in the relationship between real wages and population in England are identified around 1380 and 1484, although there were other breakpoints that were temporary and weak. The breakpoint around 1380 that was abrupt and explosive. In the relationship between GDP per capita and population, England experienced a breakpoint in 1519. However, it is recognized that previous this turning point, the period from 1420's to 1519 was fundamental in the origin of this great change. These results coincides with the vision of Pamuk (2007) and Broadberry (2013).

Considering the contributions of the economic growth theory that model the transition from a Malthusian regime to a modern economy, it is very hard to explain the beginning of the escape of Holland and England from the economic dynamics of the rest of the European economies, from a very early period such as the years after the Black Death [e.g. Kremer (1993); Jones (2001); Stokey (2001); Lucas (1998, 2009, 2017); Lee (1980, 1988); Galor and Weil (2000) and Hansen and Prescott (2002)]. In any case, the theoretical contributions of other authors on changes in marriage patterns, fertility, and urbanization process could make more sense to explain the beginning of this early divergence after the Black Death [e.g. Becker, Murphy and Tamura (1990); Tamura (2002); Voigtländer and Voth (2013) and Becker, Glaeser and Murphy (1999)]. However, to achieve these changes in these patterns, a previous step is necessary, which would consist of a significant reallocation of the population derived from the Black Death.

For this reason, the paper proposes a discussion about the possible events that occurred during these breakpoints and their relationship with the processes of change in marriage, fertility and urbanization patterns. It is pointed out that although serfdom had already undergone a process of weakening, as Bailey (2014) points out, the peasant revolts of 1381 could have been the determining factor in definitive collapse of this medieval labor institution. It is proposed that the collapse of serfdom could generate new processes of fertility change, marriages and reallocation of population in England.

The remainder of this paper is organized as follows: The next section 2 presents the analysis on convergence/divergence among the European economies. In section 3 is presented the analysis to identify the breakpoints that determined the origin of the early escape of England from the club of European economies. Finally, in section 4 it is presented an intriguing discussion about how some events observed during the breakpoints could have contributed to create the key drivers of the escape of England during this early period (urbanization, change in patterns of marriage and fertility).

## **2. The Divergence among European economies**

In recent years, several economic historians has been debating about the period in which the Little Divergence in Europe began. Some historians point out that the roots of this economic divergence are found in the period followed by the Black Death, while others believe that the plague only produced temporary gaps and mismatches in the patterns in economic variables among countries. According to this last group of economic historians, the differences observed in the economic variables during this long period of pests occurred as a result of the population's shortage. In this vision, real wages, GDP per capita, and living standards would eventually regress to the minimum levels of subsistence, in the long term. Therefore, in sum, this group of historians concludes that the divergence in the economic variables among countries was temporal, determined by the Malthusian dynamics, and that the Little Divergence originated in a later period.

On the other hand, from the Smithsonian approach, some economic historians conclude that Black Death generated a series of impacts that had considerable and sustained effects in Europe, in a differentiated way among its regions. In Northwestern Europe, these effects were found in labor productivity gains and demographic changes in marriage patterns, as well as in greater urbanization that eventually promoted specialization, investment in human capital and the accumulation of knowledge. Therefore, the period of population's shortage sparked a sustained economic divergence among countries. Although there was no a total escape from the Malthusian economy for Northwestern Europe, the Smithsonian approach argues that the roots and first signs of the Little Divergence began during this transition period from the late Middle Ages to the Early Modern Period. In sum, the Little Divergence had begun already.

The central idea in this section is to analyze whether the economic divergence in this early period was persistent and sustained over the long term. In this way, it is analyzed not only whether the gaps in GDP per capita among different European economies did not regress to the levels prior to the first shock of the plague in 1348, but also whether these gaps and the dynamic in transition trends transcended in the early seventeenth century, prior the of the catastrophic plague waves of 1629-1630 and 1656-1656-1657.

### **2.1. Theoretical Background**

Economists have developed several theoretical models to explain the escape from a Malthusian economy, characterized by an economic stagnation, to a modern economy, characterized by sustained growth. This literature highlights that the Malthusian economy is based on land intensive factor, which is fixed, and innovation and technological progress is almost nil. A central aspect is that the economy is characterized by diminishing returns to labor. Therefore, although there may be periods of growth and prosperity, in which the population responds positively, income, consumption and living standards regress to the minimum levels of subsistence, given that a larger population depresses income by diminishing marginal productivity, thus generating stagnation. Economists have explored several key drivers to explain the escape of this Malthusian trap.

From the theory of economic growth, economists have highlights several key drivers to explain the transition from Malthusian stagnation to Modern Growth regime. It have been argued the role played by the technological progress in the transition [Lee (1980; 1988); Galor and Weil (2000); Hansen and Prescott (2002)], innovation and the production of new ideas [Kremer (1993), Jones (2001)], human capital accumulation, marriage patterns and fertility [Becker, Murphy and Tamura (1990); Lucas (1998, 2017); Tamura (2002); Voigtländer and Voth (2013)], International trade [Stokey (2001); Lucas (2009)], urban economies [Becker, Glaeser and Murphy (1999)] among other aspects. A fundamental and common aspect that almost all of these models highlight is the role of population growth to engine the key drivers of the transition toward the sustained economic growth. These models also highlight the role played by institutions to explain the differences in timing and speed among countries to escape from the Malthusian economy.

For example, Kremer (1993) shows that that among technologically separate societies, those with higher initial population had faster growth rates of technology and population. Galor and Weil (2000) focuses on the evolution of population, technological progress and output growth<sup>1</sup>. A central aspect in this model is that technological progress and fertility are endogenous, and the increase in population size increases the rate of return to human capital accumulation and intensifies the pace of technological change. To achieve this transition, the economy takes advantages from an exogenous technological change to bring about proportional increases in output and population. For Jones (2001), the increase in population size engines the transition toward a virtuous circle in which more people are essential for the production of new ideas and, therefore, for economic growth. In this model, increasing returns to cumulative factors, determined by a process of knowledge accumulation and therefore by institutions that promote property rights, are essential to escape the Malthusian stagnation. Jones (2001) even mentions that absent the large improvements in innovation-promoting institutions, the Industrial Revolution would have been delayed by more than 300 years.

Two central aspects for the analysis of this paper, that have been provided by the theory of economic growth, are family changes and the process of agglomeration economies after the Black Death in Northwestern Europe. In the first case, Voigtländer and Voth (2013) provide a model of agricultural production in two sectors (grain and livestock) to explain the emergence of the European Marriage Pattern, which is characterized by the reduction of births and the postponement of marriage. These authors highlight the relative changes in the endowment of production factors, where the abundance of land caused a shift towards the pastoral sector, giving women more employment opportunities and driving a significant change in family patterns.

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<sup>1</sup> Galor and Weil (2000) consider three distinct regimes in economic development (Malthusian stagnation, Post-Malthusian regime and Modern Growth regime) that are characterized by the behavior of income per capita and the relationship between the level of income per capita and the growth rate of population. The economy moves from a situation where technological progress and population growth is almost nil, income per capita is constant and the relationship between income per capita and population growth is positive to a world where it is achieved an steady growth in both income per capita and the level of technology and the relationship between the level of output and the growth rate of population is a negative.

In the second aspect, the increase in the urban population derived from a dynamic of migration from rural to urban areas, Lucas (2017) highlights the negative correlation between the increase in real income levels and the decline in the population dedicated to traditional agriculture. In Tamura (2002), the transition from agriculture to industry is determined by the endogenous technological change. Hansen and Prescott (2002) provide a model in which the transition from a land-based economy to a capital-based industrial economy occurs when there is a shift in the productivity among these technologies. This change leads the economy to abandon Malthusian technology, making the use of the a Solow production process more profitable. Finally, Becker, Glaeser and Murphy (1999) provide a model in which the Malthusian effects are much weaker during a process of greater urbanization. When there is a greater population and urbanization, the economy works with increasing returns derived from specialization, greater investment in human capital, and a faster accumulation of new knowledge. Therefore, these non-rivalry in knowledge and innovation implies that high population encourages technological change.

In sum, both family changes and urbanization process after the Black Death increased the value of human capital and innovation. Then, the differences among countries in both aspects determine the ability to escape from the Malthusian economy, as well as the speed of transition between the old and the modern regimes. In the analysis of this paper, family changes and urbanization process observed in Northwestern Europe is essential.

## 2.2. Methodology

In order to examine the existence of a possible economic divergence among economies, the analysis focuses on two tests: i) Sigma Convergence and ii) Econometric Convergence Analysis and Club Clustering proposed by Phillips and Sul (2007).

### 2.2.1. Sigma Convergence:

The literature related to economic growth frequently uses two concepts of economic convergence: Beta Convergence and Sigma Convergence. This approach arises from the use of neoclassical and endogenous growth models. In the neoclassical growth model, it predicts the convergence among the economies, given the existence of diminishing returns on capital. In contrast, endogenous theory postulate non-convergence since it incorporates non-diminishing returns to innovation or human capital.

Sigma Convergence is an estimator, used to measure the dispersion of GDP per capita among countries. This measure of dispersion is given by the coefficient of variation. If the Sigma Convergence estimator has a decreasing trend over time, it implies that the economies that are analyzed are converging. Otherwise, if the Sigma Convergence shows an increasing trend, it implies that the economies are diverging. This literature was developed by Baumol (1986), Barro y Sala-i-Martin (1992) y Mankiw et al. (1992). Friedman (1992) supports the test of sigma convergence over other techniques.

Sigma Convergence is given by the following formula:

$$\sigma_t = \frac{\sqrt{\frac{1}{T} \sum_{i=1}^N \{ \ln(y_{it}) - \mu_t \}^2}}{\mu_t} \quad (100) \quad (1)$$

Where  $\sigma_t$  is Sigma Convergence for the year  $t$ ;  $\ln(y_{it})$  is the natural logarithm of the GDP per capita for the economy  $i$  in the year  $t$ ;  $\mu_t$  is the mean of the natural logarithm of the GDP per capita for all the economies analyzed in the period  $t$ ; and  $T$  is the number of years that considered in the period that is analyzed. Sigma Convergence is just the ratio between the standard deviation of the logarithm of GDP per capita between the countries that are analyzed and the average of the same variables.

Beta convergence is used in the neoclassical model, in which it is predicted that the poorer economies usually tend to grow at higher rates than rich economies. This convergence occurs when there is an inverse relationship between the growth rate of GDP per capita and its initial level. However, because the period analyzed in this paper is characterized as being a Malthusian economy, Beta Convergence will not be estimated.

### 2.2.2. Convergence Analysis and Club Clustering: Log t regression test

The methodology “Log t regression test” is a formal econometric test that was developed by Phillips and Sul (2007, 2009) to analyze convergence or divergence when there are different transition paths among economies and heterogeneous agent behavior. This methodology provides two relevant aspects: i) a test of the convergence hypothesis versus no convergence hypothesis based on a nonlinear time-varying factor model (which is very relevant when we have transitions or important breaks), and ii) a procedure to identify convergence clubs or clusters of countries that shares similar levels or transition paths.

Phillips and Sul (2009) considered that several methodologies on convergence tests had significant biases and deficiencies derived from restrictions imposed on the times series. For instance, Du (2017) highlights that, under transition heterogeneity, estimation of augmented Solow regression is biased and inconsistent derived of omitted variables and endogeneity. Another example are the constraints imposed in the cointegration analysis about unit roots. In this case, Du (2017) considers that conventional cointegration tests typically have low power to detect the asymptotic co-movement, reason for which cointegration tests do not necessarily lead to the conclusion of the divergence.

A relevant aspect of “Log t regression test” is that a panel data model can consider the different behaviors of economies in transition. Therefore, a wide range of possible time paths and heterogeneity among countries are allowed. The GDP per capita of countries  $i$  in years  $t$  (represented by  $y_{it}$ ), is divided in two components: i)  $g_{it}$ , that embodies systematic components, such as permanent common components that give rise to cross section dependence, and ii)  $a_{it}$ , which represents transitory components. So,

$$y_{it} = g_{it} + a_{it} \quad (2)$$

Two of the main advantages of this methodology are, first, that the test does not impose any particular assumptions concerning trend stationarity or stochastic non-stationarity and, second, it is not assumed any particular parametric specification for the two components mentioned above ( $g_{it}$  and  $a_{it}$ ) allowing the framework to include linear, nonlinear, stationary, and nonstationary processes. Because the specification (2) may contain common and idiosyncratic components in both elements, which represent

systematic components and transitory components, that specification (2) is transformed in the next way, considering a term  $u_t$  which represent a single common component:

$$y_{it} = \left( \frac{g_{it} + a_{it}}{u_t} \right) u_y = \delta_{it} u_t \quad (3)$$

In the analysis, it will be considered  $\delta_{it}$  a time varying idiosyncratic component, known also as the time-varying factor-loading coefficient, which will interact with the single common component  $u_t$ . In the Log t regression test, convergence implies two conditions:

$$\lim_{t \sim \infty} \frac{y_{it}}{y_{jt}} = 1, \quad \text{fo all } i \text{ and } j \quad (4)$$

$$\lim_{t \sim \infty} \delta_{it} = \delta, \quad \text{fo all } i \quad (5)$$

Where  $y_{it}$  and  $y_{jt}$  are the GDP per capita for the economies  $i$  and  $j$ , respectively, in the year  $t$ . The identity in (4) implies that the GDP per capita between countries  $i$  and  $j$  would be the same, in the long term. The identity in (5) implies that the time-varying factor-loading coefficient for country  $i$  will convergence to an stable value in the long term. So, it implies that the time varying idiosyncratic component would be stationary.

Finally, the existence of convergence is determined by an hypothesis test in which is implemented by a Log t regression model. So, the test is defined as:

$$H_0: \delta_i = \delta, \quad \text{Existence of convergence}$$

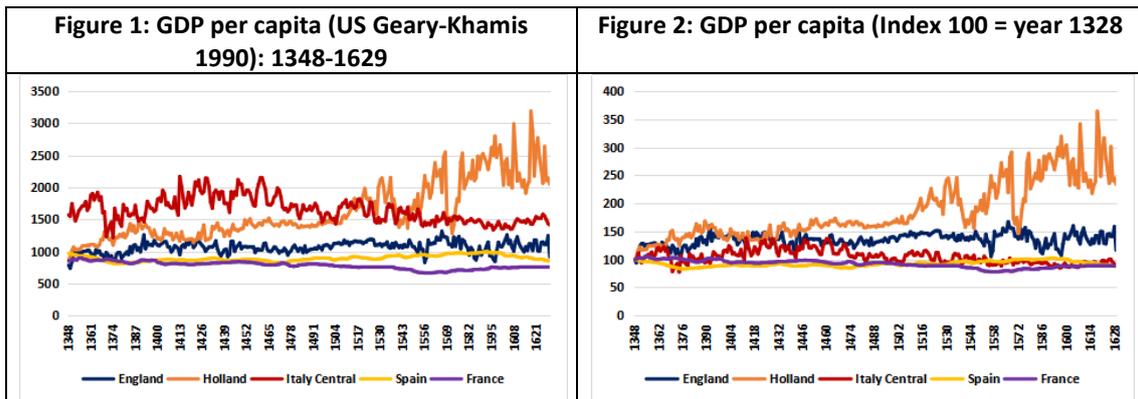
$$H_1: \delta_i \neq \delta, \quad \text{No convergence}$$

The Log t regression test has significant advantages in the analysis of divergence for the European economies during the transition period from the late Middle Ages to the Early Modern Period. With the Black Death, the demographic fracture precipitated a tremendous economic-social disorganization in Europe that lasted, perhaps, until 1450. In this period several effects and different reactions were observed by societies and rulers, which could determine the existence of differentiated patterns among European economies. In addition, the initial conditions in idiosyncratic components of each economy could also vary during this potential transformation period. For this reason, the methodology on convergence proposed in this paper considers all these heterogeneous agent behavior and evolution in that behavior, as well as breaks in economic patterns and the differentiated effects of the plague. In sum, during this period there were different paths among economies and heterogeneous agent behavior.

### 2.3. Data and Stylized Facts

The empirical analysis proposed in this paper considers several historical data series. For the analysis on convergence/divergence of the GDP per capita among European economies, it is used the series built by different authors: i) for England, Broadberry, Campbell, Klein, Overton and van Leeuwen (2015); ii) for Holland, van Zanden and van Leeuwen (2012); iii) for Italy, Malanima (2011); iv) for Spain, Alvarez-Nogal and Prados de la Escosura (2013) and v) for France, the analysis is based on the Maddison Project Database. It was used all the information collected by Fouquet and Broadberry (2015).

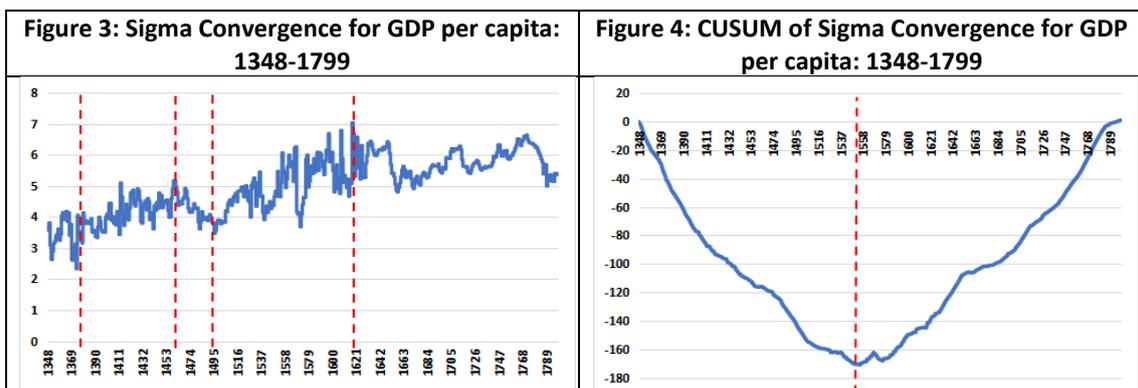
The period considered in the convergence/divergence analysis of the GDP per capita among European economies is from 1348 to 1799, in order to compare the dynamics among the two cycles identified by Broadberry et al (2015). This period was selected in order to consider the case of Holland /whose series starts from 1348). During the period analyzed, Holland is a relevant case, considering the amazing “take off” of its economy. However, the analysis focuses on the period from 1348 to 1629, which represent the time between the two most catastrophic plagues: the Black Death and the plagues of the seventeenth century. As I mentioned in the introduction, this paper aims to explore whether the timing of the roots of the Little Divergence actually occurred during the first cycle identified by Broadberry et al (2015).



However, the limitations in the use of these databases are well known. For example, there are other databases that show different levels in living standards derived, mainly, of the methodologies applied. For example Humphries and Weisdorf (2019) show a different behavior on real income. In fact, these authors consider that the period between 1650 and 1850 was the ‘golden age of labour’ in Britain, instead the period after the Black Death.

## 2.4. Results

First, convergence on the per capita GDP is analyzed based on the use of the estimator Sigma Convergence. The countries considered in this analysis are England, Holland, Central Italy, Spain and France, for the period from 1348 to 1799. The Figure 3 shows the results of Sigma Convergence through the time. The result is clear; there is a pattern of divergence between the different economies throughout the period, given that the Sigma Convergence estimator has a growing trend.



In 1348, Sigma was in a level of 3.57%, and immediately fell during the first 4 years of the first wave of the Black Death to reach a low level of 2.62% in 1352, indicating a temporal convergence among European economies. This same behavior is observed in the period from 1370 to 1371 when Sigma Convergence fell again to 2.61% and 2.62% respectively, and in 1374 when it fell down again and reached the lowest level of 2.33%. After this year, a process of significant divergence among the economies begins, where the Sigma estimator observed an increasing trend, slow but finally with a sustained and rising trend, until reaching a maximum level of 7.04% in the year of 1618. From that year, the Sigma estimator stops its increasing tendency observed for more than 250 years and moves to a stationary level between 5.5% and 6.5% for the next 180 years. In 1799, when Europe faced the French Revolutionary Wars and Napoleon led the Coup of 18 Brumaire, Sigma reached a level of 5.35%

It could be said that the divergence between the different European economies occurred within the period that runs after the third wave of the Black Death until the year of 1618, when the Thirty Years' War begins. From then on, the divergence among the economies never returned to the levels observed in the year 1348. However, from 1556 Sigma had reached a upper level of 6,07%. The Figure 4 show the Cumulative Sum Control Chart (CUSUM) for change detection, which indicates the year 1554 as the tipping point. In fact, from 1549 to 1555 can be found a significant break in Sigma convergence. Before that year, Sigma reached an average of 4.15% while after 1554 it averaged 5.69%. It is interesting to note that the Sigma estimator reached levels higher than 6% in 1556; 1587-1590; 1595-1596; 1608; in the majority of the years during the Thirty Years' War until 1651; 1705-1714; 1746-1749; 1752-1754; and 1760-1783. One might say that the state of war impacts on the economies, generating a greater divergence between countries.

From 1348 to 1799, five different periods are observed. The first would be from 1348 to 1374, where Sigma was decreasing and corresponds to the period of great economic disorganization generated by the first waves of the Black Death. The second period would be from 1375 to 1454, in which sigma had a growing trend, showing an early divergence between economies. This period could coincide with the first changes and differences that occurred among the countries after the Black Death. The third would be a brief period from 1455 to 1494, where sigma shows a declining trend, which indicates the existence of a little convergence among economies. In this period, a relative peace was achieved in some regions in Europe, derived from the Peace of Lodi as well as the end of the Hundred Years' War. The fourth period goes from 1495 to 1618, where there is a significant divergence among European economies. Finally, from 1618 to 1799, sigma enters a stationary dynamics and economies keeps their divergence reached in 1618.

From a formal econometric analysis based on the Log t regression test, the period from 1348 to 1629 is characterized by a divergence, in which there are heterogeneous behavior and different transition paths among economies. The test results clearly show the existence of a convergence between the European economies. T stat is -32.1698, reason why  $H_0: \delta_i = \delta$  is rejected and convergence does not hold. Therefore, when taking the alternative hypothesis  $H_1: \delta_i \neq \delta$ , it is concluded that during this period there is a divergence between the GDP per capita of the European economies.

In addition, based on the methodology developed by Phillips and Sul (2007), it is observed two clusters of countries that shares similar absolute levels in their GDP per capita during the period from 1348 to 1629. In the first club, with the highest level of GDP per capita, were Italy and Holland; the second club was made up of England and Spain; while France is a particular case. These results are somehow similar to those observed in Figure 1. However, considering the economic dynamics and the transition paths, through an indexed series as is shown in Figure 2, where all economies start with the same base of 100 in 1348, it is observed a significant change in these clubs. The methodology by Phillips and Sul (2007) results in a single club of convergence among Spain, France and Center Italy. Holland and England escaped separately from the dynamics of convergence of that group. From the decade of 1430's Holland took its own way while England also took a separated trend from that club around 1470.

In sum, there are two angles to see these results. On the one hand, if the absolute levels of GDP per capita are considered, England was still far to overtake Central Italy, as Malanima (2013) observed. From this angle it is also correct to think that the decline of Italy is due to the severe demographic crisis of the seventeenth century, thus generating the divergence with the emerging northern European economies, as Alfani (2013) points out. However, from an angle of transition trends (dynamics, acceleration or decline in GDP growth rates per capita), it can be observed that since 1430 and 1476, Holland and England respectively escaped from the club of the European economies. From this last vision, it could be said that the divergence among the economies had begun at an early period. Although, the escape of Holland is evident given its impressive economic growth, England's escape from the dynamics of the medieval economy also began to appear.

From the theory of economic growth, it is very hard to explain the beginning of the escape of Holland and England from the economic dynamics of the rest of the European economies, from a very early period such as the years after the Black Death. As it was mentioned before, a fundamental and common aspect highlighted by that literature is the role of population growth to engine the key drivers of the transition toward the sustained economic growth. However, in 1430 or 1476 is hard to say that it was a process of technological progress, innovation and production of new ideas, human capital accumulation or international trade. In addition, population was not significant in those years. Although from the second half of the fifteenth century the English population began to show increasing rates, which reflected the beginning of the demographic recovery, its levels were very far from the levels reached before the Black Death. According to Broadberry et al (2015), the population in the year 1450 had hit bottom, reaching 1,903,200 inhabitants, far from the 4,820,400 inhabitants in 1348.

Nevertheless, it is possible to find before 1476 some possible institutional changes that distinguished England from the rest of the European economies [as Jones (2001) mentioned] although they are also determined exogenously and endogenously. Perhaps two other aspects that could explain the roots of growth would be the urbanization process and changes in marriage patterns [as Voigtländer and Voth (2013) and Becker, Glaeser and Murphy (1999) observed]. I will discuss these points in 4 of this paper.

### **3. Identifying the first breakpoints**

In economic history and other disciplines much has been discussed about the causes and timing in which the roots and the first breakpoints that caused the Little Divergence in Europe, as well as the Great Divergence between Europe and Asia, were generated. For example, for the Great Divergence between Asia and Europe, Tabellini and Greif (2010, 2017) consider that the collapses of the Chinese Han dynasty and the Roman Empire were the turning points in the cultural and institutional evolution between China and Europe. The clan and the corporation determined significantly the cooperation and, therefore, the bifurcation between these regions many centuries ago. At the other extreme, Pomeranz (2000) points out that the Great Divergence between Asia and Europe was undertaken until the year 1800, with the Industrial Revolution, derived from the new use and endowments of coal in England and cotton provided by the Americans.

The central objective in this section is to identify the firsts turning points, hitherto unknown, in which the early divergence could have begun, focusing the attention on the England's economic takeoff and its institutional changes experienced. For this purpose a CUSUM test for structure stability is used, in order to detect those abrupt variations that represent sudden transitions in time series data. The analysis focuses on possible ruptures in the trends of relevant economic variables for England during the period immediately following Black Death. As noted in the previous section, there are different periods in which the trends of the GDP per capita implied a divergence process in the long term. For example, the period from 1375 to 1454 shows an early divergence between economies in which it could coincide with the first changes and differences that occurred among the countries after the Black Death. In this section the analysis focuses in the potential transition that could occur in labor institutions. This analysis would allow to identify those events that occurred in England during these critical years related to these turning points, as well as to analyze how those events could have influenced to the beginning of long-term divergence in real wages and GDP per capita in Europe.

#### **3.1. Background**

For some scholars, the Black Death is a cornerstone of the transformation of different economic activities and social dynamics that contributed significantly, in the long term, in the emergence of the modern economy [Herlihy (1997); Epstein (2000); Allen (2011); Voigtländer and Voth (2013)]. For Campbell (2016), the fourteenth century witnessed a series of profound and abrupt changes in the long-established historical trends, in which the Black Death, in combination with other factors, played a significant role in the early economic transformation. Pamuk (2007) points out that the plague impacted considerably on real wages and originated the divergence between Northwestern Europe versus the rest of the continent, which began to emerge after 1450. Haddock and Kiesling (2002) observe that the realignment on the relative values of factors of production derived from the Black Death led to the transformation of property rights in some regions. Allen (2011) and Voigtländer and Voth (2013) suggested that the Black Death, in ultimately, contributed that the Industrial Revolution occurred in northwestern Europe.

Broadberry (2013) goes further, noting that this early divergence in Europe also led to the Great Divergence between Europe and Asia. Broadberry (2013) argues that the key turning points of this divergence were around 1348 and 1500, when occurred both the European Little Divergence (Britain and Holland overtook Italy and Spain) and the Asian Little Divergence (Japan overtook China and India). Therefore, the Great Divergence between Asia and Europe is found during this period in the sense that this process of divergence occurred when the leading economies in Northwestern Europe grow faster than the leading economy in Asia. In a certain way, this same vision is shared by Broadberry and Gupta (2006), for a later period from 1500 to 1800, who point out that prosperous parts of Asia look similar to the stagnating southern, central, and eastern parts of Europe rather than the developing Northwestern parts. These authors consider that high wages of Northwestern Europe were not simply a monetary phenomenon, but reflected high productivity in the tradable sector, reason why the Great Divergence between Europe and Asia was already well underway many years before 1800.

In contrast, other authors consider that the origins of the Little Divergence are more evident in a later period, ranging from 1500 to 1800. Clark (2005, 2007, 2016) suggests that the break from the Malthusian of stagnation era in England came around 1640, many years before the Industrial Revolution, and even before the emergence of the modern political regime in 1689. Even Allen's famous work (2001) focuses on the period between 1500 and 1750, in which is observed the beginning of the divergence in real incomes. North and Thomas 1973 and North and Weingast (1989) consider that the strengthening of private property rights in the face of public power, as well as the process of accumulation of capital, achieved in the seventeenth century, were key triggers for the beginning of an industrial revolution. Humphries and Weisdorf (2019) consider that the salaries achieve high levels between 1650 and 1850.

Some economic historians have pointed out a combination of factors which made possible the Malthusian escape from England and Northwest Europe. De Pleijt and Van Zanden (2016), in an analysis from 1300 to 1750, support the idea that human capital formation was the driver of growth, as well as to a lesser extent institutional changes, in particular the rise of active Parliaments. Fochesato (2018) considers that in the period from 14<sup>th</sup> to 18<sup>th</sup> century, the Little Divergence started from the 16<sup>th</sup> century, when it was a significant difference among real wages from cities located in Northwestern Europe versus cities located in other areas. He argues that changes of fertility regimes, rural and urban labor organizations and non-Malthusian growth mechanisms as key drivers of this divergence.

In sum, there are several positions on the period in which the first breakpoints that led to Europe to the Little Divergence occurred, which have been very diverse. A lot of attention also has been paid to identify the key drivers of England's economic transformation, to understand the emergence of the industrial revolution in that country, although this interest has also been extended to other countries in Northwestern Europe some years ago [Hoppenbrouwers and van Zanden (2001)]. However, on these key drivers of the transformation of England there are also very different positions. Therefore, the identification of the first breakpoints is relevant to understand the key drivers that led England to escape the dynamics of the rest of the European economies.

### 3.2. Methodology

The relationship between real wages and population, as well as between GDP per capita and population, is relevant in a Malthusian economy. When this relationship is abruptly altered, as a result of an extreme shock such as the Black Death, the structural stability in the relationship previous the shock is broken. In this sense, identifying the breakpoints of the structural stability in these relationships - real wages and population, and GDP per capita and population -, would not only provides the periods in which the divergence began. The identification of breakpoints would provide valuable information about the possible events that occurred during these tipping points, that impacted on the previous stability and finally represented disruptions of the relationship between the variables.

The methodology employed in this paper is the CUSUM test for structure stability, originally developed by Brown, Durbin, and Evans (1975). This test analyzes the existence of instability in the parameters that are estimated by a regression. The test focuses on the trend of the cumulative sum of the recursive residuals versus a critical interval determined. When this trend line breaks and crosses beyond the established interval, it is concluded that the estimated parameter is unstable and, therefore, indicates is the period in time in which this break is found means that is breakpoint.

The methodology defines recursive residuals  $w_t$  as the standardized difference between the real value of the dependent variable at time  $t$  and the value of forecast generated by the regression based on previous information. It is said that these are recursive residuals since estimates of the regression parameters are also made recursively, in the sense that the regression is estimated repeatedly. If the real value is very similar to the value of prediction by the regression,  $w_t$  would be close to zero, implying a structural stability in the parameters estimated in the regression and the trend of the cumulative sum of the recursive residuals would be inside the interval. Otherwise not are stable the parameters of the regression after the time when the trend of the cumulative sum of the recursive residuals breaks and crosses beyond the interval.

Two graphs are obtained from the test. The first observes the trend of the CUSUM statistic  $W_t$  versus the critical interval that has an expected value  $E(W_t) = 0$ . The CUSUM test indicates that if  $W_t$  is inside this critical interval, there is no evidence of the existence of breakpoints in the relationship between the dependent variable (in our case real wage or GDP per capita) and independent variables (in our population). The second graph observed the CUSUM square statistic  $S_t$  versus another critical interval that has a linear expected value that goes from zero to one. The CUSUM square test indicates that if the statistic  $S_t$  is inside the new critical interval, there no is evidence of breakpoints in the variability observed in the relationship between the dependent variable and independent variables. Generally, CUSUM square test is used to analyze the volatility in the relationship between the economic variables that are being tested.

Therefore, the test has the following statistics:

$$W_t = \sum_{k+1}^t \frac{w_i}{s} \quad (6)$$

In which this statistic represent a accumulated sum that is going according to t, and it would be  $t = k+1 \dots T$ ; k represent the number of parameters that are estimated by the regression, and it determines the number of observations that are taken to estimate the parameter  $\beta$  of the regression; s is the standard error of the regression adjusted to all n sampling points and  $w_t$  is the forecast error. So, s and  $w_t$  are defined as:

$$s = \sqrt{[\sigma^2(1 + x_t'(X'_{t-1}X_{t-1})^{-1}x_t)]} \quad (7)$$

$$w_i = y_t - y_t^{predict} = y_t - x_t'\beta \quad (8)$$

In which  $y_t$  is the observed value in the dependent variable in period t (in our case, real wage or GDP per capita),  $y_t^{predict}$  is the forecast value of the dependent variable in period t,  $x_t'$  is the vector with the values of the independent variable (population in our case) in period t;  $\beta$  is the estimated parameter of the regression of the independent variable y versus the dependent variable x;  $\sigma^2$  is the constant variance of the recursive residuals which has a normal distribution with zero mean;  $X'_{t-1}$  is matrix of the regressors.

On the other hand, the CUSUM square test is determined by the next statistic  $S_t$ :

$$S_t = \frac{\sum_{k+1}^t w_i^2}{\sum_{k+1}^T w_i^2} \quad (9)$$

It is important to note that unlike the CUSUM statistic  $W_t$  which has an expected value  $E(W_t) = 0$  in all the entire time range defined by the complete period analyzed, the CUSUM square statistic  $S_t$  has an expected value defined as  $E(S_t) = (t - k)/(T - k)$ , which takes a value zero when  $t = k$  and increases linearly over time to reach the value of 1, when  $t = T$ . Around this line would be the critical interval which defines the test.

The explanation for both cases is related to the stability of the estimated parameters in the regression  $\beta$ . If these estimated parameters remain constant from period to period and there are no structural change or any disruption in the data series that is analyzed, the trend of the CUSUM statistic  $W_t$  will be close to the expected value of  $E(W_t) = 0$ . However, if these estimated parameters  $\beta$  change according to the time, and there is an abrupt change in the series, altered as a result of an extreme shock,  $W_t$  will diverge from the expected value  $E(W_t) = 0$ . This is the same case for CUSUM square statistic,  $S_t$  which will also diverge from its expected value  $E(S_t) = (t - k)/(T - k)$ , in case the volatility observed in the data series change abruptly as a result of a strong disruption.

### 3.3. Data and Stylized Facts

The empirical analysis in this section considers the data series on nominal wages expressed in grams of silver per day, real wages and the consumer price index developed by Allen (2001), for both skilled and unskilled workers. With this information would be analyzed possible breakpoints in the series on real wages for two representative European cities: London and Florence. These two cities are taken due to the fact that by the year 1348, under the same methodology developed by Allen (2001), there are only information for three cities: London, Oxford and Florence. However, Oxford would be subject to very similar interventions than London derived that both cities are in the same country.

It could be said that Florence and London were two very different cities, in the sense that the economy of the former was characterized by having more developed sectors in industry and services than London (for example, the presence of banks and manufacturing workshops, mainly cloths of high quality). However, the wages between both cities were very similar in 1348, since the nominal salary for skilled workers in London was 4,795 grams of silver, while in Florence it was 4,0192 grams of silver. The same appreciation is true for real wages, which were also very close between the two cities in 1348. London had a real salary of 10.9116 while Florence was 9.8340.

Figure 5. Nominal Wages London – Florence

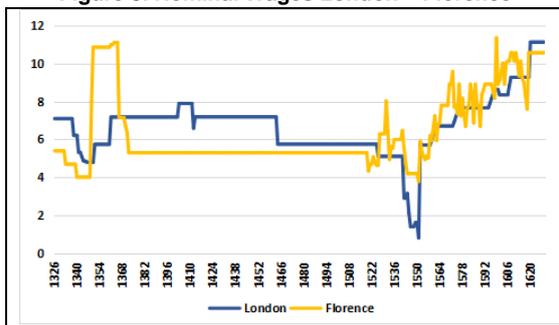
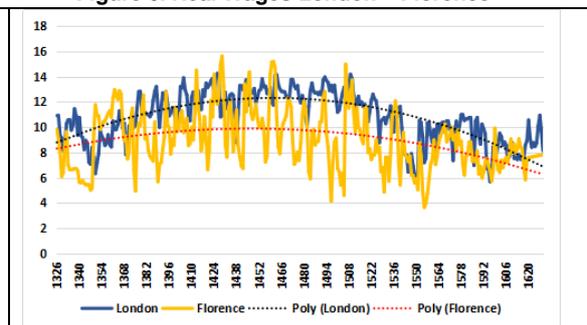


Figure 6. Real Wages London – Florence



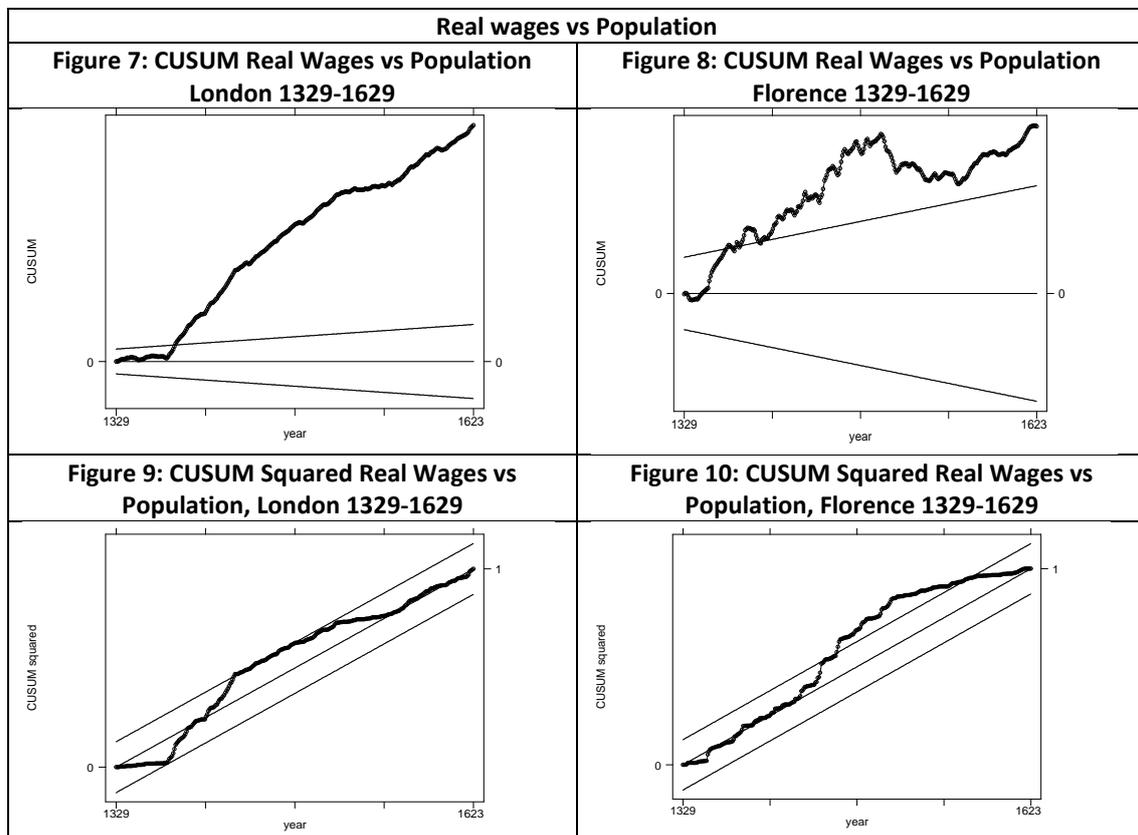
Subsequently, this section 3 of the paper also will identify the potential breakpoints in the GDP per capita for England. In this analysis it is considered the series built by Broadberry, Campbell, Klein, Overton and van Leeuwen (2015).

The limitations of the analysis are a function of the limitations given on the series of data considered in this section. As is known, there are significant differences between the series of data related to real wages used by the literature, which are derived from their methodologies and which have generated very interesting debates among historians. It is recognized that these series of both real wages and GDP per capita have been questioned by various authors, such as Malanima (2011), Humphries and Weisdorf (2019), among others. A second limitation lies in the fact that for real wages there is only one city to make the comparison regarding the GAP (Florence). However, for the identification of break points, it is sufficient to focus attention on information about England or London.

### 3.4. Results

It is proceed to estimate the CUSUM test for structure stability, as well as the CUSUM square test to analyze changes in variability patterns (structural change in series volatility). For this analysis, first, the dynamic in the relationship between real wages and population are studied separately, both for England and for Florence. In this way, the analysis will indicate, independently between these cities, the periods where, in any case, there were structural changes (that is, if the estimator). This would allow to see when the initial relationship between the economic variables is broken. Likewise, the CUSUM square test is carried out to analyze the potential structural changes in the volatility or variability patterns of the relationship between the economic variables. Subsequently, it will be analyzed the dynamics in the relationship between GDP per capita and population for England, based on the CUSUM test for structure stability.

The following graphs show the results for both tests in which it is observed the dynamics breakpoints in the relationship between real wages and population and its instability.



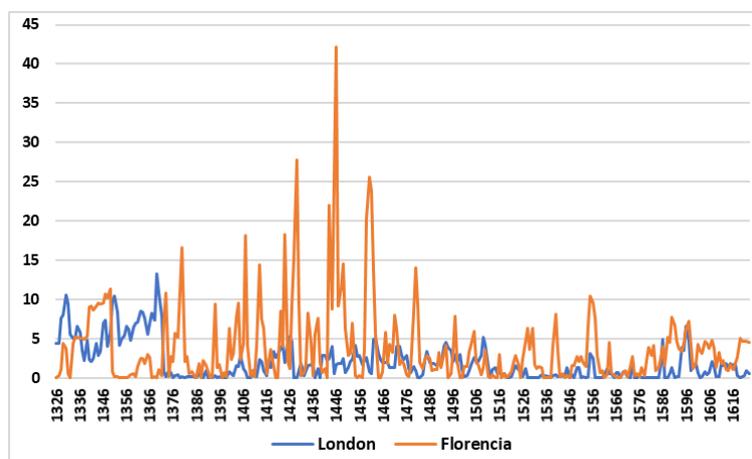
Figures 7 and 8 show the behavior of the CUSUM statistic  $W_t$  for London and Florence, respectively, in which a first breakpoints for both series is displayed (when CUSUM statistic  $W_t$  crosses beyond the critical interval). In the case of London, the first break occurs around the year 1380, while for Florence it occurs around the year 1365.

Figures 9 and 10 show the behavior of the CUSUM square statistic  $S_t$  for London and Florence, respectively. It is observed that London did not cross strictly its critical interval while Florence crossed its critical interval around 1494, when the Italians Wars began.

It is interesting to note that the breakpoint in London was later than the tipping point observed in Florence, with a difference of 15 years between both events (1365 for Florence and 1380 for London). Likewise, the breaking of the CUSUM statistic  $W_t$  for London was very explosive around the year of 1380 and it moves away significantly from its critical interval. In this sense, the disruption that occurred in London around 1380 must have been abrupt and too strong to avoid the  $W_t$  statistic approaching to its interval again after its breakpoint. This is not the case for Florence. Although there was also a breakpoint for this city in an earlier year (1364), the trajectory of its CUSUM statistic  $W_t$  was not as explosive as the one observed in London around 1380. In fact, the Florence's CUSUM statistic not only did not move too far from its interval, but also did not regress or did not approach it again since the year of 1494.

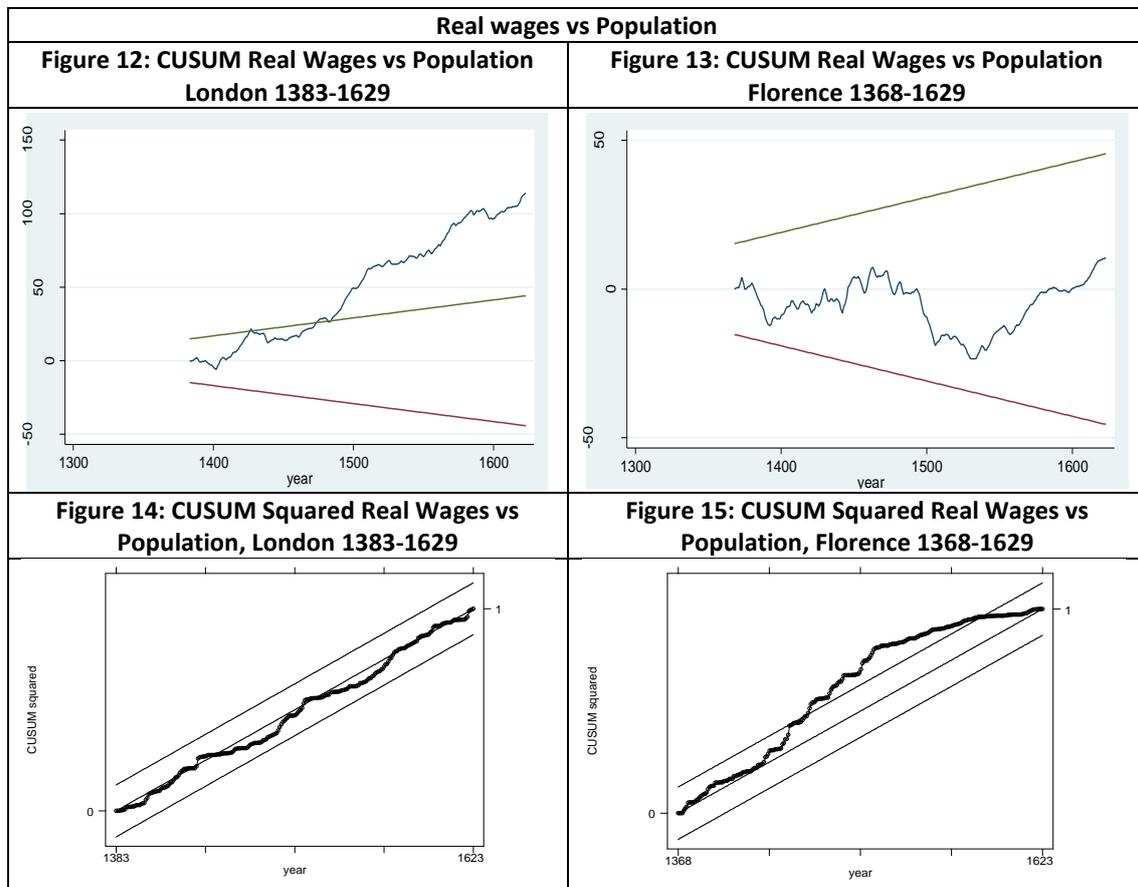
In the case of the analysis for the CUSUM square statistic  $S_t$ , it is observed that the relationship between real wages and population did not show a breakpoint that would represent a significant variance during the period analyzed for London. This does not mean that volatility has not been observed in the series for London. However, its volatility did not represent a breaking point at which it could be identified different periods. In contrast, Florence was characterized by facing a strong and diverse volatility in its series. This volatility could be framed within the period of the Wars. This can be seen in the following Figure 11, where volatility for Florence and London is shown.

**Figure 11: Volatility on Real Wages represented by the Squared Mean Deviation London and Florence 1326-1629**



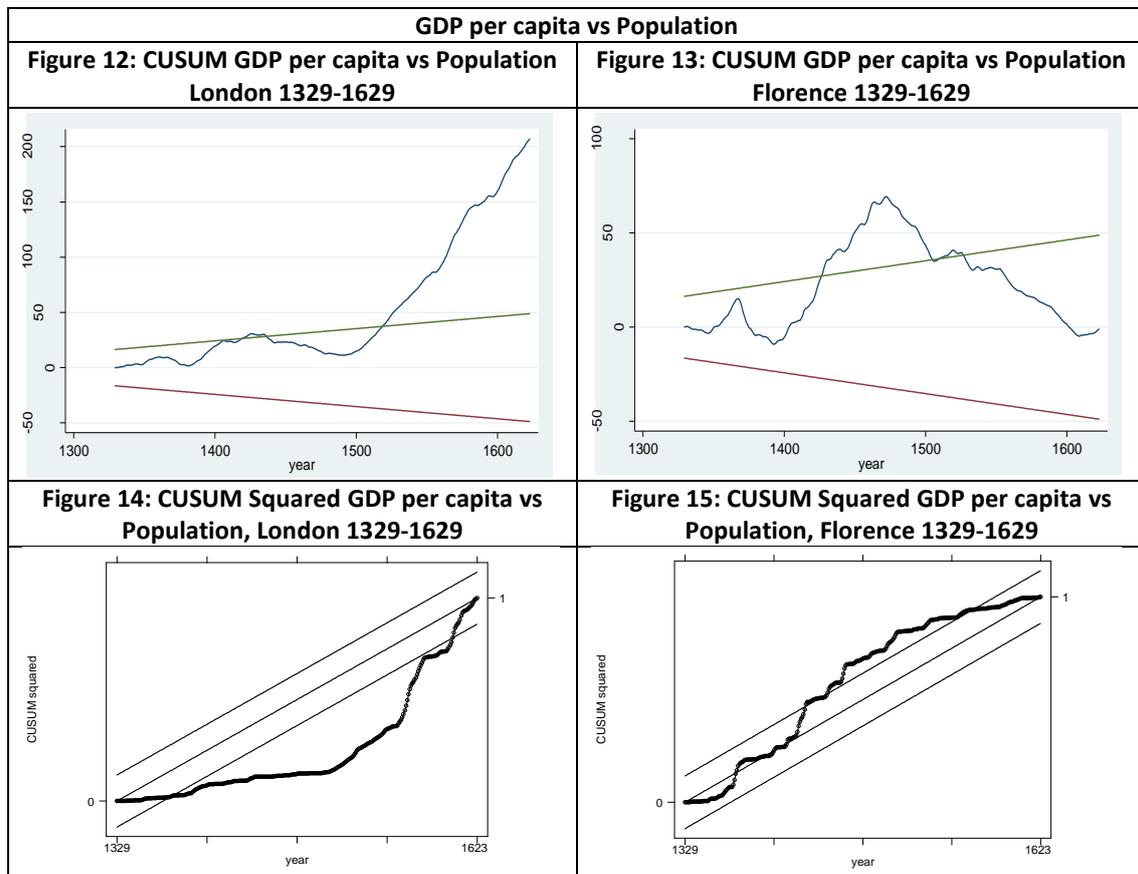
The breakpoints in real wages identified for London and Florence suggest that the events that occurred around those years (1364 for Florence and 1380 for London) may have influenced, in some way, in the beginning of the divergence. The second wave of the Black Plague during the 1360s, or other events such as the Battle of Cascina may provide relevant information. Also, some events related to the Hundred Years' War, such the occupation of Brittany by French, the poll taxes created to finance the war as well as the Peasants' Revolt of 1381, may be critical events to understand the disruption in wages.

Now it is analyzed the existence of a possible second breaking point in the years after the first tipping points already identified in 1364 for Florence and 1380 in London. The following graphs show these results for both tests.



Figures 12 and 13 show the behavior of the CUSUM statistic  $W_t$  for London and Florence, after 1381 and 1364, respectively. In Figure 12, it is observed a three new breakpoints for London, which occurred in the year of 1427, 1474-1481 and 1484. After this last year, the CUSUM statistic  $W_t$  for London did not regress to the critical interval. The break point observed in 1484 also was not as abrupt and strong as that observed in 1380. However, in 1484 the previous pattern in the relationship real wages and population was broken and the trend did not returned to the critical interval. The breaking point from 1474 to 1481 coincides with the findings obtained in the last section 2, where it is proposed that England escaped from the club of European countries in 1470's to have its own economic dynamics. In the case of Florence, as it is observed in Figure 13, after 1364 a new break point is no longer observed. The break points identified after 1474 for London in the year 1475 is very close to the restoration of Ricardo III in 1471, who established a period of peace that would last until his death in 1483. Figures 14 and 15 show the behavior of the CUSUM square statistic  $S_t$  for London after 1383 and Florence after 1368, respectively. It can be seen again that the relationship between real wage and population for London does have high volatility. However, the relationship for Italy is characterized by high volatility after the Italians Wars had begun.

Finally, it is analyzed the relationship between GDP per capita and population, for both England and Central Italy. It proceeds in the same way analyzing the CUSUM test for structure stability and the CUSUM square test.



The dynamic between GDP per capita and population of England identifies two periods of breakpoints. The first was a temporary escape in which the previous relationship between GDP per capita and population was broken from 1420-1436, although the CUSUM statistic  $W_t$  regressed to the critical interval. However, from 1519 a permanent escape is observed, whose incremental trend of the CUSUM statistic  $W_t$  exploded around the year 1500. It will be very important to analyze in the future the gestation of this disruption in the period between 1436 and 1500. Although this breaking point was not as abrupt as the one observed in 1380 for real wages, the escape in 1519 was so blunt that the CUSUM statistic  $W_t$  did not return to the critical interval.

For Central Italy, the dynamic between GDP per capita and population identifies one temporary period of breakpoints from 1427 to 1504, when finally the CUSUM statistic  $W_t$  regressed to the critical interval. It will be worth analyzing what happened during the first period started from 1420's when Italy escaped for many decades from its previous dynamics between GDP and population until 1504, while England just escaped by a brief period. Something more important will be to know the reasons why Italy returned to its critical interval, after it had already escaped from its previous dynamics and why England escaped permanently and strongly after 1500. This goes beyond the purpose of this paper.

## **4. Discussion on the beginning of the Little Divergence**

Black Death in Europe has been considered by several historians as the agent of a great historical fracture (Romano and Tenenti 1980). Although the Great Famine of 1313-1317 had already uncovered failings in the medieval markets and represented a hard blow to the confidence on certain institutions [Slavin (2013)], the Black Death generated a severe economic damage not seen since the Plague of Justinian in the sixth century. In addition to affecting the demographic dynamics, the plague also precipitated a tremendous economic-social disorganization in Europe that lasted until 1450. This complex situation could have undermined trust in several medieval institutions and the well-functioning of economic relations, therefore contributing to altering the long-term economic growth trends among economies in Europe. According to Haddock and Kiesling (2002), the plague placed insupportable stress on feudal institutions. North (1993) emphasizes that the sources of the institutional change that led to the transition from the Middle Ages to the Modern Age in Europe were generated by this severe demographic fracture.

Broadberry (2013) argues that the key turning points of the early divergence in Europe were around 1348 and 1500, when Britain and Holland overtook Italy and Spain. Pamuk (2007) also considers that a wage gap began to emerge between the northwest and the rest of the continent after 1450. The previous sections of this paper also find some breakpoints around the years 1380, 1470-1484 and 1519 in which the relationship between economic variables and population in England were drastically modified. These disruptions could have implied the beginning of transformation processes that could have finally determined England's early escape from the dynamic of rest of the European economies.

However, from the theory of economic growth, it is very hard to explain the beginning of the escape of Holland and England from the dynamics of the rest of the European economies, from a very early period such as the years after the Black Death. One of the explanations given by theoretical economists of economic growth has been the accumulation process in human capital as a trigger for economic growth in England and other regions of Northwestern Europe [e.g. Becker, Murphy and Tamura (1990); Lucas (2004); Tamura (2002)]. However, although the printing press had already been invented in the fifteenth century, one could not point out the existence of incentives by families to invest in the generation of human capital or to promote its diffusion during this period. In addition, if it is true that there was the presence of universities in some cities in Europe, the diffusion of knowledge was very limited among the European population. In this sense, the contributions of these theoretical economists of economic growth, in any case, would apply to a period far away after the Black Death. Nor could mention the existence of technological progress and innovation during the fifteenth century [as mentioned by Kremer (1993); Lee (1980; 1988); Galor and Weil (2000); Jones (2001); Hansen and Prescott (2002)]. No doubt this technological progress began to show the first signs at the end of the sixteenth century while the innovation processes, perhaps, began to be observed until the seventeenth century. Also, the trade expansion had not yet begun during the break points identified around 1380 and in the decade of 1430.

In addition, a common and highlighted aspect by that theoretical literature is the role of population growth to engine the key drivers of the transition toward the sustained economic growth. However, population was not significant in 1380 and 1470's. During the second half of the fifteenth century the English population began to show increasing rates, which reflected the beginning of the demographic recovery. Nevertheless, the levels of population were very far from the levels reached before the Black Death. According to Broadberry et al (2015), the population in the year 1450 had hit bottom, reaching 1,903,200 inhabitants, far from the 4,820,400 inhabitants in 1348. In any case, the theoretical contributions of other authors on changes in marriage patterns and fertility, as well as urbanization process and agglomeration economies could make more sense to explain the roots of this early divergence after the Black Death [e.g. De Vries (1981); Voigtländer and Voth (2013) and Becker, Glaeser and Murphy (1999)].

However, to trigger all these changes in marriages, fertility and urbanization process, a previous step is necessary, which would consist of a significant reallocation of the population derived from the Black Death instead an increase of population. For this reason, in this discussion it is proposed that the reallocation of the population after the Black Death in England was possible due to the weakening and subsequent accelerated collapse of Serfdom. By eliminating this institution of forced labor arrangements, thousands of peasants acquired greater mobility, which generated a new reallocation of labor among the regions of England. This institutional transition from serfdom to a labor market system could have generated significant efficiencies in the economy, considering that economic and political institutions with labor repression produce inefficiencies [Acemoglu and Robinson (2006, 2008); Acemoglu and Wolitzky (2011)].

According to Jedwab, Johnson and Koyama (2019), the Black Death played a relevant role in determining both the sizes and placements of populations, with significant impacts in cities in the short-run and long-run. From this demographic fracture, a reversal of fortune of the cities was observed, where the Northwestern Europe experienced significant growth in cities in contrast to the slow urban recovery of the Italian cities and Eastern Europe. In this way, the Black Death triggered a significant reallocation of population in Northwestern Europe, which had a positive impact on the growth of urban areas, therefore having future implications in terms of production of new ideas and changes in incentives to invest in human capital. In addition, the period of the decline of serfdom suggested by Bailey (2014) coincides with the period in which a process of greater migration and urbanization began in the Northwest of Europe, in contrast to the rest of Europe. In fact, the periods of the decline of serfdom also coincide with the first breakpoints identified in this paper. In summary, the decrease in servitude could have led to England achieving greater efficiencies and starting with a process of greater urbanization, in which the agglomeration and indirect effects economies could have generated increasing returns, and thereby achieve future economic growth, by breaking the relationship between real wages and population since the end of the 14<sup>th</sup> century.

On the other hand, Foreman-Peck and Zhou (2015) show that the Western European Marriage Pattern emerged as a result of the high mortality of the fourteenth and fifteenth centuries. These authors suggest that with the decline of feudalism could have contributed

to promote an institutional change in marriage and fertility. For example, they suggest that the female age at marriage increased sharply between the decades of 1430's and 1460's in England, moving from 19,5 to 24,5 years in average. The period of this process of change in female age at marriage pointed by Foreman-Peck and Zhou (2015) coincides with the period suggested by the results expressed in this paper about the breakpoints observed for England, in the relationship between real wages and population.

Although there are several arguments about the causes of the decline of the serfdom, which has generated much controversy among historians [e.g. Blum (1957); Postan (1966); Domar (1970); North and Thomas (1971); Brenner (1976); Conning (2007); Acemoglu and Wolitzky (2011)], the identification of the moment of the process of its extinction in England is now more understood with Bailey's work. This identification is relevant for the analysis on the breakpoints that led England to move towards a more dynamic economy, as well to understand more about the origins of the Little Divergence. Bailey's recent work (2014) provides new findings on this extinction process, based on the analysis of 38 manors in England. This work has a very different view on the causes and chronology of the decline of serfdom compared to other authors. For Bailey, the seigniorial reaction after the Black Death and the peasants' revolt in 1381 are not significant events in the process of extinction of serfdom.

Undoubtedly, the Black Plague could have a very impact between the Northwestern Europe and the rest of the continent, in terms of the differentiated processes of decline or strengthening of serfdom as a labor institution, given some very particular characteristics among the regions. However, in England, the findings presented by Bailey (2014) show that serfdom had already begun its process of decline, derived from the decrease in land value, immediately after the first waves of the Black Death (instead 1381). For Bailey, the evidence shows that the decline of serfdom was a result of a process of negotiation between landlords and peasants, as well as a competition among landlords to retain and to recruit peasants, in the face of labor shortage, rather than a seigniorial reaction. While the decline of villein tenures occurred in a period from 1350 to 1380, the decline of personal servility occurred in a longer period from 1350 to 1400. In this way, Bailey concludes that the Black Death was a nuclear event in the transformation in rural areas in England, with significant implications for its economy and future social dynamics.

Derived from the identification of the first breakpoint in the relationship between real wages and population in England around 1380, according to the analysis in this paper, it possible to consider at least three possible interpretations. The first is that, as Bailey (2014) points out, the breaking point in 1380 was the result of a continuity of facts that were developed during previous decades, such as the process of replacing of customary villein tenures with leasehold or copyhold tenure. A second interpretation would be that the breakpoint around of 1380 practically indicates that the peasant revolt of 1381 was the cause of the rupture that occurred abruptly and explosively in the process of extinction of serfdom, as many years before was thought by part of the literature. A third interpretation would be the combination of the two previous interpretations, in the way that the decline had begun since 1350, but the peasant revolt was a reinforcement process that resulted in the acceleration of the collapse of that feudal institution.

Considering the results of the previous section on the breaking point between real wages and population, the third interpretation mentioned above makes sense. The breakpoint around 1380, identified in this paper, indicates that something happened around that year that was abrupt and explosive. In addition, the trend that relates real wages and population (the CUSUM statistic  $W_t$ ) moves away significantly and sharply from its critical interval around 1380 versus the trend observed for Florence, in which its breakpoint was around 1365, but its trend tried to return to its old dynamics, even though this city faced the Revolt of the Ciompi from 1378 to 1382. While the series analyzed is about real urban wages for the city of London, and not about wages or compensation to rural workers, Fochesato (2018) points out that the performance of both indicators are closely related. Finally, it makes sense that Serfdom, as a medieval institution, was able to break its path dependence supported by a process of reinforcement against a potential reversal. In social networks, complex contagion requires reinforcements in order to achieve the successful diffusion of a radical change [Centola and Macy (2007) and Centola, et al (2018)].

In addition, the visibility of certain facts or attributes to achieve institutional change may be relevant. Greif and Laitin (2004) developed an endogenous institutional change theory, in which there are parameters that are not exogenously determined, but also endogenously changed, named as quasi-parameters. If these quasi-parameters are observable and their importance well understood, decision makers might actually realize that past behavior is no longer self-enforcing and leads to an intentional institutional change. In contrast, when quasi-parameters are unobservable, the institutional change can be characterized by a long process of agony due because less individuals' willingness to deviate from past behavior. In this way, the Wat Tyler's Rebellion of 1381 in England could have been an observable quasi-parameter that could have facilitated the English elite to realize that serfdom was no longer self-enforcing institution. This observation is important due theoretical economists of economic growth recognize the relevance of institutions in the transitions from a Malthusian regime to a Modern regime. However, they omit that institutions can also be determined endogenously.

Finally, from the analysis elaborated in the previous sections, two other periods of breaking points were identified which could have also determined the early escape from England of the rest of the European economies and, therefore, to determine the beginning of the Little divergence. The second period of breaking points was also in the relationship between real wages and population and it lasts from 1427 to 1484, with two temporary breakpoints in 1427 and 1474-1481, and finally a permanent breakpoint in 1484. This last breakpoint was not as abrupt and strong as that observed around the year if 1380. The third period was in the relationship between GDP per capita and population, from 1500 to 1519, when finally the previous relationship was broken. Both periods of breakpoints occurred at a time when some of the key drivers of growth mentioned above could be operating, such as changes in marriage and fertility, as well as the beginning of an urban agglomeration process. The last breakpoint is fundamental to understand the early escape of England from the Malthusian regime. The evidence for Florence highlights the possibility of observe a reversal of the escape when there are not reinforcements.

## 5. Conclusions

This paper has two contributions to the discussion about the origin of the Little Divergence and the early transformation of northwestern Europe focusing attention on England during the period from the late Middle Ages to the Early Modern Period. First, the analysis finds the existence of a divergence among the European economies throughout the period from 1348 to 1799 where five different periods were identified. The first runs from 1348 to 1374, in which an economic convergence was observed during this period of economic disorganization generated by the first waves of the Black Death. The second period was from 1375 to 1454, in which the economies shown an early divergence. The third was a brief period from 1455 to 1494, in which a little convergence among economies was observed. The fourth period goes from 1495 to 1618, in which it was observed the greatest divergence among the European economies. From 1618 to 1799, it was a period characterized by a stationary dynamics and economies keeps their divergence reached since 1618.

In addition, based on the transition trends in the GDP per capita, Holland and England respectively escaped from the club of the European economies since a very early period. This result contrast when it is just considered the absolute levels of GDP per capita. Under this last vision, England was still far to overtake Central Italy. In any case, under this last vision there are two clubs of countries that shares similar absolute levels in their GDP per capita. In the first club, with the highest level of GDP per capita, were Italy and Holland; in the second club were England and Spain; while France was a particular case. However, this last vision is limited given that when there are some economies that observe different trends and transition dynamics, it is more important to take in consideration the dynamics of the GDP per capita in the analysis (such as acceleration or decline rates).

The second contribution of this paper is the identification of those turning points, hitherto unknown, in which the early economic divergence could have begun. There are three periods. The first is around the year of 1380, in which the previous relationship between real wages and population was sharply broken. The result indicates that something happened around that year that was abrupt and explosive, versus the breakpoint observed for Florence, around 1365, whose trend tried to return to its old dynamics. The second period of breaking points was also in the relationship between real wages and population and it lasts from 1427 to 1484, with two temporary breakpoints in 1427 and 1474-1481, and finally a permanent breakpoint in 1484. This last breakpoint was not as abrupt and strong as that observed around the year if 1380. The third period was in the relationship between GDP per capita and population, from 1500 to 1519, when finally the previous relationship was broken. Both periods of breakpoints occurred at a time when some of the key drivers of growth mentioned above could be operating, such as changes in marriage and fertility, as well as the beginning of an urban agglomeration process.

From the theory of economic growth, it is hard to explain the beginning of the escape of Holland and England from the dynamics of the rest of the European economies, from a very early period such as the years after the Black Death. A significant reallocation of the population, instead the population growth, is a necessary previous step in order to trigger the key drivers of economic growth such as change in marriage and fertility trends as well as urbanization. For this reason, it is proposed that the accelerated collapse of Serfdom played a relevant role to achieve the beginning of the economic transition in England. Thousands of peasants acquired greater mobility. By eliminating this medieval institution, significant efficiencies in the economy could have been generated, leading England to start with a process of agglomeration economies and increasing returns. In this way, the Wat Tyler's Rebellion of 1381 in England could have been an important reinforcement to the process of decline of serfdom that had begun after 1350, facilitating the English elite to realize that serfdom was no longer a self-enforcing institution.

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