Demographic shocks, labor institutions and wage divergence in early modern Europe

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Abstract

Why did real wages in European regions diverge in late medieval and early modern times thus characterizing a different pattern towards industrialization? This question, which is fundamental for the understanding of the long run development of Europe, is at the basis of the present paper. It combines a simple theoretical framework for wage determination in late medieval rural and urban sectors with an empirical analysis of population and wage trends to check the hypothesis that the early modern divergence was the result of different late medieval rural labor institutions, which caused a differential impact of mid-14th century demographic shocks on the long run evolution of northern and southern economic systems.

Keywords: Pre-industrial Europe, North-South economic divide, real wages, labor market institutions, rural-urban sectors.

JEL Classification Numbers: J11, N13, N33.

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1 Introduction

One of the most relevant issues in the economic history of early modern Europe is the emergence of a striking and persistent divide in real wages between northern and southern regions at least 150 years before the advent of the industrial revolution. The study of such a divergence is important for at least two reasons. First, because according to several economic historians, as such Allen (2009), this divide was so striking and long that was at the root of the industrial revolution in England and Low Countries and the economic stagnation of southern regions. Second, because regional differences in Europe still persist nowadays and, as pointed out for example in Carlin (2010) and Boltho (2010), the analysis of their origins and path dependence might help to understand contemporary problems of preventing a convergence that would create a unified social and economic European area.

The main conjecture of this paper is that at the origins of the divide were the different institutions governing wage bargaining in late medieval rural labor markets. In particular, this hypothesis is investigated checking whether the complementarity between such organizations and the mid-14th century demographic shock, initiated in the 1348 by the devastating bubonic plague commonly known as the "Black Death", determined the subsequent different paths in real wage response to population change in early modern Europe. The main result will be to show, through a careful empirical analysis, that in some of the Northern European regions real wages were detached from population trends already in early modern times.

Several economic historians have dealt with the divergence of economic growth and income distribution between northern and southern European areas in late Middle Ages and early modern time.

The great divide in real wages was first shown by Robert Allen, who made an extensive comparative analysis of skilled and unskilled real daily urban salaries in several European cities in the period spanning the 16th-18th centuries (see also Allen (2001).) He observed that northern urban centers, such as Amsterdam, Antwerp and London, experienced, at least two hundred years before the advent of the industrial revolution, higher real incomes than several southern cities, such as Florence and Valencia.

Then, the economic historian Şevket Pamuk, provided a fundamental contribution to the subject linking the divergence to the 1348 bubonic plague (see Pamuk (2007).) He has argued that the decreased labor force subsequent to the plague caused a sharp rise in real wages while, on the other hand, the increased land-to-workers ratio caused a decline in the relative price between agricultural and manufacturing goods. Per capita incomes and wages increased throughout all European regions in the decades following the Black Death, remaining higher than pre-plague levels until the end of the 15th century. But in the following decades long term effects differed dramatically in Europe and the divergence appeared.

This evidence have motivated many contributions that have tried to provide an explanation to this long run divide in income distribution and economic growth.

Several authors have focused on the demographic regimes that might have caused the striking rise of northern real wages. These works, which usually confront the issue using a Malthusian approach, have theoretically and empirically stressed how the long run higher per capita incomes might have been caused by persistent high death rates (see Voigtländer and Voth (2013)) or by their combination with technological improvement (see Sharp et al. (2012).) Leaving aside the fact that the Malthusian demographic regime for pre-industrial Europe is far from being empirically proved, as shown in Lee (1973), these studies have an additional shortcoming. They motivate the higher northern Europe real wages as the consequence of the persistence, in early modern times, of higher death rates due to precise causes, such as wars, plague, and spread of disease through urbanization and trade. However, they do not explain why these factors, while being effective in northern areas, were not capable of determining higher per capita incomes in the south, where war and urbanization were equally great and high death rates were no less persistent.

A second group of interpretations focuses on the possible institutional explanations for the economic divergence. What made some regions have long lasting higher wages was the adoption of particular societal or economic organizations in early modern times.

Some have focused on the importance of geographical or technological advantages of northern regions and the role of these factors in the adoption of growth enhancing institutions. In Acemoglu et al. (2005) Atlantic trade has been suggested as a key factor for the earlier economic development of northern areas. Those countries, England and the Netherlands in particular, having easy access to the Atlantic maritime trade, had the sufficient stimulus for the development of economic and social organizations fostering growth. These explanations, although revealing important features of the development of northern regions, have the limit of do not, however, fully explain the delay of other regions with similar geographical or technological endowments (such as Spain or Germany.) In addition, as the historical works of Davis (1954) and Rapp (1975) show, also the timing of trade development pointed by Acemoglu et al. (2005) seem to be wrong. While, in fact, according to the latter, northern growth occurred in 16th-17th centuries, as a response to the discovery of Atlantic routes, the former studies show that British maritime trade was already developed in the 15th century, hence indicating an earlier growth of such regions.

In North and Weingast (1989), the emergence of social and political institutions securing property rights and, therefore, enhancing economic activities, are the fundamental explanation for the exceptional northern development. In particular, the changes occurred after the 1668 Glorious Revolution and the adoption of the constitutional law, are pointed out as the key factors securing the property rights of the arising British entrepreneurs and justifying, therefore, the subsequent exceptional economic development of these areas. This explanation, although capturing an important feature in the consolidation of northern development, might misunderstand the real causes and effects of such institutional changes. As shown in Greif (2008) early modern constitutionalism often emerged to regulate the relationships between the ruler and the other important social groups in a certain political entity. It

might have been correlated with growth, as in early modern England, but it might also have been the cause of stagnation. The constitutionalism process in 16th-17th centuries Poland, for example, which fixed the relationships between the King and the aristocracy, limited the possibilities for the economic initiative of lower social groups. Therefore, since the adoption of the rule of law had actually ended up in divergent economic paths, it is possible to conclude that this factor may only partially explain the northern distinctive development.

An important contribution to the institutional explanation for the divide has been given in Pamuk (2007). The work is relevant, as the author carefully presents the great variety of institutional differences that might have accounted for the divergence between northern and southern European regions. More recently, also in Broadberry (2013) an analysis of the possible institutional and technological causes for the European divide has been provided. However, also because it is out of the scope of the two works, the authors do not provide a definitive explanation of the causal mechanisms why the plague might have had different effects on workers' bargaining power, wages and the other political and social changes that occurred after the mid-14th century demographic crisis. Causal mechanisms that might have played a relevant role in determining different paths in economic development.

Finally, Robert Allen has also investigated the possible causes of early northern economic development. In Allen (2003) the author analyzes a large set of data through a simultaneous equation model and checks the importance of the different explanations given in literature. Results reveal two crucial factors for the northern early development: the growth of trade and the effective improvements in urban labor productivity. He also shows that these factors explain northern prosperity more than the political and legal changes occurred in 16th-17th centuries, such as the ones mentioned above, or the particular demographic regimes. This contribution is important because it quantitatively assesses the role of each possible determinant in the divide. However, it does not provide a definitive explanation of the reasons why the relevant causes for growth in the north did not emerge in the southern regions.

Many scholars, therefore, have analyzed the divergence of real wages between European areas but several important questions remain. Why did the divergence occur? What was the actual role of the mid-14th century demographic shock? To what extent were northern regions exceptional with respect to southern ones?

The contributions mentioned above show two main limits in the literature. First, there is a failure in pure economic forces, such as changes in demographic patterns or technological advance, to explain alone the divide. Second, the institutional interpretations, while capturing relevant mechanisms of the divergence, do not always provide a convincing reason for the emergence of certain organizations in some areas and not in others.

The main hypothesis of the present paper is different from both the two groups of explanations. In fact, it will be argued that what mattered for the long run different impact of the demographic changes on European incomes were the heterogeneous labor institutions, and in particular the rural ones, pre-existing the plague. When in the late Middle Ages the

demographic collapse occurred and there was a shock in labor supply, in those European areas where the combination of the pre-existing labor institutions and the shock favored the increase in the bargaining power of workers, real wages did not fall once population restored. Instead, in the regions where the combined effect of pre-demographic changes institutions and the shock reduced the bargaining power of workers, real wages fell once population had returned to the pre-plague levels.

This hypothesis, therefore, stresses that pure economic forces, such as the demographic changes, cannot explain alone the whole story about the divergence, and their role on the different patterns in income distribution and economic growth can be understood when combining such changes with the pre-existing different conditions in European societies. For this reason, this approach follows the Robert Brenner's idea about the rural origins of European industrialization firstly presented in Brenner (1976) and then widely debated by several economic historians in Aston and Philpin (1985). There, the different class structure among social groups in rural late medieval Europe, which implied different labor organizations and forms of wealth and income distribution, are stressed as the fundamental causes for how subsequent changes in demographic patterns, technology and trade, affected the long run divergence among northern, southern and eastern European areas.

In this paper the analysis is restricted to Western European societies and it checks for the combined role of pre-existing labor institutions and demographic changes on the long run development of real wages of the unskilled labor force.

Before introducing the analysis of wages and population, section 2, shows some main historical facts that might motivate the subsequent theoretical and empirical study. In section 3, a simple theoretical framework for the determination of urban wage in a two-sector late medieval economy is presented for the analysis of the long and short term effects of demographic shocks on European urban wages. Then, in section 4, the Robert Allen's dataset on early modern European wages and a new dataset on long run population trends are analyzed with the objective to test whether and how wages in European regions differently responded to changes in population. The main novelty of this analysis will be to show that in some northern European regions the expected negative lung run response of wages to population detected for southern areas was, in fact, absent or very small. Was this particular reaction due to the different late medieval rural labor institutions? The historical investigation presented in section 5 supports such hypothesis showing the heterogenous labor organizations governing European rural sectors already before the mid-14th century demographic shock. Finally, concluding remarks are shown in section 6.

2 Historical evidence on real wage divergence and demographic changes

Using the real wages dataset provided by Allen (2001) it is possible to assess that a divergence in European real incomes existed since the early modern times. The dataset collects urban

daily salaries for craftsmen and labourers in the building sector of several European cities.[1] In the present work, since the objective is to understand whether there was a particular response of wages to population changes occurred in the 14th-15th centuries, the analysis is restricted to the seven cities of the dataset with the longest series and representative of both northern and southern regions. The cities analyzed (with the years of the series in parentheses) are: Amsterdam (1344-1800)[2], Antwerp (1399-1800), Florence (1326-1800)[3], London (1301-1800), Paris (1431-1786), Strasbourg (1395-1800) and Valencia (1413-1785). In addition, only data of unskilled workers are presented since, as shown in Pamuk (2007) and Malanima (2013), the results of the studies about the trends in incomes of skilled workers show a less clear divergence.

Some authors have recently criticized the nature of these data. In Malanima (2013), for example, many criticisms and corrections have been suggested to the wage and consumer price index series for late medieval and early modern England and Florence. Especially, the series for florentine skilled workers has been reviewed with a deeper analysis of the sources used. For the present work, a similar analysis has been conducted on the sources used for the construction of the series of unskilled workers in the city of Florence and the data used here results from that correction.

The procedure implemented to obtain real wages from nominal ones has followed two steps. First, according to the method and information provided in Allen (2001), nominal wages have been made comparable across regions through a conversion of their values in silver grams.[4] Second, data have been deflated using a Laspeyres Consumer Price Index constructed by Robert Allen for each city under observation and arbitrarily made relative to the 1744-45 CPI for Strasbourg in order to compare them at a purchasing parity power. Differently from the Allen's deflation procedure, where real wages are computed using the concept of welfare ratios, here the nominal wages in silver grams for each year have been divided by the corresponding CPI in silver grams at purchasing parity power.

As shown in Figure 1, the divergence among real wages of unskilled workers is striking. After the 1348 demographic shock, and throughout all the following century, real wages sharply increased in both northern and southern areas. Then, since the first half of the 16th century an undeniable divergence emerged with some regions having higher real wages,

[1]Data are available online at http://www.nuffield.ox.ac.uk/People/sites/Allen/SitePages/Biography.aspx.

[2]In the original Robert Allen's dataset, the series of Amsterdam covers the period 1500-1800. Thanks to Jan Luiten van Zanden and Bas van Leuween, the series has been extended using real wages for the urban laborers in the Holland region, and it now also covers the period between 1344 and 1500, see also van Zanden and van Leuween (2012). The authors have made the data comparable to the Allen's series and the series is available online at http://www.cgeh.nl/reconstruction-national-accounts-holland-1500-1800-0.

[3]The series for Florence is realized combining the wages of urban workers in the Tuscan city for the period 1326-1600 with the wage for laborers in Milan in the following two centuries. In Malanima (2013) it has been shown that, for the period in which both the two series are available, wages almost overlapped. In addition, the aggregation of the two wage series is also supported by the almost similar demographic and economic conditions of the two cities in early modern times. Taking this into account, the series will be labeled as "Florence" in the rest of the paper.

[4]Silver grams values used for the conversion are available at http://www.nuffield.ox.ac.uk/People/sites/Allen/SitePages/Biography.aspx.

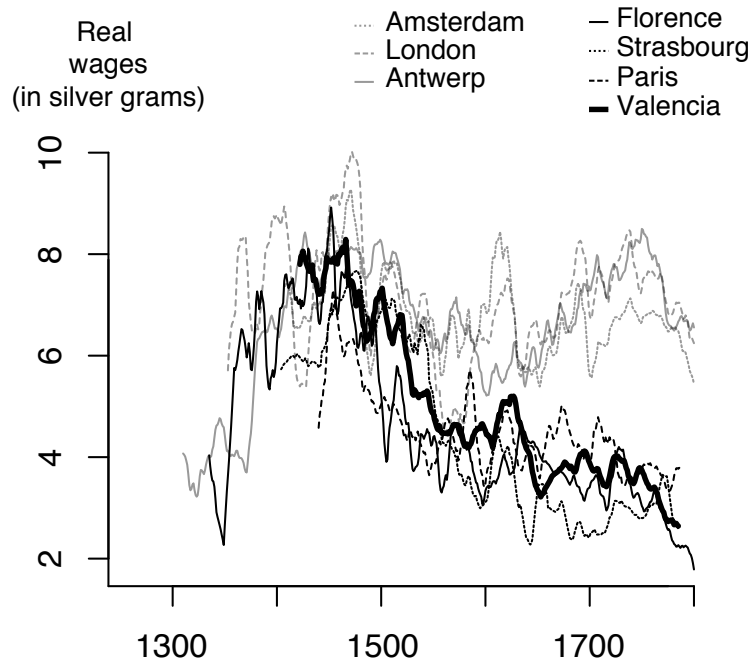


Figure 1: **The long run European divergence in real wages (unskilled workers.)** The lines show the real wages trend for seven cities in Europe. Series have been smoothed by 10-years moving average. The series for Antwerp, London, Paris, Strasbourg and Valencia are from Allen (2001) and are realized according to the methods described in the text. The series from Amsterdam is from Allen (2001) and van Zanden and van Leuween (2012). The series of Florence has been built following the information suggested in Malanima (2013) and using the following sources: de La Roncière (1982), Goldthwaite (1982) and De Maddalena (1949, 1974).

London, Amsterdam and Antwerp, and other, Strasbourg, Florence, Paris and Valencia, experiencing salaries declining to their pre mid-14th century levels.

What was the extent of the population shock occurred in the mid-14th century? Was it an isolated episode or did it persist in the following decades?

As observed with large detail in Ziegler (1969), Herlihy (1997) and more recently in Benedictow (2004), since the second half of the 1340s a devastating bubonic plague, commonly known as the "Black Death", reached the European regions. Population dramatically decreased with several areas experiencing, in the following decade, death rates even higher than 50 percent. In Table 1 it is reported the most reliable evidence of increases in mortality in some of the European areas. Data reveal that a dramatic mortality affected both continental Europe and the northern areas, such as England. Few data are available about the Black Death effect on Belgium and Netherlands, and several authors, as for example Biraben (1975), have stressed the smaller impact of the plague on such regions with respect to the other European areas. However, as observed in Blockmans (1980), even if the Low Countries had lower mortality rates associated to the Black Death than the rest of the continent, these regions experienced, in the following decades, a substantial decline in population due to recurrent epidemics.

When at the beginning of the 1350s the bubonic plague left the continent, European

Table 1: **Death rates in main European regions (1330-1350.)**

Country	Region	Estimated death rates
Spain	Kingdom of Navarre	60-65%
	Catalonia	50-70%
	General population	60-65%
Italy	Florence	60%
	Prato	45%
	San Gimignano	66%
	Siena	60%
	Bologna	40-45%
	Piedmont	52.5%
	General population	50-60%
France	Provence	60%
	Albi	60%
	Savoy	60%
Belgium	General population	37.5-47.5%*
England	General population	62.5%

*Data are only partially representative of Belgium population. Source: Benedictow (2004).

population did not restore immediately. In the following decades and throughout all the 15th century, several minor epidemics hit the population in the European regions keeping the pace of demographic recovery low at least until the first half of the 17th century. As reported in Blockmans (1980), Low Countries and Belgium were hit by the plague at least three times by the end of the 14th century and eleven times in the following hundred years (epidemics struck these regions in the years 1400, 1409, 1450, 1420, 1438, 1450, 1456, 1466, 1481, 1487 and 1492). During the 16th century, Netherlands were hit by the plague at least once, in the 1572. The Kingdom of Valencia experienced a similar path with at least six episodes of pestilences between the 1420s and 1460s. During the 1466 a devastating plague reduced Paris population of almost 40,000 inhabitants, as reported in Kohn (2007). In addition, during the first half of the same century, mortality in this area and all the northern part of France was also increased by the devastating effects of the Hundred Year's War. In 1565, as reported in Biraben and Blanchet (1998), a minor plague hit again the city of Paris. Also the population in northern and central Italy suffered from a prolonged decline during the 15th-16th centuries. Continuous military conflicts among the belligerent regional states drastically reduced population, as observed in Caferro (2008), and recurrent plagues and epidemics prevented demographic trends from restoring. As observed in Del Panta (1980) and in Alfani (2013), also the 16th century was characterized by frequent diseases and epidemics. Finally, also in England similar high rates of mortality persisted in the 15th-16th centuries. As shown in Wrigley and Schofield (1981), the recurrences of plagues and the diffusion of other diseases limited the recovery of population until the beginning of the 17th century.

Summarizing, the historical evidence about the trends of wages and population across

Europe shows some stylized facts. Since the mid-14th centuries all European regions went through a period of demographic stagnation, initiated by the dramatic 1348 plague and persisting at least for one century and a half, because of the combined effect of the frequent plagues and military conflicts. These continuous demographic shocks likely caused a sharp reduction of labor supply that reflected in the increase of real wages observed in these centuries in almost all the European regions. However, since the beginning of the 16th century, when the lower frequency of plagues and wars favored the recovery of population, real incomes diverged.

What remains to be explained is whether and how in certain region real wages differently reacted to long run changes in population. Were wages in northern Europe detached from population trends and, therefore, differentiating, these areas from southern ones? What institutional changes might have accounted for such difference? The next sections attempt to answer to these questions through the combination of a theoretical framework with a quantitative and qualitative analyses of historical information.

3 A hypothesis on urban wages determination in late medieval Europe

Two main facts emerge from the historical evidence shown above. First, a long wave of exogenous negative population shocks affected most of the European regions between the mid 14th century and the end of the 16th century. Second, during this period, real wages across all these areas converged on high levels while, when population restored, a striking divergence in real incomes emerged across Europe. In this section a brief theoretical framework is presented in order to make a hypothesis about the way in which population changes might have been linked to wage trends and whether and how different institutions governing wage bargaining could have accounted for the divide.

The starting point of the analysis are some stylized facts emerging from historical studies on wage determination in late medieval European cities. According to the evidence presented in Goldthwaite (1982) for Florence, Geremek (1969) for Paris and in Epstein (1998) for a more general analysis of Europe, a first important distinction should be made between skilled and unskilled workers. The former, being those having some specific and recognized skill in a certain manufacturing activity, were usually organised in guilds. These associations were contracting their wages, protecting their employment and regulating several other aspects of their labor relationship. Urban skilled workers were usually employed on a monthly basis and with salaries contracted by the guilds. The unskilled workers, those having not a particular skill and usually serving as helpers of the skilled ones, had a different employment condition. They were employed on a daily basis and contracted their salaries directly with the master of the project. Hence, their working condition was characterized by an higher instability and, as a consequence, in periods of unemployment they often returned to their farm of origin in the country side to earn an agricultural income, as shown in Bloch (1965) and van Bath (1966).

Hence, following the Arthur Lewis' seminal study on expansion and growth in a two sector developing economy (see Lewis (1954)), it is possible to assume that late medieval societies were likely to be similar to the modern developing economies where, quoting Lewis,

> "[...] men will not leave the family farm to seek the employment if the wage is worth less than they would be able to consume if they remained at home". (Lewis (1954, p.149))

Wages in the urban sector were determined on the basis of how much a worker could have obtained returning to work his land, but this was likely to be true only for unskilled workers, as the wages of the skilled ones were protected by guilds. In addition, interpreting the urban wage as determined on the basis of the rural income, considered as a reservation position for the urban unskilled worker, would imply that in equilibrium the urban wage would have been greater than the rural one. This consequence is not unrealistic for late medieval Europe, since a rent for the unskilled urban workers could have existed for several historical reasons. For example, the higher wages could have been motivated by the fact that manufacturing employees, already working in the city, could have performed their tasks better than peasants called from the countryside, as shown in Cipolla (1994), or because guilds, even if not formally protecting these categories of workers, could have also indirectly raised the wages of unskilled employees, a mechanism at work, for example, in medieval Florence, as described in Doren (1940).

Therefore, in this interaction between urban and rural sector, it becomes relevant to understand how agricultural income was determined. According to several authors, and in particular to Bloch (1965), rural sectors in late medieval Europe were characterized by low productivity, extensive production and the incomes for peasants were usually equal to the average product from land. The more were those working on a field, the less the portion of income that each farmer could have enjoyed. Therefore, an inverse relationship between population and agricultural income should have existed. A sudden demographic decrease could have risen the rural income as a consequence of the increased average product from land. In turns, since rural incomes were the fallback position for urban unskilled workers, also an increase in urban wages should have occurred, explaining the short run positive effect of the mid-14th century plague on real wages in European cities.

However, the organization of the agricultural production in the late Middle Age was also characterized by the persistence of feudal customs and rents reducing the capacity of peasants to fully dispose of the average product from land. As shown in Bloch (1965) and van Bath (1966), were often subjected to the payment of tithes (the tenth part of their product), *tailles* (sums originally paid to the ecclesiastical power in the early Middle Age and then paid to the landlord in the 12th-14th centuries), other arbitrary rents and customs imposed by the lords as well as they could have had to provide some unpaid work on the landlords' fields, the so-called *corvée*. As shown in Bloch (1965) and van Bath (1966), these feudal

institutions persisted with different degrees in late medieval European areas motivating a possible different effect of the changes in population on rural income and urban wages.

In fact, in those regions where before the 14th-15th centuries population shocks feudal institutions were strong, the post-plague higher incomes of rural workers could have been less persistent, because of the permanence of seigniorial constraints on rural activity. In a situation of relative land abundance, because of the scarcity of labor supply, the existing conditions of labor organization would have mattered in the post plague transformation of the sector. Rural workers would have immediately enjoyed higher incomes but the persistence of strong feudal constraints would have limited their capacity of using these extra incomes to increase productivity. In addition, the existing low bargaining power of peasants could have affected their capacity to maintain the higher incomes over time. Therefore, when population restored, the weakness of peasants would have not impeded the decline in rural income and, in turn, urban wages.

On the contrary, in those societies in which feudal links were already weak before the demographic shock, because, for example, peasants ownership had a consistent dimension with respect to the seigniorial sector or rents were lower, a different outcome to the labor shock supply could have occurred. The combination of relative land abundance, due to the reduced rural labor force following the population shocks, and the low pre-existing feudal constraints on peasants' activity could have either reduced the power of rural employers to cap real salaries once population restored or it could have given sufficient autonomy to farmers to use part of the extra agricultural product to improve productivity and keep their incomes high. In both the two cases, this would have ended up in a situation of persistently higher rural incomes even under restoring population. As a consequence, higher real wages would have persisted also in the urban sector.

Summarizing, this synthetic representation of the urban wage bargaining process in the late medieval European economies shows that if an exceptionality of northern societies existed, this would have been likely caused by the complementarity between weaker feudal institutions existing before the plague and the consequence of the demographic shock on labor income. The population decline would have created a temporary situation of labor scarcity that, joint with weak prior feudal institutions, would have been capable of stably improving the peasants' economic position. This change in rural economies would have then affected urban real wages, that persistently remained high also when population restored. Overall, this particular combination would have resulted in a long run different response of urban wages to population changes. Where feudal institutions were strong, a long run negative relationship between the two would have existed while, where such institutions were weak, urban wages should have been detached from population trends.

4 An empirical analysis on real wages and population trends

The historical analysis of the previous section has revealed that if a real wage diverged existed between European societies, this might have been motivated by different pre-plague institutions, and It might have resulted in a divide across cities in their response of wages to population changes. The objective of this section is to test this last implication in order to understand if in some European societies urban labor income exceptionally detached from demographic trends before the industrial revolution.

4.1 Dataset description

The relationship is estimated in the seven cities already mentioned in Section 2, where also the nature and source of urban wage series has been widely described. Almost all of them come from Allen (2001) except for Florence, whose wages for unskilled workers have been revised for the present work using the sources described in the Figure 1, and Amsterdam, whose series has been taken from van Zanden and van Leuween (2012).[5] Wages have been all deflated and reported at a purchasing parity power with a procedure described in Section 2. The quantities of grams in the currencies of registration and the CPIs for each city used for this deflation procedure have been taken from Allen (2001).

The long run evolution of wages and demographic changes has been studied for each of the seven cities using two series of population: urban and regional one. There are two reasons behind this choice. First, since there is no univocal consensus about the degree of mobility across different urban and rural areas, it is necessary to analyze two different scenarios. When using the urban population, which includes usually those living in the countryside surrounding the city, it is assumed low mobility across urban areas, limiting rural-urban migration to a single city and its nearby communities. Instead, when studying the relationship using regional population, it is assumed that a higher degree of mobility existed and labor force migrated from one city to another inside a certain region. In addition, testing the model with both measures of population might represent a simple check on the robustness of results.

Historical information on population data in European cities are more scarce and fragmentary than the data on real wages. For the construction of urban population in each city, data have been gathered from two main sources: Chandler and Fox (1974) and Bairoch et al. (1988). These information, which have been critically compared, have been then integrated with other data provided by several additional edited sources (the details of the construction of urban and rural population in each city and region are in Appendix A.) Following this procedure, it was possible to obtain urban series with point figures at a maximum of fifty years of distance. Missing data have been linearly interpolated in order to use such series in the regression analysis.

[5]The new series for Florence is available under request.

Regional populations have been constructed identifying the most historically representative area around a certain urban center. Hence, the population of Holland, provided in van Zanden and van Leuween (2012), has been considered as the regional population for Amsterdam. Similarly the Brabant, Tuscany and the Kingdom of Valencia (at the 1238-1707 boundaries) have been used as regional population respectively for Antwerp, Florence and Valencia. For three cities, London, Paris and Strasbourg, a reliable series for regional population is under construction and, for the moment, national populations, allowing for boundaries to vary over time, have been used.

Of course, using population size as a proxy for labor force over a long period, during which the 14th-15th centuries plagues could have changed the demographic structure of population, could represent a problem in establishing a correct relationship between wages and labor supply. However, even if existing sources do not allow to fully establish the evolution of demographic structure of all European areas across the 14th-18th centuries, it is possible to show some evidence that support the use of population size as a good proxy for labor supply over the period observed. A computation from the data provided in Coale and Demeny (1966) shows the following age structure in late medieval Europe: 43% of population were individuals between 0 and 14 years old, 48% where those in working age group (between 15 and 49 years old) while those above 50 years were the 9% of population. Data on early modern demographic structure of European societies are available only for certain regions. In Galloway (1994), for example, it is presented the evolution of age groups in England and Italy since 16th to 19th centuries. There, it is possible to observe that those in the working age group (15 to 49 years old) in the two regions remained around the 50% of population until the industrial revolution. These evidence suggest that the great late medieval population shocks did not radically affect the demographic structure of the early modern European population therefore supporting the use of population size as a proxy for labor supply.

4.2 Cointegration analysis using an ADL model

The first step towards the estimation of the long run relationship between wages and population implies the analysis of unit roots and cointegration relationship of wages and population series.

Two tests have been implemented to check for the existence of unit roots in the series, the Augmented Dickey Fuller Test for unit root and the KPSS test for stationarity[6]. Results reveal that all the population and wage series are non stationary and have a unit root (Results are shown in Appendix B.) The presence of unit roots in all the series rise problems related to spurious results in the estimation of a linear relationships between them. Therefore, for each pair of wages and population whose long run relationship has to be estimated, cointegration tests have been run in order to exclude these problems. Three tests to detect

[6]See also Greene (2003) for more details on the two tests.

cointegration have been implemented: a simple analysis on the residuals coefficients of a linear regression model between wages and population in each city and the Philips Oliaris test. Both the two methods reveal that for all cities the pairs of natural logarithm of real wages and regional and urban population size are cointegrated, as shown in Appendix C. In addition, the results of the Johansen test for cointegration, also shown in the Appendix C, reveals that each pair of variables has a single cointegrating vector[7].

According to Pesaran and Shin (1999), the existence of a single cointegrating vector between two variables guarantees that OLS estimation of autoregressive distributed lag model (ADL) gives consistent estimates of the short run relationship between two variable and super consistent one for the long run relationship, with a valid inference made using standard distribution. In addition, the ADL model gives same results as a corresponding error-correcting model. Therefore, the short run dynamics of the relationship between of population on urban real wages is studied estimating the following ADL model

$$ln(w_{i,t}) = b_0 + b_1 ln(w_{i,t-1}) + \sum_{j=1}^{n} b_{j+1} ln(pop_{i,t-j}) + e_t \tag{1}$$

where the natural logarithm of w_{it}, the urban real wage of unskilled workers in the city i in the year t, is regressed on the natural logarithm of population size (regional or urban), the variable *pop*, in the previous years, with optimal number of lags determined for each population according to the Akaike information criteria (see also Greene (2003) for more details on the method), but not on population in year t, as it is unlikely that demographic changes immediately influenced the level of salaries. Also, one lag for the natural logarithm of real wages, $w_{i,t-1}$, is added to account for time dependence of incomes. Finally, e_t is the error term and $b_0, ..., b_n$ are the coefficients to be estimated.

However, the main conjecture of this paper is that, while in the short run southern and northern areas might have had a similar reaction of real wages to changes in population they, instead, had a different behavior in the long run. For this reason, it is built a coefficient capturing the responsiveness of real salaries to demographic changes in the long term. The procedure used to create it is here shown with the optimal number of lags assumed equal to two, and is then generalized. For a given city the Eq.(1) has the form

$$ln(w_t) = b_0 + b_1 ln(w_{t-1}) + b_2 ln(pop_{t-1}) + b_3 ln(pop_{t-2}) + e_t \tag{2}$$

with b_0, b_1, b_2 and b_3 being the parameters estimated with OLS. Assuming long run stationary distribution in wages and population, which implies that the long run variance of b_0 is 0, then the Eq.(2) becomes

$$ln(w_t)[1 - b_1] = ln(pop_{t-1})[b_2 + b_3] \tag{3}$$

[7]See also Greene (2003) for more details on tests used to detect cointegration.

Rearranging (3), the coefficient η, when the optimal number of lags for population is two, is

$$\eta = \frac{ln(w_t)}{ln(pop_{t-1})} = \frac{b_2 + b_3}{1 - b_1} \tag{4}$$

and, when the optimal number of population lags is n, it becomes

$$\eta = \frac{\sum_{i=1}^{n} b_{i+1}}{1 - b_1} \tag{5}$$

The coefficient η, which can be interpreted as an elasticity, since variables are all in logarithms, shows the percent change in urban wages of a certain city as a response to a unit percent change in population.

Table 2 and Figure 3 show the long run coefficients obtained from the regressions.

Table 2: Long run effect of population size on urban real wages

City	Long run effect of urban population	Long run effect of regional population
Amsterdam	-0.02(0.01)	-0.03(0.05)
Antwerp	-0.10(0.03)**	-0.26(0.11)*
Florence	-1.38(0.17)**	-1.01(0.08)**
London	0.05(0.04)	-0.09(0.15)
Paris	-0.28(0.04)**	-0.57(0.09)**
Strasbourg	-0.88(0.22)**	-1.48(0.15)**
Valencia	-0.80(0.09)**	-0.79(0.25)**

Standard errors of the coefficients are in parenthesis and are computed using the delta method (See also Greene (2003, p.175)). **Significant at 99%confidence interval. * Significant at 95% confidence interval.

Results for the coefficients computed using urban population reveal that a divide across European regions existed in the response of real wages to demographic changes. A group of countries show a striking long run negative elasticity with some cities having a large coefficient, e.g. Florence, Valencia and Strasbourg, while others, as Paris, showing a smaller value. The mean coefficient for them is large, -0.83, and the null hypothesis of it being equal to zero is rejected at $p < 0.05$ (computed with the t-test.) Its sign clearly shows that southern regions experienced a long run negative response of real wages to population changes. Three cities, instead, show a non negative (or very small negative) elasticities: Amsterdam, Antwerp and London. Their average coefficient is equal to -0.02 and is not significantly different from zero (the null of equality to zero cannot be rejected, $p = 0.468$ computed with the t-test). In addition, the coefficient of London and Amsterdam appear to be not significantly different from zero. This confirms that the long run effect of population on wages in northern regions was exceptionally null or very small. Finally, it can be observed that the average coefficients of the two groups are statistically different at 95% interval of confidence, confirming that the divide among them existed. [8]

[8]In this case and for regional population the statistical significance of the difference of the means between

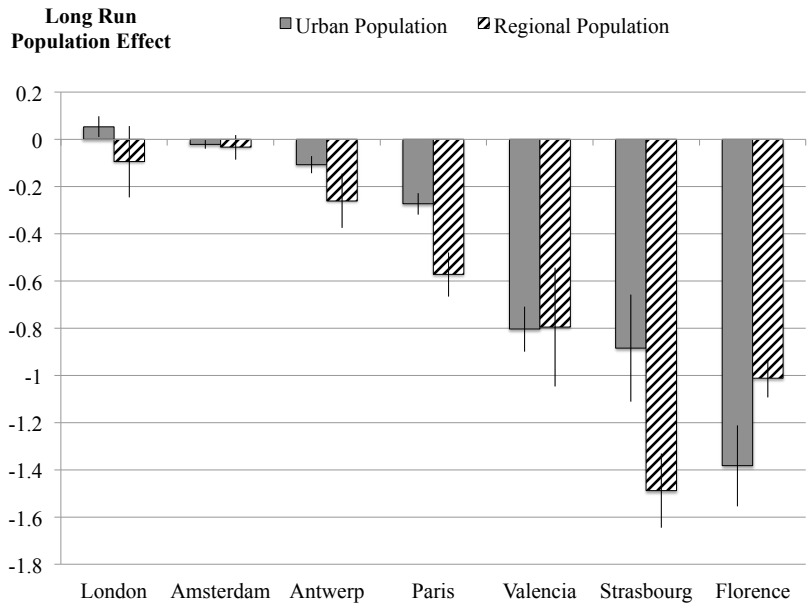


Figure 2: **City and regional population effect on real wages.** Grey and dashed bars are the long run coefficients computed using the results of the regressions with respectively city and regional population. Standard errors are computed using the delta method. Sources: see text and Table 2.

Results are slightly different when looking at the coefficients computed using regional populations. Southern cities show a larger average coefficient, -0.96, which is still significantly different from zero (null hypothesis of equality to zero rejected at $p < 0.05$ computed with the t-test.) The average elasticity for northern countries is still lower than southern regions but larger, -0.12, than when it was computed using the results from urban population and it is not statistically different from zero ($p = 0.156$ computed with the t-test). Also in this case, the coefficients for Amsterdam and London are not statistically different from zero, confirming that in the long run also regional population had a null or very small effect on real wages of northern economies. Finally, the average coefficients for regional population effect in the two groups are still statistically different at a 95% interval of confidence.

4.3 A robustness check: estimating a DOLS model

An alternative method for the estimation of the long run relationship between two non stationary variables both with one unit root and a single cointegrating vector among them, is called dynamic OLS (DOLS) and is provided in Stock and Watson (1993). The method consists in estimating the linear relationship between the two variable at time t using OLS and adding a certain equal number of leads and lags of the first difference of the regressor and a constant term. In the present case the model estimated has the following form

the two groups has been tested using the Welch's t-test, see also Welch (1947).

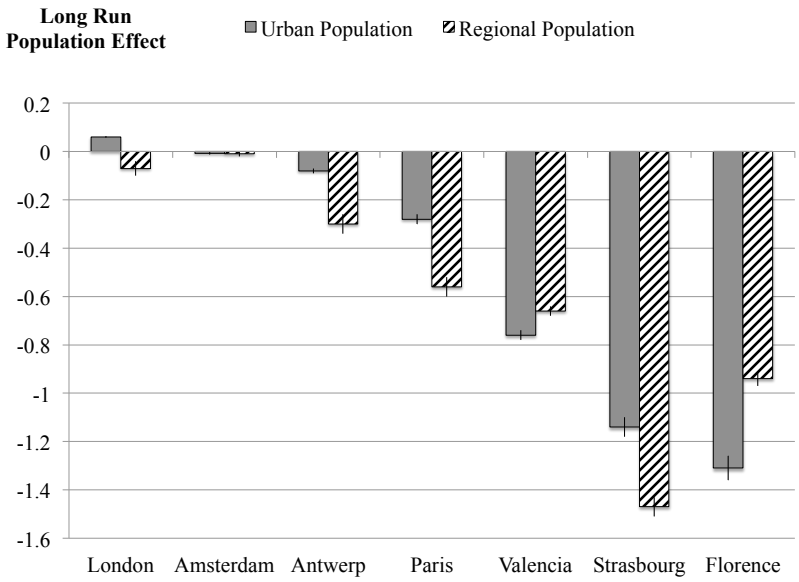


Figure 3: **City and regional population effect on real wages.** Grey and dashed bars are the long run coefficients computed using the results of the regressions with respectively city and regional population. Standard errors are computed using the delta method. Sources: see text and Table 2.

$$ln(w_{i,t}) = b_0 + b_1 ln(pop_{i,t}) + \sum_{j=-3}^{j=+3} b_j \Delta ln(pop_{i,t+j}) + e_t \tag{6}$$

where $ln(w_{i,t})$ and $ln(pop_{i,t})$ are the natural logarithms of, respectively, real urban wages and population (regional or urban) at time t, and $\Delta ln(pop_{i,t+j})$ are the leads and lags of the first difference of population. The number of leads and lags is arbitrarily chosen equal to 3 (choosing a different number do not affect the final result) and the coefficient b_1 is the long run relationship between wages and population.

Results of the DOLS estimation are in Table 3 and Figure **??**

Table 3: Long run effect of population size on urban real wages from Dynamic OLS.

City	Long run effect of urban population	Long run effect of regional population
Amsterdam	-0.007(0.006)**	-0.01(0.01)
Antwerp	-0.08(0.01)**	-0.30(0.04)**
Florence	-1.31(0.05)**	-0.94(0.03)**
London	0.06(0.009)**	-0.07(0.03)*
Paris	-0.28(0.02)**	-0.56(0.04)**
Strasbourg	-1.14(0.04)**	-1.47(0.04)**
Valencia	-0.76(0.02)**	-0.66(0.02)**

Standard errors of the coefficients are in parenthesis. **Significant at 99%confidence interval. * Significant at 95% confidence interval.

Results of the effect of urban population on real wages show that the average coefficient for southern cities is -0.87 and it is statistically different from zero at 95% interval. The average coefficient for northern cities is -0.009 and not statistically different from zero (the null hypothesis of the mean coefficient being equal to zero cannot be rejected with a $p = 0.844$.) The average coefficients of the two group are statistically different at 95% level of significance (using the Welch t-test.)

Also the coefficients obtained from estimating the relationship between regional population and real wages, are similar to the ones given by the ADL model. The average coefficient for southern regions is 0.90 and is statistically different from zero at 95% level of significance. The average coefficient for northern regions is 0.07 and is not significantly different from zero (the p-value is 0.588.) The average values of the two groups are statistically different at 95% significance level.

Overall, it is possible to conclude that estimating the long run relationship between wages and population using two different techniques to deal with cointegrating variables, gives similar results. Northern cities show a close to zero long run effect of population to real wages while southern regions present a large and heterogenous degree of negative relationship between the two variables.

4.4 Estimating the impact of a permanent of shock of population on real wages

An additional test on the wage response to population changes has been done using the impulse response function. This econometric tool allows for understanding how a permanent exogenous shock in one variable might affect the behavior of another one. This situation, of course, does not exactly describe what happened in the late medieval and early modern Europe, where shocks in population, although they were prolonged, were not permanent. However, it might confirm the previous results, providing, therefore, a robustness check. If on the whole period under observation a northern city would show a flat response to a permanent shock in population, then this would suggest that their economies were in the long run capable of detaching real incomes from demographic trends, a result confirming the one found with the long run elasticities. On the contrary, a steep increase in real wages as a response to a permanent shock in population is expected for southern countries, and this would confirm the long run negative coefficient found above.

The impulsive response function are computed estimating the effect of a negative shock (the positive shock effect would be just the mirrored version) on both regional and urban population and results are shown in Figures 4 and 5. They confirm that the three northern countries with a long run exceptional response of wages to population changes might have also distinctively reacted to a permanent shock in population. In fact, Amsterdam, Anwterp and London have an almost flat response of wages to a permanent increase in both city and regional population. The other areas, instead, show a different path with all of them experiencing sharp increases in wage after persistent reduction in population (city and

regional.)

5 Rural labor market institutions in late medieval Europe

The empirical results of the previous section have shown that three cities in Europe, Amsterdam, Antwerp and London, experienced a different response of wages to demographic changes across the period spanning the 14th-18th centuries. These findings raise some historical questions. Which were the characteristics of rural-urban labor market institutions in these regions that accounted for the different long run impact of demographic changes? Were the institutions existing prior the plague different such as they justify a long run divergent path in urban real wages?

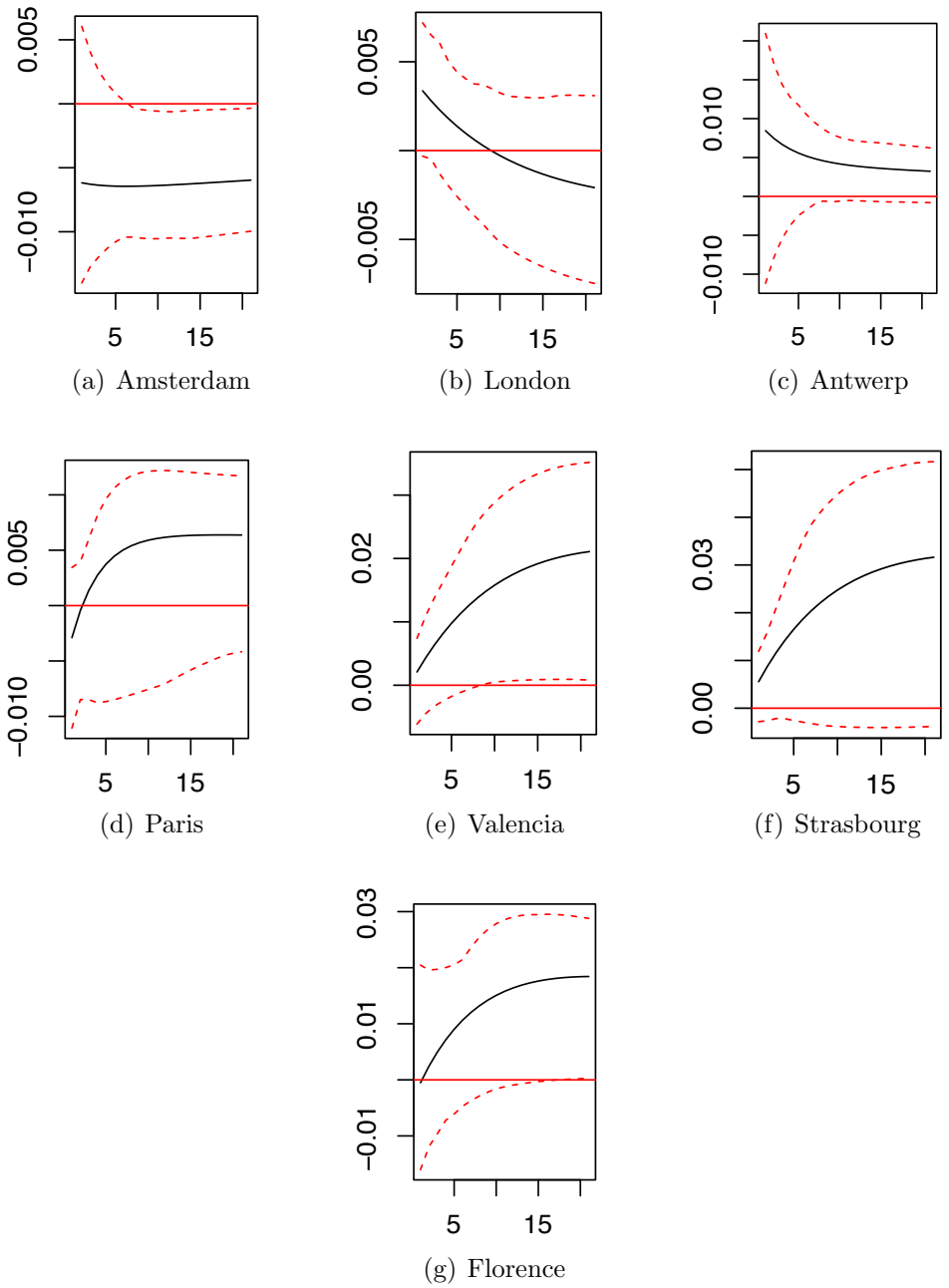
This section answers to these questions comparing the main characteristics of rural labor conditions in several regions of late medieval central Europe with the ones in England and the Low Countries.

5.1 Central and southern Europe

During the period spanning the 11th-13th centuries almost all European areas experienced a generalized improvement in economic conditions. In particular, urbanization and trade rose, and the majority of continental cities developed sophisticated forms of political, judicial, fiscal and economic organization (see also Lopez (1976) for the late medieval commercial and urban revolution in Europe.) These cities, as for example the northern Italian ones, became prominent economic centers for the exchange of goods and the circulation of people and ideas.

However, rural areas, usually restrained by both the political control of major urban centers and by the feudal power of historical lords, were in relatively less developed conditions and rarely caught up with the improvements occurring in nearby urban centers. In Italy, for example, as described in Cortonesi (2006), land ownership was organized around the system of large manors, usually owned by aristocratic families and labor was subjected to feudal customs. Workers were granted the right to farm from the lords under sharecropping agreements. They could inherit the use of land but usually were not free to transfer to other manors. Where farmers with small property holdings existed next to the large manors, they were continuously subjected to land expropriation implemented under the direct control of urban centers and favoring large ownership structure, as observed in Cherubini (1984). Therefore, even if urban centers were experiencing rapid economic growth, rural areas were still characterized by strong feudal burdens, farmers were living under conditions of mere subsistence and, as a consequence, trade of agricultural products were undeveloped.

A similar process of reinforcement of feudal relationships took place in other areas of continental Europe. According to the vast analysis of medieval rural France presented in Bloch (1976), during the process of land reclamation occurred in the country between the 11th and 14th centuries, fundamental changes harshened the relationships between lords and

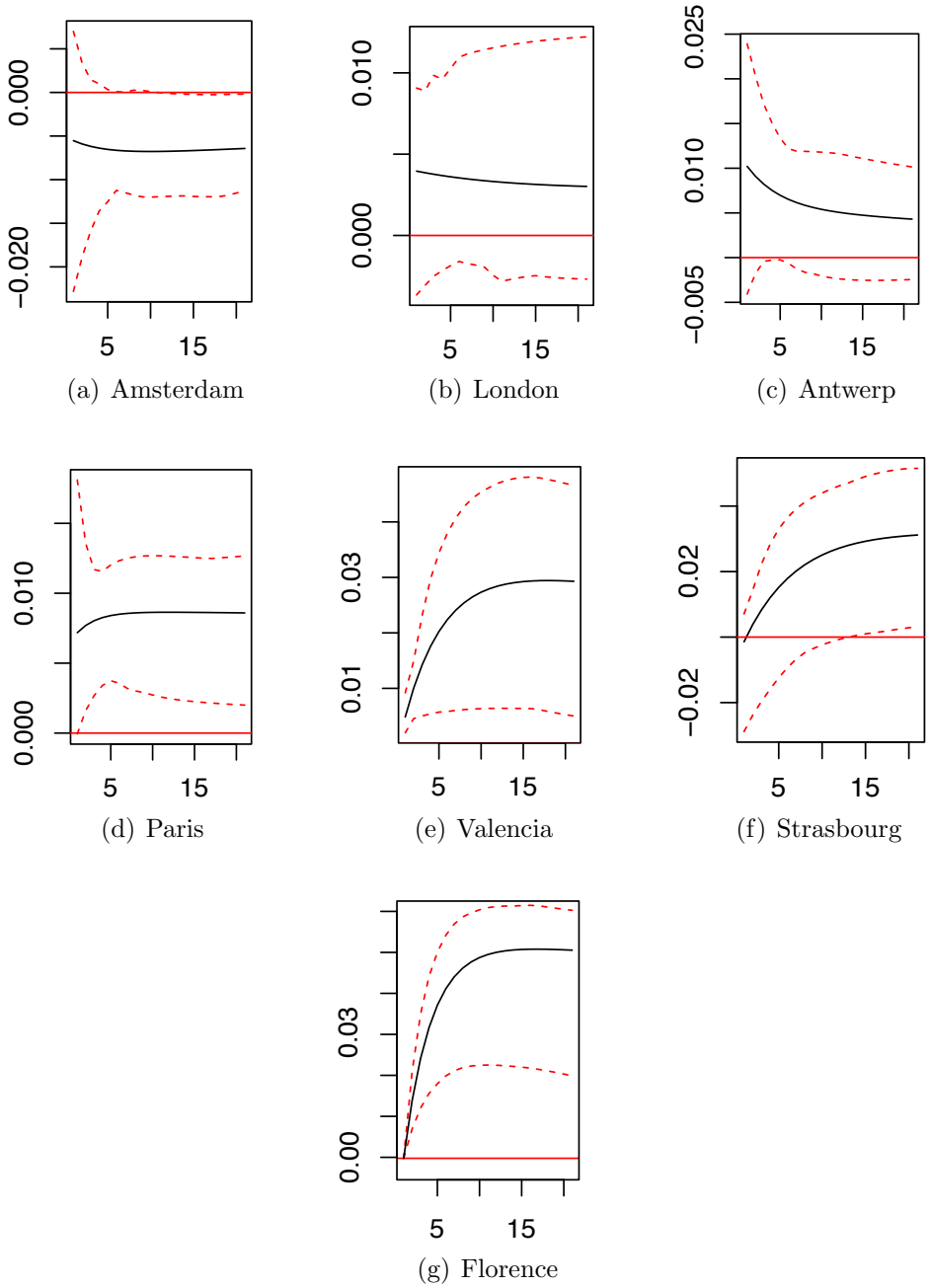


(a) Amsterdam (b) London (c) Antwerp

(d) Paris (e) Valencia (f) Strasbourg

(g) Florence

Figure 4: **Impulse response function of real wages to city population.** Functions are computed for 20 periods ahead the impulse. Dashed lines are the confidence intervals computed using bootstrap methodology. Source: see text and Appendix A.



(a) Amsterdam (b) London (c) Antwerp

(d) Paris (e) Valencia (f) Strasbourg

(g) Florence

Figure 5: **Impulse response function of real wages to regional population.** Functions are computed for 20 periods ahead the impulse. Dashed lines are the confidence intervals computed using bootstrap methodology. Source: see text and Appendix A.

tenants. The seigniorial sector, which mainly relied on the system of unpaid work provided by tenants (the so-called *corvée*) already since the 8th-9th centuries, saw a reinforcement of the power of lords who monopolized administration of justice in their legal disputes with tenants, and introduced new forms of monetary charges (the tithe and the *taille*). Both free men and serfs were attached to the lord rather than to land. They could not move without the lord's permission and several cases of agreements between lords were set up to reinforce such constraints.

The advent of the Black Death in 1348 dramatically impacted on the land ownership structure and labor organization of these areas. In the decades immediately following the demographic decline, real wages increased, as observed in van Bath (1966) and, as shown in the previous sections, also urban salaries. However, in the following centuries, deep changes occurred in rural areas of central and southern Europe, causing an almost general tendency towards economic stagnation.

In Italy, as observed in Piccinni (2006a), although the rise of wages in the countryside was striking, there were also immediate attempts from the city-states to limit salaries of rural workers. Rules were set to impede them to demand higher incomes, their mobility was even more limited and the adoption of sharecropping was favored where wage labor was still in use. These changes, which reveal the strong capacity of landlords to react to the increased bargaining power of rural workers, also affected the subsequent evolution of agricultural organization. The relative size of cultivated land was reduced in favor of cattle as it gave rise to a more immediate profit to the land owners, while those workers who had accepted sharecropping could have benefitted from temporary special fiscal reductions granted by the urban political power. In this way also the city-states would have had an immediate return, consisting in their maintained capacity to collect fiscal resources from rural areas, as widely described in Piccinni (2006b). In the long-run there were three main effects of the combination of pre-plague conditions and demographic shocks: a general impoverishment of rural society, the persistence and extension of the system of large manors with sharecropping and the limited mobility between rural and urban labor markets. Together they limited the possibility to create a self-sustained internal market for non agricultural goods.

In France, a different evolution of the rural sector in the post-plague decades led to a similar stagnation in the following period. As shown in Bloch (1976), in the 14th-15th centuries the conjoint effect of the demographic decline, the Hundred Years' War and the continuous depreciation of the currency made by the monarchy in order to obtain resources to finance warfare, caused a slow but deep crisis in the seigniorial structure. Lords became land rentier, they were less able to require the *corvée* and preferred to impose additional monetary charges to peasants rather than directly command their work. Legal conditions of tenants (both free men and serfs) changed: they were progressively less attached to the lord and more to the land, even if their mobility was limited and the manor could not be left without the lords' permission. This process of decline of the power of the old seigniorial sector was also characterized by the participation of the monarchy in the rising

contrasts between lords and tenants. The central State favored small ownership of land and contributed to the reduction of feudal power of lords. For example, the monarchy effectively substituted the landowners in the administration of justice but this did not translate into an actual improvement of the rural sector. As observed in Brenner (1976), the State simply substituted lords in the extraction of the surplus causing a long term depression of rural production, a tendency towards subsistence agriculture and, consequently, the inability for the urban sector to effectively develop.

The region of the Alsace, surrounding Strasbourg, knew a similar process of strengthening of rural feudal ties in the late Middle Ages. Being a march, although experiencing important improvements in land administration and use of common fields, the region was also subjected to several processes of reinforcement of landlords' power. They maintained strong property of lands and, when giving the grant of use them to farmers, were receiving in change services, rents and, in some cases, the capacity to limit their freedom. As described in Hauner (1865) and Juillard (1992), the post-plague development of the region did not show impressive improvements in the conditions of these rural areas.

The evolution of the rural labor markets and feudal organization was not different in Spain and, in particular in the region of Valencia. As shown in Garcia-Oliver (1991) and Furió (1995), during the 12th-14th centuries a process of strong transformation of land ownership occurred in the region. The seigniorial sector, which controlled 73% of cultivated land at the beginning of the 13th century, acquired even more power in the following two hundred years, owning almost 4/5 of the cultivated land of the region at the end of the 15th century. However, as observed in Furió (1997), the lords had a contrasting relationship with the Crown in this period. From one side, in the 12th century, the King attempted several times to limit their power. Measures were taken by the kingdom administration to keep landholdings small, lords had property on land but not on peasants and their jurisdictional power was limited. As a response, aristocracy continuously protested against the Crown and, also because of their importance for the provision of military support, the King granted to them, through the 1329 set of rules called *Jurisdicció Alfonsina*, a large set of jurisdictional powers in both civil and penal disputes.

During the 14th century, the region of Valencia and its seigniorial sector went through a series of reforms similar to the ones occurred in early modern France. The Crown tried again to weaken the old aristocracy through heavy tax impositions and to limit their power in legal disputes. The overall objective of the King was to create a new aristocratic class sufficiently rich to support his military expenditures, but not enough powerful to compete with him. The objective was pursued limiting the large land concentration of the old aristocracy and counterbalancing the ancient lineages with the creation of new ones, usually representing urban families that had become wealthy after investments in land. However, these new lineages were still granted with feudal customs and rights that would have repaid their loyalty to the King. Overall, in the 12th-15th centuries, although several changes had involved the seigniorial sector, and the majority of these were made to weaken its power,

the Crown progressively substituted the old aristocracy with a new one, smaller and more loyal to the King but not less capable of exerting feudal customs and, thus, preventing the economic development in the rural sector from occurring.

Therefore, after the demographic decline in mid-14th century, even if with significant differences, several of the main regions of central and southern Europe experienced a long run tendency towards stagnation. History shows that this process was likely to be linked to the strong pre-shock feudal conditions and it limited the subsequent improvement of rural areas.

5.2 England and Holland

A different economic trajectory with respect to central and southern European regions is the one experienced by London and Amsterdam and their respective regions.

With less developed urban centers (see also Carus-Wilson and Coleman (1963)), in 12th-13th centuries the rural areas of England went through a unique process of transformation of the legal and economic status of rural inhabitants. As shown in Postan (1973), these areas experienced a continuous tendency towards the increase in the number of free-holder individuals. They became progressively more immune to arbitrary impositions of landlords and, once the land became scarcer and landlords forced to renegotiate their contracts with peasants, the latter were not burdened by worse contractual conditions. Hence the increasing strength of the economic position of peasants during these centuries characterized a slow but continuous loosening of feudal constraints. According to Campbell (2000), these progressive changes lead to a rural system that, at the eve of the demographic shock, was characterized by a minor significance of the seigniorial sector with respect to the peasants' one. In addition, lords did not make use of feudal privileges preferring, rather, having recourse to hired work. However, following Brenner (1976) and Allen (1992), low investments were made in the rural sector. Landlords used their capital to maintain their status rather than investing in productivity gains, and peasants, who were overtaxed, also made low investments to raise productivity. Less economically developed than the central European regions, at least with respect to trade, manufacturing and banking activities, and with low gains in productivity due to irrelevant technological changes, at the same time England experienced a progressive waning in its feudal relationships in the countryside and, hence, the arise of a land ownership structure based on small-tenants properties.

Following the work of Campbell (2000) and Overton (1996), it is possible to summarize the main effects of the Black Death on the rural economic system of England. The decrease in prices and the increase in rural wages favored small-size tenants and provoked a crisis in the large demesnes. Lords either preferred to lease, thus fostering the development of small agricultural tenants, or, if they wished to directly produce, they continued to prefer hired to customary labor. In addition, the central state failed to control and limit salaries,

as witnessed by the 1381 Peasants' revolt.[9] In the following centuries, even if England had unimpressive productive gains in agriculture (as shown in Clark (2009)), the structure of its rural economy and its relationship with the urban sector were drastically changed. Together with a deeper commitment to trade, the country also had, in the 15th century, an exceptional rise in manufacturing activities which fostered the creation of an internally sustained market for manufacturing goods and, hence, anticipated the industrial revolution.

An even more exceptional pre-industrial economic change than the one observed for London and England, is the one that, according to several historians, Amsterdam and the Holland region experienced. As shown in van Bavel and van Zanden (2004) and van Bavel (2002, 2006), before the Black Death the Holland rural area was characterized by three main factors. First, feudal relationships were weaker than in other contemporary European regions. Second, the manorial system was almost non existent with a great number of free peasants who owned the land that they were farming (according to van Bavel and van Zanden (2004) those owning land made up two thirds of Holland farmers). Finally, agricultural production was already making use of capital intensive technologies, a change which had been probably driven by its particular geographical constraints.

How did these characteristics of the rural sector affect the impact of the 1348 plague on the region? As all the other European areas, also Holland dramatically suffered from the plague experiencing a decrease in urban and rural population. However the impact on the economic structure was rather different. In the decades immediately following the plague, real wages rapidly grew in Amsterdam and its surrounding countryside. This phenomenon was accompanied by an immediate increase in non-agricultural activities in the rural areas, e.g. textile and brewing activities, a factor that in the following centuries would have favored the emergence of a self-sustained internal market for manufacturing goods, as suggested in van Bavel and van Zanden (2004). In fact, during the 15th-17th centuries, the structure of Holland's economy radically changed taking on characteristics strikingly different from the rest of Europe. Urban capital owners, whose revenues from manufacturing activities were rapidly rising, largely invested in the rural areas, progressively bringing land ownership towards a structure characterized by a concentration of property and land accumulation (see also van Bavel (2006).) These changes in the property structure led to the extension of wage labor as opposed to the customary one in the countryside, pushing the whole region towards an early modernization in both rural and urban markets.

Overall, as also suggested in Vries and van der Woude (1997), historical facts confirm that the outstanding performance of Amsterdam and Holland was primarily driven by the late medieval weaker feudal relationships which had facilitated rapid changes in the structure of rural and urban economic sectors after the mid-14th century demographic shock.

The late medieval development of the city of Antwerp and the Brabant region was not different from the Holland one. Several cases of weakening of feudal constraints are witnessed

[9]More information on the England 1381 Peasants' revolt and its positive effects on farmers' economic conditions can be found in Dobson (1970) and Hilton and Aston (1984).

in the centuries before the Black Death. When in 13th-14th centuries, for example, the Dukes of Brabant progressively occupied the northern lands of the region, they removed a large part of the preexisting feudal constraints, as described in Steurs (1982). In fact, they granted large privileges and autonomies to the new founded cities and rural communities and, at the same time, they weakened the feudal power of the lords. In the process of imposing their sovereignty in the territory, they bought, collected and expropriated the ownerships of those seigniors that did not accept their authority, and offered their protection to the ecclesial demesnes in change of their loyalty. At the same time they favored the birth and economic development of new free cities, which were free to administer the rural areas around them. This example concerning the northern areas of the region, shows that also the Brabant region had distinctive weak feudal institutions, already in the centuries before the Black Death. As a consequence, even if having a less impressive growth than Holland, also the region of Antwerp had an exceptional development of rural areas after the 14th century, as shown in Thoen (2006).

The historical information about the particular pre-plague institutions governing rural labor markets in late medieval England and Netherlands, have shown that rural labor institutions in northern areas were strikingly different from the southern ones already before the mid-14th century demographic shocks and likely affected the exceptional long run economic development of these areas. However, history has also shown, that in the two regions the combination of such institutions with the following shocks in population ended up in two different ways of sustaining the economic position of peasants in the 14th-16th centuries. While, in fact, in Holland, the almost absent feudal customs in the pre-plague times favored, after the shock, the striking development of rural non agricultural activities which, in turn, prevented average product in the rural sector from declining, England had a different trajectory. In the post-plague decades peasants in the region did not experience relevant gains in productivity. However, they eventually succeeded in defending their agricultural incomes from landlords' pressure, as the rebellion occurred at the end of the 14th- century shows. What was the origin of such peasants' bargaining power? Again, the answer confirms the main idea of the present work. The combination of weak pre-plague feudal links and the demographic decline occurred in the mid-14th century, likely gave to the few free farmers the strength to defend their position and get higher incomes even before they could get relevant improvements in productivity.

6 Conclusion

This paper has presented a new hypothesis to explain the puzzling question of the early modern north-south Europe divergence in real wages. In particular, it has been argued that what mattered for the different long run impact of the mid-14th demographic changes on European income distribution, were the different combinations between the pre-existing rural labor market institutions and the demographic shock itself.

A simple theoretical framework has combined insights of the classical theory of a two-sector economy by Arthur Lewis, with the model for wage determination under no shirking condition developed by Shapiro and Stiglitz, with the objective to single out four key features of the problem. First, it has been shown that the rural income in a late medieval economy might have served as the reservation position for unskilled workers. Second, it has been formally represented how exogenous changes in population might have caused variations in the agricultural income of workers and, as a consequence, the correspondent modifications in the urban real wages. Third, it has been pointed out that if northern countries did show any exceptional trend in urban wages, this would have resulted in a long run capacity to detach salaries from demographic trends. Finally, it has been argued that, once this exceptionality would have been proved, the reason of it should have been searched in the rural institutions existing prior the population shocks and that caused different degrees of bargaining strength in the rural areas. An econometric estimation conducted on a long run series of real urban wages and population in seven European major centers in the late Middle Ages and early modern times, has confirmed that the three cities, Amsterdam, Antwerp and London, which had persistent high real salaries across centuries, were also those which had a distinctive response of wages to population changes. While, in fact, for the other centers, a long run negative reaction of salaries to demographic trend has been detected, the three northern areas had a non negative relationship and, hence, they detached wages from population already before the industrial revolution. Finally, the historical comparison of rural labor institutions in the late medieval Europe has supported one of the main point of the conjecture. Different European areas did not approach equally to the mid-14th century demographic shock and, instead, already had in the previous century, varying degrees of feudal strength in the agricultural sector. The history of these areas has shown that this factor crucially mattered when, after the population shock, farmers asked for higher incomes. In the areas where previous feudal links were stronger, the bargaining power of peasants ended up when population recovered. Instead, the declining feudal power of employers in the other areas, prevented peasants' incomes from declining and fostered a sustained development of rural and urban wages.

These results have two main implications. First, they reveal a new insight for the understanding of the long run divide across European regions. In fact, the work has shown for the first time that the exceptionality of northern regions consisted in their different response of wages to population already before the Industrial Revolution. Second, it provides a different interpretation about the success of northern countries. While the Netherlands succeeded in fostering a non agricultural rural market, England kept higher wages through the increased bargaining power of peasants.

The work also introduces several questions that might be the object of future studies. For example, it could be important to understand why in early and late Middle Ages different areas of the continent adopted different feudal relationships. Digging historical sources that might be informative on the issue, could further improve the knowledge of the fundamental

causes of economic and social divides which, to some extent, still persist nowadays. Also, the particular agricultural productive choices that each region developed after the mid-14th century population shock might help to understand more the divide. In the historical section it has been mentioned that, while southern European areas, as for example Tuscany, largely implemented cattle and other pastoral activities, northern Europe moved towards capital intensive rural production. Understanding the reasons of these different productive choices and their combination with diverse labor relationships (e.g the southern sharecropping vs. the northern wage labor) might help to understand their role on the different development of the agricultural and urban sectors in the European regions. Finally, the comparative analysis of the processes studied here could be extended to the late medieval development of Eastern Europe. Several scholars, such as Domar (1970) and Brenner (1976), have studied the changes that occurred after the 14th centuries demographic shocks in eastern regions underlining, in particular, their return to serfdom. The analysis made in this paper could improve the knowledge of the economic development of such regions showing the fundamental causes of their long run difference with respect to western ones.

Appendices

A Population data

This section reports the main sources used for the construction of population time series for each city, in urban and regional areas. Linear interpolation has been used to fill gaps in the series.

Antwerp

Urban population. Sources and information about urban population for the city of Antwerp are available from Bairoch et al. (1988) for the period ranging the 1200-1800 years and data are given for every hundred years. These information have been integrated with figures coming from Russel (1958) about the 1437 population and from Klep (1976) about population in 1374, 1474, 1480, 1526, 1565, 1709, 1755, 1806. In particular, in Klep (1976), the following information are given: extension of the Antwerp area (urban and rural) in square kilometers across centuries, population density per square kilometer and urbanization rate. The figures used in the present analysis have been obtained multiplying the extension of the urban area times population density and extracting from this the percentage of those living in the city (the urbanization rate). Resulting number are similar to the ones shown in Bairoch et al. (1988) for the periods covered by both the datasets. Sources: Russel (1958), Klep (1976), Bairoch et al. (1988).

Regional population. Regional dimension for the city of Antwerp has been identified as the one living in the area of the Brabant. Population has been obtained from Klep (1976) multiplying the extension of the region in square kilometres times the population density (urban and rural) per square kilometer. Data points range from 1374 to 1806 and a linear interpolation has been implemented to obtain a continued series. Sources: Klep (1976).

Amsterdam

Urban population. The data from Bairoch et al. (1988) for the city of Amsterdam starts in the year 1200 and, with a 100 years time interval, cover the whole period until the year 1800. These data have been integrated with the data point information in 1470 given in Russel (1958), three data for the 16th-17th centuries obtained from Kuypers (2005), the years 1585, 1625 and 1632, and the 1622 population figure given in Vries and van der Woude (1997). The available data on Amsterdam population do not allow to account for the high mortality experienced by the areas in the Low Countries in the second half of the 14th century and the whole 15th century. As reported in Blockmans (1980), the region experienced plagues, with different degrees of strength, in the following years: 1360, 1368, 1382, 1400, 1409, 1420, 1438, 1450, 1456, 1466, 1481, 1487, 1492. Linear interpolation of Amsterdam has taken into account of the increased mortality in these years. Sources: Russel (1958), Bairoch et al. (1988), Vries and van der Woude (1997), Kuypers (2005).

Regional population. The interpolated series for Holland population is taken from the estimation of Holland national accounts produced by Jan Luiten Van Zanden and Bas van

Leuween available online at http://www.cgeh.nl/ and used for van Zanden and van Leuween (2012). In the online statistical appendix of the paper, the authors carefully explain what information and procedure they used to build up the series. The series spans since the 1344 to the end of the 18th century and is mainly based on the work of Vries (1984) and Vries and van der Woude (1997). Authors also inform that the continuous series is obtained taking into account of the following demographic changes not captured by the series: the population decline in the 1572-1576 period, the increase in demographic growth after the 1580 and the reduction in population due to the epidemics occurred in the 1630-70 years. Sources: Online statistical appendix of van Zanden and van Leuween (2012).

Florence

Urban population. In Bairoch et al. (1988) population figures for Florence is given for the following data points: 1300, 1400, 1500, 1600, 1700, 1750, 1800. These data are integrated with figures provided by Chandler and Fox (1974) for the year 1350, Russel (1958) for the years 1424, 1458, 1470, 1474, 1551, and Armengaud et al. (1968) for the year 1622. Linear interpolation has been used to build a continuous series. Sources: Russel (1958), Armengaud et al. (1968), Chandler and Fox (1974), Bairoch et al. (1988), Bardet and Dupaquier (1997).

Regional population. A convincing reconstruction of population series for Tuscany is given in Malanima and Breschi (2002). Data range the 1300-1900 period and are presented with a 10 years interval. The authors inform that the construction of the dataset has combined two procedures. For the period between 1300 and 1575, population has been reconstructed on the basis of the historical information about urbanization rates, number of cities in the region and population data of the main Tuscan urban centers. Since 1575, when birth and death rates become available, the authors have followed the method of inverse projection. Sources: Malanima and Breschi (2002).

London

Urban population: The population figures for the years 1200, 1300, 1400, 1500, 1600, 1700, 1750, 1800 are taken from Bairoch et al. (1988). These data have been integrated with the figure for the year 1377 provided in Chandler and Fox (1974), 1520 and 1670 given in Wrigley (1985) and 1554 given in Russel (1958). Sources: Russel (1958), Chandler and Fox (1974), Wrigley (1985), Bairoch et al. (1988).

Regional population. Consistent and available measures for the population of London since the 14th century are not available yet and, therefore, the reconstruction for England population (excluding Wales) has been used. Information of the 14th-15th centuries population are provided in Armengaud et al. (1968), where data are given with a 50 years interval. Since the 16th century, a reconstruction of the England population using the method of the inverse projection is given in Wrigley and Schofield (1981). Sources: Armengaud et al. (1968), Wrigley and Schofield (1981).

Paris

Urban population. The information on Paris population provided in Bairoch et al. (1988) cover the 1200-1800 period with a 100 years interval. These data have been integrated for

the 14th-15th centuries with figures from Chandler and Fox (1974) for the years 1328, 1350, 1438, 1450, 1553. The 16th-18th centuries population data have been integrated with the data points provided in Biraben and Blanchet (1998) and concerning the years 1565, 1590, 1636, 1684, 1755, 1792 and 1800. Sources: Chandler and Fox (1974), Bairoch et al. (1988), Biraben and Blanchet (1998).

Regional population. A reliable series for the population in Île-de-France is under construction. For this reason, at the present time, national France population has been used. For the 14th-15the century, data from Armengaud et al. (1968) for France at 1328 boundaries have been used, while for the following centuries data have been taken from Armengaud et al. (1968) and Malanima (2008), considering France at the 1794 boundaries. Sources: Armengaud et al. (1968), Malanima (2008).

Strasbourg

Urban population. The data for city population in the 14th-15th centuries have been taken from Bairoch et al. (1988). Population trends in the following period, since the 1477 to the 1800, have been reconstructed using the data from Chandler and Fox (1974). Sources: Chandler and Fox (1974), Bairoch et al. (1988).

Regional population. As for the Île-de-France, a reliable and continuous measure for population in Alsace is currently under construction. As a larger measure of population for Strasbourg, it has been considered the France population series used for Paris. Sources: Armengaud et al. (1968), Malanima (2008).

Valencia

Urban population. The primary source for reconstructing the trend in population of Valencia is Pérez Puchal (1972), where figures of population from tax censuses are provided for the 15th-18th centuries. The author usually presents data estimated from individuals registered in the tax reports using two multipliers: 4 and 4.5. Data have been taken into the present dataset using as a multiplier the midpoint 4.25. Population figures for the 14th century have been taken from Chandler and Fox (1974), for the years 1300, 1350, 1355, and from Russel (1962) for the year 1418. Sources: Russel (1962), Pérez Puchal (1972), Chandler and Fox (1974).

Regional population. The regional dimension for the city of Valencia has been identified with the territory of the Kingdom of Valencia (1238-1707). Data points for the 15th-18th century period are taken from Pérez Puchal (1972). Compared with the reconstruction of population for the *País Valenciano* made in Ardit (1991) using the inverse projection, the data point given in Pérez Puchal (1972) seem reliable. From Cruselles Gómez (2003), it has been taken the initial datapoint, year 1300, of the series. Linear interpolation has been done considering the following years of plagues: 1428, 1439, 1450, 1459, 1466, 1469, 1509, 1648. In addition, interpolation has also taken into account the immigration of *moriscos* in the Kingdom of Valencia occurred in 1571 and their expulsion occurred in 1609. Sources: Cruselles Gómez (2003), Pérez Puchal (1972), Ardit (1991).

B Unit root tests

In order to detect whether the time series used in the text are stationary or not, two tests for unit roots have been implemented. First, the augmented Dickey Fueller test for the presence of unit roots has been used without detrending the series. The null hypothesis is that the series on which the test is implanted has a unit root. As it can be seen from Table B.1, for all the series the null hypothesis cannot be rejected at 95% confidence interval. For robustness also the KPSS test for stationarity has been implemented. The test has been run both on the stationarity in level and trend. The null hypothesis in this case is that the series is stationary. As it can be seen from Table B.2 the null hypothesis is rejected for all series at 95% confidence interval. Results from the two tests allow to conclude that all the series are non stationary.

Table B.1: ADF tests for unit root in natural logarithm of real wages and population series.

City	Wage	Urban population	Regional population
Antwerp	0.41	0.78	0.97
Amsterdam	0.48	0.99	0.90
Florence	0.29	0.60	0.69
London	0.62	0.99	0.99
Paris	0.44	0.93	0.85
Strasbourg	0.25	0.90	0.85
Valencia	0.10	0.96	0.93

For each city are given the p-values for the null hypothesis of one unit root in the logarithm of real wages, urban and regional population.

Table B.2: ADF tests for unit root in natural logarithm of real wages and population series.

City	Wage		City population		Regional population	
	(l)	(t)	(l)	(t)	(l)	(t)
Antwerp	0.01	0.05	0.01	0.01	0.01	0.01
Amsterdam	0.04	0.01	0.01	0.01	0.01	0.01
Florence	0.01	0.01	0.01	0.01	0.01	0.01
London	0.01	0.01	0.01	0.01	0.01	0.01
Paris	0.01	0.01	0.01	0.01	0.01	0.01
Strasbourg	0.01	0.01	0.01	0.01	0.01	0.01
Valencia	0.01	0.01	0.01	0.01	0.01	0.01

For each city are given the p-values for the null hypothesis of stationarity of the logarithm of real wages, urban and regional population. Columns (l) and (t) report the p-value for stationarity in, respectively, level and trend.

C Cointegration tests

Three methods have been implemented to check for cointegration in each pair of natural logarithm of real wages and population size.

First, a simple two-step procedure is implemented. The natural logarithm of real wages at time t is regressed, without constant term, on the natural logarithm of population size at time t and an ADF test without constant is implemented on residuals. Table C.1 shows the results of the ADF tests for unit root on the residuals of these regressions. Since the null hypothesis of unit root is rejected in each case at 95% confidence interval (with the only exception of Valencia where the null hypothesis in urban and regional cases is rejected at 90% confidence interval), residuals are stationary and, therefore, all pairs of variables result to be cointegrated among them.

Two other tests confirm that each pari of variable is cointegrated. First, the Philips Ouliaris test for cointegration is run on each pair of variebles. The test is implemented without a trend and the null hypothesis is that the two series are not cointegrated. As Table C.3 shows the t-statistics are greater than critical values and the null hypothesis is rejected at 95% confidence interval for each pair of natural logarithms of real wages and population (urban and regional). All the pairs of variables are, therefore, cointegrated. Finally, the Johansen test is implemented on the pairs of variable in order to detect whether in each case there is a single cointegrating vector. Table **??** reports the t-statistics for the null hypothesis of the existence of a single cointegrating vector. Results show that the null hypothesis cannot be rejected in any of the pairs of the variables tested.

Table C.1: ADF tests for unit root in the residuals of the regression of natural logarithm of wages on population .

City	Urban population	Regional population
Antwerp	0.01	0.01
Amsterdam	0.01	0.01
Florence	0.01	0.01
London	0.01	0.01
Paris	0.01	0.04
Strasbourg	0.04	0.03
Valencia	0.08	0.08

For each city are given the p-values for the null hypothesis of one unit root in the residuals of the regression of natural logarithm of real wages on natural logarithm of urban and regional population.

Table C.2: Philips-Ouliaris test for cointegration between natural logarithm of wages on population .

City	Urban population	Regional population
Antwerp	166.46	168.69
Amsterdam	99.51	93.97
Florence	167.47	214.64
London	113.28	178.02
Paris	199.66	198.18
Strasbourg	89.58	91.40
Valencia	175.67	154.14

For each city are given the t-statistics for the null hypothesis of no cointegration between natural logarithm of real wages on natural logarithm of urban and regional population. Critical value at 5% is 48.84

Table C.3: Johansen test for cointegration between natural logarithms of wages on population .

City	Urban population	Regional population
Antwerp	5.55	0.06
Amsterdam	3.21	5.35
Florence	1.22	1.87
London	0.01	1.74
Paris	1.85	0.24
Strasbourg	6.60	0.01
Valencia	1.06	0.17

For each city are given the t-statistics for the null hypothesis of one single cointegrating vector between natural logarithm of real wages on natural logarithm of urban and regional population. Critical value at 5% is 8.18

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