Reconstructing the demographic evolution of Piedmont from 1612 to 1900

Published Version:
Scalone, F. (2023). Reconstructing the demographic evolution of Piedmont from 1612 to 1900. RIVISTA DI STORIA ECONOMICA, 39(2 (Agosto)), 233-260 [10.1410/108000].

Published:

DOI: http://doi.org/10.1410/108000

Reconstructing the Demographic Evolution of Piedmont from 1612 to 1900

Abstract.

The object of this work is to examine the specific demographic profile of the Piedmont region in Northern Italy, embracing a long period from the seventeenth to the nineteenth century. The approach of this study is basically based on macro serial data and aggregative methods. These data largely comprise census information and parish series of baptisms and burials and are used to estimate the regional population's size and the main fertility and survival trends.

The analysis covers a crucial and critical period from the last catastrophic cycle of the seventeenth-century plague to the beginning of the Italian demographic transition in the late nineteenth century. As a general conclusion, in the seventeenth and eighteenth centuries Piedmont was characterized by a "high-pressure" demographic regime, with high birth and death rates, and a critical sensitivity to short-term economic crises. The study also shows the coexistence of different territorial patterns in the regional demographic evolution.

1. Introduction

The object of this work is to examine the specific demographic profile of the Piedmont region in Northern Italy, embracing a long period from the seventeenth to the nineteenth century, approximately from the last plague epidemic of 1654-55 (Del Panta 1980) to the onset of the health and the demographic transition, which started in Italy around 1880 with the decline of infant mortality occurred from 1880 (Corsini and Viazzo 1997; Del Panta et al. 1996).

Attempts to reconstruct the population and its dynamic components, such as mortality and fertility, are relatively scarce for the pre-unification period in Italy, whether it involves macro-level reconstructions of the demographic system as a whole (e.g. Breschi 1990; Galloway 1994) or other study focusing on occupational structure and wealth distribution (e.g. Alfani 2010a; Chilosi and Ciccarelli 2022). The reconstruction of Italy's population before 1861 holds significant importance in comprehending the country's economic history, as the population is a crucial determinant of economic development.

The demographic transition theory suggests that societies progress from high fertility and high mortality in the pre-modern phase to low fertility and low mortality in the post-modern phase as they undergo modernisation (Kirk 1996). This article emphasizes the importance of studying the demographic transition in Piedmont in the late nineteenth century. The focus is on the pre-transitional period and the decline in mortality rates, primarily driven by advancements in health knowledge and the prevention of infectious diseases. These improvements in survivorship preceded the decline in fertility and resulted in significant changes and growth rates in the population (Canning 2011). This demographic transition not only had social implications but also had significant economic consequences, particularly in terms of economic growth (e.g. Bloom and Canning 2008; Galor 2011; Lee and Mason 2010). The ongoing debate among economic historians regarding these themes highlights the need for new empirical evidence (e.g. Guinnane 2011). These discussions have sparked renewed interest in understanding the practical aspects of the historical demographic transition, including its timing, causes, and the overall transformation of European populations. In this context, the presented contribution specifically examines the Piedmont region, which offers an interesting case study from both an economic and demographic perspective.

So the purpose is to analyse the dynamics which regulated the demographic system and lead to the demographic transition. From this point of view, the Piedmont region demonstrated a number of features that make it of historical and theoretical interest. As a matter of fact, Piedmont was one of the regions that led the process of modernization and socio-economic improvement in Italy. Its royal family of Savoia supported the process of national unification. Moreover its active and powerful bourgeosie created, in the second half of the nineteenth century, the basis for strong industrial development (Barbero, 2008). In these terms, the process of demographic change is inextricably bound up with the analysis of the transition from the traditional to the modern world, and from the agricultural to the industrial society.

In the last decades, the study of the historical population has clearly demonstrated that it is not possible to define a unique paradigm for the *ancient regime*. Wrigley and Schofield (1989) defined two "ideal types" to interpret the demographic systems in preindustrial age as two contrasting models of the interaction between the economic and demographic functioning of society. In the "high-pressure" regime both fertility and mortality are high, population is large relative to available resources and growth is curbed principally by the Malthusian positive check, suffering periodic mortality rises as the demographic burden exceeds a critical threshold. On the other hand, in the "low-pressure" regime the preventive checks are predominant, thus limiting marriages and births and consequently the population growth over sustainable levels. From this point of view, it is interesting to highlight a still open question concerning whether a northern subalpine area like Piedmont was closer to a high or a low pressure demographic regime. In order to give a specific answer to this question, an analysis based on long demographic series will be performed as it has been already done by authors for Tuscany (Breschi, 1990; Breschi and Malanima, 2002), northern Italy (Galloway, 1994) and some macro territorial areas (Breschi et al., 1994). A rich sample of serial data comprises census information and vital series in order to estimate regional population amounts, total fertility rates and the expectancy of life from 1612 to 1900. This analysis covers a critical period from the seventeenth century plague to the beginning of the Italian demographic transition in the late nineteenth century. The approach of this study is basically based on macro serial data and aggregative methods and when finished, an historical demographic scenario of three hundred years will be available.

It is important to underline that this demographic reconstitution takes into account the first half of the seventeenth century. In this crucial period, not many regional studies were carried out for Italy, except for two works on Tuscany and Northern Italy (Breschi, 1990; Breschi and Malanima, 2002; Galloway, 1994). This is possible for Piedmont, since it offers such a consistent set of serial demographic data (Scalone, 2001). Consequently the main characteristics of the demographic regime will be reconstituted by applying the inverse projection technique (Lee, 1974; 1985; 1993; and also Barbi et alt., 2004). This macro-aggregative approach has already been used for the same period in studies by Breschi (1990) and Galloway (1994). It is also important to say that other scholars carried out this same procedure for other regions of Italy in the eighteenth and nineteenth centuries (Rosina, Rossi, 1998; Gerondi, 1998; Breschi et al., 1994) providing an extremely useful framework to clarify the differential patterns of the demographic evolution in Italy (see also Del Panta, Breschi, 1995; Del Panta et alt. 2002).

As Guido Alfani already noted about the northern Italy demography of the sixteenth century, sometimes the overused expression "old demographic regime" turns out to be misleading, since it covers a wide range of different demographic patterns that already existed before the so called "demographic transition" (Alfani, 2007).
So a purpose of this work is also to underline the coexistence of different demographic dynamics in the same historical and geographical region. The hypothesis is that in a system of precarious equilibrium some geographical factors could play a fundamental role in the demographic evolution and transformation. Since Piedmont is located in the north-west of the peninsula and its historical boundaries includes a vast area from the Padana plain to the western part of the Alps on the French border, it is worth verifying the possible coexistence of different territorial patterns and specific demographic regimes in the same regional area. As a matter of fact, Piedmont offers a remarkable variety of situations and encompasses a wide mountainous chain, a territory of hills and the western portion of the Po valley. In order to assess the existence of possible territorial regimes, a preliminary analysis will initially focus on a sample based on villages and centres of the Alpine area, in the hilly zone and in the Padana plain territory, from between the eighteenth and the nineteenth century.

2. Sources and Methods

This section outlines the sources and methods used in the study, particularly the inverse projection technique for estimating demographic indicators. It emphasizes the importance of initial population size and the choice of mortality and fertility models. The availability of vital series and census data for the Piedmont case is highlighted, including published and unpublished sources that provide reliable demographic information from parish registers and official records. The inclusion of data from various periods, including pre- and post-unification, enhances the analysis.

The Inverse Projection Technique

Since the annual series of vital events and population amounts are available by using an annual inverse projection procedure, it is possible to calculate life expectancy, total fertility rate, and gross and net reproduction rates (Lee, 1974 and 1985).

The main advantages of the inverse projection technique are its ability to estimate fertility and survival indicators even in the absence of complete mortality tables and detailed birth distributions by mother's age. It allows for estimating population characteristics and the main mortality and fertility indicators. Additionally, the method is flexible and can be applied to historical populations where comprehensive data may be limited. However, there are some drawbacks to consider. As the method simplifies complex demographic processes, slight variations in assumptions about fertility and mortality models may have minimal impact on the final results. However, it is worth noting that any overestimations or underestimations of the initial population can potentially introduce more noticeable distortions.

Overall, the inverse projection technique offers valuable insights into historical demographic trends but requires careful consideration of initial population size and assumptions about migration and demographic models. Nonetheless, inverse projection provides the ideal solution for analyzing the long-term evolution of crucial demographic indicators in historical populations, given the scarcity of quantitative information from past demographic sources that hinders traditional demographic analysis tools.

This method allows the estimation of proper fertility and survival indicators in the absence of a complete mortality table and without the distribution of births by mother's age (for further details about the inverse projection technique see Lee, 1974 and 1985). It is important to specify that the method is based on the logical (not temporal) inversion of the traditional forecast technique. As a matter of fact, instead of using a series of vital rates in order to project a series of births, deaths, and age distributions, this method uses a given sequence of births and deaths to derive sequences of demographic indicators and age distributions. Indeed, the inverse project technique provides estimates of the population distribution by age and sex, along with other demographic characteristics such as total fertility rates (TFR), female gross reproduction rate (GRR), female net reproduction rate (NRR), life expectancy at birth (e0), and crude death, birth, and marriage rates (referred to as CDR, CBR, and CMR, respectively) for the historical period under analysis.

In order to illustrate the inverse projection technique suppose that for a given period we know the initial population age distribution and the total number of vital events on each time unit, and have chosen a model life table family. It is possible to demonstrate that only one age schedule of rates (from that family) will imply - if applied to the initial population structure - the given number of deaths. In this way, age specific mortality can be estimated. This age schedule of mortality, together with the number of births and the initial population age distribution, can be used to calculate the age distribution of the population to the beginning of the next period. So the procedure can be iterated for the next year or for a five years period (if annual or quinquennial measures are required). In a similar way, choosing a model fertility schedule, when population age structure has already been estimated, the procedure will distribute the total number of births, in the interval, by age of the mother. So it will be possible to easy calculate total fertility rates and gross reproduction rates (Del Panta, 1997; Del Panta and Rettaroli, 1994).

It often happens that we do not know exactly the population age distribution at the beginning of the first period for which event counts are available (Lee 1993). Fortunately, for any given initial population size, choice of the initial age distribution is not particularly significant. As it has been demonstrated mathematically (Wachter, 1986), the effect of the initial distribution by ages rapidly decreases as the inverse projection iterates.

However, inverse projection is highly sensitive to the selection of initial population size: a wrong size leads to important errors which do not diminish over time; it can vary over time or it can also induce a false trend in the estimates of fertility and mortality, and therefore is potentially a particularly important source of error (Del Panta, 1997).

As far as fertility and mortality models are concerned, they certainly play a central role in inverse projection. However, it can be shown with simulations that modest alterations in the assumed mean age of childbearing, schedules of mortality, and fertility do not substantially alter the outcome procedure. This is because the number of events - births and deaths - is already given for each interval, so the wrong choice of family (model) cannot alter the total flows into (births) and out (deaths) of the population (Del Panta, 1997; Galloway, 1994).

As real populations are not closed, if population sizes are available for at least the beginning and the end of the total period (or for any sub-period), a constant rate of net migration has to be assumed. So the net migrants can then be distributed by age in the usual way, choosing a standard migratory schedule (see appendix 2). Even for this case, it can be demonstrated that slight differences in the assumed net migratory schedule lead to not visible alterations of the results.

Regarding the application to Piedmont, it is important to underline the significant preliminary study on the mortality models in pre-transitional Italy (Del Panta, 1998). Moreover, specialist software for the inverse projection procedure has been used (Rosina, 1996). The assumed models, ages schedule and other technical details are reported in appendix 2.

Vital Series and Census Data

Italy offers a large number of articles containing serial demographic data. All these studies were published by many historians and demographers providing long and reliable series of births, deaths and marriages. As already noted by Galloway (1994), the quality of the historical registration of the vital events appears fairly reliable. In the particular case of Piedmont, the available data offers a very rich collection of published series about numerous communities (Dossetti, 1977; Levi, 1974). Moreover, the present study can rely on an important unpublished collection of data which has already been used in some previous studies on the demography of Piedmont (Costa and Reginato, 1999; De Castro, 1962; Del Panta et al., 2002; Scalone, 2001). All these series are collected from parish registers and have variable lengths from the early years of the seventeenth century to the end of the nineteenth century (for further details see appendix 1).

Before National Unification in 1861, shorter series from 1828 to 1837 were collected from the Statistical Office of the Savoia's State (Muttini Conti, 1962; Romani, 1982). The period after the National Unification is covered by the official data collected by the Statistical Direction of the new Italian State (Muttini Conti, 1962; Romani, 1982; Istituto Centrale di Statistica, 1965).

The necessary data about the total amount of the population related to the period of analysis is also taken into account. The available data is based on a collection of *Status Animarum* which comes from the above mentioned sources (De Castro 1962; Scalone, 2001). The *Status Animarum* offers important information about the number of inhabitants in every community evaluated. Moreover, fiscal enumerations and censuses give other important information about the population's size in the villages and the regional areas (Castiglioni, 1860; Prato 1906; Beloch, 1994; Muttini Conti, 1962; Romani, 1982). So regional and villages population amounts at census times (1838, 1849, and 1861) and the early fiscal enumerations (1774, 1734, and 1612) are available[1]. Finally, the official sources provide complete census information for the period after the 1861 National Unification (Muttini Conti, 1962; Romani, 1982; Istituto Centrale di Statistica, 1965).

3. Differential Demographic Regimes in Piedmont between eighteenth and nineteenth century

A previous study based on the inverse projection approach (Breshi, Pozzi and Rettaroli 1994) summarises population trends in the different states that constituted Italy before its unification in the

---

[1] The total population amounts of Piedmont have been reconstructed referring to the administrative borders of the region at the 1861 National Unification (thus including the present-day Valle d'Aosta region). In order to calculate the population, data from the monumental Beloch's work has been mainly used for 1612 (Beloch, 1994; p. 628), 1734 and 1774 (Beloch, 1994; p. 568-569). Population amounts of those territories which were temporarily under the bordering Dukedom of Milano have also been taken into account (Beloch, 1994; p. 523, 542, 545, and 555). The total regional population at 1824, 1838, 1849, and 1861 is reported in *La popolazione del Piemonte nel secolo XIX* (Muttini Conti, 1962; p. 36-40).

late 19th century and the immediate aftermath of unification. Using data predominantly from the official records of the respective, a nuanced regional picture emerges, demonstrating the coexistence of different demographic regimes on the peninsula. A similar study on Emilia-Romagna (Del Panta and Scalone 2002) during the pre-demographic transition era delved into finer geographical details, revealing the coexistence of subregional demographic sub-regimes. These sub-regimes were attributed to significant variations in environmental factors, such as lower survival rates in the Apennine areas compared to the wet and marshy regions of Romagna. Furthermore, additional reconstructions using inverse projection confirm the diverse demographic situation at both regional and subregional levels (Ge Rondi 1998; Rosina and Rossi 1998).

In order to test environmental influences in Piedmont, the following analysis will be based on the parish series of some communities in Piedmont. This first group of demographic series has been selected adopting a simple criterion of territorial representation. In total, the sample included 12 communities which are distinguished by “hilly” (Asti, San Damiano, Biella, and Ivrea), “mountain” (Ormea, Valdieri, Susa e Monpantero, and Gressoney) and “plain” zones (Cuneo, Fossano, Turin, Moncalieri, Carmagnola) according to the classification of the National Italian Institute of Statistics (Muttini Conti, 1962). The selected communities are also situated in five of the main historical provinces of the Piedmont region (Aosta, Asti, Biella, Cuneo and Turin).

The analysis is based on the application of the annual inverse projection procedure (see appendix 2) in order to estimate the main survival and fertility indicators. For reasons of brevity, the serial annual outputs are presented as average calculations on three separate periods 1734-1750, 1751-1800 and 1801-1850 in the table 1.

Table 1 - Piedmont Communities: Results of the Inverse Projection. Average values calculated for the periods 1734-50, 1751-1800 and 1801-1850

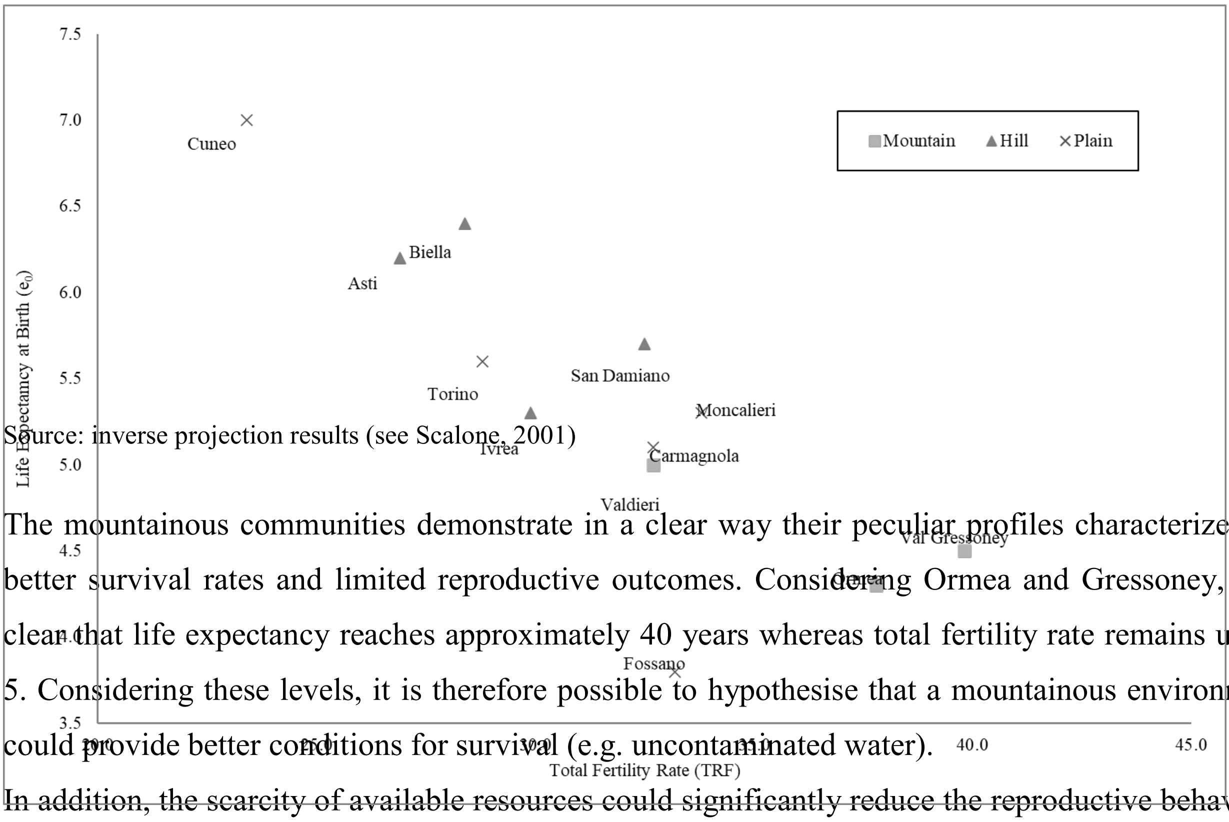
1734-50	CMR	CBR	CDR	r	e_0	GRR	NRR	TFR
Asti	11,2	45,9	46,7	5,9	22,8	3,1	1,0	6,5
San Damiano	8,0	38,8	38,7	1,9	25,2	2,5	0,9	5,1
Biella	9,3	43,6	42,7	6,5	24,2	2,9	1,0	6,0
Fossano	9,3	34,3	34,6	3,7	29,6	2,4	1,0	4,9
Ormea	7,9	37,6	34,5	4,4	31,6	2,6	1,2	5,4
Ivrea	8,4	39,5	31,3	9,7	35,4	2,9	1,5	6,0
Moncalieri	10,0	37,7	34,8	7,4	29,9	2,5	1,1	5,3
Carmagnola	7,7	37,2	37,2	8,9	25,0	2,2	0,8	4,5
Gressoney	9,5	33,0	26,2	1,3	41,1	2,5	1,5	5,1
1751-1800	CMR	CBR	CDR	r	e_0	GRR	NRR	TFR

Asti	10,1	43,2	37,4	4,6	28,4	3,1	1,3	6,4
San Damiano	7,7	38,5	31,9	2,3	32,5	2,7	1,3	5,7
Biella	8,5	41,9	39,1	1,2	26,9	3,0	1,2	6,2
Cuneo	9,4	47,8	45,0	3,4	23,4	3,4	1,1	7,0
Fossano	7,6	28,2	29,0	3,2	33,2	1,9	0,9	3,8
Ormea	5,9	30,2	27,6	3,2	37,8	2,1	1,1	4,3
Valdieri	6,3	34,7	26,3	-0,2	32,7	2,4	1,1	5,0
Turin	-	39,1	35,9	-0,4	28,8	2,7	1,1	5,6
Ivrea	9,1	38,1	33,9	2,6	29,9	2,6	1,1	5,3
Moncalieri	9,7	36,1	30,1	4,5	33,8	2,5	1,2	5,3
Carmagnola	7,2	35,0	31,0	2,8	32,7	2,5	1,2	5,1
Gressoney	7,8	30,7	24,8	1,5	39,8	2,2	1,2	4,5
1801-1850	CMR	CBR	CDR	r	e_0	GRR	NRR	TFR
Asti	7,7	36,1	32,3	6,5	30,5	2,4	1,1	5,0
San Damiano	7,3	36,7	27,7	5,6	36,3	2,6	1,3	5,3
Biella	7,7	39,7	36,3	5,9	27,9	2,7	1,1	5,6
Cuneo	9,1	46,1	40,4	4,1	26,8	3,3	1,3	6,8
Fossano	7,6	28,2	28,4	2,0	36,5	2,0	1,0	4,1
Ormea	6,6	28,0	22,7	1,7	45,8	2,1	1,4	4,4
Ivrea	10,2	36,7	31,1	5,0	33,0	2,6	1,2	5,4
Moncalieri	7,6	34,8	32,9	2,5	31,1	2,4	1,1	5,0
Susa e Monp.	7,5	36,8	37,4	2,9	28,3	2,6	1,1	5,5
Carmagnola	7,8	33,8	29,4	1,6	34,3	2,3	1,1	4,8
Gressoney	6,4	29,9	27,2	-0,2	37,0	2,1	1,1	4,3

Source: inverse projection results (see Scalone, 2001)
Legend: CMR: crude marriage rate (‰); CBR: crude birth rate (‰); CDR: crude death rate (‰); r: annual rate of increase (‰); e_0: expectancy of life; GRR: female gross reproduction rate; NRR: female net reproduction rate; TFR: total fertility rate.

The following figure represents the twelve communities according to their average survival and fertility levels for the period 1751-1800. The x-axis of the diagram relates to life expectancy, whereas the other axis reports the estimated total fertility rates. This demographic framework appears significantly variegated, since the total fertility rate varies from 4 to 7 births per woman and the life expectancy ranges from a minimum of 23 years to a maximum of 40. A linear relationship between fertility and survival is evident.

Figure 1 – Life Expectancy at Birth (e_0) and Total Fertility Rate (TFR) levels in some communities of Piedmont. Average values calculated on serial Inverse Projection results, 1751-1800



Source: inverse projection results (see Scalone, 2001)

The mountainous communities demonstrate in a clear way their peculiar profiles characterized by better survival rates and limited reproductive outcomes. Considering Ormea and Gressoney, it is clear that life expectancy reaches approximately 40 years whereas total fertility rate remains under 5. Considering these levels, it is therefore possible to hypothesise that a mountainous environment could provide better conditions for survival (e.g. uncontaminated water).

In addition, the scarcity of available resources could significantly reduce the reproductive behaviour (Mathieu, 2000). Limited fertility could contribute to control living demographic growth limiting the pressure on the available resources and guaranteeing less vulnerability in case of subsistence crises and the homeostatic equilibrium (Netting, 1996). As a matter of fact, some studies have already pointed out the existence of a typical “low pressure demographic regime” characterized by moderate levels of fertility and survival (Viazzo, 1990). This model has been confirmed by several other studies on the Alps communities for the sixteenth (Alfani, 2007) and eighteenth centuries (Albera et alt., 1988). In addition, it is also interesting to note the lowest values of the crude marriage rate that are estimated for Ormea (5,9) and Valdieri (6,3).

Starting from the middle of the eighteenth centuries, the rates of demographic increase of the mountain communities are generally lower than the ones of the other communities (see table 1). However it is possible to confirm the slow and constant demographic growth that was sustained by the improvements in agriculture in this period (Mathieu, 2000).

Looking at the plains territory and the urban centres[2] (table 1), it is possible to recognize the typical characteristics of a high pressure demographic regime. Considering the average values of life

---

iven the political fragmentation and other factors in Northern Italy, the term “city” is difficult to define. Many centers had modest demographic size and performed typically urban functions (Alfani 2007). In our case, Turin is one of the most important cities in Northern Italy and was the capital of the Savoia’s Reign prior to National Unification. Cuneo expectancy (see table 1) the survival indicators of the towns registered the lowest levels in each observed period. As figure 1 clearly shows Asti, Biella, Cuneo and Turin were characterized by the worst values of life expectancy (less than 30 years in the fifty years from 1751 to 1800). Looking at table 1, Asti and Cuneo registered the lowest levels of life expectancy in all the periods considered. For the fifty years from 1751 to 1800, the estimated expectancy of life in Turin is equal to 28,9 with an evident decrease of population.

This could confirm the consolidated image of the urban centre as a "man eater" with high mortality levels (for Northern Italy, see also Alfani, 2007). Some of the causes of higher mortality could be due to the contagious environment, inefficient hygienic systems and mass fluxes from the countryside during famine crises. However, during the considered period, the region saw several wars. Thus some outbreaks of urban mortality could be correlated with the severe sieges of the enemy armies (Barbero, 2008; Rosso, 1994).

Besides this, the urban fertility tendencies appear to be peculiar. During the period 1751-1800, the estimated total fertility rates of Asti, Cuneo and Turin result higher than the other observed communities. Moreover Asti and Cuneo register an average value of total fertility rates equal to 5,0 and 6,8 in the subsequent fifty years 1801-1850. On the one hand, this higher level may be clear evidence of a situation still far from the onset of the fertility decline. On the other hand, it could be related to a significant proportion of newborns that were brought from the countryside and baptized in the urban churches.

4. Reconstruction of the regional population and vital events from 1600 to 1900: a possible historical scenario

Having considered interregional demographic regimes, it is now necessary to reconstruct the long term evolution of the region from the post-plague era (approximately after the last pestilence of 1630) to the beginning of demographic transition (around National Unification). Embracing almost three hundred years, this reconstituted scenario allows for a detailed study of the demographic *ancient regime*, specific mechanisms of population growth, and the causes that led to demographic transition.

Sample

---

and Asti were two historical sites which exerted an important influence on the surrounding villages and countryside (Gabotto, 2005; Vergano, 1990).

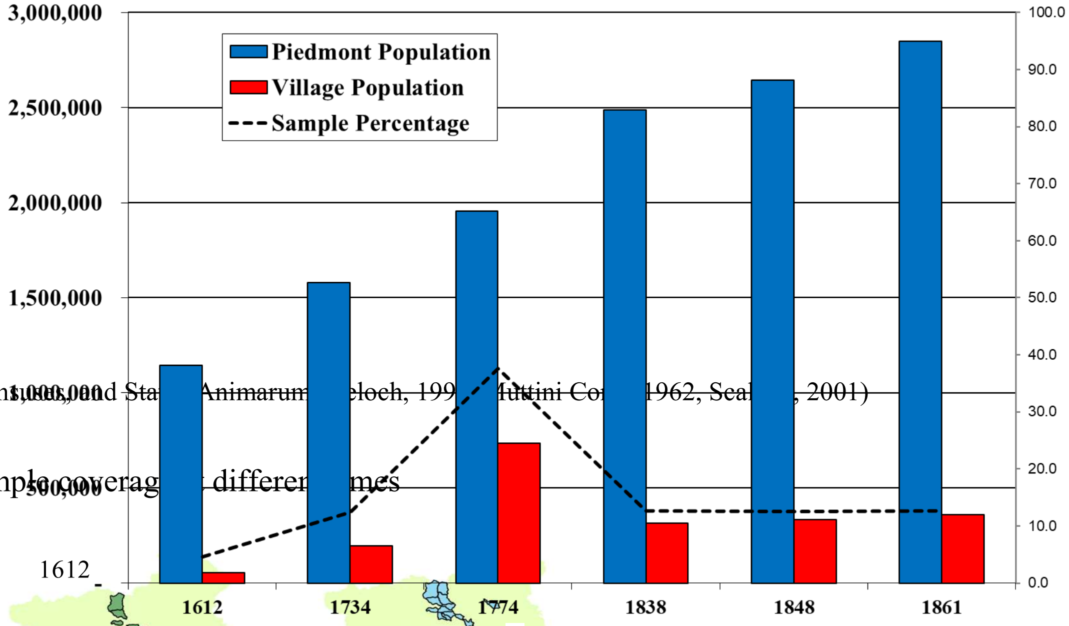
In order to reconstruct the demographic regime of Piedmont, this study relies on a sample collection of 80 vital series, which covers from 1612 to 1900. Names of villages or towns, sources, and lengths are reported in appendix 1. By using information on population size from Status Animarum, fiscal enumerations and censuses (Scalone, 2001; Del Panta et alt., 2002), it is possible to calculate the consistency and the weight of the sample data at each census (1838, 1849, and 1861) and fiscal enumeration (1774, 1734, and 1612). As figure 2 shows, the weight of the Piedmont sample is not constant: given the longer period of reference, the sample includes a variable amount of population and its weight changes largely on the time axis[3]. The sample weighs 12,5 percent in the 1838 census, 37,6 percent in the 1774 fiscal enumeration (in fact, a large collection of published series is available from 1770 to 1799, covering various provinces), 12,4 in 1734, and 4,2 in 1612.

It is important to underline that the sample selection is not based on any statistical criteria, since collected data for previous historical demographic research is used. However, as is possible to see from figure 3, the available data covers the most part of the regional territory. Even if some north-western and south-eastern areas are not represented, large portions of alpine, subalpine, and plain zones are included, providing a balanced territorial representation.

Figure 2 – Example of Sampling Weights: Population of Piedmont and Villages on the Left Axis, and Percentage Weight of the Village Sample on the Right Axis

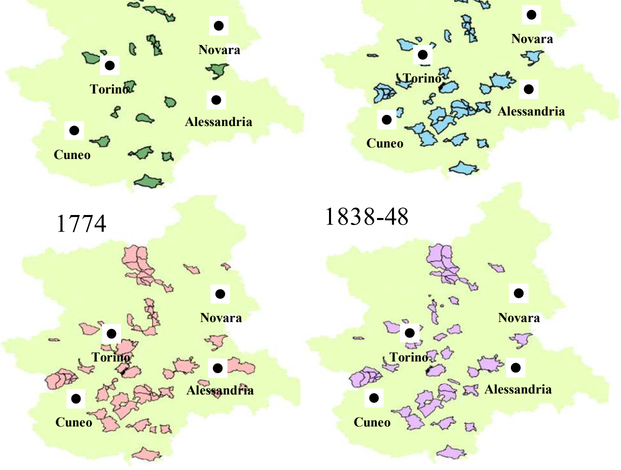
---

[3] Actually, in 1612 the population size is not known for every village. However in order to represent the size of the villages' sample in figure 2, the missing amounts are estimated assuming that between 1612 and 1734 these villages grew at the same increase rate of the overall sample.



Source: Fiscal enumerations, Censuses, and Status Animarum (Beloch, 199, Muttini Conti, 1962, Scalone, 2001)

Figure 3 – Examples of sample coverage at different times



Source: Fiscal enumerations, Censuses, and Status Animarum (Scalone, 2001)

Method of Estimation

The regional estimations of vital series are based on a simple procedure. First of all, the ratios between the population of every village and regional population are calculated at each census time (see table 2). Secondly, the annual number of vital events is added for every village. Afterwards, it is necessary to multiply the ratios by each annual value of the parish series. In the end, the regional estimations of the annual number of births and deaths are obtained.

So considering a given year t, the regional estimation of the total amount of births is calculated according to the following expression:

$$B_t^* = \frac{P_0}{\sum_i p_{i0}} \times \sum_i b_{it}$$

where B_t^* represents the estimation of the regional amount of births at year t, P_0 is the regional population size at the referred census year 0 (column 1 in table 2), p_{i0} and b_{it} are respectively the population size at census year 0 and the number of births at year t of the village i. The total sum Σp_{i0} of the sample population villages at each census is reported in column 2 of table 2. The referred census varies in different periods, as can be seen in table 2.

It is also important to underline that the multiplier on the 1612-1769 period is not constant. Parish series cover different lengths on the time axis and thus the consistence of the sample of villages is variable (see table 2). In addition, there is no complete information for the population amounts of all the villages at the fiscal enumeration of 1612. Thus the necessary multipliers are calculated on the basis of the 1734 fiscal enumeration, assuming the hypothesis that during the period in question the population of each village grew approximately at the same increment rate.

In this time interval, the multiplier varies largely from 8 to 24, which was the highest calculated value in the early years of the considered period.

Table 2 – Piedmont: population, ratios and intervals of estimation

Sources	Piedmont Population (1)	Village Population (2)	Ratios (1) / (2)	Interval
Census 1861	2.849.930	360.493	7,9	1849-1861
Census 1848	2.644.928	331.675	8,0	1848-1838
Census 1838	2.487.561	313.804	7,9	1815-1827
Census 1838	2.487.561	267.832	9,3	1800-1814
Fiscal enumeration 1774	1.954.150	734.691	2,7	1770-1799
Fiscal enumeration 1734	1.581.694	variable	variable	1612-1769

Source: Fiscal enumerations, Censuses, and Status Animarum (Beloch, 1994, Muttini Conti, 1962, Scalone, 2001)

However, it is not necessary to estimate birth and death series between 1828 and 1837 because the complete series for the entire regional state regarding that period was published by the Statistical Office of the State of Piedmont (Muttini Conti , 1962). In addition, after National Unification in Italy, official statistical sources are used to cover the period 1861-1900 (Istituto Centrale di Statistica, 1965).

Having estimated annual regional births and deaths, it is possible to retroject annual population amount between two consecutive censuses by using the balancing equation: $P_{t-1} = P_t - B_t + D_t$ where t refers to the year. As a matter of fact, the total amount of the regional population is known in 1612, 1734, 1774, 1824, 1838, 1848 and 1861 (see also Galloway, 1994). Having retrocalculated the annual population size on an interval between two censuses, it is possible to estimate the net external migration by calculating the difference between the actual population size at the first census time and the population amount which has been obtained by using the balancing equation. Dividing this amount by the number of years between the two censuses, the annual net external migration is estimated. In order to correct the calculated population, the estimated annual net external migration must be added to every amount in each year. This procedure of estimation and correction has to be iterated on each period between two censuses. Once the annual population amount is known, annual vital rates can be systematically calculated.

Reconstructed vital series and population rates of increase

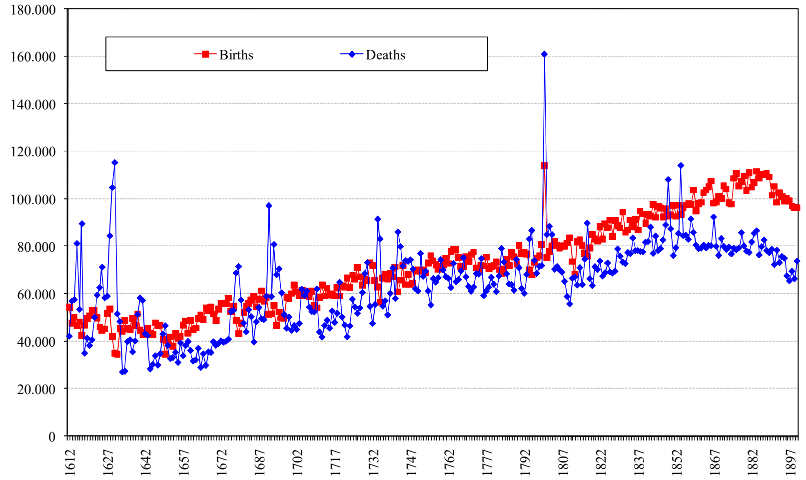
During the seventeenth and eighteenth centuries, it seems that the demography of Piedmont is a typical high pressure demographic regime. Strong and frequent mortality crises played a key role causing repeated falls of fertility and consequently reducing the potential burden on the available sources and the production system. From a strictly Malthusian perspective, these periodic and severe mortality crises work as a mechanism of control of demographic growth and represent a typical positive check.

By inspecting the reconstructed series of vital events and rates, it is possible to note several effects of frequent famines, plagues and military invasions. In the period before 1700, the rate of increase of Piedmont is largely variable because this region suffered many severe mortality crises and epidemics (see figures 4, 5 and 6). As shown, the plague of 1630 harmed an already decreasing population. As a matter of fact, the catastrophe of 1629-30 was anticipated by two severe epidemics of typhoid (Corradi, 1973). However, it is interesting to note the remarkable potential of recovery. The high mortality phase remains circumscribed in the first half of the century, and in the following period 1650-1675 a new phase of stability is characterized by containment of the crude mortality rates and continuous population growth. This tendency was probably also sustained by the progressive introduction and diffusion of maize and potato cultivations (Levi, 1984). However between the last quarter of the seventeenth century and the first decade of the eighteenth, the demographic signs of a typical crisis reappear: a severe increase of mortality in the biennium 1677-78 due to a catastrophic famine, further peaks of deaths (smallpox, war, famine; see Barbero, 2008) in the last decade and another difficult period in the early years of the eighteenth century.

What was the role of the birth rates in this difficult growth process? The inspection of the crude rates (figure 5) demonstrates that the birth rate tends to remain on a level of about 40 per thousand following the effects of mortality fluctuations. Thus it seems that the intensive phases of demographic growth were mostly influenced by the mortality reductions. In addition, the birth rates reduce to 30 per thousand relatively later, only after the middle of the nineteenth century, whereas the population of Tuscany already experienced these values in the eighteenth century (Breschi and Malanima, 2002).

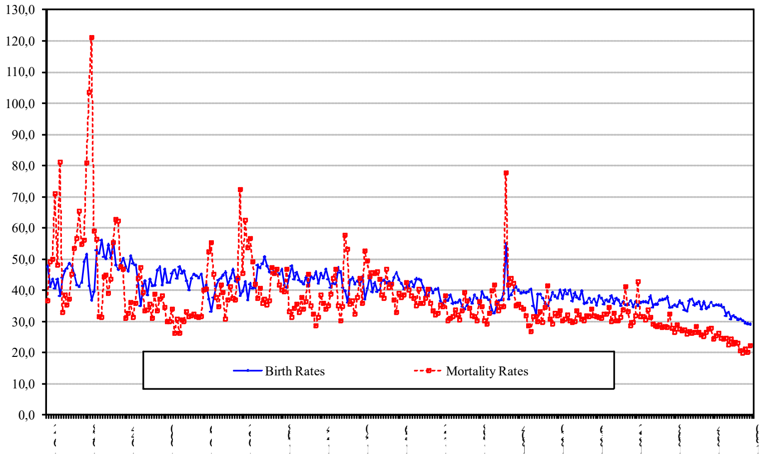
After the early problematic years of the eighteenth century, the next thirty years are characterized by a recovery phase in which the birth rates are higher than the death rates and the demographic increase is constantly positive. This virtuous trend is suddenly interrupted by a severe mortality rise in the biennium 1734-35 (famine and smallpox) with the consequent decrease of growth rates. During the second half of the century, the population experiences the progressive stability of mortality with a significant reduction in crisis frequency and magnitude. Indeed, in this period the sudden mortality rises are less frequent and intensive. However, the demographic growth still appears slower and less continuous than the nineteenth century.

Figure 4 – Piedmont: regional series of births and deaths, 1612-1900



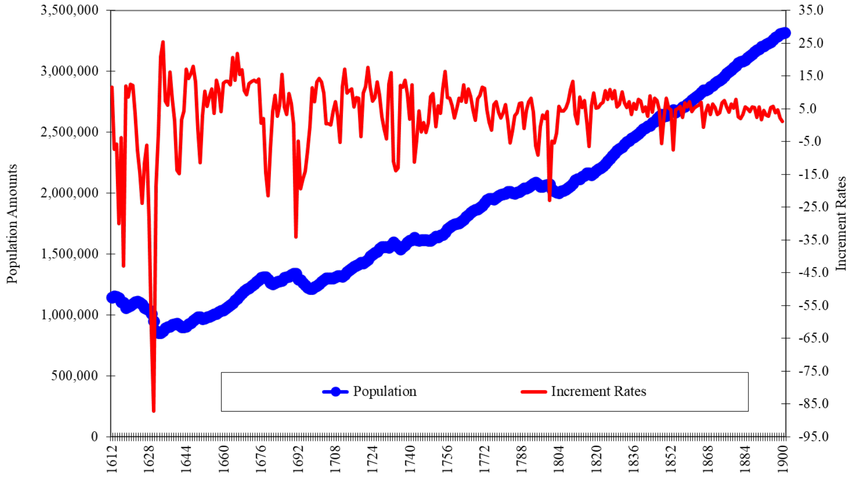
Source: estimated vital series (see Scalone, 2001)

Figure 5 – Piedmont: Crude Birth and Mortality Rates, 1612-1900



Source: estimated vital rates (see Scalone, 2001)

Figure 6 – Piedmont: Population and Rates of Increase, 1612-1900



Source: estimated population amounts (see Scalone, 2001)

The nineteenth century began with an outbreak of mortality, which was mostly due to the effects of the war (French conquest and war against Austrian-Russian armies). So the early years of the century register the highest mortality crisis in terms of absolute number of deaths (see figure 4). Only after 1830, mortality started to stabilize and the growth of the population began to increase gradually reaching an increase rate above 5 per thousand. However, this rate of increase is still lower than the 8 per thousand which has been calculated for Tuscany approximately at the same time (Breschi and Malanima, 2002). Although the epidemic crises reduced their intensity and became less frequent, the general values of the crude death rates remained approximately above 30 per thousand. The signs of a mortality reduction are evident only in the last quarter of the nineteenth century. However the general demographic increase is still weak, because of negative net migration (see also M. Breschi et al., 1994) as a consequence of the agrarian crisis of the 1880s (Barbero, 2008).

Estimated survival and fertility indicators

Since the inverse projection procedure gives some more accurate indicators like life expectancy, gross reproduction rate and net reproduction rate, it is possible to calculate the long-term survival and fertility levels from 1612 to 1900, by using the estimated regional series of vital events and populations[4].

Considering figure 7, the general tendencies of life expectancy are similar to the trends observed in the previous paragraph. However, the graph shows the large fluctuations of this indicator during the first half of the seventeenth century, demonstrating the extreme frailty of the survival regime. In addition, it also possible to see the impressive levels reached during the twenty years 1655-75 and the period between 1715 and 1730. These post-crisis recovery effects have also been observed for Tuscany (Breschi and Malanima, 2002). As the figure shows, the survival levels decreased till the

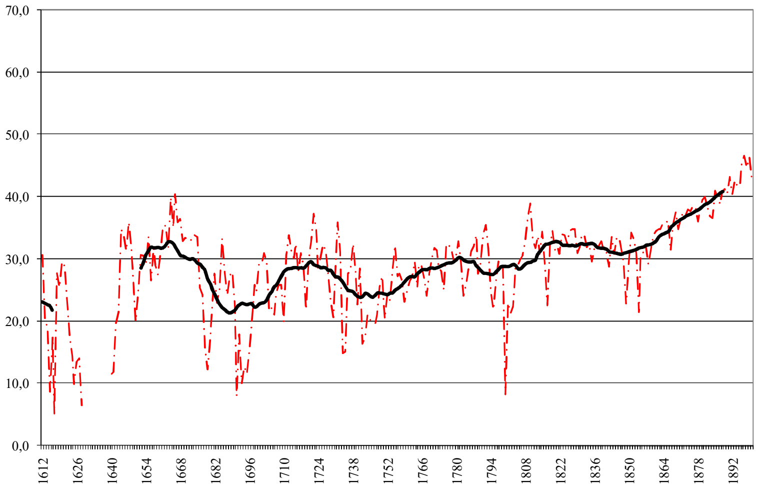
---

[4] Only expectation of life, gross and net reproduction rates are presented. In a previous work, all the complete outcomes of the procedure are fully reported (Scalone, 2001). Extremely low survival levels (less than 10 years of expectation of life) are calculated for some years. It is also possible to see such catastrophic decreases of life in the Tuscany reconstitution (Breschi and Malanima, 2002). Ronald Lee (1974) explained that this could be attributed to the combined effect of the mortality rates and specific age structure in the observed population. In our case, the underestimations correspond to extremely high mortality years. Since the inverse project procedure estimates 'period life expectancy', the calculated indicator must be interpreted as the average age of death of a hypothetical cohort that experienced the same age-specific mortality rates of the referred years. To give an example, the estimated expectation of life for 1628 is the average number of years that a newborn would live being all his entire life under the same (extremely high) mortality risks by age experienced in 1628 population. In these terms, it is possible to explain why the mortality crises produce these visible underestimations. Thus because of the biases due to catastrophic mortality, no estimations are given for the period around the plague (1629-1639).

end of the sixties and improved in the next forty years. The expectancy of life still remains under 30 years during all the eighteenth century.

Only after the first part of the eighteenth century, the survival indicators of Piedmont improve and become more stable. Thus the disappearance of the catastrophic mortality crises could be considered a turning point towards a new demographic regime (Del Panta et al., 2002). These schemes confirm that the early phase of mortality transition was characterized by the decline, or even disappearance, of mortality crises caused by epidemic infections/disease (Schofield and Reher, 1991). Indeed, the "stabilisation of mortality" in Piedmont led to the gradual elimination of the characteristic "peaks" on all mortality trends. As already noted, general survival remained stationary during the first half of the nineteenth century. The turning-point occurred only in the second part of the century, when the life expectancy increased from approximately 30 years to over 40 during the few decades after the National Unification (see also table 3). This evident improvement was, above all, due to the significant progress in terms of public health, sanitary and hygienic systems.

Figure 7 – Piedmont: Life Expectancy (values and moving averages on 25 terms), 1612-1900



Source: inverse projection results (see Scalone, 2001)

It is possible to adopt another possible point of view to interpret the survival trends. As a matter of fact, it is interesting to note that the most critical periods almost all coincide with the military campaigns that crossed the Piedmont territory. As is easy to see (figure 7), the life expectancy levels dropped during the Spanish-French war in the first half of the seventeenth century, then during the Piedmont-France war (1690-1696), the war for Austrian succession (1740-1748), and the Napoleonic war (1798-1800). However, it must be said that the majority of the deaths cannot be considered direct combat victims. As has been explained (Sella, 1982; Alfani 2010b), on the one hand, the foreign armies that invaded the region used to confiscate farms, livestock, and food supplies. On the other hand, the peasants that were forced to enlist abandoned their fields. All that brought about the collapse of food production, delivery, and storing. As a consequence of famines, epidemics found the most favourable conditions to spread.

On average, total fertility rates are stationary until the middle of the eighteenth century, slightly reducing after 1750. In the last 25 years of the nineteenth century, they are still above 5,2 (table 3). In figure 8, the tendencies of gross reproduction rates are represented. According to these estimations, fertility follows a cyclic course till the middle of the eighteenth century. These cycles were already observed by Athos Bellettini (1987) for the Bologna area during the same periods. However Bellettini, who observed series of absolute births, made two main hypothesises.

The first one explained these birth waves in term of changing of population amounts, whereas the second one took into account the changing reproductive behaviour. So in the case of Piedmont it seems that the findings confirm the second hypothesis, since the estimated fertility indicators are not affected by changes in population amount and structure. These waves of fertility have also been registered in Tuscany (Breschi and Malanima, 2002). In addition, it is interesting to note that in both regions the fertility cycles are almost perfectly synchronized to the life expectancy indicators.

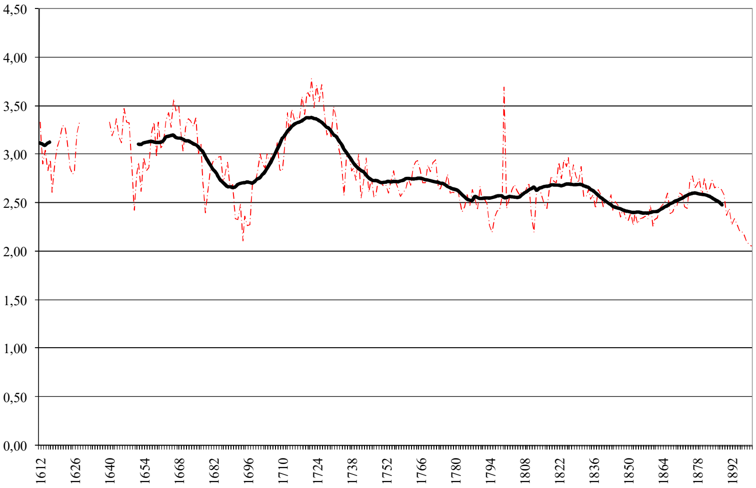
Table 3 - Piedmont Region: Results of the Inverse Projection. Average values calculated on 25 year periods

	CBR	CDR	CMR	e_0	TFR
1651-1675	43,6	33,2	9,3	32,2	6,5
1676-1700	42,6	43,7	9,6	22,0	5,6
1701-1725	44,9	37,5	9,9	28,5	6,7
1726-1750	42,2	41,1	9,4	24,9	6,2
1751-1775	41,1	37,6	8,8	27,1	5,7
1776-1800	37,2	35,6	8,4	28,7	5,3
1801-1825	38,8	35,2	8,6	29,9	5,5
1826-1850	37,0	32,0	7,8	31,7	5,4
1851-1875	35,8	29,8	8,1	33,6	5,0
1876-1900	33,4	24,5	7,4	40,7	5,2

Source: inverse projection results (see Scalone, 2001)

Legend: CMR: crude marriage rate (‰); CBR: crude birth rate (‰); CDR: crude death rate (‰); e0: expectancy of life; TFR: total fertility rate

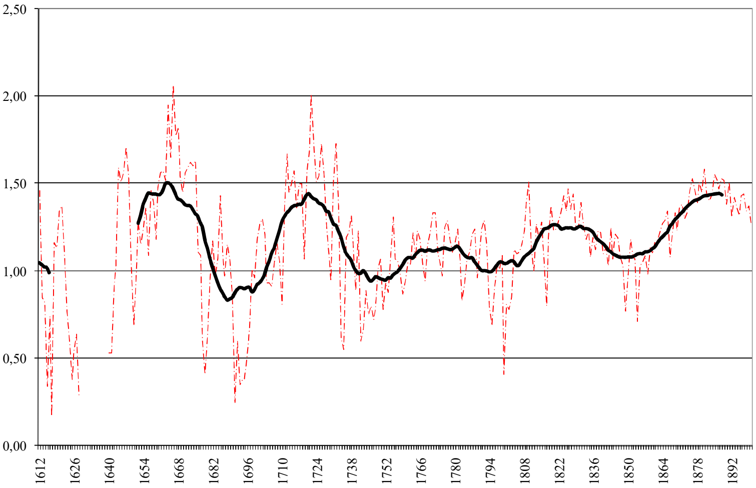
Figure 8 – Piedmont: Gross Reproduction Rate (values and moving averages on 25 terms), 1612-1900



Source: inverse projection results (see Scalone, 2001)

In addition it is worth noting the combined effect of reproductive behaviour and survival levels by considering the estimations of the net reproduction rate (figure 9), which can express the real potential growth of a population. Even from this perspective, it is possible to see two waves of extraordinary recovery (1650-1675 and 1710-1730), when the indicator overcomes the substitution threshold of 1. During the second half of the eighteenth century and the first part of the nineteenth, the net reproduction rate remains stable on the substitution threshold. The fall of the French period could be considered an exception[5]. Only in the second half of the century, after National Unification, the values of this indicator progressively increase, thanks to the steady improvements of survival levels.

Figure 9 – Piedmont: Net Reproduction Rate (values and moving averages on 25 terms), 1612-1900



Source: inverse projection results (see Scalone, 2001)

---

[5] The post crisis recovery of 1801 gives an extremely high gross reproductive rate (see figure 8), probably due to the sample bias and the typical period effect which affects the inverse projection's outcome (see also footnote 8).

5. Conclusions

Main Summary

In this paper we have examined the specific demographic profile of the Piedmont region, embracing a long period from the seventeenth to the nineteenth century. The approach has been basically based on macro serial data and aggregative methods, by using a collection of parish series and official sources. Since fiscal and census information were also available, it was possible to carry out some annual inverse projection procedures.

As already pointed out in previous studies, our results confirm the coexistence of different sub-regional demographic dynamics. In fact, a preliminary analysis has focused on a first sample of communities of the Alpine area, in the hilly zone and in the Padana territory in the eighteenth and the nineteenth centuries. Our results confirm that the mountainous areas were characterized by better survival rates and limited reproductive outcomes, maintaining a homeostatic equilibrium. In addition, we have provided further evidence that in the urban centres survival conditions were significantly worse, registering lower survival levels.

Total fertility rates and expectancy of life were estimated in the overall region from 1612 to 1900. As a general conclusion it is possible to state that in the seventeenth and eighteenth centuries Piedmont was characterized by a "high-pressure" demographic regime, with high birth and death rates, and a critical sensitivity to short-term economic crises. Our estimations show large fluctuations of life expectancy during the first half of the seventeenth century, demonstrating the extreme frailty of the survival regime. Only after the first part of the eighteenth century, the survival indicators of Piedmont improved and become more stable. Thus the disappearance of the catastrophic mortality crises could be considered a turning point towards a new demographic regime. According to our results, the fertility levels followed a cyclic course till the middle of the eighteenth century. During the nineteenth century, progressive improvements of survival led to stabilization of the reproductive behaviour.

In one of its early formulations (Notestein, 1945), the theory of demographic transition declared that the "transitional growth" came substantially from the mortality decline provoked by the new controls over diseases, sanitary and medical advances, etc. Even if this is the basic and general scheme, the present analysis on Piedmont reveals a more articulated pattern of demographic evolution. As a matter of fact, demographic transition could be conceived as a systemic passage toward a new equilibrium between sustainable demographic growth, available food resources and production systems.

Future Research Steps

The implications of these findings are crucial for comprehending the Malthusian model in the pre-industrial era and the dynamics preceding the demographic transition (e.g. Breschi and Malanima 2002; Del Panta and Scalone 2002; Pedersen, Riani and Sharp 2021). They emphasise the necessity for future research employing sophisticated econometric models to explore the intricate interactions among demographic factors, available resources, and production systems. These models can serve as a valuable framework for understanding the reciprocal relationship between demographic factors and living standards during this period (e.g. Galloway 1986, 1988; Chiarini 2010; Nicolini 2007).

By examining the interplay between population growth, mortality rates, fertility patterns, and living standards, this econometric approach could provide insights into the complex dynamics that influence the well-being of individuals and communities. Cointegrating demographic and economic series enables a nuanced understanding of how changes in living standards, such as wages and access to resources, can impact demographic behaviour and societal well-being (Møller and Sharp 2014).

Therefore, further research should focus on refining these econometric models by incorporating insights from analysing the Piedmont region. Considering the reciprocal relationship between demographic factors and living standards, a comprehensive understanding of the Malthusian model and the dynamics preceding the demographic transition can be achieved (Pederse, Riani and Sharp 2021; Murphy 2010). Adopting an econometric approach will contribute to advancing our historical knowledge of demographic transitions and their underlying mechanisms, shedding light on the multifaceted nature of societal changes.

The considerations above lay the foundation for future research endeavours in this field.

Appendix 1.A – Series of Vital Events: communities, periods and sources

	Births	Deaths	Sources
ALESSANDRIA			
Casale Monferrato	1600-1900	1600-1900	Unpublished
ASTI	1697-1900	1700-1900	Unpublished
S. Damiano	1600-1900	1600-1900	Unpublished
BIELLA	1600-1900	1600-1900	Unpublished
CUNEO	1671-1900	1698-1900	Unpublished
Alba + Barbaresco	1696-1900	1696-1900	Unpublished
Busca	1644-1900	1633-1900	Unpublished
Ceva	1647-1900	1644-1900	Unpublished
Cherasco	1657-1900	1623-1900	Unpublished
Fossano	1652-1900	1700-1900	Unpublished
Grinzane	1725-1900	1725-1900	Unpublished
Mondovì	1600-1900	1664-1681	Unpublished
		1731-1900	
Ormea	1628-1900	1724-1900	Unpublished
Savigliano	1667-1900	1770-1900	Unpublished
TURIN			
Angrogna	1699-1900	1736-1900	Unpublished
Bobbio	1746-1900	1800-1900	Unpublished
Carmagnola	1700-1900	1700-1900	Unpublished
Chivasso	1768-1900	1768-1900	Unpublished
Ciriè	1670-1900	1680-1900	Unpublished
Ivrea	1677-1900	1700-1900	Unpublished
Lanzo	1600-1900	1674-1900	Unpublished
Luserna S. Giovanni	1730-1900	1800-1900	Unpublished
Lusernetta	1690-1900	1800-1900	Unpublished
Moncalieri	1602-1900	1641-1900	Unpublished
Pinerolo	1697-1900	1698-1900	Unpublished
Rivarolo	1600-1900	1648-1699	Unpublished
		1770-1900	
Rivoli	1688-1900	1700-1900	Unpublished
Rorà	1739-1900	1800-1900	Unpublished
Susa	1677-1900	1747-1900	Unpublished
Torre Pellice	1699-1900	1800-1900	Unpublished
Villar Pellice	1698-1900	1800-1900	Unpublished
Viù	1600-1900	1604-1900	Unpublished
VERCELLI			
Borgosesia	1653-1900	1682-1900	Unpublished
AOSTA			
Ayas	1614-1900	1705-1900	Unpublished
Brusson	1632-1900	1671-1900	Unpublished
Challand St. Victor	1620-1900	1684-1900	Unpublished
Fontainemore	1606-1900	1694-1900	Unpublished
Gressoney La Trinitè	1686-1900	1686-1900	Unpublished
Gressoney St. Jean	1720-1900	1709-1900	Unpublished
Issime + Gaby	1685-1900	1692-1900	Unpublished
Lilianes	1668-1900	1680-1900	Unpublished
Perloz	1688-1900	1688-1900	Unpublished
Polonghera	1600-1800	1600-1800	Unpublished
Strambino	1600-1800	1600-1800	Unpublished
Visché	1600-1800	1600-1800	Unpublished

Appendix 1.B – Series of Vital Events: communities, periods and sources

	Births	Deaths	Sources
Bra	1617-1693 1748-1900	1600-1800	Dossetti (1977)
Villanova Solaro	1646-1800	1646-1800	Dossetti (1977)
Romano	1627-1800	1632-1800	Dossetti (1977)
Candia	1729-1800	1680-1800	Dossetti (1977)
Mazzé	1600-1800	1648-1800	Dossetti (1977)
Pocapaglia	1659-1800	1601-1800	Dossetti (1977)
La Morra	1660-1800	1678-1800	Dossetti (1977)
Torre S. Giorgio	1691-1800	1687-1800	Dossetti (1977)
Verduno	1600-1800	1662-1746	Dossetti (1977)
San Front	1661-1800	1662-1800	Dossetti (1977)
Torino	1763-1800	1702-1800	Levi (1974)
Acqui	1770-1799	1770-1799	Levi (1974)
Nizza Monferrato	1770-1799	1770-1799	Levi (1974)
Campagna della diocesi di Acqui	1770-1799	1770-1799	Levi (1974)
Alessandria	1770-1799	1770-1799	Levi (1974)
Campagna della diocesi di Alessandria	1770-1799	1770-1799	Levi (1974)
Arona	1770-1799	1770-1799	Levi (1974)
Campagna della diocesi di Biella	1770-1799	1770-1799	Levi (1974)
Campagna della diocesi di Fossano	1770-1799	1770-1799	Levi (1974)
Vicariato di Capriata	1770-1799	1770-1799	Levi (1974)
Diocesi di Pavia (parte piemontese)	1770-1799	1770-1799	Levi (1974)
Saluzzo	1770-1799	1770-1799	Levi (1974)
Abbazia di S. Benigno	1770-1799	1770-1799	Levi (1974)
Abbazia di S. Mauro	1770-1799	1770-1799	Levi (1974)
Carignano	1770-1799	1770-1799	Levi (1974)
Campagna dell'abbazia di S. Michele	1770-1799	1770-1799	Levi (1974)
Baldissero	1815-1861	1815-1861	Muttini Conti (1962)
Castellamonte	1815-1861	1815-1861	Muttini Conti (1962)
Chieri	1815-1861	1815-1861	Muttini Conti (1962)
Collegno	1815-1861	1815-1861	Muttini Conti (1962)
Muriaglio	1815-1861	1815-1861	Muttini Conti (1962)
Settimo Torinese	1815-1861	1815-1861	Muttini Conti (1962)
Piemonte and Valle d'Aosta	1828-37	1828-37	Muttini Conti (1962)
Piemonte and Valle d'Aosta	1862-900	1862-900	Muttini Conti (1962) - Istat (1965)

Appendix 2 - Application of the Inverse Projection Technique

Here, the selection of the necessary models for the inverse projection is briefly explained.

Mortality models

As far as mortality is concerned (but approximately the same occurs for fertility), the inverse projection procedure uses two life tables, drawn from the same family, and interpolates between these two tables (or extrapolates outside their range), generating at each period another table which belongs to the same family (Del Panta, 1997).

The Brass system can be very useful in applications of Inverse Projection, since it enables to deduct, from an empirical life table, the two required one-parameter tables (Brass, 1968, 1971). As matter of fact, it produces two life tables which have different levels of e_0 but the same age survival schedule.

In the present study, the inverse projection applications make use of the life tables of the Italian provinces that were calculated by using official data of the period 1881-82 (Del Panta, 1998). The basic hypothesis is that the life table of 1881-82 could be adopted as a good model of the Italian risk of mortality by age before Unification. Indeed, it is possible to assume that during the modern age the curve of death probability by age remained almost the same, while only the intensity of mortality was subject to significant change. However, this assumption could not be valid for certain epidemic crises, when the mortality structure by age could change in a dramatic way. For the first application to the sample of twelve communities in the period 1734-1850, we adopted the life table of the province in which the community was situated. For the application to the reconstructed regional series, a regional Piedmont life table was adopted (Del Panta, 1998). As the inverse projection technique requires, each selected life tables was transformed by using the Brass's method, as has already been explained. Thus in order to obtain two life tables belonging to the same parametric family but with a different intensity, the "b" parameter was made equal to 1, whereas the "a" parameter varied from +0,2 to -0,2.

Fertility and migration schedules

The assumed schedule for fertility was a model of Coale and Demeny with a mean age at birth of 32 (Lee, 1974 and 1985; Coale and Demeny, 1966) and a standard schedule of net migrations by age in which most migrations concern the population between 15 and 35 years and ages of childhood (Scalone, 2001; Rosina 1996).

Selection of the age structure

As already said, the basic hypothesis is that during the modern age the populations of Piedmont followed the typical trend of a stable population. Consequently, standard tables of Coale and Demeny are used to estimate the distribution by age of the considered populations, because this kind of data is not available for the long period before the nineteenth century.

In order to select the appropriate age structure, firstly the rate of increase during the period under study for each considered population was calculated. After comparing the selected 1881-82 life tables of the considered populations with a Coale and Demeny standard mortality model, the procedure adopted the structures by age corresponding to a level 8 table for the southern female area. So for each of the considered populations, the age structure corresponding to the calculated rate of increase was assumed.

References

- Albera, D., Dossetti, M. and Ottonelli, S. (1988), "Società ed emigrazione nell'alta valle Varaita in età moderna", *Bollettino Storico Bibliografico Subalpino*, 86.

- Alfani, G. (2007), "Population and Environment in Northern Italy during the Sixteenth Century", *Population-E*, 62(4).

- Alfani, G. (2010a), "Wealth Inequalities and Population Dynamics in Early Modern Northern Italy". *The Journal of Interdisciplinary History*, 40(4), 513–549.

- Alfani, G. (2010b), *Il grand Tour dei Cavalieri dell'Apocalisse. L'Italia del "lungo Cinquecento" (1494-1629)*, Marsilio, Venezia.

- Barbero, A. (2008), *Storia del Piemonte. Dalla preistoria alla globalizzazione*, Einaudi, Torino.

- Barbi, E., Bertino, S. and Sonnino, E. (2004), *Inverse projection techniques: old and new approaches*, Springer, Berlin.

- Bellettini, A. (1987), *La popolazione italiana. Un profilo storico*, Einaudi, Torino.

- Beloch, K. J. (1994), *Storia della popolazione d'Italia,* Casa Editrice Le Lettere, Firenze.

- Bloom, D. E. and Canning, D. (2008). "Global Demographic Change: Dimensions and Economic Significance"*, Population and Development Review*, 34, pp. 17–51.

- Brass, W. (1968), *The Demography of Tropical Africa,* Princeton University Press, Princeton.

- Brass, W. (1971), "On the Scale of Mortality", in W. Brass, (ed), *Biological Aspects of Demography*, Taylor & Francis LTD, London.

- Breschi, M. (1990), *La popolazione della Toscana dal 1640 al 1940. Un'ipotesi di ricostruzione,* Dipartimento statistico, Firenze.

- Breschi, M., Pozzi, L. and Rettaroli, R. (1994), "Analogie e differenze territoriali nella crescita della popolazione italiana, 1750-1911", *Bollettino di demografia storica*, 20.

- Breschi, M. and Malanima, P. (2002). "Demografia ed economia in Toscana: il lungo periodo (secoli XIV-XIX)", in M. Breschi & P. Malanima, (eds), *Prezzi, redditi, popolazioni in Italia: 500 anni (dal secolo XIV al secolo XX)*, Forum, Udine.

- Canning, D. (2011), "The causes and consequences of demographic transition", in *Population studies*, 65(3), pp.353-361.

- Castiglioni, P. (1860), *Introduzione storica sopra i censimenti delle popolazioni italiane, dai tempi antichi fino al 1860: Censimento degli Antichi Stati Sardi*, Torino, Ministero dell'Agricoltura, Industria e Commercio, Vol. I.

- Chiarini, B. (2010). "Was Malthus right? The relationship between population and real wages in Italian history, 1320 to 1870." Explorations in Economic History, 47(4), 460-475.

- Chilosi D. and Ciccarelli C. (2022), “Evolving gaps: Occupational structure in southern and northern Italy, 1400–1861”, *The Economic History Review*, 75(4), pp. 1349-1378.

- Coale, J. and Demeny, P. (1966), *Regional Model Life Tables and Stable Populations*, Princeton, Princeton University Press.

- Coale, J., Demeny, P. and Vaughan, B. (1983), *Regional Model Life Tables and Stable Populations*, New York, Academic Press.

- Costa, C. and Reginato, M. (1999), “La popolazione piemontese nel 1600. Un contributo preliminare”, in SIDES, *La popolazione italiana nel Seicento*, Bologna, CLUEB.

- Corradi, A. (1973), Annali delle epidemie occorse in Italia dalle prime memorie fino al 1850 (1865-1894), 2 voll., Bologna, Forni.

- Corsini, C.A. and Viazzo, P.P., (eds.), (1997) *The decline of infant and child mortality: the European experience, 1750-1990*, Martinus Nijhoff Publishers.

- De Castro, D. (1962), “Il movimento naturale di alcuni nuclei demografici del Piemonte dalla fine del secolo XVI”, *Rivista Internazionale di Scienze Sociali*, Anno LXX, Fasc. I.

- Del Panta, L. (1980), *Le epidemie nella storia demografica italiana (secoli XIV-XIX)*, Torino, Loescher.

- Del Panta, L. and Rettaroli, R. (1994), *Introduzione alla demografia storica*, Roma-Bari, Laterza.

- Del Panta, L. and Breschi, M., (eds.), (1995), *Le Italie demografiche*, Udine, Dip. Scienze Statistiche, Università degli studi di Udine.

- Del Panta, L. (1997), *Inverse projection technique and its applications*. Paper presented at the Summer School of SIDES (Società Italiana di Demografia Storica), Firenze.

- Del Panta, L. (1998), “Costruzione di tavole di mortalità provinciali abbreviate 1881/82”, *Bollettino di demografia storica*, 29.

- Del Panta, L. and Forini, M. E. (1994), “Disponibilità alimentari e tendenze della mortalità in Italia: un tentativo di analisi per il periodo 1861-1921”, *Bollettino di demografia storica*, 20.

- Del Panta, L. Livi Bacci, M., Pinto, G. and Sonnino, E. (1996), *La popolazione italiana dal Medioevo ad oggi, Laterza*, Bari-Roma.

- Del Panta, L., Pozzi, L., Rettaroli, R. and Sonnino, E. (eds.), (2002). *Dinamiche di popolazione, mobilità e territorio in Italia, secoli XVII-XX*, Udine, Forum.

- Del Panta, L., Reginato, M. and Scalone, F. (2002), “Un tentativo di ricostruzione demografica del Piemonte tra XVII e XIX secolo, in Del Panta, L., Pozzi, L., Rettaroli, R. and Sonnino, E., (eds.), Dinamiche di popolazione, mobilità e territorio in Italia, secoli XVII-XX, Forum, Udine.

- Del Panta, L. and Scalone, F. (2002) “L’Emilia-Romagna tra XVII e XIX secolo: aspetti del regime demografico”, in L. Del Panta, L. Pozzi, R. Rettaroli and E. Sonnino (eds.), *Dinamiche di popolazione, mobilità e territorio in Italia, secoli XVII-XX*, Forum, Udine.

- Dossetti, M. (1977), “Aspetti demografici del Piemonte occidentale nei secoli XVII e XVIII”, *Bollettino storico-subalpino*, 75.

- Dribe, M. and Scalone, F. (2010), “Detecting Deliberate Fertility Control in Pre-transitional Populations: Evidence from six German villages, 1766–1863”, *European Journal of Population*. Published online Feb. 5.

- Gabotto, F. (2005), *Storia di Cuneo*, Savigliano, L’Artistica Editrice.

- Galloway, P. R. (1986), “Differentials in demographic responses to annual price variations in pre-revolutionary France: a comparison of rich and poor areas in Rouen, 1681 to 1787”, *European Journal of Population*, 3/4.

- Galloway, P. R. (1988), “Basic patterns in annual variations in fertility, nuptiality, mortality, and prices in pre-industrial Europe”, *Population Studies*, 2.

- Galloway, P. R. (1994), “A reconstruction of the population of North Italy from 1650 to 1881 using annual inverse projection with comparisons to England, France and Sweden”, *European Journal of Population*, 10.

- Galor, O. (2012), “The demographic transition: causes and consequences”, *Cliometrica*, 6(1), pp.1-28.

- Ge Rondi, C. (1998), “La dinamica delle provincie lombarde tra Sette e Ottocento”, *Bollettino di demografia storica*, 28.

- Guinnane, T.W. (2011), “The historical fertility transition: A guide for economists”, *Journal of economic literature*, 49(3), pp.589-614.

- Istituto Centrale di Statistica (1965), “Sviluppo della popolazione italiana dal 1861 al 1961”, *Annali di Statistica*, anno 94, serie VIII - vol. 17.

- Kirk, D. (1996), “Demographic transition theory”, *Population studies*, 50(3), pp.361-387.

- Lee, R. (1974), “Estimating series of vital rates and age structure from baptisms and burials: a new technique, with applications to pre-industrial England”, *Population Studies*, 28(3),

- Lee, R. (1985), “Inverse Projection and Back Projection: a critical Appraisal, and Comparative Results for England, 1539 to 1871”, *Population Studies*, 39(2),

- Lee, R. (1993), “Inverse Projection and Demographic Fluctuations: a Critical Assessment of New Methods”, in D. Reher and R. Schofield, (eds.), *Old and New Methods in Historical Demography*, Oxford. Clarendon Press.

- Lee, R. D. and Mason, A. (2010). “Fertility, human capital, and economic growth over the demographic transition”, *European Journal of Population*, 26(2), pp. 159-182.

- Levi, G. (1974), “Gli aritmetici politici e la demografia piemontese negli ultimi anni del Settecento”, *Rivista Storica Italiana*, Anno LXXXVI, Fasc. II.

- Levi, G. (1984), “Distruzioni belliche e innovazione agricola: il mais in Piemonte nel 1600”, in A. Guarducci, A., *Agricoltura e trasformazione dell'ambiente (secoli XIII-XVIII)*, Firenze, Le Monnier.

- Mathieu, J. (2000), *Storia delle Alpi 1500-1900*, Bellinzona, Casagrande.

- Møller, N. F. and Sharp, P. (2014), “Malthus in cointegration space: evidence of a post-Malthusian pre-industrial England”, *Journal of Economic Growth*, 19, pp. 105-140.

- Murphy, T. E. (2010), “Persistence of Malthus or Persistence in Malthus? Mortality, income, and marriage in the French fertility decline of the long nineteenth century”, Bocconi University Innocenzo Gasparini Institute for Economic Research Working Paper, 363.

- Muttini Conti, G. (1962), “La popolazione del Piemonte nel secolo XIX”, *Archivio Economico dell'Unificazione Italiana*, II, vol. IV., Torino, ILTE.

- Netting, R. (1996*), In equilibrio sopra un'alpe,* Roma, NIS.

- Nicolini, E. A. (2007), “Was Malthus right? A VAR analysis of economic and demographic interactions in pre-industrial England”, *European Review of Economic History*, 11(1), pp. 99-121.

- Notestein, F.W., (1945), “Population – The Long View”, in Schultz, T.W., (ed), *Food for the World*, Chicago, University of Chicago Press.

- Pedersen, M., Riani, C. and Sharp, P. (2021), “Malthus in preindustrial northern Italy?”, *Journal of Population Economics*, 34, pp. 1003-1026.

- Prato, G. (1906), “Censimenti e popolazione in Piemonte nei secoli XVI, XVII e XVIII”, *Rivista italiana di sociologia*, Anno X, fasc. III-IV, Roma.

- Prato, G. (1908), “La vita economica in Piemonte a mezzo il secolo XVIII”, *Laboratorio di Economia Politica "S. Cognetti De Martiis" della R. Università di Torino*, Torino.

- Rosina, A. (1996), *IPD 3.0 Applicazione automatica dell'Inverse Projection Differenziata*, Dipartimento di Scienze Statistiche dell'Università degli Studi di Padova.

- Rosina, A. and Rossi, F. (1998), “Il Veneto tra Sette e Ottocento”, *Bollettino di demografia storica*, 28.

- Romani, M. (1982), *Storia economica d'Italia nel secolo XIX*, Bologna, Il Mulino.

- Rosso, C. (1994), “Il Seicento”, in P. Merlin, C. Rosso, G. Symocox, and G. Ricuperati, *Il Piemonte sabaudo. Stato e territori in età moderna*. Torino, UTET.

- Scalone, F. (2001), *Tendenze evolutive e fattori del regime demografico in alcune aree dell'Italia Settentrionale (secoli XVII-XIX), un'analisi basata sull'impiego di dati seriali*, Ph. D. Thesis, Università di Bari.

- Scalone, F. (2002), “Sulle relazioni tra variabili demografiche ed economiche in Emilia-Romagna durante i secoli XVII-XVIII”, in M. Breschi and P. Malanima, (eds.), *Prezzi, redditi, popolazioni in Italia, 500 anni (dal secolo XIV al secolo XX)*, Udine, Forum.

- Schofield, R. S. and Reher, D. (1991), “The Decline of Mortality in Europe”, in R. S. Schofield, D. Reher, and A. Bideau, (eds.), *The Decline of Mortality in Europe*, Oxford, Clarendon Press.

- Sella, D. (1982), *Guerra, crisi e pestilenza, L'economia lombarda durante la dominazione spagnola*, Bologna, Il Mulino.

- Viazzo, P. (1990), *Comunità alpine. Ambiente, popolazione, struttura sociale nelle Alpi dal XVI secolo ad oggi*, Bologna, Il Mulino.

- Vergano, L. (1990), *Storia di Asti*, Asti, Gribaudo.

- Wachter, K. W. (1986), “Ergodicity and Inverse Projection”, *Population Studies*, 40(2).

- Wrigley, E. A., Schofield, R. S. (1989), *The population history of England, 1541-1871*, Cambridge, Cambridge University Press.

- Wrigley, E. A., Davies, R. S., Oeppen, J., Schofield, R. S. (1997), *English population history from family reconstitution 1580-1837*, Cambridge, Cambridge University Press.