Vital events and economic conditions: testing the Malthusian theory on Northern Italy's historical data (1650-1860)

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Abstract

This paper investigates whether the Malthusian theory holds in Northern Italy between 1650 and 1860. We aim at detecting how macro socioeconomic changes affect demographic behaviours, analyzing the relationship between vital rates and economic trends. We rely on two different data sources: vital rates come from a reconstruction of population trends for the period of interest while, in lack of data on the agricultural production, we use the series of wheat prices as a proxy of general wellness conditions. By means of a descriptive comparison between crude vital rates and price trends we document a strong correlation between wheat prices and birth, mortality and nuptiality rates. Our results, furthermore confirmed by a polynomial distributed lag model, do support first the existence of preventive and then of positive checks. We thus conclude that the Malthusian theory is able to explain the demographic development in Northern Italy for the period here analyzed.

1 Introduction

In his famous *An essay on the principle of population* written in 1798, Thomas Malthus stressed that population, when unchecked, increases in a geometrical ratio, while subsistence increases only in an arithmetical ratio (Malthus, 1985). As a consequence of this natural mechanism, the population growth would contrast high living standards. However, Malthus also argued that the population is able to slow its growth through *preventative checks*, which affect the birth rate and age at marriage, originating from moral restraints (i.e. postponement of age at marriage, pre-marriage chastity and birth control) and *positive checks*, which act increasing the death rate (i.e. epidemic diseases, wars and famines). According to Malthus, while the latter are common to the whole human history, the former regard only developed economies –i.e. modern Europe– and in particular England. An opposite theory has been developed by the so-called *anti-Malthusian theorists*, who argue that Malthus did not consider inventive and technological human abilities. They state that the reduction of food supply gives a boost to individuals in order to invent new technological solutions enabled to manage the population growth. Moreover, according to Kuznets and his *modern economic growth*

theory (Kuznets, 1955; 1973; 1986), the population growth always corresponded to important changes in the agricultural and industrial sectors by leading to the rise of both society's well-being and individual per capita income.

At last, some scholars have noted as the neo-Malthusian model is more suitable to describe past economies or those countries where economies are mainly based on agricultural techniques, while the anti-Malthusian theory fits better industrialized countries (see Livi Bacci, 1991; Lee, 1981; Eckstein et al., 1986; Galloway, 1988; Tsoulouhas 1992; Bayley and Chambers, 1993; Grantham, 1999; Allen, 2001; Lee and Anderson, 2002; Nicolini, 2004).

Along the above lines, this paper aims to verify whether the Malthusian theory holds in Northern Italy between 1650 and 1860, when the economic production was mainly based on agriculture and demographic behaviours followed a *natural* trend. In particular, we aim at detecting how macro socioeconomic changes affect demographic behaviours, analyzing the relationship between vital rates and economic trends.

The rest of the paper is structured as follows: section 2 gives the historical panorama of Northern Italy in the period 1650-1860; data and methods are described in the third section; section 4 reports some descriptive analyses of demographic variables and socio-economic indicators; section 5 presents our main results; section 6 concludes.

2 Northern Italy between 1650 and 1860

From 1650 to 1850, the Italian territory was not yet unified but divided and dominated by several foreign powers. In order to discuss the social and economical conditions of Northern Italy in those years, we consider two homogeneous sub-periods: the first, 1650-1750, is a period of crisis involved by several socio-economical changes while in the second period, 1750-1850, renewal forces took place and Italy was approaching the demographic transition. In our analyses, Northern Italy comprehends the following regions: Piemonte, Lombardia, Veneto, Friuli, Toscana and Emilia Romagna, which may be considered a homogeneous area according to both its climatic and environmental conditions and its socio-economical, historical and political evolution in the considered period. The regions Liguria, Trentino-Alto Adige and Valle d'Aosta were not included in the analysis due to lack of historical data.

2.1 An "epochal" crisis and socio-economic changes (1650-1750)

During the period 1650-1750, which we refer to as the first sub-period, Italy was dominated by the Spanish Empire and –after the Utrecht Peace of 1713– by the Austrian Empire. From the end of the sixteenth century until the beginning of the seventeenth century, Northern Italy faced a hard economic crisis affecting all the important sectors in the society. The causes were several and related to different fields; they can be synthesized as follows: frequent and dramatic epidemic diseases (e.g. plague, typhus and cholera); the fiscal pressure of the Spanish Empire finalized to cover war's expenditures; the Thirty Years' War (1618-1648); the shift of the maritime commercial main centre from the Mediterranean Sea to the Atlantic Ocean, with the consequence of depressing the Italian maritime exchanges. According to Livi Bacci (1996) in that period we assist to an "epochal crisis" affecting every sector of the Italian production. Before the crisis, Italy was one of the most developed economies in the occidental Europe characterized by a booming manufacturing industry and a generalized well being. During this period, Italy became a depressed area where food supply was unable

to afford population's growth and where the manufacturing industry was overcome by the agriculture sector. Also at an international level, Italy lost its role as importer of raw materials and exporter of manufactured products becoming importer of the latter and exporter of the former (Cipolla, 1961).

2.2 The long "introduction" to the demographic transition (1750-1860)

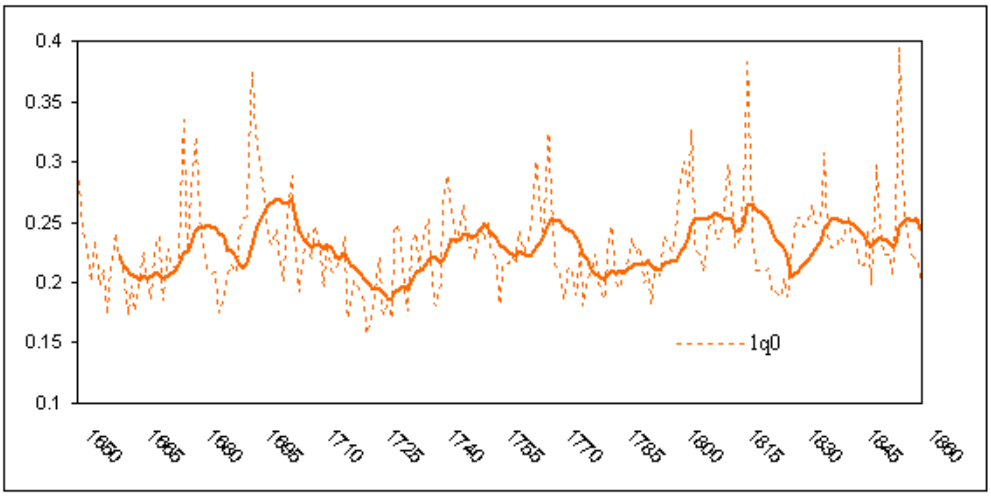
In the second sub-period considered (1750-1860), Northern Italy began slowly to react to the precedent shocks and experienced great social, economical and political changes. The Austrian domination was interrupted by Napoleonic Wars (1799-1815) and by the consequent "Napoleonic Age", which corresponded to the birth of the French "Sisters' Republics" (i.e. the Cisalpine Republic and the Republic of Liguria), composed by the Northern regions[1] (1802-1814). After the fall of Napoleon (1815), Congress of Vienna re-established the Austrian domination in Northern Italy. These historical processes led to the beginning of the Italian Risorgimento and Independence Wars ended with the birth of the Kingdom of Italy in 1861. During this long period several innovations took place, aimed at reacting against the dramatic crisis of the previous century. During the Enlightenment period, Maria Theresa of Austria planned several financial and educational reforms; she promoted also commerce and reorganized the agriculture sector by implementing new technologies. Later, the Napoleonic period drew an important program of socio-sanitary and administrative reforms (e.g. compulsory vaccination of smallpox, removal of cemeteries from the city centres, etc.).

Thus, in this period the most infective epidemic diseases disappeared while others became less frequent and aggressive. According to Bengtsson et al. (2004), this period coincides with the end of a process of indiscriminate mortality (i.e. not differentiating by gender, social conditions, age) and the beginning of the selective mortality where socio-economic and contextual factors assumed a fundamental role in survival chances. In the same manner, also technological innovations in the agricultural sector highly increased the production (e.g. the introduction of maize and the consequent disappearance of famines).[2]

Despite all these improvements, this period is still antecedent to the first demographic transition, which took place in Italy only at the end of the nineteenth century. As described in the next Figures (1 and 2), both the level of infant mortality (i.e. probability of dying between age 0 and 1) and life expectancy at birth show a high variability during this period but still no changes in the long term. With respect to the former, in the short term fluctuations around the mean equal 20-25‰, while in the latter these are equal to 20-25 years.

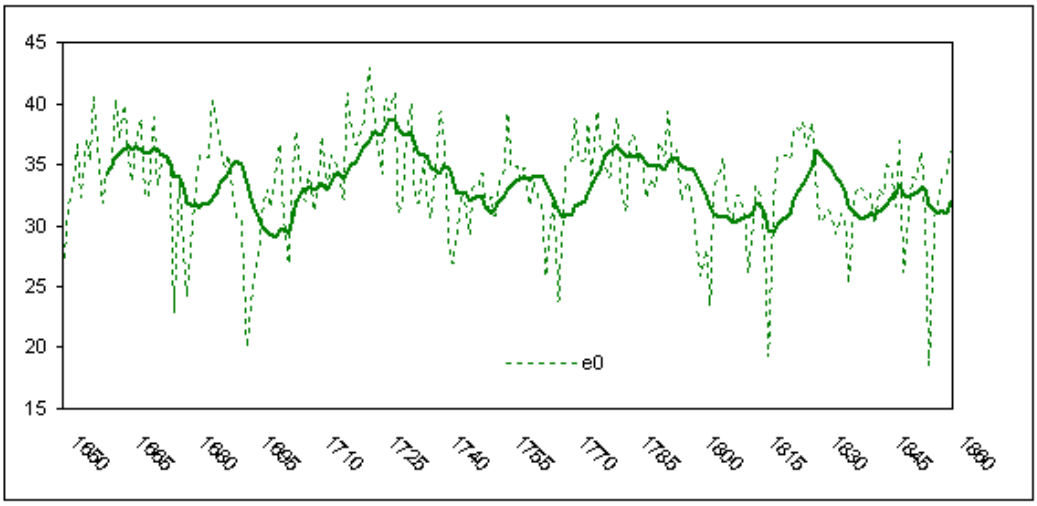
[1] With the Campoformido Treaty, the Republic of Venice, created by Napoleon, was instead given to Austria, ending in this way the secular autonomy of the Veneto territory.
[2] The last famine occurred in 1815-16.

Fig. 1 – Infant mortality ($_1q_0$), Northern Italy, years 1650-1860.



Source: Own computation on Galloway data (1994).

Fig. 2 – Life expectancy at birth (e_0), Northern Italy, years 1650-1860.



Source: Own computation on Galloway data (1994).

3. Data and Methods

To develop our analyses we rely on two distinct sources of data for the vital rates and the economic information needed. We focus on 200 years starting from 1650 up to 1860 –i.e. one year before the Italian unification– and on Northern Italy, which, according to Galloway, comprehends the regions of Tuscany, Emilia, Piedmont, Lombardy and Veneto.

Information on the demographic series are gathered by P.R. Galloway (1994), who reconstructed the total amount of Northern Italian annual population as well as the total number of births, deaths and marriages from 1650 to 1860 by using the inverse

projection method.[3] In this section, the annual death, birth and nuptiality rates are respectively described.

For what concerns economic data, in lack of data on the agricultural production, we use the series of wheat prices gathered from the Allen-Unger database (2006), freely downloadable for public use. The reason for this choice is that we are interest in studying short term changes in real income calculated in food consumption; therefore we use the wheat price as a proxy of this variable. Indeed, the most part of household income and consumption was directed on food, especially on grain related products, and Northern Italy in the two centuries here analyzed was a pre-industrial area, which based its economy essentially on agricultural production and the Italian diet was principally composed of grain related products. On these bases, wheat prices proved to be a reasonable proxy of the wellness condition of the population.

The Allen-Unger database provides data on grain price yearly series for several Italian cities. As can be noticed from Figures 3 to 6, wheat price series for some major North Italian cities follow roughly the same trend, both in the long run and in the short-run. This trend similarity is confirmed by the Pearson's coefficient (Table 1). Basing on this consideration and on the fact that prices where set in urban markets, we selected the price series for the city of Milan, which proved to be a very reliable series. The starting point of the series is 1701, therefore we needed to account for prices in the previous 50 years. To this aim, we used the price series of Udine, which proved to be very correlated to the series of Milan: the Pearson correlation coefficient in fact equals to 76%. The high correlation among the four considered series allows us to consider Milano and Udine's series as proxy of the whole area. Data are provided both in Italian lire and lire milanesi for Udine and Milan respectively, and in a conversion form, that is, in grams of silver per litre, where the conversions are based on the known quantity of silver in the relevant coinage and the size of the current measure used. This converted form allows comparisons of the price series over time and across political boundaries. In what follows we apply a further conversion, by multiplying the whole price series for a factor of 20, in order to come back to the scale value of the original prices and ease comparison with the demographic series.

After removing the long term changes in our time series (in log-scale) with the Hodrick-Prescott filter, we analyzed the deviations from the trends. For an easier interpretation of the results, we consider the series on a log scale.

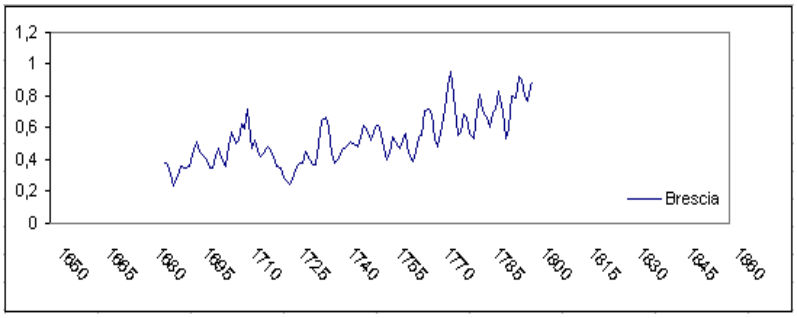
Tab. 1 – Pearson's coefficients among the Corn flour's prices of Brescia, Udine, Milano e Siena. Years 1650 – 1860.

	Udine	Milano
Brescia	0.81	0.91
Siena	0.57	0.74
Udine	-	0.76

Source: Own computations on Allen, Unger' data (2006).

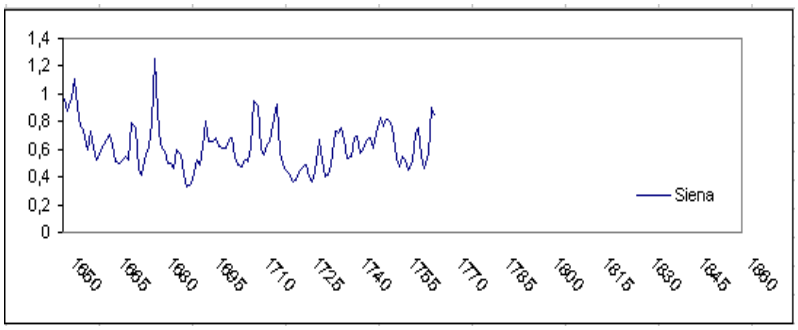
[3] Starting from the 1861 census data on the population totals, births and deaths and using the equation $P_{t-1} = P_t - B_t + D_t$, under the assumption of closed population, Galloway reconstructed North Italian population back to 1650. He furthermore provided estimates, between others, of the life expectancy at birth and, basing on 1861 available data on marriages, also of the CMR. For more details on inverse projection methods procedures see Lee, 1985 and 1993.

Fig. 3 – Wheat prices. Brescia, 1650 – 1860.



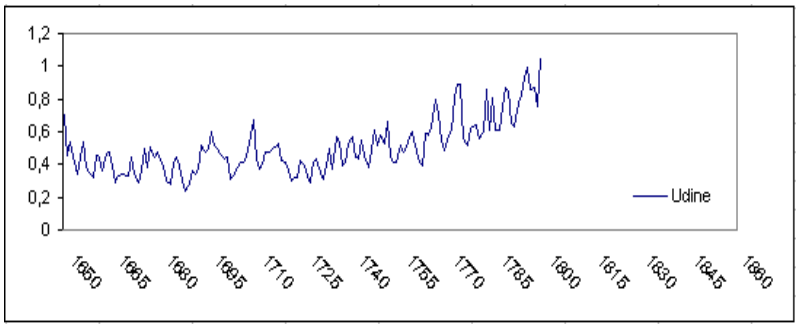
Source: Own computations on Allen, Unger' data (2006).

Fig. 4 – Wheat prices. Siena, 1650 – 1860.



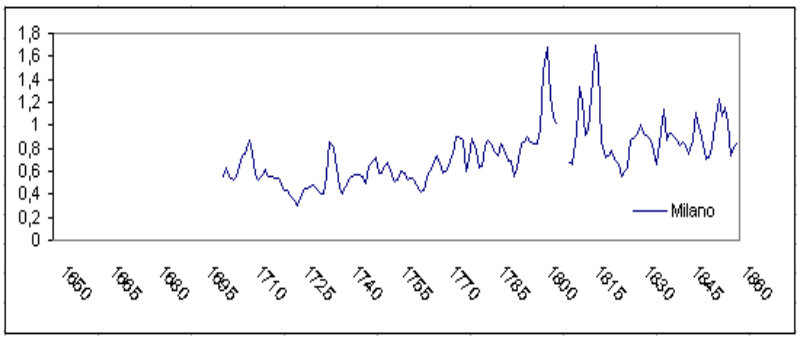
Source: Own computations on Allen, Unger' data (2006).

Fig. 5 – Wheat prices. Udine, 1650 – 1860.



Source: Own computations on Allen, Unger' data (2006).

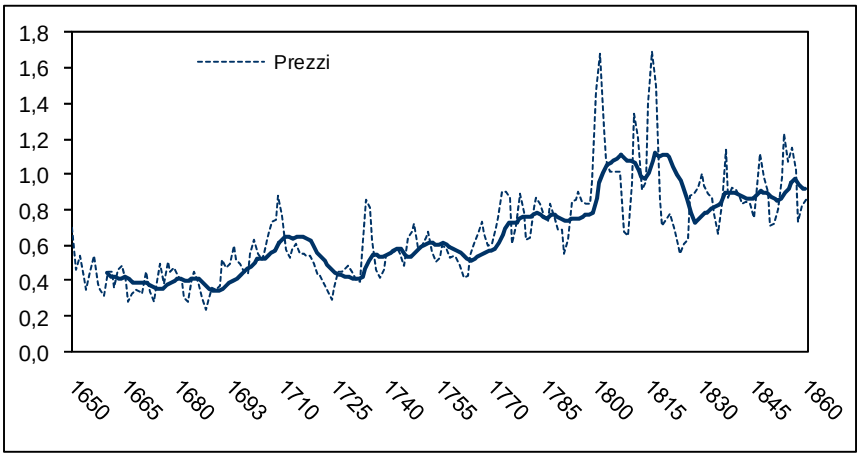
Fig. 6 – Wheat prices. Milano, 1650 – 1860.



Source: Own computations on Allen-Unger database (2006).

Figure 7 shows the price trend obtained combining the series of Milan and Udine. Prices remained quite stable until the beginning of the 18th century, when the series begins a long-term trend upward. A sequence of price crises can be observed between 1800-1830, but in generally only small variations are observed from one year to the other.

Fig. 7 – Wheat price. Udine, 1650-1700 e Milano, 1701- 1860.



Source: Own computations on Allen, Unger' data (2006).

In order to study the relationship between economic and demographic trends, we first compare each series of vital rates (Crude Marriage Rate –CMR–, Crude Birth Rate –CBR– and Crude Death Rate –CDR) with the price series. Secondly, we apply a Polynomial Distributed Lag model, also known as Almon Lag model, to estimate the lagged impact of price variations on the three series of vital rates –CBR, CDR, CMR. All series are smoothed with Hodrick-Prescott filter. The model assumption is that the current value of the dependent variable depends on the current as well as on the lagged value of the price series. In all regressions we consider a time lag of four years for wheat prices. According to theoretical assumptions, in the regressions for fertility and nuptiality we also control for mortality, and in the former case we also control for nuptiality.

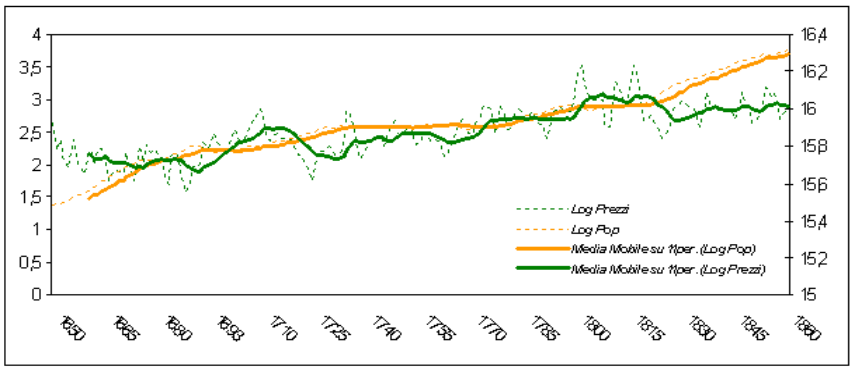
4. Results

4.1 Demographic behaviours and price trends: a descriptive analysis

In this section, we try to disentangle the relation between population and prices during the observed period, by the means of a comparative descriptive analysis. To this aim, we first show the series of vital rates and then we relate each of them to the price series. Figure 10 plots the logarithmic series of total population and price trends during the whole period considered. The two curves seem to be significantly correlated: wheat prices tended to increase when the population was rising. More in detail, prices grow annually at a rate of 15‰, while the population grows at a rate of 4‰. Thus, the Malthusian hypothesis seems to be confirmed: population increases faster than subsistence does. Nevertheless, the relation between prices and population changed at the beginning of the XIX century, when population continued to grow, whereas prices remained stable. This latter trend is probably related to the fact that Northern Italy was

approaching the so called Modern Economic Growth at the beginning of the demographic transition.

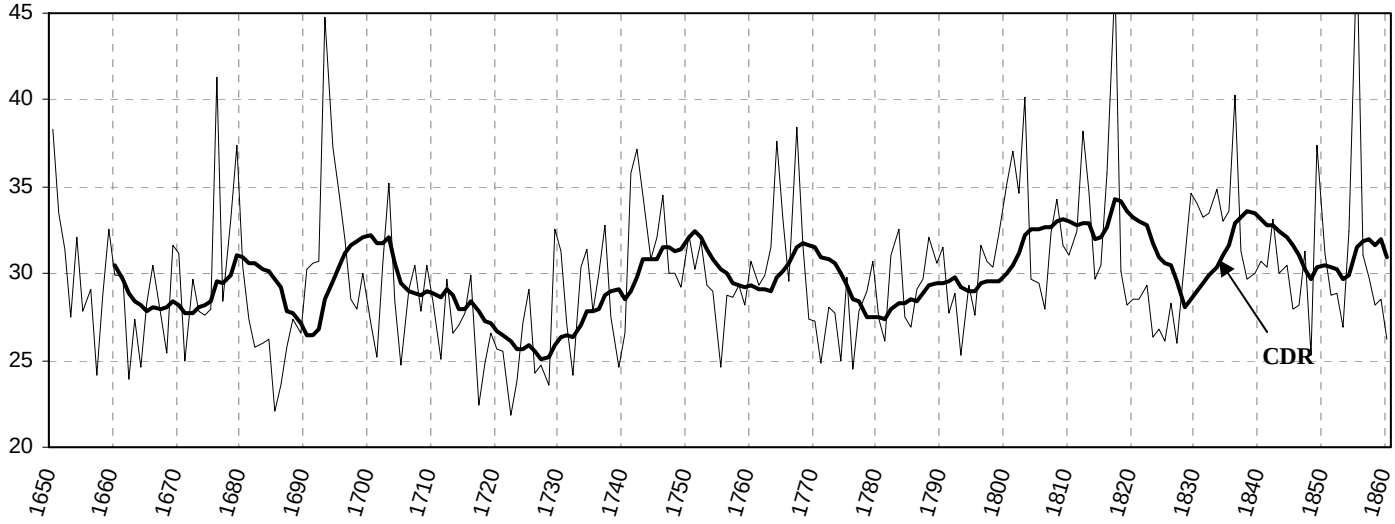
Fig. 10 – Total population and corn flour's Price trends. Northern Italy, 1650-1860



Source: Own computations on Allen, Unger' data (2006) for economic data and on Galloway (1994) for demographic data.

Figure 11 shows that during a two-hundred-years time period, the long-term mortality trend is quite stable around a value of 30‰. Nevertheless, the long-term trend is the result of high and frequent fluctuations in the short term as a result of the changes occurred in the causes of mortality. In particular, the 17th century is characterized by a spread mortality due to epidemic diseases, e.g. plague (1630), chickenpox (1693-94), and famines. Starting from the 18th century, epidemic diseases become less frequent, until disappearance during the nineteenth. They progressively leave the place to causes of death more influenced by the historical and economic context. Thus, such peaks in the death rate are observed in correspondence to the Napoleonic wars (1799-1802), the last typhus crisis (1815-16) and the first two Independence wars (1848-49; 1859). To summarize, in this two centuries, what changed is not the level of mortality but the profile of causes of death by leading to a more selective mortality process.

Fig. 11: Crude Death Rate, Northern Italy, 1650-1860

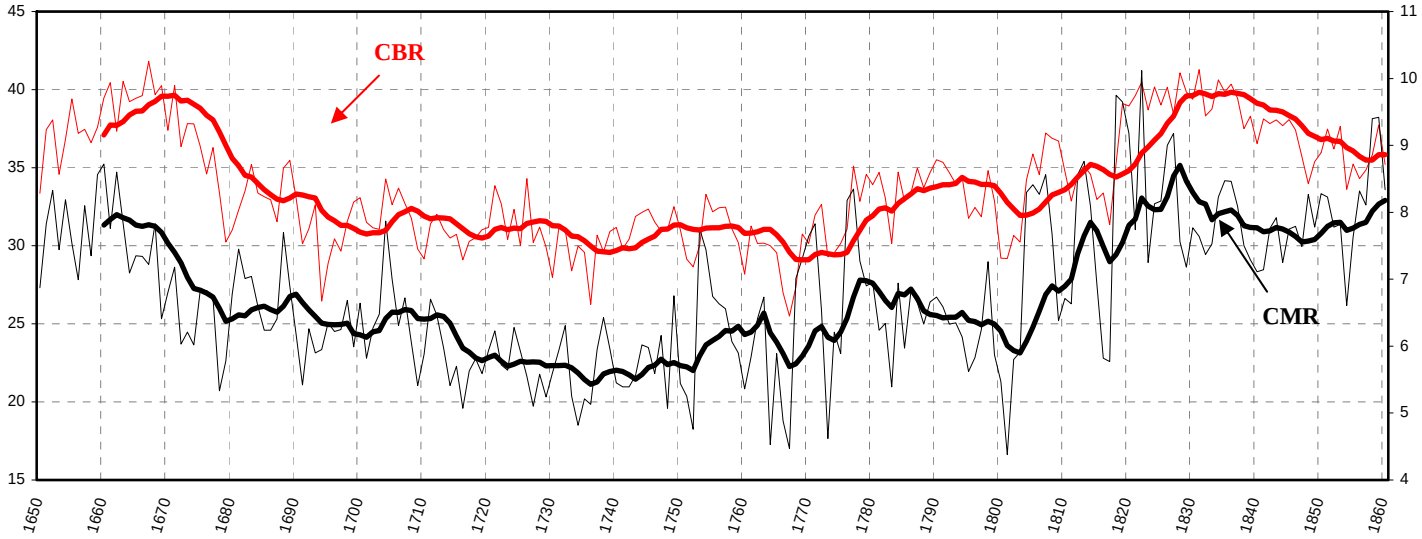


Source: own computations on Galloway (1994).

The Crude Birth Rate clearly mirrors the long term Crude Marriage Rate trend (Fig. 12): both series reach a first peak around the values of 40‰ and 7.5‰ respectively, in response to the 1670/1675's plague, then they both decrease and stabilize for a century around the values of 30‰ and 6‰ respectively and finally rise again to the same peak value experienced approximately two centuries before. The growing long-term trends observed in the last period can be interpreted as resulting from the mortality crises which occurred during the 19th century (see Fig. 11): the increased amount of widows and widowers lead to a rise in remarriages while the favourable economic opportunities (also access to inheritance) for those not yet married allowed them to marry.

The annual birth and marriage rate series can be divided in three different phases. Being the two schedules very similar, we concentrate on the birth series: at the beginning, a decreasing trend is observed from a peak of 41‰ in 1670/1675 to 31‰. The second phase is more stationary: after 1680 when the minimum value of 31‰ is reached, the birth rate remains almost constant until the end of the 18th century, when it starts to increase again (third phase) by achieving the same value observed two centuries before, i.e. 41‰.

Fig. 12: Crude Birth Rate and Crude Marriage Rate, Northern Italy, 1650-1860



Source: own computations on Galloway (1994). Values in ‰.

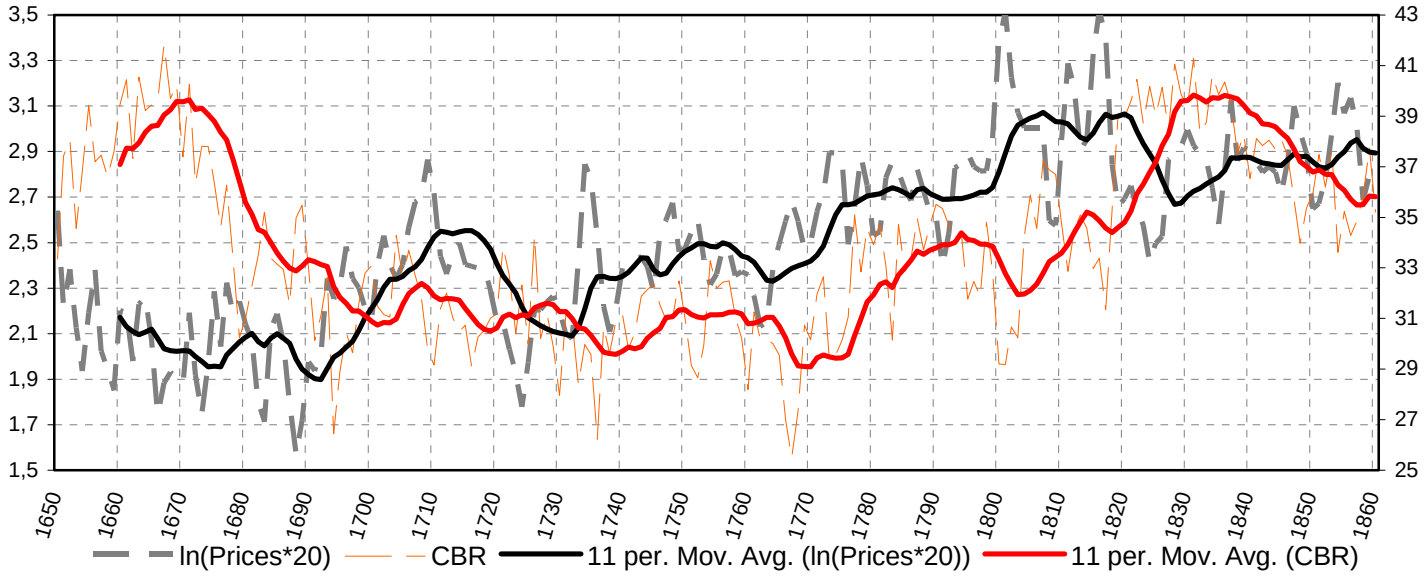
Nevertheless, the two observed peaks represent different population checks. The first one represents the population check to the plague of 1630: since the births, lost during a period of high mortality, are recovered during the following years (Lee, 1981), the first peak can be interpreted as a kind of deviation from the secular variation of fertility represented by the stationary phase of the 18th century. The second peak, instead, represents the response to the mortality crises of the 18th century. As argued by Ohlin (1981), in many pre-industrial populations the pattern of marriages, inheritance and succession are linked: it seems that the increasing importance of the historical and economic background altered not only the mortality pattern but also the amount of people at risk of marriage and thus the number of new births.

To summarize, the observed demographic rates suggest that the period from 1650 to 1860 is characterized by two distinct behavioural trends: 1. from 1650 to 1750, where

spread mortality and high fertility are accompanied by stable marriages; 2. from 1751 to 1860, where selective mortality and high fertility are accompanied by an increasing trend in marriages.

As can be seen from Figure 13, fertility responds quite strongly and quite quickly to price variations: a price increment corresponds to a birth decrement. Fertility seems to start responding to a price increase in the same year, even though the peak in the fertility drop can be seen one year after the price shock, while in the following years the effect gradually disappear. Furthermore, fertility responds more to price increases than to prices decreases, as confirmed by the theory and the correlation between the two variables weakens over time

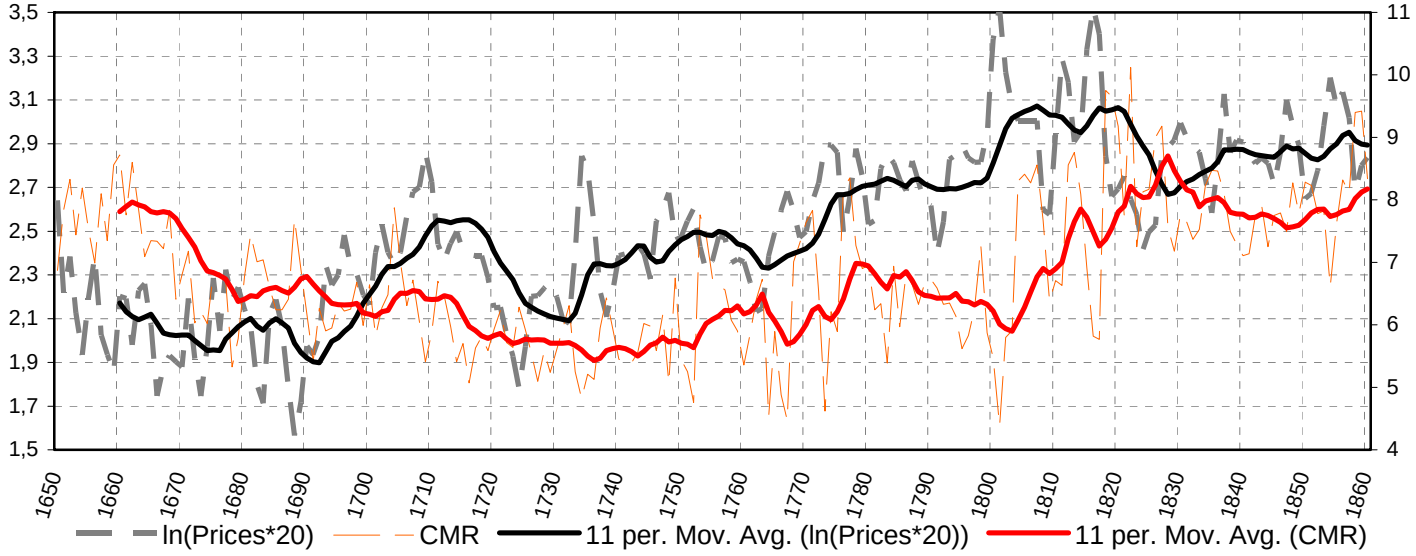
Fig. 13: Crude Birth Rate and wheat prices, Northern Italy, 1650-1860



Source: Own computations on Allen-Unger database (2006) for economic data and on Galloway (1994) for demographic data.

A similar relation is observed between prices and marriages (Fig. 14): during periods of economic crises, people tend to postpone marriages. Thus, the presence of the Malthusian preventive check seems to be confirmed.

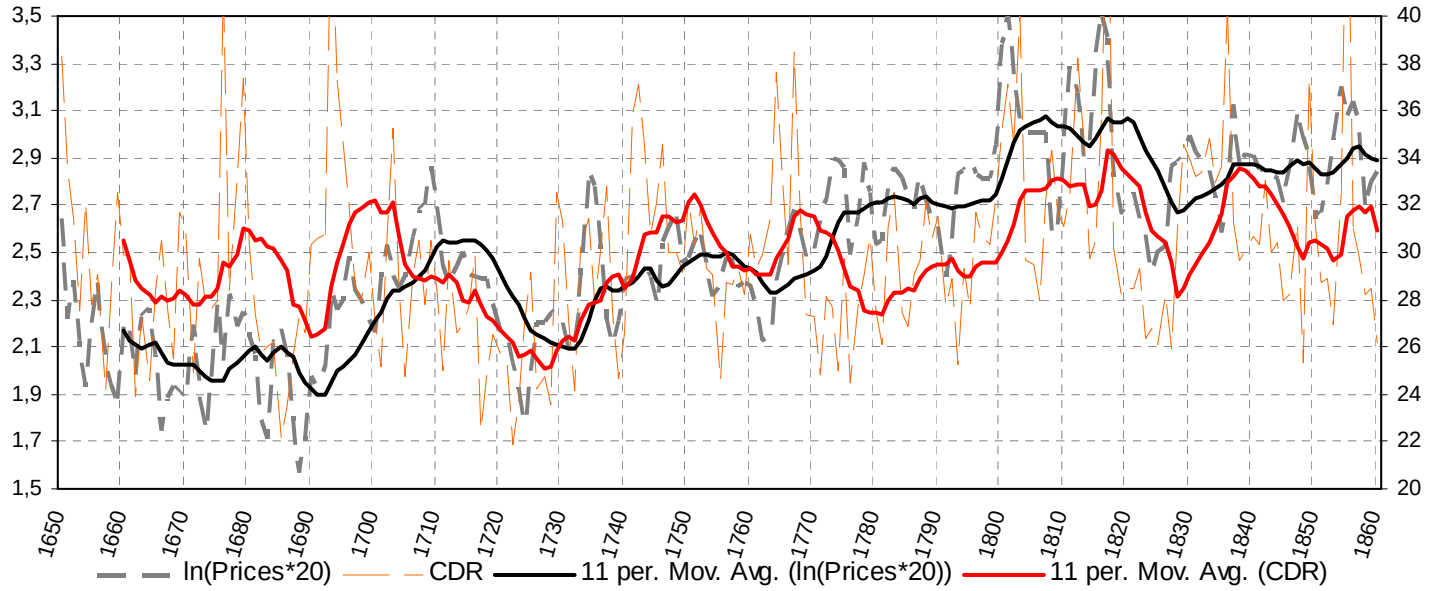
Fig. 14: Crude Marriage Rate and wheat prices, Northern Italy, 1650-1860



Source: Own computations on Allen-Unger database (2006) for economic data and on Galloway (1994) for demographic data.

Until the beginning of the 18th century, prices and mortality do not show any particular relationship: a change in prices did not correspond to an equivalent variation in the mortality level (Figure 15). The relation between prices and mortality becomes clear only in the first decade of the 18th century, when the correlation between the two curves starts to be stronger and relevant until the end of the considered period. These considerations seem therefore to confirm the hypothesis of the evolution of the force of mortality over time: from indiscriminate and universal, starting from the 18th century, mortality becomes selective and responsive to short-term economic stress.

Fig. 15: Crude Death Rate and wheat prices, Northern Italy, 1650-1860



Source: own computations on Galloway (1994).

4.2 Demographic behaviours and price trends: a regression analysis

The descriptive analyses presented in the previous section give an idea of the existing inverse relation between population growth and wealth in Northern Italy, especially in the last of the two centuries considered. In this section results of the Polynomial Distributed Lag Model are presented and discussed.

As Figure 13 clearly shows, fertility seems to react promptly to price variations, controlling for both mortality and nuptiality. Results from the regression model confirm the descriptive analysis for what concerns the second period (1751-1860), when an increase in wheat prices causes an immediate (in the same year and with one-year lag) decrease in the CBR, which could be explained by behavioural components, i.e. voluntary birth control through increased contraception. Linking the latter pattern to the one related to the marriage rate, we can assert the existence of Malthusian preventive checks. In the first period (1650-1750), prices have apparently no impact on fertility. In the first sub-period the impact on fertility of a change in mortality is negative and disappears after one-year lag. In the second period, the trend of the coefficient is quite different: apart from the simultaneous negative response, fertility is affected by a mortality shock until a three-year lag. For what concerns the relationship between CBR and CMR, of course the two variables are strongly related: the coefficients are positive and significant for the both periods, but if the lagged association is quite clear, the instantaneous one could seem strange at first sight. Nonetheless it can be explained by the month distribution of marriages that was common in Italy during the last centuries. In fact, usually marriages took place during the first 4 month of the year, especially in April.

During periods of economic crisis, the population generally postpones unions, and this is particularly true in Western countries, where the nuclear family model prevails. The immediate negative response of marriages to changes in wheat prices –net of mortality– is also visible from the lagged regression in both the sub-periods. Regressions also show that two and three years after a price shock occurred, marital rate tends to increase again, while the year after the economic crisis does not seem to influence marriages. The positive lagged effect of prices is also visible for fertility after mid 1700s. During the first sub-period, a change in mortality does not imply any change in nuptiality. Instead, during the second period, evidence shows a simultaneous negative response to an increase in mortality. This can be explained by a diminished amount of population at risk, marriage postponement due to future partner deaths or to social customs and traditions (mourning time). The positive effect found at lag 3 could furthermore be explained by the fact that an increase in mortality increases inheritance availability.

Our estimates show that a short term price stress causes an increase in mortality starting from one year later. This is in line with the theory which states that malnourishment has a delayed effect on mortality. In this period, mortality was primarily caused by epidemic diseases and famines. The effect is delayed maybe because people learnt to forecast a bad harvest or bad conditions in general. After 4 years the negative effect of prices is recovered by a slight decrease in mortality. In the second period, instead, a Malthusian positive response on a short-term economic crisis seems to be in act. In fact, mortality increases during the first two years after price shock, pertaining to the economic situation.

Table 2: Polynomial distributed lag regression model, Northern Italy, 1654-1750 and 1751-1860

		Fertility		Nuptiality		Mortality	
		1654-1750	*1751-1860*	*1654-1750*	*1751-1860*	*1654-1750*	*1751-1860*
Prices	0	-0.003	-0.022 ***	-0.005 ***	-0.010 ***	0.019	0.024 **
	1	-0.005	-0.011 ***	0.000	-0.001	0.015 **	0.018 ***
	2	-0.003	-0.002	0.002 *	0.004 **	0.006	0.009
	3	0.001	0.005 *	0.003 ***	0.005 ***	-0.008	-0.002
	4	0.008	0.009	0.002	0.001	-0.026 **	-0.016
Mortality	0	-0.090 *	-0.080 **	-0.020	-0.060 ***		
	1	-0.050 *	-0.070 ***	0.000	-0.020		
	2	-0.030	-0.060 **	0.010	0.010		
	3	-0.040	-0.050 *	0.010	0.020 *		
	4	-0.070	-0.030	-0.010	0.010		
Nuptiality	0	0.880 ***	0.800 ***				
	1	0.550 ***	0.450 ***				
	2	0.390 *	0.260 ***				
	3	0.420 **	0.220 ***				
	4	0.640 *	0.330 ***				

p-value: *** < 0.01; ** < 0.05; * < 0.10.

Conclusion

Taking advantage of available time series data for the main vital events and taking socio-economic factors into account, modelled by the means of the wheat price series, our study shows that the Malthusian theory is a good explanation of the demographic evolution occurred in the North-Italian context in the period between 1650 and 1860. Based on our evidence, in both the observed periods it is possible to recognize the existence of a positive check. A preventive check can be observed in both periods too, operating through nuptiality (bad times cause marriage postponement), even though the effect for the second period considered is twice the one observed for the first period. A preventive check operating through the fertility mechanism can also be found, but only in the second observed period, when family planning begins its diffusion.

In conclusion, during the considered periods North Italian vital rates seem to be affected by short term economic stresses, thus following the Malthusian theory, through both positive and preventive checks. However, we expect that, as the demographic transition would occur in Italy in the following decades, the Malthusian framework is expected to be replaced by the "Modern Economic Growth" Theory.

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