SECULAR CHANGES IN THE SHORT-TERM PREVENTIVE, POSITIVE, AND TEMPERATURE CHECKS TO POPULATION GROWTH IN EUROPE, 1460 TO 1909

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Abstract. Annual variations in births, marriages, deaths, grain prices, and quarterly temperature series in England, France, Prussia, and Sweden are analyzed using a distributed lag model. The results provide support for the existence of the short-term preventive, positive and temperature checks to population growth. Decreases in fertility and nuptiality are generally associated with increases in grain prices. Increases in mortality appear to be associated with high grain prices, cold winters and hot summers. Changes in these responses over time are examined within the context of economic development.

'The causes of a high mortality are various; but the greater number of known causes may be referred to five heads: 1) excessive cold or heat; 2) privation of food; 3) effluvial poisons generated in marshes, foul prisons, camps, cities; and epidemic diseases, such as typhus, plague, small pox, and other zymotic diseases; 4) mechanical and chemical injuries; 5) spontaneous disorders to which the structure of the human organization renders it liable.' - Farr (1846, p. 164).

'...a foresight of the difficulties attending the rearing of a family acts as a preventive check, and the actual distresses of some of the lower classes, by which they are disabled from giving the proper food and attention to their children, acts as a positive check to the natural increase of population.' - Malthus (1798, Chapter 4).

Introduction

One measure of development may be reflected in the ability of a society to successfully insulate itself from the vagaries of exogenous environmental shocks. For example, in modern industrialized countries an annual increase in the consumer price index or an annual reduction in the real wage probably has little impact on overall annual mortality. Institutional programs (especially in northern and central

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European countries) are generally thought to be sufficient to prevent deaths of the poor from possible starvation and malnutrition resulting from an annual increase in prices or overall reduction in the real wage. On the other hand, the impact of annual changes in the standard of living on annual variations in fertility in developed countries can be substantial. A decrease in the annual real wage may cause couples to end or postpone reproduction. However a decrease in the annual real wage might reduce the opportunity costs of working wives and lead to an increase in fertility.

One purpose of this paper is to examine how annual changes in exogenous forces like food prices and seasonal temperatures affect demographic behavior and how the magnitude of these short-term effects changes over time in preindustrial England, France, Prussia and Sweden. Mortality responses to annual fluctuations in the economy (the short-term positive check) and the weather (the short-term temperature-mortality check) should diminish according to some measure of economic development. In other words, as a country's living standard rises, insulation from these kinds of exogenous shocks should also increase. We will also examine annual fertility responses to annual variations in the standard of living (the short-term preventive check) and weather (the short-term temperature-fertility check). The impact of annual fluctuations in living standards on annual variations in nuptiality will also be analyzed.

Another purpose of this paper is somewhat more technical. Examination of the relationship between short-run fluctuations in vital events and the economy has become standard practice in historical demographic research (Table I). The statistical techniques are relatively simple, the only data needed are long series of vital events and prices, and the results are usually informative. However, previous attempts to measure the impact of price (and sometimes temperature) effects on vital events have always been affected, perhaps flawed, by the somewhat arbitrary choice of start-points and end-points and the assumption that the responses within a given interval are more-or-less the same throughout the interval. Researchers interested in examining whether responses change over time for a given place have usually segmented the time interval for which data were available. The start-points and end-points of these segments were often arbitrarily defined, or based on some fuzzy notion of structural change. This study attempts to address these problems using two methods each with its own particular set of problems and advantages, but both of which should yield similar conclusions.

**Background**

Figure 1 presents a stylized and somewhat simplified characterization of the impact of annual changes in various more-or-less important environmental factors on annual variations in births and deaths in a preindustrial society. As in most of these types of diagrams the arrows could conceivably connect all the boxes in all directions, with the exception of weather effects which are truly exogenous. The signs