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Protein supply and nutritional status in nineteenth century Bavaria, Prussia and France

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ABSTRACT

What determined regional height differences in the 19th century? We compare anthropometric evidence with production estimates of different food products and other economic variables. To this end, we concentrate on 179 rural regions and 29 towns in Bavaria (Southeast Germany). This regionally disaggregated level of analysis enables us to study the influence of the local supply of different food products on the nutritional status of the population, among which milk turned out particularly important. This result is tested and confirmed with regional data from Prussia and France.

1. Introduction

Nearly all previous anthropometric studies have pointed to the importance of regional height differences. To give just a few recent examples of a large literature, Komlos (2007) studied the regional height differences in the 19th century Habsburg monarchy, finding that military recruits in Austria and today's Croatia were significantly taller than those in the Polish- and Romanian-speaking parts of the Empire.[1] Stegl and Baten (forthcoming) and Moradi and Baten (2005) assessed recently heights in the Middle East and Africa, respectively, and found marked regional differences. The influence of protein production per capita was often causing differences in height in remote and sparsely populated areas (see also Cuff, 2005).

In this study, we assess regional differences in the Southeastern German kingdom of Bavaria in the 19th century at the level of 179 rural districts and 29 towns, whose population averaged 14,000 (in 1844). This regionally disaggregated level of analysis enables us to assess the influence of the local supply of different food products and other economic variables on the nutritional status of the population. We will assess whether the proximity to protein production, and milk production in particular, has a positive influence on regional heights. This core question will be called the "milk hypothesis" (see also Bogin, 1999, and on Bavarian convicts Baten and Murray, 2000). In addition, we compare the main results of the analysis of Bavaria with two other states, Prussia and France.

Between 1803 and 1816 Bavaria consisted of many small territories with different economic structures. Upper Franconia in the northeast and parts of Swabia were regions with large proto-industrial sectors particularly in textile and metal manufacturing, as large on a per capita

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[1] See also Komlos (1985) on regional differences.

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basis as that of Saxony or Bohemia. The rest of Bavaria was dominated by agriculture (Bosl, 1985). Nevertheless, different soils, transport facilities, and population densities implied different production structures. Milk and beef production in the southern and eastern mountain regions contrasted with grain and pork production along the Danube and Main Rivers. In the lower Main region and in the Palatinate near the Rhine, quite a lot of potatoes were produced as well as pork, grain and wine, and this was also true of the proto-industrial region in the northeast. These regional differences make a study of the influence of regional production structures on nutritional status interesting. This analysis should also contribute to our general understanding of the relationship between nutritional status and economic development at the early phase of industrialization.

Similar differences existed in Prussia and France. Roughly speaking, Prussia had dominant cattle-farming areas in the Northwest, whereas its industrial cores were situated in the Rhineland, Silesia, and region around Berlin. French agriculture produced more protein in the Northeast, and the industrial centers were the North, Alsace-Lorraine, and Paris.

2. Data sources

Two types of anthropometric data sources are analysed in this study—individual records of conscripts and published conscription statistics.

Individual conscript lists 1815–1849: Although there was a minimum height requirement, all 21-year-old males were first measured, except very few volunteer soldiers, emigrants and priests.[2] A large number of conscription lists are available for birth cohorts between 1815 and 1849. These lists report health, height, name, district of birth, district of conscription, birth year, and occupation of the conscript and that of his father (or mother, if she was unmarried or widowed).[3] There are some gaps in the archives for the proto-industrial weaving districts, the potato region, and the industrially developed towns, i.e., Augsburg and Nuremberg. The conscript lists are used in the entire study.

Conscription statistics at the district level 1809–1835: Gaps in the archival lists can be bridged to a certain extent by the published conscription statistics, which are available for the birth cohorts 1809–1835 (Fig. 1).[4] These aggregate statistics report (a) the number of conscripts from a certain year and district, (b) the percentage rejected because of short stature, and (c) the percentage rejected because of illness. Average height is not recorded, but as we know that heights are normally distributed, we estimate average height as a function of the percentage of those subjects rejected because they were too short.[5] Similar sources will be analyzed for Prussia and France.

Using the individual conscription lists of 1815–1849, we can actually estimate the relationship between average heights and the rejection rate by regressing the average height in a district on the share of conscripts rejected there, who were shorter than 155.6 cm, by district and 5-year-birth period:

$$\text{Average height}(\text{in cm}) = -0.8 \times \text{rejection rate}(\text{in}\%) + 169.3\,\text{cm}$$

(P-values are 0.00 for both coefficient and constant, adj. $R^2 = 0.52$; $N = 63$).

Hence we estimated that a 1% change in the rejection rate meant a 0.8 cm change in average height.[6]

3. Characteristics of Bavaria

Before we test the milk hypothesis and other potential determinants of height, we examine the characteristics of Bavaria. Compared to other countries, Bavaria had a larger number of cattle per capita. In 1852/1853, there were 0.57 cattle per capita in Bavaria, while in France (1852), Hungary (1857), and Germany as a whole (1857) there were only about 0.34 cattle per capita, and in Austria (1851) there were 0.42 (Hoffmann, 1965; Böhm, 1995; Mitchell, 1975; Sandgruber, 1987). Moreover, Bavaria's grain production was not much lower than in other European countries, while the industrial sector was less important, except in regions such as Swabia and Franconia (Nuremberg). Only 23% of the population of Bavaria was employed in industry, in contrast to 48% of the British population (Hoffmann, 1965).

Before the railway age, the possibilities for the transportation of bulky goods were more limited in Bavaria than in other parts of Europe. Water transport was the only cost-efficient way of moving bulky goods long distances, but the only navigable rivers in Bavaria were the Main and the Rhine in the North West and the Danube in the southern half of the country. However, the Danube flowed in the wrong direction from an economic perspec-

[2] The conscripts were chosen by lot from those eligible. Those who could afford it could buy substitutes to do the military service, and the sons of noblemen had the privilege of entering the cadet corps, however, they, too, were recorded and measured (see Regierungsblatt für das Königreich Bayern, München, 1830, pp. 441–607). For the sources, see Table 1.

[3] A few groups were recorded but not examined. Their share (between 0 and 3%) was too small to bias the result. The following groups were not measured: (a) volunteer soldiers already serving in the army; (b) those who disappeared illegally; (c) priests who had taken orders. Percentages of the three groups were extremely low, and they belonged to different social strata. Military volunteers might have been a little bit taller than the average because of the minimum height requirement, although this minimum requirement was extremely low (155.6 cm). Priests were also probably taller, because their parents tended to belong to the middle and upper classes. By contrast, missing recruits were mostly born in the lower social classes, as the occupations of their parents recorded in the lists suggest.

[4] But not for Lower Franconia up to 1819. They were published in a contemporary statistical journal, see Beiträge zur Statistik des Königreichs Bayern (1854, 1859).

[5] Certainly, there are disadvantages in the conscription statistics, compared with the individual archival lists. Occupations were not recorded, and the statistics did not go beyond the birth year 1835 on an annual basis. In addition, the counting method changed between the birth years 1830 and 1831 (see notes to Table 1).

[6] If the rejection-rate was higher, the coefficient decreases. For the conscripts of the Grand Duchy of Baden born between 1820 and 1840, for example, a 1% change in rejection rate was brought about by only a 0.5 cm change in average heights (calculations on the data from Ammon, 1899).