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THE FERTILITY TRANSITION IN BAVARIA

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The Fertility Transition in Bavaria

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Abstract

The decline of human fertility that occurred in Europe and North America in the nineteenth century, and elsewhere in the twentieth century, remains a topic of debate largely because there is no accepted explanation for the event. Disagreement persists in part because researchers have rarely used the detailed quantitative information necessary to form adequate tests of alternative theories. This paper uses district-level data from Bavaria to study the correlates of the decline of fertility in that German kingdom in the nineteenth century. Bavaria's fertility transition was later and less dramatic than in other parts of Germany. The European Fertility Project, the most influential study of the European fertility transition, used very large units of analysis and unrefined measures of economic and social conditions. This project concluded that the fertility transition reflected the simultaneous adoption of new ideas about contraception, and was not caused by adaptation to changing economic and social circumstances. We use smaller units of analysis, better measures of the possible determinants of fertility, and more appropriate econometric methods to study Bavaria's fertility transition. Our results indicate that the European Fertility Project was right about the role of religion and secularization, but missed an important role for the economic and structural effects stressed by economic historians.

KEY WORDS: fertility transition, migration, Germany

JEL CLASSIFICATION: N3, J1

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The fertility transitions that took place in Europe and North America in the nineteenth and early twentieth centuries constitute one of the most significant changes in human history. For centuries European women regulated fertility primarily by postponing or avoiding marriage. The fertility transition marks the point when marriage ceased being the primary regulator of fertility; couples began to decide when to bear children and how many children to bear. This decline has continued to the point where in some industrialized societies today fertility is at below-replacement levels. Despite long-standing interest in the historical as well as modern aspects of the fertility decline, this aspect of human history remains poorly-understood.

This paper contributes to our understanding of Europe's historical fertility transition by close study of a neglected type of fertility history, and by a (mostly implicit) methodological critique of earlier approaches. Bavaria was overwhelmingly Catholic and industrialized later than much of the rest of Germany. As such, the historiography would suggest that its late and modest fertility transition is unsurprising. Detailed empirical study confirms some of the basic outlines of this kind of story, but also demonstrates the importance of factors this story overlooks. Our methodology is not quite novel, but marks an improvement over much of what has been done in the past. Similar methods can be used — to good effect — in other European historical contexts. While we focus on Bavaria and its history this paper can be read more broadly as a demonstration of reservations about earlier research.

Standing behind any discussion of the European fertility transition today is a large-scale project undertaken at Princeton University during the 1960s and 1970s. This project has shaped much of what scholars know, or think they know, about the European fertility transition. The European Fertility Project (or the "Princeton Project") deserves considerable respect for its forerunner status. The summary statement from this project rejects a role of economic and social change, arguing instead that the fertility transition reflects an innovation of new ideas about family size and their diffusion throughout the

population. Some of our results for Bavaria confirm the European Fertility Project's explanation of the fertility transition. Our results also suggest that the project has left scholars with a vision of the fertility transition that pays insufficient attention to historical nuances.

A better appreciation of how Bavaria's economic history shaped the fertility transition requires an extensive, if necessarily short, historical outline. Some remarks on earlier approaches, especially the Princeton Project's, are necessary, since our study is motivated in large part by qualms about the shortcomings of Princeton methodology. A key part of our critique of earlier approaches rests on their failure to use the rich and informative historical evidence available, and their limitation to fairly crude statistical methods. To substantiate that critique requires extensive econometric analysis of our own. Our several approaches document the role of economic and social change in Bavaria's fertility transition and offer lessons for Europe more generally. This paper is part of a larger study of migration and fertility decline in the city of Munich during the period 1850-1914. At several points here we raise important questions that have to be deferred to other venues.[1]

1. Bavaria: 1850-1914

Figure 1 lays out the basic pattern of fertility change in rural and in urban areas for the period 1849-1912. As the figure shows, sustained fertility decline began in much of Bavaria only after 1900. The literature of historical fertility transitions neglects regions such as Bavaria relative to other parts of Germany or western Europe more broadly because Bavaria was largely Catholic, very rural, and industrialized later than other German kingdoms such as Prussia or Saxony. Thus the late and feeble

[1] The larger project focuses on Munich's *Polizeimeldebögen* (PMBs), which contain detailed life-cycle economic, social, and demographic information for anyone born in Munich or resident in Munich during the period 1860-1914. See Brown, Guinnane, and Lupprian (1993) and Brown and Guinnane (2001) for additional discussion.

character of the Bavarian fertility decline up to World War I seems to fit comfortably into either the European Fertility Transition's stress on cultural explanations of the fertility transition, or older arguments that stress urbanization and industrialization as brakes on fertility. A clearer view of Bavarian history, especially its economic history, suggests the inadequacy of that view.

Bavaria accounted for one-eighth of the population of the German Empire formed in 1871, but much less than that share of economic output. Map 1 outlines Bavaria's seven provinces (*Regierungsbezirken*), and locates major cities and four selected counties (*Bezirksämter*) to be discussed in detail later. Bavaria had an eighth province (the Palatinate, or *Pfalz*) on the left bank of the Rhine that we cannot include here because the different administrative structure of the province did not leave data comparable to what is available for Bavaria to the right of the Rhine. Economic development in Bavaria stagnated until the late 1860s, with the kingdom remaining primarily an agricultural state with the lowest ratio of businesses (*Gewerbetreibende*) to population of any of the constituent states in the German customs union (excepting eastern Prussia) in 1861 (Preißer 1993, p.31). The social and economic history that forms the backdrop to the fertility changes documented in Figure 1 can be broken into a period of gradual change until about 1880 and accelerating change thereafter. The fertility regime at the end of the 1840s reflected underlying conditions of land tenure and the response of individual regions to Bavaria's entry into the German *Zollverein* (customs union) in 1834. Sections of western and northern Bavaria that were first incorporated into the kingdom at the beginning of the nineteenth century faced increasing challenges from the formation of the customs union and continued population growth. In these regions, partible inheritance was the rule and a large share of rural inhabitants supported themselves with by-employment, particularly in linen weaving (Fried, 1975, pp. 760-761). The rapid decline of linen and other rural putting out industries (under pressure from industry elsewhere in customs the union) squeezed

these families further, even as their lower mortality rates resulted in a higher rate of natural increase (see also Hubert, 1995, pp. 118-120).

One result was a pattern of migration to places elsewhere in Germany and overseas that has been observed in other, similar circumstances. Kolb(1966, pp. 57-60) notes that for Upper and Lower Franconia, emigration took from one-third to two-thirds of the excess of births over deaths during the late 1840s and the early 1850s. Data from the mid-1850s, the pre-unification peak of German emigration, shows that emigration and rising rates of migration to the area of larger farms in southern Bavaria around Munich prompted absolute declines in population in Upper and Lower Franconia. By contrast, the rich agricultural region of Upper Bavaria around Munich prospered during this time and was the only Bavarian region consistently to experience net in-migration.

Bavaria reacted slowly to the opportunities offered by its relatively inexpensive labor. Localities fiercely guarded their right to allow the establishment of new businesses (*Konzessionrecht*) out of a fear that new sources of employment would increase the number of dependent paupers during economic downturns. The central government made little use of its own right to grant concessions for factories. These conditions gradually changed with the completion of the main north-south and east-west trunk rail lines by 1854 and the rapid expansion of the cotton textile industry in Swabia and Upper Franconia. This industry expanded from about 46,000 spindles in the mid-1840s to 540,000 by the early 1860s, overtaking older German cotton textile regions such as Baden. Complementary opportunities in Augsburg, Nuremburg, and Munich led to the development of machine-making companies. Finally, the opening up of railroad access to markets in central and eastern Germany and Austria prompted rapid development of an export-based brewing industry in Nuremburg (Zorn, 1975, pp. 799-805).

These developments took place at a glacial pace, particularly when compared with the rapid industrialization taking place in nearby Saxony and the industrial area of the Ruhr and the Rhineland in

western Germany. Bavaria's initial spurt of industrial development had expanded the share employed in trade, mining, and industry by about one percent. After a drop during the 1850s, the share of the population dependent upon agriculture was a bit over one-half. Eighty-five percent of the population continued to live in rural counties (*Bezirksämter*) as late as 1882.

Several events after 1870 prompted far-reaching changes in the agricultural labor force and in the demand for labor and in the non-agricultural sectors of the economy. During the 1870s, the shock of low grain prices initiated a period of *Landflucht* (flight from the countryside) that continued through the First World War. This outmigration included both the day laborers who were an important part of the agricultural labor force of northern and western Bavaria and the servants who traditionally lived with the farmer as a member of his household in the larger farms of southern Bavaria (Sandberger 1975). From 1895 to 1907, the number of servants fell by one-half and the number of day laborers declined by about one-third.[2] Even as the supply of farm labor declined substantially, there were other changes that imply an increased demand for female labor, including farmers' wives. The three-field system with its reliance on grazing animals on waste land and fallow gave way to crop rotations that often included labor-intensive animal feed crops. Increased cattle-growing during the last third of the nineteenth century also disproportionately raised the demands on the time of female household members (Fried 1975, p. 771, and Schlögl 1954, pp. 428-239).

Even as agricultural output increased, the share of agriculture and forestry in employment fell from about one-half in 1882 to about two-fifths by 1907. Over one-quarter of rural districts experienced depopulation. The continued expansion of employment in industry, mining, trade, and transport primarily in urban areas marked the transformation of the economy as a whole. As Bavaria industrialized after 1880, the traditional textile sector of linen and woolens, much of which was produced for consumption of the

[2]"Landwirtschaftsbetriebe"(1909).

household, continued to shed labor. Increased employment in metals, construction, and particularly in transportation and other services (including financial services) and machine-making offered better-paid employment (Kolb, 1963, Tables 10 and 11 and Zorn, 1975, pp. 808-820). Much of this employment growth was concentrated in larger urban areas, so that the share of the Bavarian population living in cities of ten thousand or greater population grew from less than one-tenth to over one-quarter in the thirty years before the First World War. While the share of population living in great cities of over 100,000 had risen to sixteen percent by 1910, it was still well below the share for Germany as a whole (twenty-one percent) (Marschalk 1984, Table 5.5). Agriculture as a share of employment dropped below one-half in the 1895 census.

Demographic developments

Knodel (1974) is the starting point for modern approaches to the fertility transition in Germany. Like most European Fertility Project authors, he focuses on the period of fertility decline, which in the German case occurs during the period following unification in 1871 (Knodel 1974, pp.38-50). Hubert (1995, p.34) shows that from the Napoleonic Wars onward, crude birth rates remained relatively constant in the German states. Knodel calculates I_g for seventy-one administrative districts in the German Empire from 1867 until 1939.[3] Like the other European Fertility Project studies, he defines the fertility transition as the point where this index fell by ten percent or more. The geographic distribution across Germany in

[3] Urban shares calculated from the censuses of Bavaria found in *Beiträge zur Statistik des Königreich Bayerns*, vols 3(1854), 20(1869), 46(1882), and 84(1912). Agricultural employment from the Bavarian population cataster for 1840 and 1852 and from the Censuses of Population and Occupation as compiled by Kolb (1963, Tables 8 and 10). Bavaria followed the practice of reporting occupational data as the number of families dependent upon a worker who earned his livelihood from a given activity. Guinnane (In press) discusses population and the economy in Germany more generally for the period 1800-1990. I_g is the index of marital fertility devised for the European Fertility Project. While formally defined to lie between zero and one, some authors multiply it by 1000 for convenience.

the timing of transition is almost as wide as the distribution across all of western and central Europe. Some districts (including Swabia in Bavaria) experienced a ten percent decline in marital fertility as early as the 1880s, while others (including Lower Bavaria and the Upper Palatinate) experienced a decline only after 1905 (Knodel 1974, p.65). The median year of decline for Germany as a whole falls in the decade of the 1890s.

The German case is a good illustration of some of the issues confronted by the European Fertility Project. One reason to focus on changes in fertility, rather than differences in the level of fertility, is that cross-sectional differences in breast-feeding practices may produce quite different levels of fertility. The Princeton studies interpreted differences in breast-feeding practices as reflecting culture or local custom, and not as having anything to do with deliberate fertility control; those authors would interpret the large variation in fertility levels on display in Map 2 as evidence that breast-feeding was more common in some regions than in others. The underlying notion is that breast-feeding reflects deep cultural notions that vary little over time or with an individual couple's circumstances. We have our doubts. Scattered evidence from Munich and Berlin suggest, for example, that during the late nineteenth century, breast-feeding underwent a noticeable decline to the point that a significant number of children were never breast-fed.[4]

Bavaria's demographic regime during the period before unification in 1871 reflected its economic stagnation. After a period of initial growth after the Napoleonic Wars, Bavaria's annual population growth rate fell to about 0.55 percent, which was only about three-fifths the rate of increase for the German states as a whole by 1871 (Hubert 1995, pp.59-70). Three features distinguished the pre-unification Bavarian demographic regime from demographic patterns in northern and central Germany: relatively high rates of mortality, high rates of births outside of marriage, and a rapid divergence of urban from rural

[4] See Vögele (1994) for a discussion of the evidence on breastfeeding from Munich and Berlin. The data cited by Kintner and Vögele (1982) must be treated with some caution, since they were drawn from populations that varied over the time period they purport to represent.

fertility once fertility decline got underway. As late as the early 1880s, mortality in Bavaria overall averaged about 29 deaths per 1,000 inhabitants per year, which was lower than in the adjacent southern kingdom of Württemberg, but higher than in Hesse or in the industrializing Rhine province of Prussia (Matz 1979, pp. 254-255). The most important aspect of Bavarian mortality was exceptionally high infant mortality. The Bavarian regions of Swabia and Upper and Lower Bavaria experienced infant mortality rates approaching 350 deaths per 1,000 children under the age of one. For all of Bavaria, infant mortality rates were 300 per 1,000 or more until the 1880s, which was about fifty percent higher than infant mortality rates in Prussia. Slightly lower mortality among children and the lower death rates in the population as a whole partially offset the effect of high infant mortality on overall mortality.[5]

Demographic patterns in southern Germany, Bavaria included, differed from those in northern Germany. One difference was illegitimacy. In the late 1840s about one-fifth of all Bavarian babies were born to unmarried women, more than in any other German state and higher than in most areas of central and western Europe as well (Lee 1977, Tables 1 and 3). The causes of south German illegitimacy have been debated several times, and there is no consensus on its causes. One factor in Bavaria was local authorities's right to refuse permission to marry. Prussia and other north German states had gradually relaxed legal restrictions on marriage and settlement after the Napoleonic Wars. But the south German states, especially Bavaria, adopted increasingly tough regulations. By the early 1830s, local governments,

[5] See the discussion in Knodel (1974, pp.157-161) and Vögele (1994, pp. 404-405). There is a long-standing debate over the causes of the high Bavarian infant mortality. The lack of breast-feeding in much of the state and the high share of extra-marital births contribute to this peculiar feature of the Bavarian demographic regime. On breast-feeding in Bavaria see Kintner (1982) and Knodel (1974, pp.164-165). Some authors have argued that the high fertility and infant mortality typical of Bavaria reflects a Catholic practice of baptizing still-born children, who were then registered as a live birth with a short life. As Grassl (1904) put it, "it is possible that the among the Catholics, the infants who have received an "emergency baptism" are more likely counted among live births than among Protestants." Yet the data show that only a small fraction of the Catholic/Protestant differential in infant mortality rates can possibly reflect differences in the registration of stillbirths. See Haines and Kintner (1999) for additional discussion.

could reject requests for legal settlement (*Heimatrecht*) and applications for marriage.[6] The most restrictive legislation was after the upsurge in extra-marital births following the Napoleonic Wars. The period of most effective enforcement (1835 to the early 1860s) coincided with a high and rising share of extra-marital births among all births. These restrictions raise the possibility, debated in the literature, that some couples formed durable unions and had several children who were illegitimate only because the state refused their parents' permission to marry. Another view attributes Bavarian illegitimacy to an underclass with little to lose from sexual conduct that might interfere with marriage plans, educations, or property transmission for middle-class or wealthy people.

Figure 2 details the share of extra-marital births across Bavarian districts and highlights the importance of the restrictions for urban fertility behavior for the period after 1846.[7] Until the relaxation of the enforcement marriage restrictions in the early 1860s, the median share of extra-marital births among the ten largest urban areas was as much as twice the median share in rural districts. In some towns such as Würzburg and Munich, illegitimate births regularly exceeded two-fifths of all births. The share began to decline as the experience of urban districts converged rapidly with rural areas starting in the early 1860s and accelerated with the passage of much more liberal marriage legislation in 1868. Nonetheless, the share of illegitimate births in urban areas remained above that in three-quarters of the rural districts through 1912 and continued to be well above levels elsewhere in Germany. The lowest share of extra-marital births in Germany was found in the industrialized provinces of Rhineland and Westphalia, where it was one-fifth to one-seventh of that in Bavaria through 1914 (Knodel 1974, p.76). In our statistical

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[6] See Lee (1977), Shorter (1978), and Matz (1979) for the most recent sustained round of discussion illegitimacy in south Germany. The marriage restrictions may be best understood as a policy response to concerns about increased pauperization of the population.

[7] Urban districts in this case are those "independent cities" with a population exceeding 5,000 in 1850. The remaining "independent cities" included Donauwörth, Kaufbeuren, and Lindau.

analysis below we focus on legitimate fertility alone. This is partly for data reasons, but mostly because we think that another dataset in development as part of our larger study will provide considerable insights into the nature of illegitimate fertility in Bavaria.[8] We defer statistical analysis of illegitimate fertility until we can answers some of the many (logically prior) questions raised in the literature.

The fertility transition in Bavaria

Maps 2 and 3 provide an overview of the fertility transition in Bavaria. The basic units here are the rural counties (*Bezirksämter*), and the smaller units are the urban districts (*Unabhängige Städte*) that were legally distinct from any rural government. Map 2 summarizes the situation in 1880, which is the starting-point for our econometric analysis, and Map 3 summarizes changes up to 1910, the end-point of our later analysis. Detailed data on fertility are available for 176 counties and cities for the period 1846 through 1912, with a break in the series from 1852 to 1862. Censuses of population were held every three years through the year of unification (1871), and every fifth year starting in 1875. Both counties and cities were at the same level of the administrative structure of Bavaria, so counties can generally be regarded as distinctly rural areas. Information on occupations and socio-economic measures is not available at the required level of disaggregation until 1880.

Figure 1 presents data on births per 1,000 females for the period 1845-1912. The figure gives the median and the boundaries marking the first and third quartiles of birth rates in the rural districts. For comparison we graph the median for the urban districts with a population over 20,000 in 1852. The movement in the median and the overall distribution illustrates the recovery from the low birth rates of the 1840s and 1850s, with the most dramatic declines during the difficult years of 1847 and 1848. By the

[8] The PMBs will allow us to ask, for example, whether women who had illegitimate children did so with multiple partners or with one partner, and whether they ordinarily ended up marrying the father of their illegitimate children.

early 1860s, the birth rate began a steady increase that peaked in the mid-1870s. The brief downturn in 1871 is the result of the Franco-Prussian War, followed almost immediately by a post-war baby boom. Birth rates begin to return to levels of the mid-1860s by the mid-1880s, and remain there until the pronounced decline sets in about 1905. In contrast, urban fertility rose even more rapidly during the 1840s and 1850s, reaching the rural median by about 1860 and remaining there until the mid-1870s. From the 1870s on we see a progressive widening of urban/rural fertility gaps, developing in two stages. The first step is a rapid decline in the decade following 1875, when the urban median moved to the lower one-quartile of the rural distribution. The second step began at the turn of the century, when urban rates fell to unprecedented low levels from which they never recovered.

One unexpected result from Figure 1 is the apparent rise in birth rates after 1850. Similar pre-transition increases in fertility have been found for several European countries in the nineteenth century. Some have argued that such increases are inconsistent with the notion that pre-transition populations were not controlling their fertility. We are sympathetic to this view, but the issue lies beyond the scope of our discussion.[9] There are other possibilities. We may be seeing not an increase in *births* so much as the improved *reporting* of births. In at least one case in the Princeton Project, what appeared as an increase in fertility turned out to be an improvement in the birth-registration system.[10] More likely, the crude birth rates reported in Figure 1 may not convey an accurate picture of marital fertility. The relaxation and then elimination of restrictions on marriage prompted a gradual upturn in marriages after 1860 and then, in

[9] Other evidence suggests fertility control in Germany earlier in the nineteenth century. Knodel (1988, Table 11.1) reports indices of parity-dependent fertility control for three villages in Bavaria. These indices suggest parity-dependent fertility control as early as the first quarter of the nineteenth century, which raises the possibility that increases in fertility later in the century may reflect the relaxation of earlier controls.

[10] The case mentioned in the text is Ireland (Ó Gráda 1991). Knodel (1974, pp.29-30) shows that by the 1860s Prussian births data were very complete, and we have no reason to think that under-registration was worse in Bavaria than in Prussia.

1869, a sixty percent jump in marriages (Matz 1979, p. 238). The share of women married continued to rise in some regions until 1910. This marriage boom produced a shift in the age-structure of married women towards younger, more fertile ages. The rise in overall fertility after the mid-1850s and some easing of infant mortality rates resulted in a younger population entering child-bearing years starting in the late 1870s. We cannot parcel out these other effects, given the data available prior to 1875. Finally, some of the increased fertility may reflect improvements in the nutritional status of the population. Demographers have found that except in extreme circumstances, nutrition has little effect on fertility. But the Hungry Forties qualify as extreme circumstances, in Bavaria as elsewhere in Germany.

Knodel (1974) argued that the fertility transition did not begin in most areas of Bavaria until the 1880s and in some cases much later. This result is an artefact of his focus on large geographic units (the seven provinces in map 1). Our counties averaged about 24,000 in population in 1852 and about thirty-five thousand by 1910. Knodel (1974)'s Bavarian units had populations ranging from 450,000 to 700,000 in 1852. Table 1 demonstrates the benefits of the smaller districts by comparing Knodel's dating of the fertility transition in each of his units to the picture gained from its constituent counties. For the period 1867-1880 we have the detailed information on the age-structure of married female population necessary to calculate the index of marital fertility, I_g, for each county. The European Fertility Project dated the fertility transition at the first point where marital fertility had fallen by 10 percent or more. This criterion is satisfied in only 35 of Bavaria's 188 rural districts by 1880, and in 20 of the 37 independent cities. By the Princeton Project's criterion, then, the period 1880-1910, which is the focus of our later analysis, covers the initial stages of the fertility transition in most rural districts.

Some older accounts stress the role of urbanization in the fertility transition, and given the growing share of cities in Bavaria's population, it is worth asking how much of the fertility transition reflects urbanization *per se*, how much a reduction in fertility in rural areas, and how much a reduction in urban

areas. The results are instructive. In 1880 about 20 percent of the population lived in urban areas, a figure that grew to 40 percent by 1910. Marital fertility declined in rural areas by about 11.5 percent on average over this period, and in urban areas by about 36.8 percent. But the rural fertility transition was crucial to Bavaria's overall experience. Fertility declined overall by about 19.6 percent. With a counter-factual fertility decline in rural areas alone (no urban decline, and no increased urbanization) the overall decline would have been 9.6 percent, about half the actual decline. Increased urbanization with no fertility decline in either rural or urban areas would have reduced overall Bavaria fertility by only 4.7 percent. Bavaria was so rural that without that decline in rural marital fertility the overall fertility decline would otherwise have been much more feeble.

Bavarians increasingly opted to have smaller families. Less clear is which contraceptive methods they used. Historians know relatively little about contraceptive methods used during the European fertility transition. Studies exist for Germany in our period, but they are based on decidedly non-random surveys. The image they leave is similar to findings for other European countries. Even as late as 1900, many couples relied on *coitus interruptus* to limit family size. Other popular methods included douches, condoms, and cervical caps. Several observers also report direct and indirect evidence of a considerable increase in the use of induced abortion, which was illegal.[11]

2. Competing explanations of the fertility transition

In the next section we present econometric models motivated by an economic understanding of fertility but addressed to the concerns of the European Fertility Project. This approach requires some explanation. The term "demographic transition theory" is associated with the views of Frank Notestein.

[11] Santow (1993, 1995) discusses the role of *coitus interruptus* both in "pre-transition" populations and in the twentieth century. On abortion, see, for example, Dienel (1995) and *Denkschrift* (1915).

His argument, which was formulated in the context of developing countries in the 1940s and later, has two strands. He thought that declines in infant and child mortality brought about by vaccination and other public-health measures would, after a time, provoke reductions in marital fertility, as couples realized they needed fewer births to have a family of a given size. The other strand stresses the role of structural transformations in the societies and economies in question. Urbanization and industrialization, in his view, altered the logic of large families and provided a second impetus for reduced family sizes.

The European Fertility Project built on Notestein's work but its final message is in large measure a rejection of his views. To see this it helps to introduce a distinction associated with Carlsson (1966). Carlsson divided explanations of the fertility transition in two groups — innovation/diffusion or adjustment. The first explanation states that the adoption of fertility control within a population represents a new behavior. The origins of this behavior may be new knowledge or changes in the moral acceptability of contraception. This view implies that high fertility prior to the transition reflects the population's lack of ability to control fertility or unwillingness to do so on moral grounds. The adjustment explanation states that fertility control reflects couples' adaptation to changing economic and social circumstances. High, pretransition fertility is interpreted as couples' response to economic and social conditions just as falling fertility is believed to reflect their assessment of the changing costs and benefits of children. Notestein's demographic transition theory can be viewed as one variant on the adjustment hypothesis.

The innovation/diffusion interpretation of fertility transitions differs from the adjustment interpretation in at least two empirically-testable ways. The innovation view implies that a fertility transition represents the diffusion of a *new* behavior. This is an important point but since it demands individual-level data we do not pursue it here. In addition, simultaneous fertility transitions in widely varying economic and social circumstances are consistent with the innovation/diffusion view, but not with the adjustment view. This is the real heart of the European Fertility Project stress on innovation and

diffusion. One influential statement concluded that “Despite the great diversity of their socioeconomic characteristics, the countries of Europe had one striking factor in common when fertility declined: time itself ... With the exception of the forerunner, France, and a few stragglers, such as Ireland and Albania, the dates of decline were remarkably concentrated” (Knodel and van de Walle 1986, p. 412). In their more general criticism of "demand theories" of the fertility transition, Cleland and Wilson concur: "clearly the simultaneity and speed of the European transition makes it highly doubtful that any economic force could be found which was powerful enough to offer a reasonable explanation" (Cleland and Wilson 1987, p. 18).[12]

Our econometric analysis focuses on this second point. The European Fertility Project drew its conclusions in part by arguing that measures of economic and social development did not help to distinguish which regions of Europe had their fertility transition first, or when. We view these conclusions as premature, given what the volumes in the project actually did. Our larger project is motivated by four fundamental reservations about the common methodology underlying the European Fertility Project, reservations we simply list here but discuss at length in Brown and Guinnane (2001). First, the units of analysis were too large and internally heterogenous; as we have shown, the units Knodel used for Bavaria were so large that they masked considerable decline in fertility in the 1880s. We are working with the PMBs because we view individual-level data as critical to meaningful tests of the competing views of a fertility transition. But better analysis of aggregate data is worthwhile and in many cases all that is feasible. Second, the definition of fertility control and the index chosen to detect the onset of fertility control are problematic. The heart of this reservation is the objection to the interpretation of I_g raised in

[12] Alter (1992) provides a nice overview of competing explanations of the fertility transition. A third view, usually called “the Easterlin synthesis,” incorporates both the economic focus on the demand for children and the problem of the costs of fertility control, including social impediments to control. A full discussion of Easterlin’s model is beyond the scope of this paper, but the following discussion indicates our sympathy with his approach. One influential statement of his model can be found in Easterlin (1976).

Guinnane, Okun, and Trussell (1994). Third, the explanatory variables used in most European Fertility Project studies were crudely defined, and do not support meaningful tests of the role of social and economic change in the fertility transition. We have assembled measures of economic and social change that better capture the notions underlying both the innovation/diffusion view and the adjustment view of the fertility transition. Fourth, the statistical methods used in most European Fertility Project studies were not adequate to the task, and in many cases do an injustice to both the Princeton Project' interpretation and those it criticizes.[13]

Economic models of the demand for children

Another perspective on fertility transitions comes from the micro-economic models of the demand for children pioneered by Gary Becker.[14] These models view the household as an optimizing agent, similar to a firm. The household demands certain goods and services defined by the usual utility function, and has to make choices about how to satisfy its demands: it can either use its members' time and little or nothing from the market to produce the good or it can rely more heavily on the market. Decisions about how to produce goods and services depend on the relative prices of market goods and services and the prices of time for household members. The price of time, to a first approximation, is what an individual could earn in paid employment outside the household.

This way of thinking becomes a theory of the fertility transition in the following way. One of the services demanded by households can be the "services" of children. The price of child services depends

[13] Our approach reflects the pioneering research of Patrick Galloway, Eugene Hammel, and Ronald Lee on Prussia. Their project resulted in several papers; the most important for our purposes are Galloway, Hammel, and Lee (1994, 1998). Richards (1977) first used Knodel's data and fixed-effects models to analyze the German case. Her approach and findings anticipate some of our own.

[14] Schultz (1981) and Bryant (1990) are convenient summaries.

on the price of time and on the prices of market inputs required to raise children (such as rent). Couples' decisions about the number of children to have will depend on the costs of children relative to other goods. Perhaps the most important input into the rearing of children is parental time, more specifically a mother's time. The more costly is that time (that is, the higher the wages foregone while caring for children) the lower fertility will be.[15] Becker's approach also enables one to think about the role of infant and child mortality. What couples really want is not a given number of births, but a given number of children who survive to adulthood. Some of the causes of death for children in the nineteenth century were beyond the control of any parent, but some were not. Care can be expensive, especially as most important care-giving efforts (for example, breast-feeding) require considerable amounts of mother's time. These considerations raise another set of decisions about how many children to have and how to care for them, and once again these decisions would be sensitive to external influences such as the value of the woman's time. Thus couples could, because of economic circumstances, alter not the number of children they raised but the number who were born. All of this implies that a fertility transition could reflect either changes in the demand for children outright, perhaps driven by increases in the value of women's time, or it could reflect a different process in which changes in economic variables led parents to have fewer children but to care for them better.

The Becker-style model readily admits the role of contraceptive technology and changes in that technology. Innovations that reduce the cost, to the couple, of having fewer births can be entered in the model as one of the costs of family-building. Note, however, that the implications of such a change can be complicated. Couples could react by relying less on infant mortality to reduce the size of their completed family, or could alter the quantity/quality mix of their brood.

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[15] That is, if children are a normal good and the substitution effect dominates the income effect of higher wages. This seems to be the case in most modern studies.

The neoclassical economic model implies several analytically distinct forms of fertility transition. One is a straightforward reduction in the demand for child services, as a rising value of female time (or some other costs) leads couples to substitute other goods and services for children. In our period this might reflect Bavarian industrialization and the many jobs it created for women in factories. Another is a change in the way couples *build* their families, perhaps having fewer children and treating them with more care. This kind of change could result from changes in contraceptive technology, or might (for example) reflect changes in the cost of breast-feeding children. We know that infant mortality declined considerably during our period, suggesting just such a shift.[16]

3. Econometric analysis of the fertility transition, 1880-1910

Our analysis relies on a consistent set of counties and urban districts for the period 1880-1910. Our basic sources are censuses for the years 1880, 1885, 1895, 1900, and 1910. Our dataset includes measures of fertility, other demographic indicators, and a rich set of potential influences on the pace and timing of fertility decline. The appendix provides precise definitions and sources for each variable. Table 2 presents summary measures of fertility and its decline for 1880-1910.

An analysis of this type requires a number of decisions about the basic approach and the type of compromises that are acceptable. We model marital fertility using a panel regression framework, with a fixed effect for each county. The idea underlying these models is that with repeated observations on the same unit, some variation comes from differences across units, while other variation comes from

[16] Becker also argues that a couple can have a small number of "high-quality" children or a larger number of "low-quality" children. Child "quality" is ill-defined in this model; the central idea is that a small number of "high-quality" children might yield as much in child services as a larger number of "low-quality" children. We can think of this decision as whether to have two children who will have expensive educations, or eight children, each of whom will have only rudimentary educations. Some child costs are invariant to their quality, while others are not.

differences (that is, changes) within the units. This approach allows us to focus on changes in marital fertility. The panel specification is most consistent with the Princeton project's emphasis on changes in fertility. Our regression model, in effect, lets the fixed effect absorb the different levels of fertility obtaining in each county in 1880, and focuses our attention on how changes in right-hand side variables affect fertility.[17] One implication of our approach is that the models in effect "difference out" some kinds of omitted variables. The fixed-effects models are no panacea, however, contrary to the impression that is sometimes given. They deal effectively with unobserved heterogeneity (or omitted variables) that are linear and constant over time, but not with other forms of heterogeneity.

The potential endogeneity of regressors poses a serious modeling problem. Right-hand endogeneity receives a great deal of attention in applied economics, and most studies use the method of instrumental variables to deal with the problem. Two points are worth stressing here. First, many of our regressors are arguably endogenous. We cannot possibly find enough suitable instruments, and have taken the approach here of restricting our attention to endogenous variables that present the most severe problems. In our case that amounts to the demographic controls, especially infant mortality, but also the marriage rate, the proportion married, and the migration rate. The most serious problem arises with infant mortality. There are several lines of causation between infant mortality and marital fertility. All have proven demographically important in at least some contexts: (1) Suppose parents would like N surviving children. If parents see that on average a fraction k ($0<k<1$) of all children die, then the couple needs to have $(1+k)N$ children to meet that target for a surviving brood size. This line of causation implies that infant mortality is *exogenous* to marital fertility. (2) Suppose most children are breast-fed for some

[17] Following a suggestion made by George Alter, we re-cast our analysis as a binary probit model with fixed effects. In that case the dependent variable is one if the county has crossed the 10-percent decline threshold used by the European Fertility Project. We cannot compute I_g for these counties, so the parallel is not exact. In any case, the results obtained were qualitatively similar to those reported here.

months after birth. Breastfeeding is a mild contraceptive.[18] If the most recent baby dies while being breastfed, this contraceptive effect will disappear, and the woman is more likely to become pregnant again than if the baby had survived. Thus declines in mortality will tend to increase marital fertility rates through a purely automatic, biological effect. Once again, this line of causation assumes that infant mortality is exogenous to the couple (and that decisions about breastfeeding are, as well). (3) Now suppose that parents have some control over the survival chances of their children. Under this argument parents have *two* ways to control family size, both of them potentially costly. Parents who do not want a large surviving brood but who find it very difficult to control births may use infant and child mortality to reduce their surviving family size. The literature on Bavaria in replete with references to the practice of this form of family limitation, known as "himmeln lassen" (allow to go up to heaven) (Schlögl 1954, p.427).

To the extent infant mortality is purely exogenous to fertility (as in (1) or (2)), we do not have to worry about it any more than any other regressor. Under this optimistic assumption we could view OLS estimates of the impact of infant mortality on fertility as simple guides to the way exogenously-drive declines in infant mortality reduced fertility in Bavaria. (We could not disentangle the effects of (1) and (2), however.) The problem arises with scenarios like (3). Infant mortality is not just something couples take into consideration in making fertility decisions, it may be part of a family-building strategy and so endogenous to fertility. This implies that some of the regressors could be correlated with the error term in an ordinary least-squares model, making the OLS estimates inconsistent.

The most common approach to dealing with endogenous right-hand side variables is to use instrumental variables (IV). Deaton (1997) stress that its use requires serious thought about the nature of

[18] Just how mild is a matter of some debate; see, for example, Bracher (1992) for a recent warning that breast-feeding is at most a weak contraceptive.

the endogeneity and the supposed correction derived from the IV model. As with most historical studies we lack the instruments we would ideally like for this task, but we do have some that serve admirably. Environmental variables such as elevation are strongly correlated with infant mortality in the nineteenth century because of their correlation with unhealthy environments. Here we use the county's elevation above sea level. Many historical studies find that mortality in general, including infant mortality, is lower at higher elevations. Elevation is not strongly correlated with the marriage variables, but population density is correlated with both infant mortality and the marriage variables. Here the association reflects the availability of jobs and housing in urban areas. Finally, for rural areas we use the number of milch cows per capita as a proxy for the cost of women's time in dairy production.[19] We interact each instrument with the year dummies. The interactions allow us to capture not just the impact of, for example, an unhealthy environment on infant mortality, but the way changes in markets, law, and technology changed that effect. We should be frank about what the IV approach can solve and what it cannot. One could worry, for example, that our elevation measures are capturing some unmeasured feature of local rural economies that affect the demand for children rather than infant mortality rates. The standard over-identification test does not support this interpretation, but this is not an absolute guarantee.[20]

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[19] Very high elevations can be damaging to health; the Bavarian Alps are not that high. The idea behind the cows variable is that dairy production competes with child-care for women's time. One might argue that it would affect fertility directly and so should be a regressor. Over-identification tests do not support this claim.

[20] Deaton (1997) suggests reporting the F-test for the instruments in the first-stage regressions to establish their predictive power. The following are F-statistics (for the null hypothesis that all the instruments are jointly zero) from regressions of the endogenous variables on all the regressors, instruments, and a constant term: Infant mortality (6.99 rural, 16.72 urban); Proportion married (5.34 rural, 5.18 urban); marriage rate (2.54 rural, 1.07 urban); migration rate (2.96 rural, 0.88 urban). With the exception of the last two values for the urban models, these are all significant at the 99 percent confidence level. The low values for the two urban variables indicate that our instruments may not have enough predictive power to correct for the endogeneity.

We do not use any direct information on breast-feeding, a decision that requires some defense. Several German states, Bavaria among them, attempted to measure breast-feeding patterns in the late nineteenth and early twentieth centuries. The best Bavarian survey comes from the records of medical officers who carried out public vaccinations during 1904-1906 (see Groth and Hahn, 1910). The resulting data yields estimates of the share of all infants who were never breast-fed and the share who were breast-fed for less than six months. Unfortunately, they are only available for about half of the cities and two-thirds of the rural districts. The measures are also fraught with reporting and selection problems. To be included a woman must have had a living child and have chosen to have that child vaccinated at the time of the survey. Low-fertility and high-mortality couples, as well as those less interested in their children's health, are thus less likely to be in the data. Our elevation instrument is correlated with the danger to children of not breastfeeding, which is the preferred approach to deal with the endogeneity of infant mortality.

We have two different models of legitimate fertility, and report them separately by urban and rural areas. Our specification strategy was to focus on building a model of the rural fertility decline, for reasons that become clear in a moment, and then estimate the closest parallel urban model. Most of our variables are best considered as part of a block: for example, the different occupational groups. Our strategy with time interactions was to enter a "main effect" and then that effect interacted with dummies for 1885, 1895, 1900, and 1910. Thus the interactions measure how that variable's impact changed after 1880. In our specification search we interacted all plausible regressors with these year dummies, but only include interactions in the final model where these interactions turned out to be important.

The regressors fall into four groups. (1) The first is a set of demographic controls. Infant mortality is important for the reasons discussed above. The two marriage variables are imperfect efforts to control for the effect of nuptiality and the age-structure of married women. The migration variable is important in

a fixed-effects model because otherwise changes in right-hand side variables that are caused purely by differential migration would appear as substantive effects. We discuss an important example below. (2) The next two sets of variables are intended to measure attitudes towards fertility and towards what social historians call modernization. Catholicism is simply the reported religious adherence in the county. The next group of variables measures votes for the main political blocks. Something like our Social Democratic Party (SPD in German) variable was used in several European Fertility Project studies to proxy for "secularization." The Center was an explicitly confessional Catholic party, and the Peasant's party was similar in outlook. The residual category here is all other parties, chiefly the several Liberal parties. (3) Urbanization is an important theme in most fertility studies, and gross differences between urban and rural areas in Bavaria were quite large. A second, related variable, the number of *Sparkassen* savings books per thousand population, can be viewed in either of two ways. Financial assets are one substitute for a large family. Alternatively, several social movements advocated savings as part of a larger program of an orderly, controlled life that would improve the well-being of the working classes.[21] (4) The final set of variables reflect aspects of economic development and structure. We divide employment into five groups: mining workers, textile workers, all other industrial workers, and all other non-agricultural workers. Agriculture is the residual group here. These distinctions are driven in part by the way the Bavarian occupations are classified, and in part by questions raised in the historiography. Mining is associated with high fertility throughout European history, and textile factories were a major source of employment for women in Bavaria in this period. Our wage variable is the prevailing female daily local wage for unskilled labor, as reported for the sickness insurance fund, corrected for changes in the cost of

[21] This variable pertains to *Sparkassen* only. These primarily municipal savings banks were the largest deposit-takers in Germany in our period, but in rural areas many households would have their savings in credit cooperatives, and toward the end of our period commercial banks developed deposit-taking networks in cities.

living over time. We divide farms into four size categories, following suggestions in the literature that changes in the demand for female labor were most acute on smaller farms. The omitted group here is the "dwarf" plots of less than 2 ha. We also include year dummies and county fixed effects. For years, the omitted value is 1880.[22]

We do not include measures of education or schooling. Many studies of fertility in developing countries today find that female education, or at least literacy, has an important impact on the decision to limit fertility. Measured male illiteracy in Germany as a whole was less than two percent at the start of our period and almost zero at the end. Primary schooling in Bavaria, as in the rest of Germany, was universal and compulsory for males and females by 1880. Data on female literacy do not exist, but there is little reason to think that it was not strongly correlated with male illiteracy at the county level. If we had reliable data on school attendance or more fine-grained measures of educational attainment we would explore these issues more, but such data are not available at the required level of disaggregation.[23]

Results: legitimate fertility in rural areas

Table 3 presents our estimates for rural fertility, and Table 4 the estimates for urban fertility. We do not report the coefficients for the 137 rural and 37 urban fixed effects. We report elasticities evaluated at the overall mean as a way of assessing the real magnitude of each variable's effect. Consider first the difference between the IV and OLS specifications. Not surprisingly, the estimates for the endogenous

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[22] The male and female wages are so highly correlated that we could not enter them both in the same model. The female wage produces a better over-all fit, and was chosen on that basis. The omitted rural county is Aichach in the *Regierungsbezirk* of Oberbayern. The omitted urban county is Freising, also in Oberbayern. For both specifications reported below, we can reject the linear restriction that forces all counties within a *Regierungsbezirk* to have the same fixed effect; that is, the county-level fixed effects are not just proxies for their province.

[23] See Ritter and Tenfelde (1992, pp. 718-719). They discuss Germany as a whole, but the Bavarian educational system was very similar to that in the rest of Germany.

variables are quite different under the two specifications. This is especially true for the infant mortality estimate. Our model implies that fully-exogenous changes in infant mortality had little impact on marital fertility at this time.

This model's message can be summed up by saying that it confirms many aspects of the story stressed by the European fertility project, but also supports our stress on the details of economic and social development that project downplayed. Consider first the evidence for the "Princeton view." Catholicism has a very large impact on fertility, and that impact grows over time. This effect must reflect the impact of Catholic outlook and social teaching, because we have controlled for two other effects. The "Center" party variable captures political Catholicism; the Catholic variable, holding the Center variable constant, is a simple statement of adherence with no particulars on the strength of outlook. More importantly, our migration variable removes the potentially confounding effect that differential migration by religion would introduce.[24] The secularization variable (SPD votes) tells a similar story in a more modest form. In 1880 a county with a heavy SPD vote actually has higher fertility. By 1910 that effect has gone away in the IV estimates, and in the OLS estimates the net effect of the SPD variables is by 1900 negative, as the European Fertility Project would have it.

What can we make of this striking pattern whereby Catholicism increases fertility in 1880, and by 1910 increases it even more? The result seems consist with a modified version of an account that stresses the importance of social norms. In 1880 Catholic regions had higher fertility; this year was at the very

[24] See Nipperdey (1993, pp.536-554) for an extended discussion of political parties in our period. This is a subtle danger of panel approaches. Once we have a fixed effect for each county, the Catholicism variable works off variations in Catholicism's changes within a county, over time, and their correlation with changes in marital fertility. Few Bavarians changed their religious affiliations. In 1901, only 2.4 per 10,000 Bavarian Protestants had formerly belonged to any other sect (Catholicism included), and only 0.3 per 10,000 Bavarian Catholics were former Protestants. Thus changes in the proportion Catholic within a county must reflect, primarily, differential migration and fertility by religion. Our migration variable controls for this potentially confounding effect.

early stages of the fertility transition in most of Bavaria. Over time more and more of Bavaria entered the transition. Those that did not join the group were predominantly Catholic. Catholicism becomes more important over time not because no Catholic counties experienced the fertility transition — this is plainly false, as the case studies will reveal — but because once the transition is well underway, Catholicism becomes an increasingly reliable marker for counties that do not reduce fertility.

Thus we have found, as did most Princeton studies, that attitudes towards contraception and the larger outlook it implies were important aspects of the fertility transition. But we should not leave the story here. We have detailed information on occupations, wages, and farm sizes, and these also play an important role. Urbanization at first raises fertility somewhat, but over time that effect attenuates, and by 1910 urbanization strongly reduces fertility, as Notestein argued. Our occupation variables, imperfect as they are, show a very striking effect: textile employment, which is the best single proxy for female off-farm employment opportunities, has a strong, negative effect on fertility. Much the same can be said for our more direct measure of female opportunities, the female wage. The time interactions show that by 1910 higher female wages exert a powerful downward force on marital fertility. The farm-size variables, finally, show the effect we expected after noting the evolution of the rural economy. Smaller farms (2-5 hectares), which rely primarily on family labor, are associated with higher fertility. The European Fertility Project studies all use much cruder measures of occupational distributions, and none use wage data or measures of savings. Better data suggests that the European Fertility Project rejection of the role of economic and social change is based at least in part on using overly-simplified measures.

The year dummies tell an important story. Once we have used all this information on the transformation of Bavaria's economy and social structure, *date tells us nothing*. If we removed many of the right-hand side variables employed here, we would see a strong time-trend in fertility, similar to that which underlies the Cleland-Wilson argument discussed above. But that would be a simple artefact of not

using the available information. Using the information available reduces the role of timing and stresses the role of relations between measurable changes in social norms and economic opportunities.

Results for urban areas

The model for urban was constructed to be closely parallel to that for rural areas. We omit the urbanization and farm-size variables, which are nonsensical for an urban area. We do not, unfortunately, have additional detail for urban areas so there is nothing to introduce. The overall message from these models is different from those for the rural areas. Here the regressors do little to explain variation in marital fertility, while there is a strong, if uneven, time-trend captured by the year dummies. In the IV specification, at least, neither religion nor voting behavior accounts for much, and the same is true of the occupation, wage, and other variables that we emphasized above. The OLS model differs only by suggesting a role for the SPD's voters, which is consistent with the views of the European Fertility Project. We can only speculate as to why the results for urban areas are so different. We clearly do not have information, analogous to our farm-size measures, that helps to distinguish subtle forces at work in the development of urban areas.

One might ask about the relative contributions of the various sets of variables in these econometric models. An informal answer to that question can be obtained by examining the adjusted R-square from subsets of the OLS models reported here. The adjusted R-square for our reported models are .94 for the rural areas and .79 for urban. Exclusion of either the religion/voting behavior variables or the economic and social variables has about the same impact in both the rural and the urban models, a reduction in adjusted R-square of about .01.[25] A somewhat closer look takes advantage of the fact that

[25] In the urban model the bulk of the variance is explained by the demographic controls, rather than the year dummies.

we can examine how much of the "between-group" variance each model explains, versus how much of the "within-group" variance. The former pertains to differences between districts, while the latter is more the focus of the Princeton studies, how fertility changes over time. Excluding the economic variables from our models has a relatively larger impact on the between-group R-square in rural areas (in urban areas the differences are about the same).[26] That is, the Princeton variables are relatively more important in explaining systematic cross-sectional differences in fertility. The most important impact of the economic variables is on changes over time within districts.

Illustrative case studies

One way to think about our regression results is to examine the histories of four specific cases. We have chosen these illustrative counties because they illustrate some "ideal types" suggested by the econometric results and because they help link the econometric results back to the concrete history of some counties. Map 1 locates each of these four counties. Two are from predominantly Catholic southern Bavaria and two are from the Protestant north. Friedberg was the most urbanized rural district in 1880. Although part of Upper Bavaria, Friedberg was economically part of the Augsburg textile region of Swabia, which led industrialization in Bavaria with the development of a mechanized textile industry beginning in the 1850s. In 1880 about one-tenth of Friedberg's employment was in the cotton textile industry, two-tenths were in other manufacturing industries such as clothing and construction, and another two-tenths were in services. The one-half of its population in agriculture farmed primarily small to medium-sized family farms. Real wages for women were below the average for rural Bavaria. Friedberg was an overwhelmingly Catholic district. The importance of the cotton textile industry had most likely

[26] In rural areas, the R-square from the within-group estimator excluding the religion and voting variables is .626, and for the between-group estimator, .299. The analogous R-squares for the model that excludes the economic variables are .650 and .510.

already depressed marital fertility, but even in 1880, its marital fertility was well above the average for rural Bavaria. Employment in textiles had risen to one-sixth of the labor force by 1910, and employment in agriculture fell to only one-third. Almost two-thirds of residents now lived in towns. Over the period 1880-1910, real wages for female day laborers rose by 60 percent and marital fertility fell by 30 percent. The regression results imply that the rise in wages paid to women accounted for up to 80 percent of the decline and the increase in textile employment explained another one-tenth. This district's substantial urbanization just about offset the increased sensitivity of marital fertility to the influence of Catholicism.

Schwabach in Middle Franconia suggests another path. This district surrounds the small city of Schwabach, which experienced substantial industrial development during the period in question with a specialization in the production of needles. Rural Schwabach had, by 1880, developed some metal wares and dyestuff industry. Despite the industrial development, only about one-sixth of the population could be classified as urbanized. Schwabach had more small farms than Friedberg, but many of these were engaged in the lucrative production of hops. In contrast to Friedberg, Schwabach was also overwhelmingly Protestant. Marital fertility in Schwabach was just a bit below the average in 1880. Economic change in Schwabach was also substantial, despite little change in urbanization. Between 1880 and 1910, agricultural employment fell from 60 to 43 percent of the population, and those engaged in the production of metal wares (including bronze and gold) and dyestuffs rose by 50 percent to over one-tenth of the population. The production of non-ferrous metal wares especially provided employment opportunities for women. Fertility declined more in Schwabach than in any rural district between 1880 and 1910 (38 percent), and in 1910, its fertility was among the lowest among all rural districts. The regression results imply only about one-half of this decline, but highlight the importance of the rise in women's wages. The already high real wage rose another 16 percent and accounted for two-thirds of the decline in

fertility. The increase in the SPD vote from near zero in 1880 to one-fifth of eligible voters helps to explain another one-sixth of the decline.

Two other districts offer striking contrasts to the sharp decline in Friedberg and Schwabach. Wolfstein, the least industrialized district in 1880, lies in the uplands known as the "Bavarian Forest." Only 11 percent of its people were employed in industry at the start of our period, and it was also the district with the largest share of the population dependent on agriculture (71 percent). Farms in Wolfstein tended to be small and unproductive. The most important source of non-farm employment was in forestry, which accounted for five percent of the population. The sparse alternatives in industry or commerce most likely account for the complete absence of a town larger than 2,000 people. Wolfstein experienced little outmigration in the years prior to 1880. This was the most Catholic county in Bavaria (99.9 percent Catholic), but in 1880 it had about the same marital fertility as Friedberg. There was little economic change between 1880 and 1910. Employment in agriculture and forestry remained about the same and the high rate of outmigration (6% in the five years before 1910) indicates its economic stagnation. Wages for women did rise between 1880 and 1910, but they did not keep pace with increases elsewhere, and by 1910, were among the lowest in Bavaria. Given the virtual absence of any economic change and the overwhelming Catholicism of the population, the regressions imply almost zero reduction in fertility; fertility actually rose from 1880 to 1910.

Kemnath lies in the *Fichtelgebirge*,a region of low mountains in the Upper Palatinate. The economy here was already diversified in 1880, with two-thirds of the population in agriculture. Quarrying (about 5 percent) and linen textiles provided the main sources of industrial employment. The largest town had a population of about 1,500. Farms were not exceptionally small. The local economy was not strong enough to prevent exceptional outmigration during the 1870s. Kemnath's population was 88 percent Catholic, but in 1880 its marital fertility was lower than in the Protestant and much more urbanized district

of Schwabach. Much of the economic change that was taking place in other parts of rural Bavaria had bypassed this district as late as 1910. Employment outside of agriculture now supported two-fifths of the population. Quarrying, cement production, and glass and porcelain manufacture provided most of the employment in industry. The textile industry all but disappeared, and outmigration continued. Despite a substantial increase in female wages, Kemnath's wages remained relatively low. The Catholic Center Party achieved some of its greatest success mobilizing voters in this district in 1907. For that reason and primarily the strong impact of Catholicism, the regression predicts almost no change in fertility between 1880 and 1910, and once again marital fertility actually registered a small increase between 1880 and 1910.

4. Summary and Conclusion

The European Fertility Project argued that economic and social change played little role in the European fertility transitions of the nineteenth and early twentieth centuries. Our larger project is motivated in part by the sense that this conclusion was premature. Here we have used the case of Bavaria to contribute to our understanding of fertility transitions in areas that received relatively little attention in other studies. Bavaria's fertility transition was late and feeble in comparison to the Prussian experience, or that of other western European regions. At first sight this seems to fit well into the European Fertility Project's summary interpretation, which stresses an innovation/diffusion view and sees Catholicism as an impediment to this kind of diffusion. We take a closer look at Bavaria and come up with a more nuanced view. Parts of Bavaria experienced considerable rapid economic and social change over the period in question. Our econometric models suggest a small but clear role for this sort of development in the region's fertility history. Catholicism and related anti-modern outlooks (as measured here by voting conduct) were closely associated with high fertility that did not decline appreciably in this period. But the

elements of an adjustment interpretation also receive considerable support from the data. Areas that experienced the kind of economic development that implies increased opportunities for women had the most rapid fertility decline. The econometric models suggest that neither the religion/voting measures nor the economic and social measures are more important, in the sense of being able to explain variance, than their alternative. Our results differ in important ways from those of Galloway, Hammel, and Lee, who studied Prussia, but they are congruent in finding that the Princeton studies downplayed the role of economic and social development by using data that was too highly aggregated and that contained too little detail on occupation, wages, and other economic variables.

Bavaria offers two larger lessons for our understanding of the fertility transition. Detailed information of the type we use here requires hard work, as do the econometric models we employ. But they also open the possibility of fair empirical tests of a range of explanations, and with them the possibility that scholars of different disciplinary backgrounds will cease talking past one another at least on this issue. More importantly, large-scale studies such as the European Fertility Project imply a scope that makes it difficult for them to dig into the details of any one country or region's history. But those details matter, and in following up the questions raised in that and in other studies, what originally seemed like details may be the most important matters to pursue. Bavaria was not simply eight lines in an all-German dataset, it was a diverse and vibrant society in its own right. Understanding how it changed and how that change affected fertility conduct offers the possibility of a richer understanding of this very important episode in human history.

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Data Appendix

Variable Name	Definition	Source
Dependent Variable		
Marital Fertility	Number of live births per married women aged 15-50 for the four-year period centered on the census year (1879-1882 for 1880, etc.).	Births are reported in the *Beiträge* and in the *Zeitschrift*. The 1880 and 1910 censuses provided the age distribution of the married population. The distribution for the remaining years was estimated on the basis of Hindelang (1909, Table 59).
Demographic controls		
Infant Mortality	Infant mortality as a percent of live births.	*Zeitschrift, Generalbericht über die Sanitätsverwaltung*
Propotion married	The share of all women married	Population censuses of 1880 and 1910 and Hindelang (1909) for 1885, 1895, and 1900
Marriage rate	The share of females married within the three years prior to the census year.	Population censuses and data on marriages reported in the *Beiträge* and the *Zeitschrift.*
Migration	Net migration within five years prior to the census year.	Population censuses and mortality reported in the *Beiträge* and the *Zeitschrift.*
Political affiliation and religion		
Share of votes for SPD	Percentage of eligible voters voting for the SDP (socialist party) candidates for the *Reichstag*	Results of the elections of 1881(for 1880 and 1885), 1893(for 1895), 1898(for 1900), and 1912 (for 1910) in the *Zeitschrift.*
Share of votes for Catholic Center	Percentage of eligible voters voting for the *Zentrum* candidates for the *Reichstag*	Results of the elections of 1881(for 1880 and 1885), 1893(for 1895), 1898(for 1900), and 1912 (for 1910) in the *Zeitschrift.*

Share of votes for the Peasants Party	Percentage of eligible voters voting for the *Bauernpartei* candidates for the *Reichstag*	Results of the elections of 1881(for 1880 and 1885), 1893(for 1895), 1898(for 1900), and 1912 (for 1910) in the *Zeitschrift.*
Catholic	Share of Catholics in the population	Population censuses of 1880,1895,1900, and 1910 found in the *Zeitschrift*
Economic structure and economic environment		
Share Urban	The share of the population living in a commune (*Gemeinde*) with a population over 2,000 in rural districts.	Population censuses of 1880, 1885, 1895, and 1905
Per capita savings books	Savings books reported by *Sparkassen* (local savings banks) per capita.	*Zeitschrift*
Employment in Mining and Metal Processing	Those employed in mining and metal processing and their dependents as a share of population.	Census of Occupations of 1882, 1895, and 1907.
Employment in Textiles	Those employed in textiles and their dependents as a share of total population.	Census of Occupations of 1882, 1895, and 1907.
Other industrial employment	Those employed outside of mining, metals, and textiles and their dependents as a share of total population.	Census of Occupations of 1882, 1895, and 1907.
Real daily wage for female labor	"*Ortsüblicher Tagelohn*" set by local insurance funds to determine the compensation for work time lost because of illness. In marks of 1880 per day for female adult laborers.	Periodically published in the *Zeitschrift* starting in 1884. The final year is 1908. Desai (1968, Table A.8) provided the cost of living index.
Distribution of farm sizes	Share of farms of various sizes as a total of all farms.	Agricultural census of 1882, 1895, and 1907.

Cattle per capita	Number of milk cows per capita	Livestock census of 1881, 1893, and 1907.
Elevation (instrument)	Elevation of the main city of the district in meters above sea level	*Amtliche Topographische Karten* (1997)

Sources and Notes for Figures

Figure 1

Source: *Beiträge zur Statistik Bayerns*, various issues, *Zeitschrift des königlichen bayerischen Statistischen Bureaus*, various issues.

Notes: Rural districts include all *Bezirksämter*. Urban districts are defined as the independent cities (*Unabhängige Städte*) that had a population of at least 25,000 in 1870 to highlight the distinction between urban areas and rural areas. The urban group thus includes Augsburg, Bamberg, Bayreuth, Fürth, Hof, Munich, Regensburg, Nürnberg, and Würzburg. Those districts totalled twenty-eight in 1880 and thirty-three in 1910.The percentile distribution refers to the value of rates for the top quarter, the median, and the lower quarter of the distribution of rural districts.

Figure 2

Source: See Figure 1 for data sources and definitions of rural and urban districts.

Notes: Data for 1852-1862 are not available from published or archival sources.

Figure 1: Fertility Rates in Bavaria by Urban and Rural Districts, 1846-1912

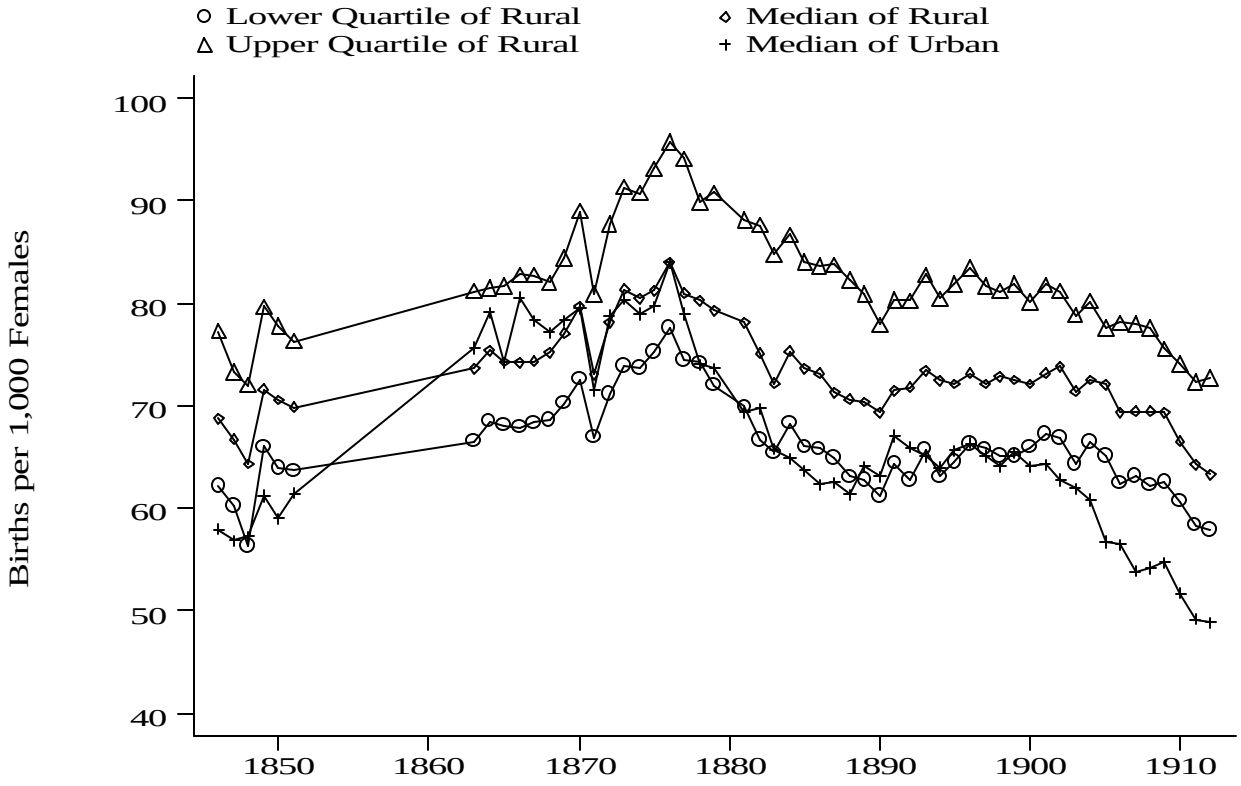


Figure 2: The Rural-Urban Distribution of the Share of Extra-Marital Births in Bavaria, 1846-1912

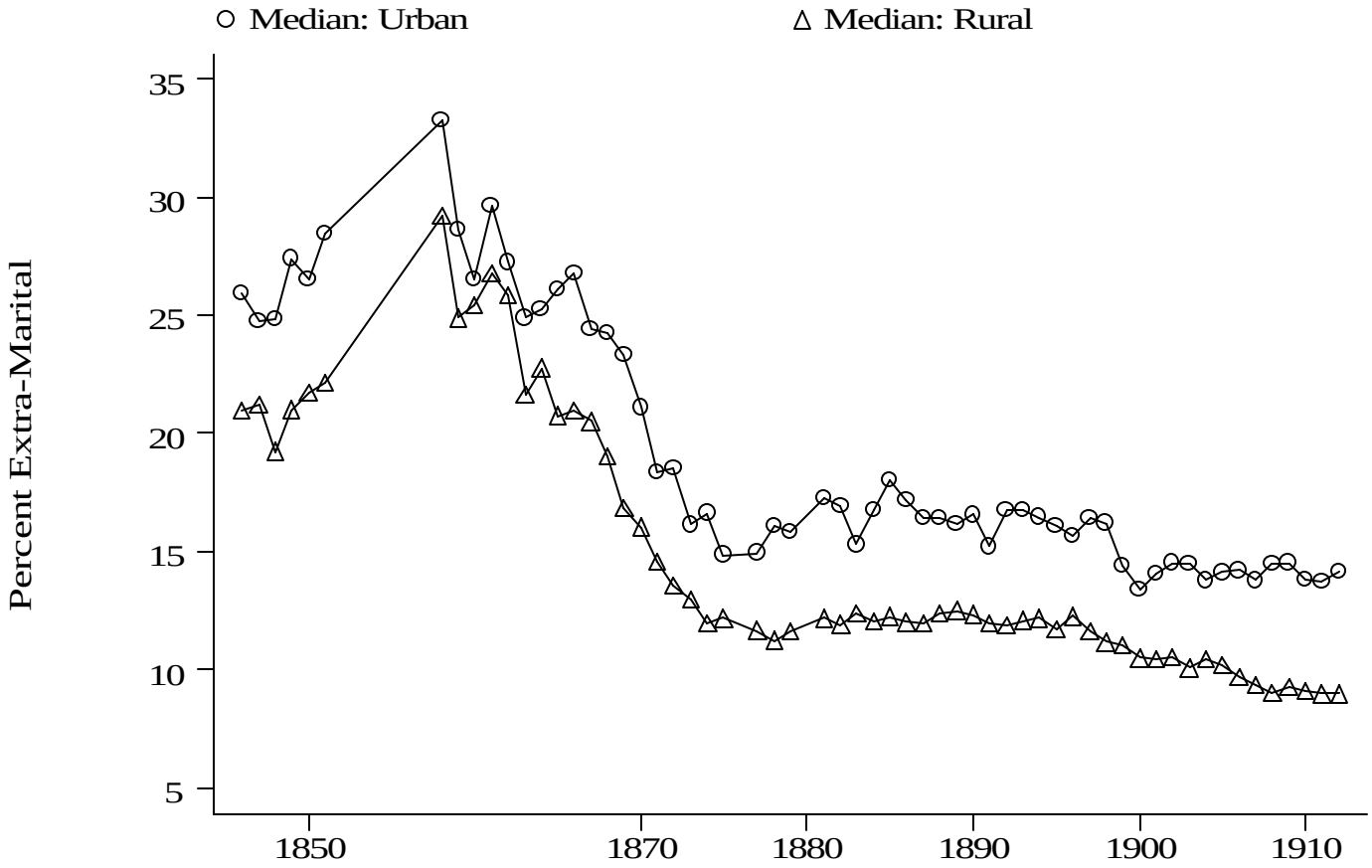


Table 1: Fertility in Bavarian Provinces on the Dates Assigned as the Fertility Transition by the Princeton Project

Region or province	Date of 10 percent decline in I_g (Princeton date)	Legitimate births per thousand married women in the first year of the Princeton range			Percent of population living in urban areas at start of Princeton interval
		Median (all Counties)	Inter-quartile range (all Counties)	Median of urban Counties	
Upper Bavaria	1885-1889	275	108	195	20.5
Lower Bavaria	After 1905	289	53	183	10.4
Lower Franconia	1900-1904	261	48	218	14.6
Middle Franconia	1885-1889	236	52	209	17.3
Upper Franconia	1900-1904	240	33	212	17.0
Upper Palatinate	After 1905	298	51	181	15.9
Schwabia	Before 1884	319	52	231	19.3

Source: Knodel 1977, Map 2.4, and County file

Note: County file results are weighted by population. “After 1905" is compared to 1910 in County file. “Before 1884" is compared to 1880 in County file.

Table 2: Summary measures of fertility decline in Bavaria, 1880-1910

Definition, period, and subset	Rural Counties		Urban Counties	
	Mean	S.D.	Mean	S.D.
Legitimate fertility (legitimate births per thousand married women aged 15-49)				
Levels:				
1880	286	42	230	28
1885	281	46	212	28
1895	281	44	222	25
1900	286	43	212	42
1910	252	48	164	25
Percentage decline:				
1880-1895	1.58	6.34	2.83	10.32
1895-1910	9.69	7.83	25.79	7.81
1880-1910	11.18	9.22	28.15	8.70
Illegitimate fertility (illegitimate births per thousand unmarried women)				
Levels:				
1880	42	17	41	16
1895	37	15	36	17
1910	29	14	29	15
Percentage decline:				
1880-1895	12.37	15.98	10.24	15.65
1895-1910	23.22	17.96	19.70	18.90
1880-1910	32.61	20.49	29.06	15.87

Source:

Notes: There are 138 rural Counties and 38 urban Counties. All calculations exclude the Pfalz.

Table 3: Rural Marital Fertility

Instrumental-variables and ordinary least-squares estimates

Variable	Instrumental variable estimates			OLS estimates			Mean of variable
	Est.	T-ratio	Elasticity	Est.	T-ratio	Elasticity	
Inf. mortality	-0.070	-0.660	-0.066	0.136	4.098	0.127	0.260
Marriage rate	8.611	3.599	0.425	3.749	5.929	0.185	0.014
Prop. Married	0.058	0.535	0.102	-0.077	-2.117	-0.137	0.494
Migration	0.059	0.564	-0.007	0.023	1.123	-0.003	-0.033
Catholic	0.433	3.049	1.208	0.292	3.143	0.813	0.780
Catholic x 1885	0.006	0.825	0.003	0.005	1.125	0.003	0.156
Catholic x 1895	0.019	2.549	0.011	0.021	4.877	0.012	0.156
Catholic x 1900	0.032	3.786	0.018	0.032	6.490	0.018	0.156
Catholic x 1910	0.041	3.787	0.023	0.037	5.809	0.021	0.156
SPD vote	0.216	2.468	0.039	0.066	1.515	0.012	0.050
SPD vote x 1885	-0.051	-0.907	0.000	0.011	0.360	0.000	0.002
SPD vote x 1895	-0.241	-2.546	-0.012	-0.054	-1.379	-0.003	0.014
SPD vote x 1900	-0.282	-2.564	-0.012	-0.068	-1.546	-0.003	0.012
SPD vote x 1910	-0.260	-3.051	-0.019	-0.105	-2.623	-0.008	0.021
Center vote	0.014	1.064	0.017	0.001	0.071	0.001	0.322
Peasant vote	0.011	1.042	0.002	-0.001	-0.137	0.000	0.059
Prop. Urban	-0.005	-0.256	-0.002	0.008	0.478	0.003	0.122
Urban x 1885	0.035	2.091	0.002	0.020	1.505	0.001	0.019
Urban x 1895	0.017	1.190	0.001	0.011	0.892	0.001	0.024
Urban x 1900	-0.015	-0.768	-0.002	-0.003	-0.223	0.000	0.030
Urban x 1910	-0.040	-2.542	-0.004	-0.036	-2.737	-0.004	0.030
Savings books	-0.005	-0.327	-0.002	-0.005	-0.414	-0.002	0.103
Mining emp.	-0.044	-0.486	-0.001	0.038	0.620	0.001	0.005
Textile emp.	-0.269	-2.761	-0.021	-0.212	-2.844	-0.017	0.022
Other ind. emp.	-0.041	-0.833	-0.030	0.007	0.263	0.005	0.207
Other emp	-0.026	-1.073	-0.016	0.000	-0.028	0.000	0.172
Female wage	0.021	1.888	0.086	0.025	3.726	0.101	1.153
Wage x 1885	-0.011	-0.953	-0.008	-0.008	-1.093	-0.006	0.220

Wage x 1895	-0.026	-2.195	-0.022	-0.024	-2.943	-0.020	0.233
Wage x 1900	-0.014	-1.079	-0.012	-0.010	-1.118	-0.009	0.239
Wage x 1910	-0.058	-3.141	-0.053	-0.042	-3.909	-0.038	0.252
Small farms	0.141	2.924	0.124	0.106	3.027	0.094	0.246
Med farms	0.040	1.103	0.050	0.036	1.251	0.045	0.357
Large farms	0.012	0.278	0.004	-0.001	-0.029	0.000	0.079
Year = 1885	0.013	1.077	0.010	0.005	0.535	0.003	0.200
Year = 1895	0.022	1.587	0.015	0.009	0.986	0.007	0.200
Year = 1900	0.002	0.155	0.002	-0.011	-1.112	-0.008	0.200
Year = 1910	0.016	0.922	0.011	0.008	0.571	0.005	0.200

Note: Instruments are elevation, population density, and number of cows per capita interacted with year dummies. The IV estimates have 679 observations, the OLS, 685 (6 observations are lost because of missing data in instruments). The adjusted R-square for the IV equation is .91, and for the OLS equation, .94. The mean of the dependent variable is .279.

Table 4: Urban marital fertility

Instrumental-variables and ordinary least-squares estimates

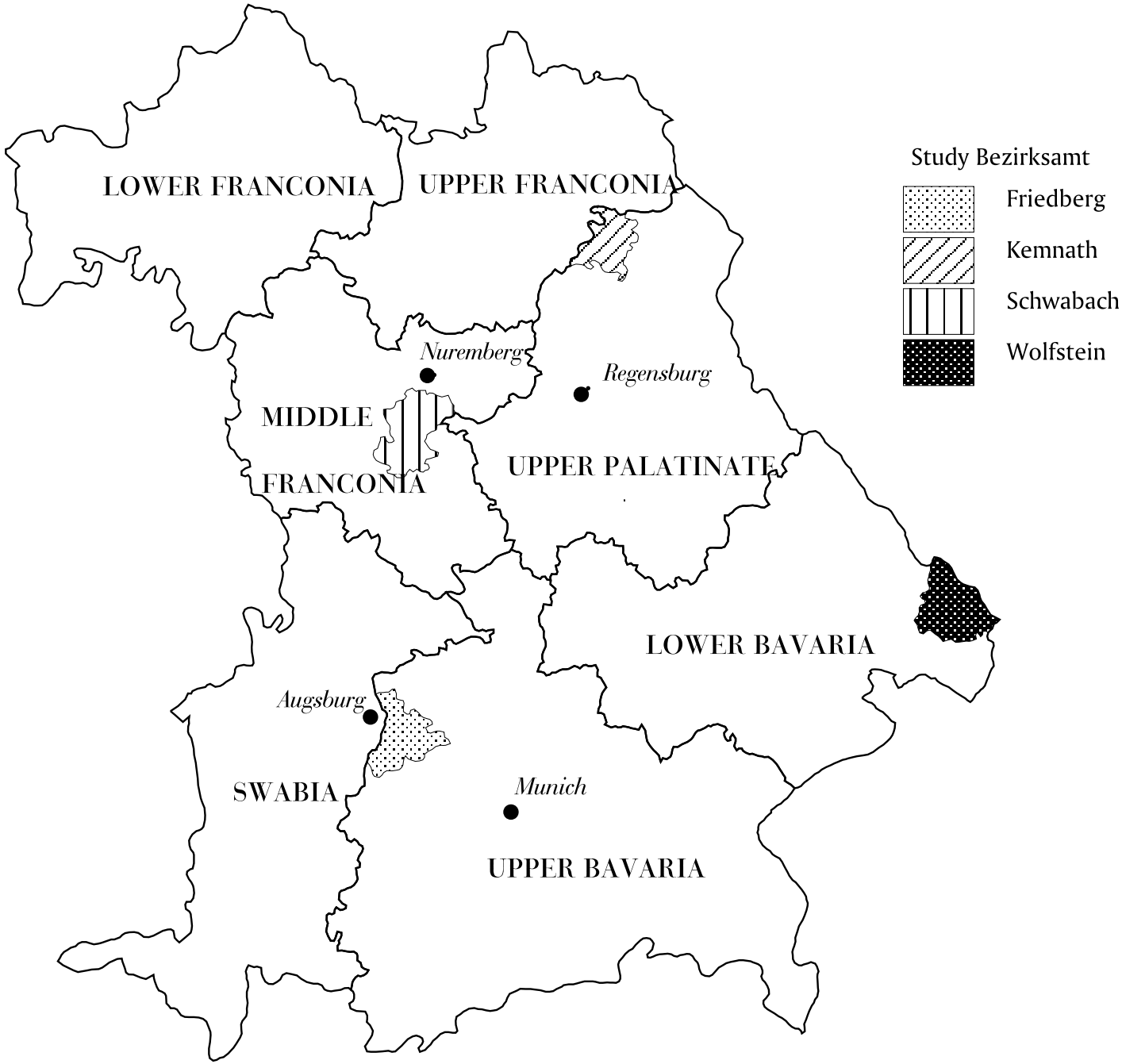
Variable	Instrumental Variables			OLS Estimates			Mean of variable
	Estimates	T-ratio	Elasticity	OLS Estimates	T-ratio	Elasticity	
Inf. mortality	0.070	0.301	0.088	0.071	1.083	0.090	0.261
Marriage rate	6.731	1.327	0.505	3.414	3.704	0.256	0.016
Prop. Married	0.013	0.028	0.028	-0.075	-0.577	-0.164	0.459
Migration	-0.037	-0.134	-0.008	0.110	2.487	0.024	0.045
Catholic	-0.132	-0.857	-0.398	-0.068	-0.931	-0.203	0.626
Catholic x 1885	0.010	0.407	0.006	-0.006	-0.586	-0.004	0.123
Catholic x 1895	0.008	0.258	0.005	-0.002	-0.159	-0.001	0.125
Catholic x 1900	0.034	1.284	0.021	0.028	1.513	0.017	0.127
Catholic x 1910	-0.006	-0.227	-0.004	-0.001	-0.076	-0.001	0.128
SPD vote	0.046	0.329	0.015	0.140	2.035	0.045	0.067
SPD vote x 1885	-0.028	-0.229	-0.001	-0.073	-1.735	-0.001	0.004
SPD vote x 1895	-0.090	-1.059	-0.008	-0.132	-2.438	-0.011	0.017
SPD vote x 1900	-0.114	-0.934	-0.009	-0.169	-2.445	-0.013	0.016
SPD vote x 1910	-0.109	-1.422	-0.013	-0.143	-2.832	-0.018	0.026
Center vote	-0.007	-0.183	-0.009	0.000	0.013	0.001	0.298
Peasant vote	-0.007	-0.137	-0.002	0.015	0.519	0.004	0.048
Savings books	-0.001	-0.019	-0.001	0.002	0.050	0.002	0.147
Mining emp.	-0.551	-0.647	-0.007	-0.320	-0.649	-0.004	0.003
Textile emp.	0.002	0.008	0.000	0.025	0.160	0.004	0.033
Other ind. emp.	0.016	0.081	0.032	0.054	0.389	0.105	0.403
Other emp	-0.049	-0.223	-0.112	-0.072	-0.509	-0.163	0.474
Female wage	-0.002	-0.067	-0.011	0.003	0.127	0.017	1.269
Wage x 1885	0.023	0.854	0.026	0.011	0.583	0.013	0.240

Wage x 1895	0.006	0.191	0.007	0.014	0.629	0.016	0.245
Wage x 1900	0.041	1.270	0.053	0.042	1.423	0.053	0.265
Wage x 1910	0.020	0.567	0.028	0.024	0.954	0.033	0.289
Year = 1885	-0.031	-0.916	-0.030	-0.012	-0.561	-0.011	0.200
Year = 1895	-0.004	-0.105	-0.004	-0.019	-0.689	-0.018	0.200
Year = 1900	-0.082	-1.842	-0.079	-0.085	-2.189	-0.082	0.200
Year = 1910	-0.061	-1.182	-0.059	-0.077	-2.091	-0.074	0.200

Note: Instruments are elevation and population density interacted with year dummies. Both models have 190 observations. The adjusted R-square for the IV equation is .74, for the OLS equation, .79. The mean of the dependent variable is 208.

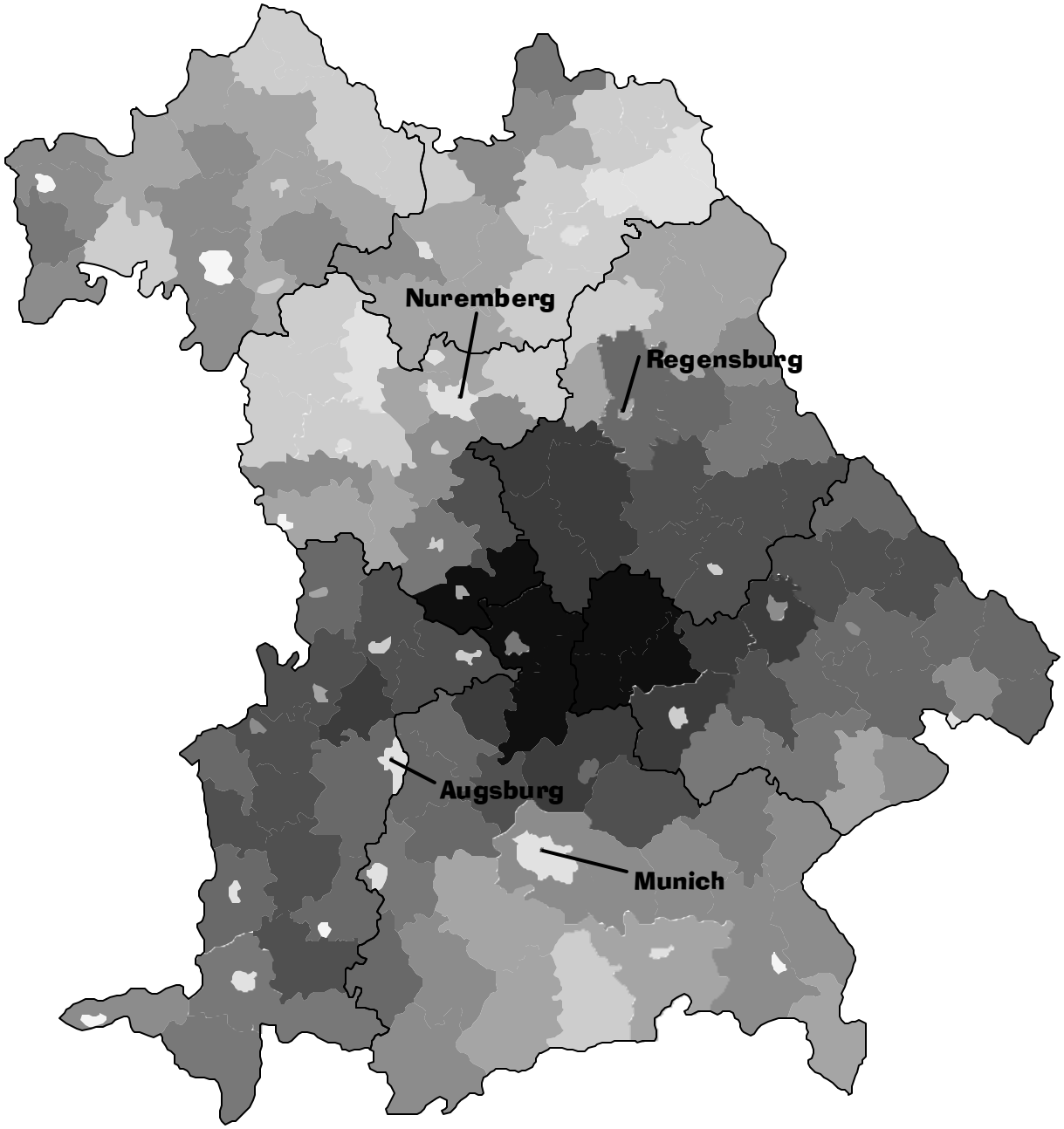
Map 1

Bavarian Regions and Principal Cities



Map 2

Marital Fertility in Bavaria: 1880



Births per 1,000 Married Women

- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- 320 - 340
- 340 - 360
- 360 - 380

Map 3

Fertility Decline in Bavaria: 1880-1910