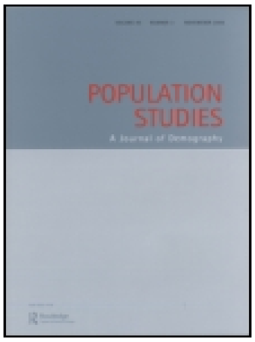

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Fertility transition in a rural, Catholic population: Bavaria, 1880–1910

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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, remains a topic of debate largely because there is no accepted explanation for the event. 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. Our results for Bavaria 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.

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 couples began to decide when to bear children and how many children to bear. The fertility decline has continued, and in some industrialized societies fertility is now at below-replacement level. Although there has been a 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. The German state of Bavaria was overwhelmingly Catholic and its industrialization was relatively late. The historiography would suggest that its late and modest fertility transition is unsurprising, and detailed empirical study confirms some of the basic outlines of the conventional view of the process. On the other hand, the detailed study also demonstrates the importance of factors overlooked by the conventional view. The approach we take reflects the pioneering research of Galloway, Hammel, and Lee 1994, 1998 which in turn built on Richards 1977. This paper is part of a larger study of migration and fertility decline in the city of Munich during the period 1850–1914 (for further discussion see Brown, Guinnane, and Lupprian 1993, and Brown and Guinnane 2001a, 2001b).

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1. BAVARIA: 1850–1914

Figure 1 presents the basic pattern of fertility change in Bavaria's rural and urban areas for the period 1849–1912. Sustained fertility decline began in much of Bavaria only after 1900. The literature on historical fertility transitions neglects regions such as Bavaria, which accounted for an eighth of the population of Germany in 1871. It was largely Catholic and rural, and it industrialized much later than the advanced states of Prussia and Saxony. The late decline fits as comfortably with a stress on cultural explanations for the fertility transition as it does with older arguments that emphasize the role of urbanization and industrialization. A closer look at the economic development of Bavaria during this period points to the inadequacy of this view. (Our discussion will exclude consideration of the Bavarian Palatinate (the *Pfalz*), a part of pre-1918 Bavaria located in southwest Germany, several hundred miles from the remainder of the state. The Palatinate's unusual status leaves us without the detailed data used later in the paper.)

Bavaria displayed remarkable diversity in the economic developments that form the backdrop to the course of fertility from 1850 to 1880. Throughout the 1870s, high fertility, low mortality, and economic stagnation in the north and west provinces (or *Regierungsbezirk*) of Upper and Lower Franconia (see Figure 2) increased pressure for out-migration (Hubert 1995, pp. 118–120 and Kolb 1966, pp. 57–60). At the same time, employment in rural putting-out industry, particularly linen, declined in the face of imports from elsewhere in Germany (Fried 1975, pp. 760–761). After a phase of emigration to the United States, growth in industrial employment elsewhere in Germany and Bavaria

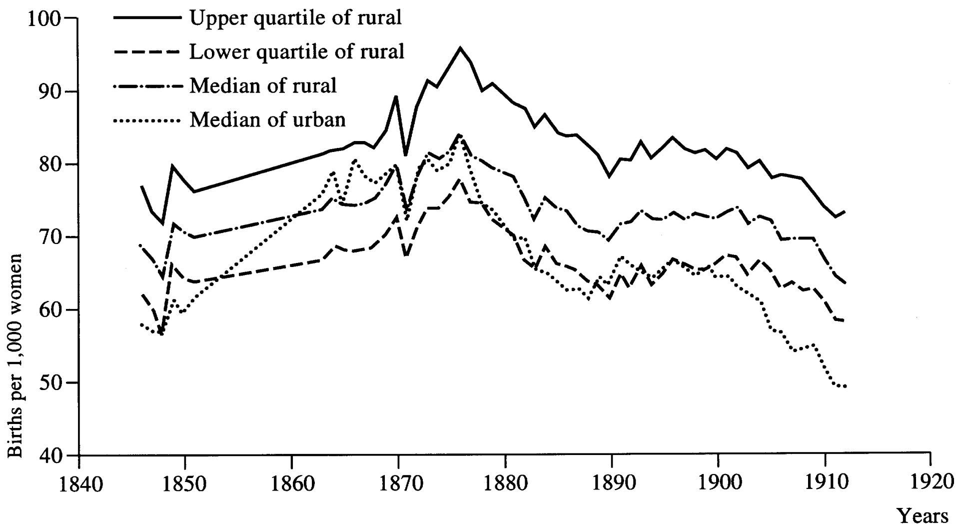

Figure 1. Fertility rates, by urban and rural districts, 1846–1912
Source: *Beiträge zur Statistik Bayerns*, various issues, *Zeitschrift des königlichen bayerischen Statistischen Bureaus,* various issues.
Notes: Rural districts include all *Bezirksämter*. Urban districts are defined as the independent 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. There were 28 of those districts in 1880 and 33 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.

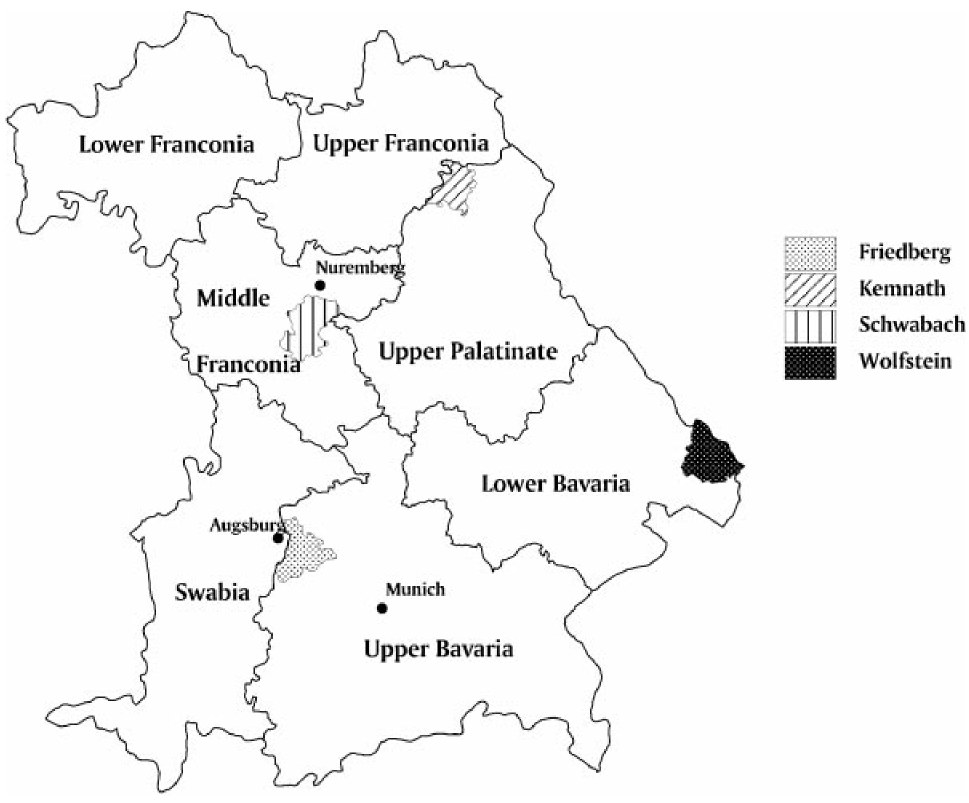

Figure 2. An overview of Bavaria and its provinces

began to asorb the surplus population. The Augsburg area, Upper Franconia, and the area around Nuremberg developed industries such as cotton textiles, machine-making, and brewing (Zorn, 1975, pp. 799–805). The southern province of Upper Bavaria, which surrounds Munich, benefited from the demand for its grain from the rest of Germany. Declining rural industry reduced non-agricultural employment, and as late as 1880 industrialization had not yet made good the loss. As in 1850, half of the population still depended on agricultural employment. Eighty-five per cent of the population continued to live in rural districts (*Bezirksämter*).

From 1880 to 1914, both Bavarian agriculture and industry underwent far-reaching changes. The historic drop in grain prices during the 1870s and the growth in alternative employment set off the 'flight from the land' (*Landflucht*) that continued for the rest of the prewar period. The out-migration included day labourers working on the small farms of the north and west and younger people who had traditionally found employment as live-in servants on the large farms of Upper Bavaria (Sandberger 1975). From the mid-1890s to about 1910, the number of day labourers fell by a third and the number of farm servants by a half ('Landwirtschaftsbetriebe' 1909). Continued pressure on the household production of linen and woollens further undermined rural employment. By 1910, a quarter of rural districts had experienced depopulation. Those remaining on the farm also faced changed circumstances. The traditional three-field system gave way to crop rotations that often included labour-intensive fodder crops, increasing the demand for family labour. Increased cattle-raising during the last third of the nineteenth century disproportionately raised demand on the time of female household members (Fried 1975, p. 771, and Schlögl 1954, pp. 428–239).

The expansion of employment outside of agriculture, particularly in industry and trade, outpaced the decline of opportunities in rural areas. The share of agriculture and forestry in employment fell from about a half in 1880 to two-fifths by 1907. The growth of high-wage industries such as metals, construction, transportation, and machine-making offered better-paid employment to migrants from rural areas (Kolb 1963, Tables 10 and 11 and Zorn 1975, pp. 808–820). The economic changes during the period 1880–1910 also spurred increased urbanization. The share of the population living in cities larger than ten thousand grew from under a tenth to over a quarter. Two-thirds of these urban-dwellers lived in great cities of over 100,000 by 1910.[1]

Bavaria's demographic regime during the period before unification in 1871 reflected its economic stagnation. Annual population growth was about 0.5 per cent from the 1820s to 1871. After 1871, population growth rose to 0.9 per cent. Two features distinguished the Bavarian regime from patterns in northern and central Germany: relatively high rates of mortality and of extramarital births. Even in the early 1880s, crude mortality in Bavaria averaged about 29 deaths per 1,000 inhabitants per year, which was higher than in neighbouring Hesse and industrialized regions such as the Rhine Province of Prussia (Matz 1979, pp. 254–255). Infant mortality rates in excess of 300 per 1,000 births made a key contribution to higher mortality. Some authors have argued that the high infant mortality reflects a Catholic practice of baptizing stillborn children. The data show that such a practice could explain at most only a small fraction of the Catholic-Protestant differential in infant mortality. Kintner 1982 and Knodel (1974, pp. 164–165) attribute high infant mortality to low rates of breast-feeding.

Observers have linked Bavaria's high infant mortality to its high levels of illegitimacy. After peaking at over thirty per cent of rural and urban births, illegitimacy fell rapidly until the 1880s. Despite some further decline, illegitimacy in 1910 still ranged from ten per cent in rural areas to over fifteen per cent in urban areas, compared to less than nine per cent for Germany as a whole (Hubert 1995, Appendix Table 7). Partly because of limited data availability, this study restricts its focus and statistical analysis to legitimate fertility. Another dataset in development will allow a much closer look at the causes of high urban illegitimacy.

The Fertility Transition in Bavaria

Knodel 1974 is the starting point for modern accounts of the fertility transition in Germany. Like most European Fertility Project authors, he focuses on dating the onset of fertility decline and then examining potential explanations. From the Napoleonic Wars onward until unification in 1871, crude birth rates remained relatively constant in the German states as a whole (Hubert 1995, p.34). From 1867 on, the availability of detailed information on births and the age distribution of married women allowed Knodel (1974, pp.38–50) to calculate I_g for 71 geographic regions (or provinces) in Germany up to 1939. (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.) Like the other European Fertility Project authors, Knodel defines the fertility transition as the point where this index fell by ten per cent or more. He finds that the median year of decline falls in the decade of the 1890s. Of equal interest is his discovery that the differences in the timing of the transition across Germany (and Bavaria) are substantial, ranging from the early 1880s in provinces such as Bremen or Bavarian Swabia to as late as 1914 in Lower Bavaria (Knodel 1974, p.65). The differences within Germany are almost as wide as differences across all of western and central Europe.

Published Bavarian statistics provide enough data to track trends in birth rates from the late 1840s to 1912 with only a decade-long interruption from 1852 to 1862. The long-run data are available for 152 exclusively rural districts (*Bezirksämter*) and 24 exclusively urban districts (*Unabhängige Städte*). The rural districts had an average population of 35,000 in 1910, which is a fraction of the population – which ranged from 600,000 to over 1 million – living in each of the seven Bavarian provinces. Figure 1 presents data on the distribution of rural birth rates (births per 1,000 women) at the district level for the period 1846–1912. The median birth rate of the larger urban districts with a population of over 20,000 in 1852 allows for a rural-urban comparison. Although the figure displays some remarkable short-term fluctuations (particularly in response to the economic and political crisis of the late 1840s), two longer-term developments stand out: the increase in birth rates throughout the 1870s and the steep decline after 1900. 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. Knodel (1988, Table 11.1), among others, has found evidence of considerable parity-dependent control in smaller German populations as early as the first quarter of the nineteenth century. Increases in fertility later in the century may reflect the relaxation of earlier controls. The apparent increase in births may also reflect improved *reporting* of births, a problem that apparently affects, for example, the orginal Princeton estimates for Ireland (Ó Gráda 1991). Knodel (1974, pp.29–30), however, reports great confidence in the quality of the Prussian data, and we see no reason to expect the Bavarian data to be of lower quality. Finally, it is also possible that Bavaria's elimination of substantial financial barriers to obtaining marriage licenses in the 1860s prompted a subsequent boom in marriages and the influx of younger and more fertile women into the ranks of married – and childbearing – women (Matz 1979, p. 238). The post-war baby boom that followed the Franco-Prussian War of 1870–1871 probably also contributed to higher birth rates. The return to lower and more stable fertility rates in the 1880s ended with the rapid decline in births after 1900. The decline in births in urban districts began a few years earlier and is even more pronounced than in rural districts.

Figure 3 illustrates the geographic distribution of marital fertility by district in 1880, with most urban districts appearing as islands of lower fertility. The boundaries of the seven provinces have been superimposed on the map. Figure 4 summarizes the geographic distribution of the decline in marital fertility. The steepest declines occurred in urban districts and in a patchwork pattern that corresponds poorly with the provincial boundaries. For all of Bavaria, marital fertility fell by 19.6 per cent in the period 1880–1910. The detailed evidence implies much more geographic variation in the levels of fertility and in timing than is suggested by the large provincial units used in Knodel's analysis. Consider the extreme example of Upper Bavaria. Knodel argues that the fertility transition in this province occurred in the period 1885–89. In 1885 the median general marital fertility ratio for the 30 districts of Upper Bavaria was 275, while the interquartile range was 108; at the date Knodel assigned for Upper Bavaria's fertility transition, a quarter of all rural districts had marital fertility levels lower than the median urban district in that province. (For additional detail on the internal heterogeneity of Knodel's provinces, see Brown and Guinnane 2001b, Table 1.)

An explanation of Bavaria's fertility transition must account for the pattern of decline in rural areas after 1880. The index of marital fertility I_g that can be calculated for each urban and rural district for the period 1867–80 suggests that only about 10 per cent of the rural districts had met the Princeton criterion of a decline of 10 per cent by 1880. About a half of the urban districts had experienced a decline of this magnitude by 1880. Some accounts stress that rural-to-urban migration, not rural fertility decline, is the driving force behind fertility transitions. Some simple counter-factual calculations show that was not the case in Bavaria, even though the share of the population living in urban areas rose from 20 per cent in 1880 to 40 per cent by 1910. Marital fertility declined in rural areas by about 11.5 per cent on average over this period. In urban areas, the average decline was 37 per cent. A counter-factual of increased urbanization with no fertility decline in either rural or urban areas would have reduced fertility overall in

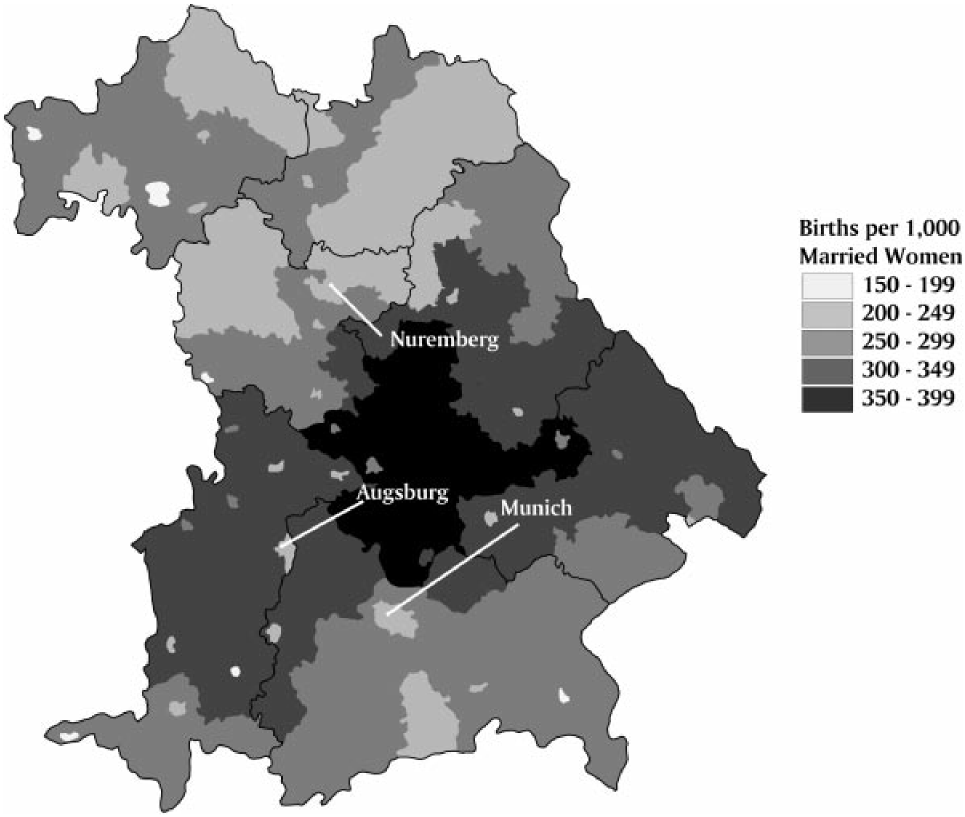

Figure 3. Marital fertility by district, 1880.

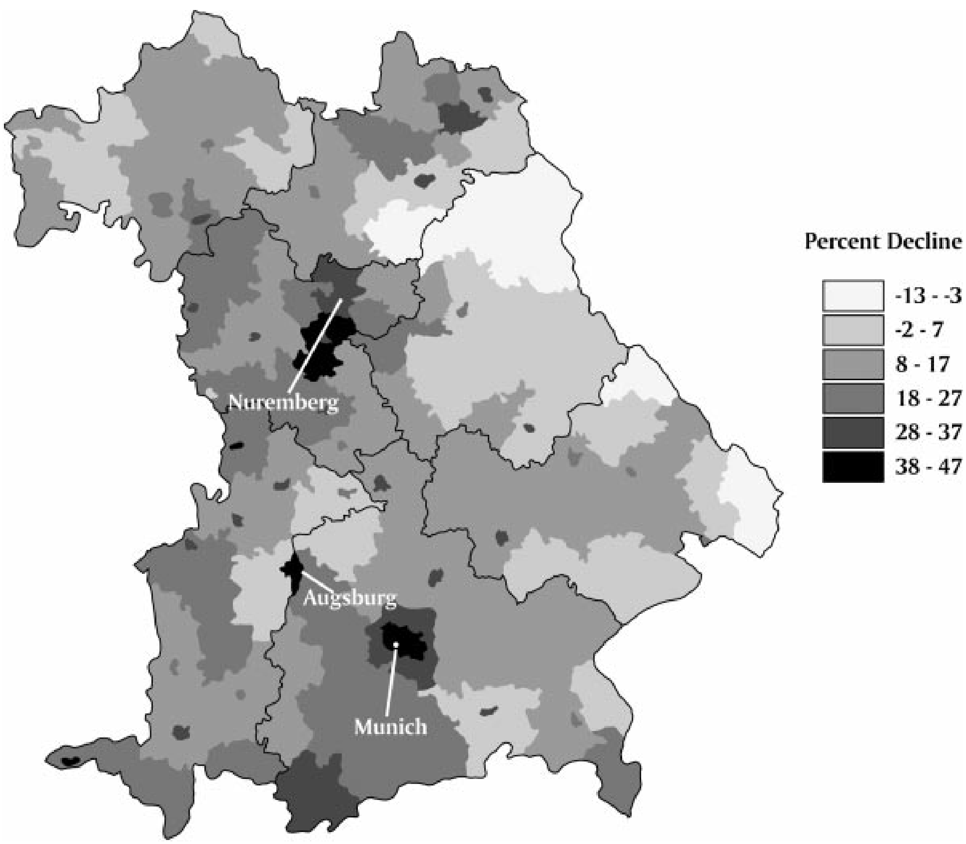

Figure 4. Percentage change in marital fertility, by district, 1880 to 1910

Table 1. *Summary measures of fertility decline in Bavaria, 1880–1910*

	Rural Districts		Urban Districts	
Definition, period, and subset	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: *Beiträge zur Statistik Bayerns*, various issues, *Zeitschrift des königlichen bayerischen Statistischen Bureaus,* various issues.
Notes: There are 138 rural districts and 38 urban districts. All calculations exclude the Pfalz.

Bavaria by only 4.7 per cent. A counter-factual fertility decline in rural areas alone (no urban decline and no increased urbanization) would have caused a fertility decline of 9.6 per cent, about half the actual decline. Without the decline in rural marital fertility, the overall fertility decline in Bavaria would have been much more feeble.

By 1910, many more Bavarian couples had opted to have smaller families. Historians have much less to say about the contraceptive methods that were used during the European fertility transition. Contemporary studies exist for Germany shortly before the First World War, but they are based on decidedly non-random surveys. The impression they leave is similar to that conveyed by 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 (*Denkschrift* 1915 and Dienel 1995).

2. COMPETING EXPLANATIONS OF THE FERTILITY TRANSITION

The European Fertility Project's view of the fertility transition is best understood in the light of a distinction associated with Carlsson 1966. Carlsson divided explanations of the fertility transition into two groups – innovation/diffusion or adjustment. According to the first explanation, the adoption of fertility control within a population is a new behaviour, the origins of which may be new knowledge or changes in the moral acceptability of contraception. This view implies that high fertility before the transition reflects either the population's inability to control fertility or its unwillingness to do so on moral grounds. In contrast, the adjustment explanation is that fertility control reflects couples' adaptation to changing economic and social circumstances. High fertility before the transition 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. We are in sympathy with a third view, usually described as 'the Easterlin synthesis', that incorporates both the economic focus on the demand for children and the problem of the costs of fertility control, including social impediments to its use (Easterlin 1976).

The European Fertility Project stressed the fact that simultaneous fertility transitions in widely varying economic and social circumstances are consistent with the innovation/diffusion view, but not with the adjustment view. 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). Cleland and Wilson (1987, p. 18) 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'. We view these conclusions as premature because of serious reservations about the methods underlying the European Fertility Project. We discuss those reservations at length in Brown and Guinnane 2001a. Other analyses, as well as the results we report below, are sufficient to suggest that the Princeton project's large units masked considerable internal heterogeneity; that the definition of fertility control and the index chosen to detect the onset of fertility control are problematic; that the explanatory variables used in most European Fertility Project studies do not support meaningful tests of the role of social and economic change in the fertility transition; and that the statistical methods used in most European Fertility Project studies do an injustice both to the Princeton Project's interpretation and to those it criticizes. This paper demonstrates the validity of the last two objections by showing how a different approach yields different conclusions about Bavaria. (The objection to the measures used by the European Fertility Project is presented in Guinnane et al. 1994. For a useful overview of competing explanations of the fertility decline, see Alter 1992).

Economic models of the demand for children

The economic approach to fertility and the fertility transition views the household as an optimizing agent that has a demand for children that depends on their costs. We cannot estimate these models given the data used here, but we can draw out two of their important implications as a rationale for our own analysis. The economic models of the demand for children are driven by variations in the cost of child-rearing. There are several such costs, the most important being the opportunity cost of parental (primarily 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 so long as children are a normal good and the substitution effect of an increase in parental wages dominates the income effect. The economic approach also suggests that the role of infant and child mortality plays a more complicated role in the demand for children than some other approaches imply. 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. The size of their surviving brood depends on the number of children born and to some extent on the effort and resources the parents devote to ensuring their children's survival. In some circumstances it makes sense to have a small number of births and devote a great deal of care to each child. In others, it is better to avoid contraception in the expectation that mortality will limit the number of surviving children. The literature on Bavaria is 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).

The economic 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. As one of the implications of such a change, couples could react to a reduced cost of contraception by relying less on infant mortality to reduce the size of their completed family.

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 women's 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.

3. ECONOMETRIC ANALYSIS OF THE FERTILITY TRANSITION, 1880–1910

Our analysis relies on a consistent set of rural 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 indicators of 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 1 presents summary measures of fertility and its decline for the period 1880–1910. We model marital fertility using a panel regression framework. This approach allows us to focus on the changes in marital fertility that are the focus of the Princeton project. Our regression model lets the fixed effect absorb the different levels of fertility in each district in 1880, and focuses our attention on how changes in right-hand side variables affect fertility.

The potential endogeneity of regressors poses a serious modelling problem. Several of our regressors are arguably endogenous. We cannot possibly find enough suitable instruments for all of them, so we restrict our attention to endogenous variables that present the most severe problems. In our case these are 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 that imply that infant mortality is exogenous to fertility and thus not a problem in an Ordinary Least Squares (OLS) model. But one line of causation discussed above implies that infant mortality is endogenous.

The most common approach to dealing with endogenous right-hand side variables is to use instrumental variables (IV). Deaton (1997) stresses that the use of this approach requires serious thought about the nature of 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 association with unhealthy environments. We use the district's elevation above sea level as one instrument. Many historical studies find that mortality in general, including infant mortality, is lower at higher elevations as long as the elevation is not extremely high, and the populated regions of the Bavarian Alps are not that high. 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 head as a proxy for the cost of women's time in dairy production. One might worry that this last instrument should in fact be a regressor, but over-identification tests suggest it is not. 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.

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 urban, 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 per cent 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 defence. 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 the period 1904–1906 (see Groth and Hahn 1910). Unfortunately, these reports are only available for about half of the cities and two-thirds of the rural districts, and the measures are 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 specification strategy was to focus on building a model of the rural fertility decline, for reasons that will 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. We deal with the period effects by entering a 'main effect' and then interacting that effect with dummies for 1885, 1895, 1900, and 1910. We include year interactions only 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. (2) The next two sets of variables are intended to measure attitudes towards fertility and towards what social historians call modernization. Catholicism is the reported religious affiliation in the district. The next group of variables measures votes for the main political blocks. Something like support for our Social Democratic Party (SPD in German) variable was used in several European Fertility Project studies as a 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. 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 programme for an orderly, controlled life that would improve the well-being of the working classes. (4) The final set of variables reflects 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. 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 (real) women's daily local wage for unskilled labour. The wages of men and women are so highly correlated that we could not enter them both in the same model. We divide farms into four size categories, following suggestions in the literature that changes in the demand for women's labour 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 district fixed effects. For years, the omitted value is 1880. The omitted rural district is Aichach in the *Regierungsbezirk* of Oberbayern. The omitted urban district is Freising, also in Oberbayern. For all specifications reported below, we can reject the linear restriction that forces all districts within a *Regierungsbezirk* to have the same fixed effect; that is, the district-level fixed effects are not just proxies for their province.

We do not include measures of education or schooling. Many studies of fertility in developing countries today find that the education of females, or at least their literacy, has an important impact on the decision to limit fertility. Measured illiteracy of males in Germany as a whole was less than two per cent 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 the literacy of females do not exist, but there is little reason to think it was not strongly correlated with male literacy at the district 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. Ritter and Tenfelde (1992, pp. 718–719) discuss the issue for Germany as a whole, and the Bavarian educational system was similar to that in the rest of Germany.

Results: legitimate fertility in rural areas

Table 2 presents our estimates for rural fertility, and Table 3 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 to assess the magnitude of each variable's effect. Not surprisingly, the estimates for the endogenous variables are quite different under the IV and OLS 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 confirms some aspects of the interpretation stressed by the European fertility project, but also supports our stress on the details of economic and social development, which that project downplayed. Catholicism has a large and growing impact on fertility. This effect must reflect the impact of the Catholic outlook and social teaching, because we have controlled for two other effects. Following Nipperdey (1993, pp.536–554), we treat the Center party variable as capturing political Catholicism; the Catholic variable, holding the Center variable constant, is a simple statement of affiliation with no indication of the strength of belief. Our migration variable removes the potentially confounding effect that differential migration by religion would introduce. This effect is a subtle danger of panel approaches. Once we have a fixed effect for each district, the Catholicism variable works off variations in Catholicism's changes within a district, over time, and their correlation with changes in marital fertility. Few Bavarians changed their religious affiliation. In 1901, only 2.4

Table 2. *Rural marital fertility*

Variable	Instrumental-variables and ordinary least-squares estimates						Mean of variable
	Instrumental variable estimates			OLS estimates			
	Estimate	T-ratio	Elasticity	Estimate	T-ratio	Elasticity	
Infant 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
Proportion 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 × 1885	0.006	0.825	0.003	0.005	1.125	0.003	0.156
Catholic × 1895	0.019	2.549	0.011	0.021	4.877	0.012	0.156
Catholic × 1900	0.032	3.786	0.018	0.032	6.490	0.018	0.156
Catholic × 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 × 1885	–0.051	–0.907	0.000	0.011	0.360	0.000	0.002
SPD vote × 1895	–0.241	–2.546	–0.012	–0.054	–1.379	–0.003	0.014
SPD vote × 1900	–0.282	–2.564	–0.012	–0.068	–1.546	–0.003	0.012
SPD vote × 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
Proportion urban	–0.005	–0.256	–0.002	0.008	0.478	0.003	0.122
Urban × 1885	0.035	2.091	0.002	0.020	1.505	0.001	0.019
Urban × 1895	0.017	1.190	0.001	0.011	0.892	0.001	0.024
Urban × 1900	–0.015	–0.768	–0.002	–0.003	–0.223	0.000	0.030
Urban × 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 employment	–0.044	–0.486	–0.001	0.038	0.620	0.001	0.005
Textile employment	–0.269	–2.761	–0.021	–0.212	–2.844	–0.017	0.022
Other industrial employment	–0.041	–0.833	–0.030	0.007	0.263	0.005	0.207
Other employment	–0.026	–1.073	–0.016	0.000	–0.028	0.000	0.172
Women's wage	0.021	1.888	0.086	0.025	3.726	0.101	1.153
Wage × 1885	–0.011	–0.953	–0.008	–0.008	–1.093	–0.006	0.220
Wage × 1895	–0.026	–2.195	–0.022	–0.024	–2.943	–0.020	0.233
Wage × 1900	–0.014	–1.079	–0.012	–0.010	–1.118	–0.009	0.239
Wage × 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
Medium 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 head 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 0.91, and for the OLS equation, 0.94. The mean of the dependent variable is 0.279.

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 (*Kirchliches Jahrbuch* 1904, pp. 315 and 339). Thus changes in the proportion Catholic within a district must reflect, primarily, differential migration and fertility by religion. Our migration variable controls for this potentially confounding effect. The secularization variable (SPD votes) tells a similar story in a more modest form. In 1880 a district with a heavy SPD vote actually has higher fertility. By 1910 that effect has vanished in the IV estimates. In the OLS estimates the net effect of the SPD variables is negative by 1900, as the European Fertility Project would have expected.

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

Table 3. *Urban marital fertility*

Variable	Instrumental-variables and ordinary least-squares estimates: Instrumental variable estimates: Estimates	T-ratio	Elasticity	OLS estimates: Estimates	T-ratio	Elasticity	Mean of variable
Infant 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
Proportion 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 × 1885	0.010	0.407	0.006	–0.006	–0.586	–0.004	0.123
Catholic × 1895	0.008	0.258	0.005	–0.002	–0.159	–0.001	0.125
Catholic × 1900	0.034	1.284	0.021	0.028	1.513	0.017	0.127
Catholic × 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 × 1885	–0.028	–0.229	–0.001	–0.073	–1.735	–0.001	0.004
SPD vote × 1895	–0.090	–1.059	–0.008	–0.132	–2.438	–0.011	0.017
SPD vote × 1900	–0.114	–0.934	–0.009	–0.169	–2.445	–0.013	0.016
SPD vote × 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 employment	–0.551	–0.647	–0.007	–0.320	–0.649	–0.004	0.003
Textile employment	0.002	0.008	0.000	0.025	0.160	0.004	0.033
Other industrial employment	0.016	0.081	0.032	0.054	0.389	0.105	0.403
Other employment	–0.049	–0.223	–0.112	–0.072	–0.509	–0.163	0.474
Women's wage	–0.002	–0.067	–0.011	0.003	0.127	0.017	1.269
Wage × 1885	0.023	0.854	0.026	0.011	0.583	0.013	0.240
Wage × 1895	0.006	0.191	0.007	0.014	0.629	0.016	0.245
Wage × 1900	0.041	1.270	0.053	0.042	1.423	0.053	0.265
Wage × 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 0.74, for the OLS equation, 0.79. The mean of the dependent variable is 0.208.

Catholic. Catholicism became more important over time not because no Catholic districts experienced the fertility transition — plainly they did — but because once the transition was well underway, Catholicism became an increasingly reliable marker for districts that did not reduce fertility.

But we should not leave the story here. Occupations, wages, and farm sizes also played an important role. Urbanization at first raises fertility somewhat, but over time that effect attenuates, and by 1910 urbanization strongly reduces fertility. Our occupation variables show a striking effect: textile employment, the best single proxy for off-farm employment opportunities for women, has a strong, negative effect on fertility. Much the same can be said for our more direct measure of women's opportunities, their wages. The farm-size variables show the effect we expected after noting the evolution of the rural economy. Smaller farms (2–5 hectares), which rely primarily on family labour, are associated with higher fertility. Better data suggest that the European Fertility Project's rejection of the role of economic and social change was at least partly a result of using overly-simplified measures.

The year dummies, finally, 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.

Results for urban areas

The model for urban areas was constructed to be closely parallel to that for rural areas. We omit the urbanization and farm-size variables. 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 do not have information, analogous to our farm-size measures, that would help to identify subtle forces at work in the development of urban areas.

Illustrative case studies

One way to think about our regression results is to examine the histories of four rural districts, each of which are shown in Figure 2. Two are from predominantly Catholic southern Bavaria and two are from the Protestant north.

Friedberg was the most urbanized rural district in 1880, and was overwhelmingly Catholic. The labour force was mainly employed in the cotton textile industry, with 20 per cent in other manufacturing industries such as clothing and construction, and another twenty per cent in services. The 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. The importance of the cotton textile industry had probably 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 a sixth of the labour force by 1910, and employment in agriculture fell to only a third. Almost two-thirds of residents now lived in towns. Over the period 1880–1910, real wages for female day labourers rose by 60 per cent and marital fertility fell by 30 per cent. The regression results imply that the rise in wages paid to women accounted for up to 80 per cent of the decline and the increase in textile employment explained another ten per cent. 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. Rural Schwabach had, by 1880, developed some metal wares and a dyestuff industry. Despite the industrial development, only about a 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. Between 1880 and 1910, agricultural employment fell from 60 to 43 per cent of the population, and those engaged in the production of metal wares (including bronze and gold) and dyestuffs rose by 50 per cent to over a tenth of the population. The production of non-ferrous metal wares was particularly important in providing employment opportunities for women. Fertility declined more in Schwabach than in any other rural district between 1880 and 1910 (by 38 per cent), and in 1910 its fertility was among the lowest among all rural districts. The regression results imply only about a half of this decline, but highlight the importance of the rise in women's wages. The already high real wage rose another 16 per cent and accounted for two-thirds of the decline in fertility. The increase in the SPD vote from near zero in 1880 to a fifth of eligible voters helps to explain another 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 per cent 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 per cent). Farms in Wolfstein tended to be small and unproductive. The most important source of non-farm employment was in forestry, which accounted for five per cent of the population. Wolfstein experienced little out-migration in the years before 1880. This was the most Catholic district in Bavaria (99.9 per cent Catholic), but in 1880 it had about the same marital fertility as Friedberg. There was little economic change between 1880 and 1910. 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. Farms were not exceptionally small. The local economy was not strong enough to prevent exceptional outmigration during the 1870s. Kemnath's population was 88 per cent 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

Those responsible for 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 driven 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 and rapid economic and social change over the period in question, and our econometric models suggest a small but clear role for this sort of development in the region's fertility history. Catholicism and related belief systems (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. Our results differ in important ways from those of Galloway, Hammel, and Lee, who studied Prussia, but they are congruent with those results in showing that the Princeton studies downplayed the role of economic and social development by using data that were 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 opens the possibility of fair empirical tests of a range of explanations. More importantly, large-scale studies such as the European Fertility Project have a perspective that makes it difficult for them to dig into the details of the history of any one country or region. But specifics 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 important episode in human history.

NOTES

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[1] 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 persons 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.

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APPENDIX: VARIABLE DEFINITIONS AND SOURCES

Variable Name	Definition	Source
Marital fertility	Number of live births per married women aged 15-50 for the four-year period centred on the census year.	Beiträge, Zeitschrift, Hindelang 1909.
Infant mortality	Infant mortality as a percentage of live births.	Zeitschrift, Generalbericht über die Sanitätsverwaltung
Marriage rate	Proportion of females married within the three years before census year.	Beiträge, Zeitschrift
Proportions married	Proportion of all women married.	Beiträge, Zeitschrift, Hindelang 1909
Migration	Net migration within five years before census year.	Beiträge, Zeitschrift
Catholic	Proportion of Catholics in the population.	Beiträge, Zeitschrift
SPD vote, Center vote, Peasant vote	Percentage of eligible voters voting in the first round for the SDP (socialist party), Catholic Center(Zentrum), and Peasants Party(Bauerpartei) candidates for the Reichstag	Elections of 1881, 1893, 1898, and 1910 in the Zeitschrift.
Proportion urban	Proportion of the population living in communes (Gemeinde) with a population over 2,000.	Beiträge, Zeitschrift
Savings books	Savings books per head reported by Sparkassen (local savings banks).	Zeitschrift
Mining employment, Textile employment, Other industrial employment, other employment.	Employment in mining and metal processing , textiles, other manufacturing, and other non-agricultural industries. Employment includes dependents. Expressed as a share of district population.	Census of Occupations of 1882, 1895, and 1907 in the Beiträge
Female wage	Real wage of female day labourer.	"Ortsüblicher Tagelohn" from Zeitschrift starting in 1884. Desai (1968, Table A.8) for the cost of living index.
Small farms, Medium farms, and Large Farms	Percentage of all farms smaller than 5 hectares; between 5 and 20 hectares; and larger than 20 hectares.	Agricultural census of 1882, 1895, and 1907 in the Beiträge.
Cows per head (instrument)	Number of milk cows per head	Livestock censuses of 1881, 1893, and 1907 in the Beiträge.
Elevation (instrument)	Elevation of the main city of the district in meters above sea level	Bavarian State Geographic Survey 1997.