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THE FERTILITY OF THE IRISH IN AMERICA IN 1910

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Abstract

In most western societies, marital fertility began to decline in the nineteenth century. But in Ireland, fertility in marriage remained stubbornly high into the twentieth century. Explanations of Ireland's late entry to the fertility transition focus on the influence of the Roman Catholic Church in Irish society. These arguments are often backed up by claims that the Irish outside of Ireland behaved the same way. This paper investigates these claims by examining the marital fertility of Irish Americans in 1910 and produces three main findings. First, the Irish in America had smaller families than both the rural and urban Irish and their fertility patterns show clear evidence of fertility control. Second, despite the evidence of control, Irish-Americans continued to have large families, much larger, in fact, than the U.S. native-born population. The fertility differential between these populations was not due to differences in other population characteristics. Rather it was due to the fact that conditional on characteristics, Irish-Americans chose to have larger families. Third, the differential fertility patterns of Irish-Americans were not just due to the effects of being immigrants. Germans and English immigrants also had higher fertility than the native-born population, but to a much larger extent than for the Irish, this higher fertility could be explained by the population characteristics of these groups.

Keywords: Ireland, United States, Fertility, Demography, Immigration

JEL classifications: J13, N3

The Irish were quite late participants in the fertility transition. In most western European societies marital fertility had started to decline by the 1880s at the latest, but in Ireland it showed little decline before the turn of the twentieth century. The crude birth rate in Ireland did fall in the late-nineteenth century, but this was due to increases in the age at marriage and the fraction of the population that never married. Among those who did marry, fertility remained high. It is not true, however, that the Irish exhibited no fertility control in marriage before the 1920s. Census data reveal that a modest fertility transition was underway by 1911. David et al (1988) find that significant minorities of Irish women in urban areas were controlling their fertility by 1911. Ó Gráda and Duffy (1995) and Guinnane (1997) further show that fertility patterns in rural areas varied with religion and social class. Yet despite this evidence of fertility control, the Irish continued to have large families.

Discussions of this phenomenon tend to focus on cultural factors -- namely, the Catholic Church and its views on sexuality and women. But some scholars argue that the distinctiveness of Irish fertility patterns owes more to economic than to cultural factors. Industrialization progressed much more slowly in Ireland than in other parts of western Europe. At the turn of the century, Ireland was still predominantly agricultural, and as a consequence, Irish women had few work opportunities outside the home. Moreover, emigration reduced the pressure on farming couples to limit family size. The costs and benefits of children were different in Ireland than in other parts of Europe, and these differences may explain why the Irish lagged behind other western Europeans in reducing marital fertility (Ó Gráda 1993: Ch. 5; Guinnane 1997).

This debate mirrors the more general debate about the causes of the fertility transition. Explanations of fertility transitions are divided into two groups – innovation/diffusion and adjustment. The innovation/diffusion view states that the adoption of fertility control within a population represents a new behavior originating in new knowledge or changes in the moral acceptability of contraception. The adjustment explanation, on the other hand, states that fertility control reflects couples' rational adaptation to changing economic and social circumstances. The debate over Irish fertility patterns is a microcosm of this more general debate. The cultural explanations of Irish fertility patterns assert that the Irish maintained moral objections to limiting family size; the economic explanations assert instead that high marital fertility was a rational response to the costs and benefits of having children in Ireland.

One method of investigating the determinants of Irish marital fertility in the early twentieth century would be to look for differences in fertility choices across different groups in Ireland. Did Catholics have more children than Protestants? Were there class differences in family size? Such an investigation is underway (Guinnane, Moehling, and Ó Gráda 2001). This paper, however, takes a different tack, looking instead beyond the shores of Ireland for insights into Irish fertility. For much of the nineteenth century over one-quarter of every Irish birth cohort immigrated to the United States.[1] Irish immigrants brought with them their cultural heritage but encountered very different economic and social conditions. Arguments about the distinctiveness of Irish demographic patterns are often "clinched" by claiming that Irish Americans behaved the same way. But these claims are usually not backed up by data. There has, in fact, been very little research comparing directly the demographic

[1]For a recent survey of the historiography of the Irish in the U.S., see Doyle (1999). The Irish went to several countries, including Canada, Australia, and Great Britain, but the overwhelming majority went to the U.S. Our focus on the Irish in the U.S. also reflects in part the availability of large national datasets with a fertility question similar to that found in the 1911 Irish Census.

behavior of the Irish in America to the demographic behavior of the Irish in Ireland. Moreover, comparisons of the behavior of Irish immigrants and the U.S. native-born population do not always support the cultural distinctiveness argument. For instance, Foley and Guinnane (1999) have shown that the nuptiality patterns of the Irish in the U.S. were not that different than those of the native-born.

The U.S. provides a great laboratory for the study of the role of culture in fertility and other individual and household decisions. In the U.S., groups with very different cultural traditions live side-by-side. Discrimination often leads to an unfair playing field, but ethnic differences in economic opportunities in the U.S. are smaller than the differences in economic opportunities across countries. This paper focuses on two sets of comparisons. First, we compare the fertility patterns of Irish immigrants a century or so ago to the fertility patterns of native-born whites of native parentage. The fertility transition began early in the U.S. By 1910, native couples in urban areas had on average only three children. The fertility patterns of this population reflect the effects of conscious fertility control and therefore provide a baseline for examining the extent of fertility control among Irish immigrants. We also compare Irish-American fertility to the fertility of two other immigrant groups: the English and the German. These comparisons help us distinguish the effect of being Irish from the effect of being an immigrant. Immigrants self-selected to come to the U.S. We would expect that immigrants, as a group, differed in unobservable ways not only from the populations they left behind but also from the U.S. native-born population. In addition, there are certain aspects of the immigrant experience that likely varied little across ethnic groups such as the separation from family, the disorientation of being in a new place, and the necessity of establishing new social networks. To the extent that these factors influenced fertility behavior, the fertility patterns of immigrants as a group would have differed from the those of the native-born. The Germans and the English are natural comparison groups for the Irish. Like the Irish, the Germans had been immigrating to the U.S. for generations and had had the opportunity to establish communities and institutions which maintained the cultural traditions of their homeland. Moreover, a substantial fraction of German immigrants were Catholic. The English are, of course, the perennial comparison group for the Irish because of the geographic proximity of their homelands, their shared language, and their interwoven histories.

Irish-American Fertility

The study of fertility in the U.S. in the early twentieth century has, to a large extent, been directed by the nativist backlash to the immigration wave of the 1890s and 1900s.   Fertility control among the native population in the face of the purportedly high rates of fertility of the immigrant population, was viewed as "race suicide." The native population, it was argued, would soon become outnumbered by the "foreign stock" (King and Ruggles 1990). These perceptions have led the study of fertility during this era to focus on the differences between natives and immigrants. A number of studies, however, disaggregate the immigrant population by ethnicity and explore the variation in fertility choices within the foreign stock. The most comprehensive of these studies is that of Morgan, Watkins, and Ewbank (1994). These authors use data from the 1910 U.S. federal census to calculate the age-specific and total fertility rates of women ages 15 to 49 using the own-child method. This method uses data on the ages of a woman's own children living in her household to establish the timing of births. Morgan, Watkins, and Ewbank find that both first- and second-generation Irish immigrants had lower total fertility rates than did native women of native parentage. But these lower rates were due to the marriage patterns among the Irish: the Irish tended to marry at later ages and a relatively high fraction never married. Fertility within marriage was much higher among the Irish than the native population. This higher marital fertility remains even after controlling for husband's occupation and place of residence in the U.S. Morgan, Watkins, and Ewbank argue that Irish-American fertility exhibited a distinct pattern in 1910, different from that of the native population and different from those of other immigrant groups. While natives reduced their fertility by fertility control in marriage, the Irish, it is claimed, reduced their fertility through their marriage patterns. Those who married and had children continued to have large families.

The distinctive Irish pattern found by Morgan, Watkins, and Ewbank would seem to indicate the prominence of culture in shaping fertility decisions. But other studies have brought into question the "distinctiveness"of this pattern. Foley and Guinnane (1999) argue that the differences between Irish-American and native marriage patterns were due more to differences in population characteristics than to differences in the proclivity to marry. The Irish in the U.S. were overwhelmingly urban, and most Irish males held relatively low-paid, low-status jobs. Native whites with these characteristics were only slightly more likely to marry than the Irish-born.

Guest (1982) further brings into question the notion that the Irish were particularly resistant to fertility control within marriage. Using data from the 1900 census tabulated by the Immigration Commission, he shows that the rate of decline in marital fertility between first- and second-generation Irish immigrants was similar to that of other immigrant groups. The Irish were not, he argues, less receptive to family limitation strategies than other immigrants.

Data

This study examines marital fertility in the U.S. using data from the 1910 U.S. Census of Population made available through the Integrated Public Microdata Series (IPUMS). The 1910 IPUMS dataset is a 1-in-250 national random sample of households enumerated in the 1910 census. Ruggles (1995) discusses the design of this sample in detail. The 1910 census is particularly useful for the study of fertility because it asked all ever-married women how many children they had borne and how many of those children were still alive on the census date.[2] These data can be used to construct measures of fertility as well as measures of infant and child mortality, a factor with potentially profound effects on fertility decisions. The 1910 census also recorded birthplace and mother's and father's birthplaces, allowing for the examination of the fertility patterns of both first- and second-generation Irish immigrants. Other demographic data recorded in the census allows us to construct age at marriage, marital duration, and age at immigration. The economic information in the census is much more limited. We only have information on occupation and home ownership. The only information we have on education is literacy. Today in the U.S. and many other countries, both developed and developing, more highly educated women have on average fewer children. The most significant weakness of the census data for our purposes, however, is the lack of information on religion. Like all U.S. censuses, the 1910 census did not collect information on religious affiliation. Immigrants from Ireland included both Catholics and Protestants, although by the late nineteenth century, most Irish

[2]The only other historical U.S. census which asked these questions was the 1900 Census. The original public use sample of the 1900 census is, however, too small to allow for a careful examination of fertility by ethnicity. Work on an expanded public use sample, though, is currently underway. In future work, we hope to take advantage of this expanded sample.

migrants to the U.S. were Catholic. The absence of data on religion prevents us from separating the effects of being Catholic from the effects of being Irish.

In the early twentieth century, fertility patterns in the U.S. exhibited substantial geographic variation. Fertility was much higher in rural than in urban areas and in the South than in the North. Immigrants were concentrated in the "low fertility" areas: urban areas in the North. In 1910, 69 percent of the foreign-born population and 80 percent of the Irish-born population lived in the urban North. Therefore, to refine the comparisons between the native population and the Irish and other immigrant groups, we limit our analysis to households in these areas.[3] We also limit our sample to women in first marriages as we have data on marital duration only for current marriages.

The Irish did indeed have high marital fertility in 1910. Figure 1 plots the cumulative distribution of children ever-born to women who had married before age 30 and had been married 20 to 29 years in 1910. The median number of children born to first-generation Irish immigrants was between 5 and 6 compared to between 2 and 3 for natives of native parentage.[4] What is most striking about Irish-American fertility is the large fraction of very large families. Over half of the first-generation Irish had six or more children. The prevalence of large families among first generation immigrants was not, however, unique to the Irish. First generation German immigrants also had large families and in fact, the incidence of families with nine or more children was even higher for first-generation Germans than first-generation Irish. The fertility of the Irish in America was, however, higher than that of the English. The

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[3]Here we use the census definition of urban: places with populations of 2,500 or more.

[4]By "first-generation immigrants" we mean foreign-born migrants to the U.S. "Second-generation immigrants" are the native-born children of those migrants.

cumulative distribution of children ever born for first-generation English immigrants lies between those of the natives and first-generation Irish immigrants.

How different was the marital fertility rate of the Irish in the U.S. from that in Ireland? Table 1 explores this question using data from Anderson (1998). Anderson constructed measures of marital fertility in Ireland, Scotland, and England/Wales using published tabulations from the 1911 Fertility Census. Anderson used the data from the county boroughs as a measure of "urban" fertility in Ireland and then constructed a measure of "rural" fertility by subtracting the county borough data from the aggregate data.[5] To facilitate the comparison, we consider the more narrowly defined subset of women who had married between ages 20 and 24 and had been married 25 to 29 years on the census date. These women married at approximately the mean age at marriage for the four U.S. groups under study and had likely completed their fertility by 1910.

Irish migrants to the U.S. had smaller families than those who remained in Ireland. The mean number of children ever born for migrants to the U.S. was only slightly lower than that of the urban Irish. The gap between migrants and the rural Irish, though, was much larger -- a difference of over one in mean children ever-born. To the extent that migrants to the U.S. came from rural areas in Ireland, this difference may best capture the change in fertility patterns that accompanied migration. But even this difference seems small given the contrasts between life in rural Ireland and the urban U.S. The difference in mean children ever born between first-generation Irish immigrants and the native population in the U.S. was over three children.

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[5] Ó Gráda (1991) has pointed out the problems inherent in this division. The county boroughs include only the very large cities. The "rural" fertility measure includes many areas that by the U.S. census definition would be urban.

Anderson's data allow us to answer another question: Was the gap in Irish and English fertility larger in the U.S. or the United Kingdom? In terms of the mean number of children ever born, the gap between rural Ireland and England was larger than that between the Irish and the English in the U.S. But focusing on means obscures other significant differences in fertility patterns. What is notable about first-generation English immigrants in the U.S. is the small fraction with very large families. Only a third of English migrants to the U.S. had six or more children compared to over half of women of the same age and marital duration in England. In contrast, large families were almost as common among first generation Irish-Americans as among the rural Irish.

Figure 1 and Table 1 also present data on the fertility of second-generation immigrants. Defining second-generation immigrants is complicated by intermarriage. All three of the immigrant groups under study here had relatively high rates of intermarriage with the native population and with other immigrant groups (Pagnini and Morgan 1990). Here we use the most inclusive definition of second-generation immigrants: an individual is defined as a second generation immigrant from country X if at least one of her parents was born in country X. This definition leads to some individuals being classified as members of two different immigrant groups. The alternative, however, would be to define second-generation immigrants as only those whose parents had the same nativity or to assume that ethnic identification followed the maternal or paternal lines.[6]

Second-generation Irish immigrants had lower marital fertility than first-generation Irish immigrants. But the degree of change between generations was in many respects smaller for the Irish than for the other immigrant groups under study. This can best be seen in Figure 1. The cumulative

[6] In future work, we will consider separately mother's and father's birthplaces to see whether they have differential effects on fertility choices.

distribution of children ever-born for the second-generation English is very close to that of the native-born of native parentage. Second-generation Germans still had larger families than natives but had smaller families than all three groups of first generation immigrants. In contrast, the second-generation Irish family size distribution was closest to that of the first-generation English.

Differences between first- and second-generation immigrants are frequently interpreted as an indicator of assimilation and we will follow in that tradition. But a word of caution is in order here. Our basic source, the 1910 census, is a cross-section, and we must bear that in mind in interpreting our findings. Irish-born people who lived in the United States in 1910, and who were in their child-bearing years, left Ireland well after the Great Famine of the 1840s. The second-generation Irish, on the other hand, were the children of people who left Ireland much earlier in the nineteenth century. Their parents had left an Ireland that was poorer, and in the cases of some in crisis. They were raised in the United States but by people whose experience in Ireland was very different from those who constitute our first generation. The details of German history differ, of course, but something similar has to be born in mind for those people. The difference between the first and the second generation in the United States is not simply generational.

Figure 1 and Table 1 are instructive, but we must be careful not to infer too much from differences in sample means. The lesson of Foley and Guinnane (1999) is that differences in demographic behaviors across groups may simply reflect differences in other population characteristics. The occupational distribution as well as the geographic distribution of Irish immigrants were very different than those of the native population and may explain, at least in part, the higher fertility of the Irish. The examination of this issue requires the estimation of multivariate models of fertility choices to which we will turn shortly. But it is instructive to see in the raw data whether ethnic differences in fertility survive disaggregation by social class.

Table 2 presents data on the number of children ever born to women who married before age 30 and had been married 20 to 29 years in 1910, broken down by nativity and husband's occupational class. As the cell sizes indicate, the Irish occupational distribution was skewed toward unskilled occupations. But the Irish occupational distribution alone cannot explain the higher fertility of Irish couples. In each occupational category, Irish immigrants and their children had larger families than their native counterparts.

Multivariate Models of Marital Fertility

Testing the distinctiveness of Irish fertility patterns requires estimating multivariate models of marital fertility. Such models will allow us to evaluate how much of the differences in fertility patterns between the Irish and other groups were due to differences in observable population characteristics and how much must be explained by differences in fertility choices conditional on those characteristics. Given data constraints, these models cannot, however, isolate the effects of "culture" on fertility. As discussed above, the census data lack information on religion and education which may have influenced fertility choices. Education attainment and the religious composition varied greatly across ethnic groups in 1910. The effects of ethnicity we estimate will reflect the differences in these omitted variables as well as any true cultural effects. Nonetheless, such models will allow us to assess whether, conditional on all the characteristics we can observe, Irish fertility patterns differed from those of other groups in the U.S.

Estimating empirical models of fertility poses some challenges. The number of children ever born to a couple – the information on fertility provided in the census data – is a non-negative integer or 'count' variable. Ordinary least-squares (OLS) models do not respect the character of such data; OLS models are heteroskedastic and often yield nonsensical predictions such as -1.45 children ever born. Another problem stems from the likely endogeneity of infant mortality. The first problem has straightforward solutions; the second, unfortunately, does not.

Count Models

The most commonly-used alternative to OLS for count models is to assume a parametric (conditional) distribution for the counts and estimate the model by maximum likelihood (ML). We employ a version of that strategy here. For each observation in the count representation the contribution to the likelihood function is P(CEB=k |X) where CEB is the number of children born, k is an integer, X is the vector of covariates. These models are consistent with duration analysis, which is more widespread in the demography literature. Corresponding to any distribution of counts is a distribution describing the waiting-times between births. The key difference is a loss of information: the hazard rate might have been higher or lower in the first interval than in the second. The count models assume, implicitly, that the hazard rate was the same (for a given duration) across all intervals. Count models are in fact the closest analogue to hazards or event-history models possible given the census data.[7]

[7]See Cameron and Trivedi (1998) for a discussion of count models.

The most commonly-used parametric distribution for count-data models is the Poisson distribution. The probability that CEB takes on a given value k is given under the Poisson distribution by:

$$P(CEB = k) = \frac{m^{k} e^{-m}}{k!}$$

where F is the Poisson parameter to estimate. In most studies the covariates are introduced by the functional form

ln F = Xß

The Poisson distribution, however, has the unfortunate feature that its (conditional) mean is equal to its (conditional) variance:

$$E(CEB) = Var(CEB) = m$$

This assumption places a strong restriction on the data. In the hazard representation it amounts to assuming that hazard rates do not depend on duration; in the count representation, it amounts to a condition rarely satisfied. Like most other historical data on family size, our data suffer from *overdispersion*: the variance is substantially higher than the mean. For Irish-born married women ages 55 and younger, the mean of the number of children ever born is 3.8 while the variance is 9.

Researchers have taken several approaches to contend with overdispersion. One is to use an alternative distribution that allows for more flexibility. The negative binomial distribution is popular in part because the Poisson model is nested within it. For the negative binomial distribution, the relationship between the mean and variance is a function of a parameter that itself is estimated:

$$E(CEB) = \mu$$

$$Var(CEB) = \mu + a\mu^2$$

When a is equal to zero, the negative binomial simply collapses to the Poisson distribution. Testing whether a equals zero is, therefore, a straightforward test of the assumption that the data are distributed according to the Poisson distribution.

Another approach to dealing with overdispersion is to deal with mass points in the sample distribution. Overdispersion in most fertility data is due to excess zeros. Returning to the sample of Irish-born women, if we ignore couples with zero children the mean number of children born is about 4.6 and the variance is 8. These figures still violate the assumptions of the Poisson model, but the violation is less severe. The econometrics literature has developed two, parallel approaches to contending with excess zeros: the hurdle model and the splitting model. The two models view the source of the overdispersion differently. The hurdle model assumes that the excess zeros arise because there is some fixed cost associated with the activity that is counted. The splitting regime model assumes that the data are drawn from two different regimes. In one regime the outcome is always zero and cannot be otherwise. In the other regime it may or may not be zero.

We believe that in the context of fertility decisions, the splitting model is more appropriate. Due to biological reasons, some couples will not be able to have children and will therefore be in the 'always-zero' regime.[8] We cannot identify on an individual basis which couples are in which regime, but with some structure we can estimate the probability that a couple is in the always-zero regime, and

[8] There may also be fixed costs to childbearing. (Guinnane 1997, in fact, stressed these as an explanation for Ireland's late fertility transition.) Fixed costs to childbearing would imply a relatively small number of women at all of the low parities.

thus the probability that a couple is not in the always-zero regime. Once we have the probability that a couple is not in the always-zero regime we can estimate the probability that they have k children following a distribution such as the negative binomial. In our model we assume that there is a process that determines whether a couple must always have zero children, and another process that determines, for those who are not in the always-zero regime, how many children they will have. For the remainder of our discussion we will refer to the two regimes as the 'always zero' regime and the 'kernel' regime.

It is important to note that even in the kernel regime, some couples will have zero children. This model is fully consistent with the arguments made by Morgan (1991) and Tolnay and Guest (1982) that some of the childlessness during this period was voluntary. There are two types of childless couples in this model: those that cannot have children due to biological reasons and those who choose not to have children. Identification of the two types of childless couples arises from functional form assumptions, choice of covariates, or both. It is important to recall that these models are sensitive to many specification decisions. In the empirical work below, we use three variables to identify couples in the always-zero regime: an indicator for whether the wife was 30 or older at marriage and the difference between the husband's and wife's ages, and this difference squared.

The great benefit of this approach is that it allows us greater flexibility; it is implausible that any simple distribution would fit the observed empirical distribution with all the zeros included, but by making this zero-inflation modification we are in a position to fit more precisely a distribution that has fewer zeros. By combining the splitting-regime approach with a negative binomial distribution we are applying two distinct but complementary solutions for the excess-dispersion problem noted in connection with the Poisson distribution.

The log-likelihood function for the zero-inflated model is built up as follows. Let B be the probability that a couple is in the always zero regime. This is the part of the model estimated by a binary dependent variable model such as the probit. Couples who have one or more children contribute (1-B)*Probability(K=k) for k>=1. In words, this is the probability that they are not in the always zero regime times the probability of having k children if they are in the kernel regime. Couples who have zero children contribute [(1-B)*Probability(K=0)] + [B]. In words, the first part of this expression is the probability of not being sterile times the probability of having zero children from the kernel distribution. The second part, B, is just the chance that the couple is sterile. We build the likelihood in the usual way by combining observations, and can check that this is a proper likelihood by noting that the conditional probabilities sum to one for each individual.[9]

Endogeneity

The second consideration we face is endogeneity of regressors. It is likely that several of our regressors are endogenous, but the one of most concern is the measure of child mortality. As Preston and Haines (1991) have shown, infant and child mortality rates were still quite high in the U.S. in the early twentieth century. Table 3 presents data on the mortality experiences of the women whose fertility choices were illustrated in Figure 1. A substantial fraction of these women had experienced at least one child death. The mortality experiences of first-generation immigrants are particularly disturbing: over half of the women in these groups had lost at least one child and among these women,

[9] We estimate the models using Stata's ZINB command. In future work we will experiment with less heavily-parametric forms of the splitting model.

the average number of children lost was 2.5.[10] Child mortality is expected to influence fertility decisions in a variety of ways. Perhaps most important is the so-called ‘replacement effect’. If couples have a desired family size, we would expect them to ‘replace’ a deceased child with another birth. Testing for the replacement effect, therefore, is a test of fertility control. Variations in this effect would also be evidence of differences in contraceptive intensity. For example if the Irish had a weaker replacement effect than the native population, this is evidence, independent of implied family sizes, of less fertility control among the Irish.

Estimating the replacement effect, however, requires dealing with the likely endogeneity of child mortality. There are several economic as well as biological connections between mortality and fertility at the household level that imply that infant and child mortality were likely endogenous to fertility outcomes. Parents have some control over the survival chances of their children. Parents who find it difficult to control births (for whatever reason) may choose to invest less to protect the health of their offspring, in effect using mortality to reduce family size. This link does not require active infanticide; rather, parents may simply not provide as many health-enhancing resources (such as breastfeeding or supervision, both of which require parental time) if they are concerned about having too large a family.

This endogeneity problem is widely recognized in the literature on fertility, but only a few studies have attempted to address it. The usual solution to an endogenous variable is an instrumental-variables approach. With the appropriate instruments one can purge the regressor of the component that is endogenous and in effect replace the actual variable with a variable that is only the exogenous component of the original regressor. The challenge for fertility studies is that most variables that affect

[10] See Preston, Ewbank, and Hereward (1994) for further discussion of differences in infant and child mortality by ethnicity and race in 1910.

mortality can also plausibly affect fertility. The few fertility studies that have addressed the endogeneity problem have used as instruments variables capturing differences across space in climate and public infrastructure (See Okojie 1991; Benefo and Schultz 1996). Here we experiment with similar instruments: summer temperatures, miles of public water mains per 100,000 persons, and the interactions of these variables.

Data on summer temperatures comes from the U.S. Climate Division dataset. This dataset provides data back to 1895 on average monthly temperatures and precipitation totals for the 344 climate divisions of the 48 contiguous states.[11] These data were converted to county-level data using ArcView software to place each county in the climate division which contains its geographic center. The county-level data were then linked to the census data.

Hotter temperatures, even today, tend to lead to more hostile disease environments, but this was especially true a hundred years ago when the icebox was the most effective means of food refrigeration that was available and many cities were still building their sewer systems. Some of the biggest killers of infants and children in this period were gastro-intestinal diseases. Hot summer temperatures hastened food spoilage and the fermentation of refuse promoted the spread and intensity of these diseases. We use two variables to capture the potential effects of summer temperature on child mortality: the mean summer temperature and the number of summers during a couple's marriage (between 1895 and 1909) in which the average temperature was one standard deviation or more greater than the mean. The first variable captures differences in disease environments across space due to differences in typical climates. The second variable captures the effects of exposure to extreme

[11]These data are publically available at the National Climatic Data Center website: http://lwf.ncdc.noaa.gov/oa/climate/onlineprod/drought/ftppage.html.

climate conditions. This variable captures the variation in mortality risk not only across space but also across couples with different marital durations within a given area.

Water main mileage per capita captures variation across cities in mortality risk. Troesken (2002), using data on fifteen large American cities in 1908, finds that more dense water delivery systems, as measured by miles of water mains per capita, reduced the incidence of waterborne diseases. We use data on water main mileage in 1903 published by the Census Bureau in its report, "Statistics of Cities Having Populations of Over 25,000, 1902 and 1903." These data have two limitations. First, they pertain only to cities with populations of 25,000 or more, requiring that we limit the analysis to couples living in such cities. Second, the report only contains data on water main mileage for cities with public waterworks. 49 out of the 175 cities included in the report had private waterworks. Therefore, we use two variables to capture differences in waterworks across cities: miles of public water mains per 100,000 population and an indicator variable for having a private waterworks.

We also use as instruments interactions of the waterworks variables and the number of hot summers during a couple's marriage. Safer water delivery systems may have mitigated the effects of adverse climate conditions.

This instrument strategy suffers from a number of shortcomings. It is based on the premise that the exogenous mortality risk faced by a couple is determined by its place of residence. This is problematic for a number of reasons. Although couples cannot control the weather, they do, within their economic constraints, choose where to live. In that sense, climate and public infrastructure are not exogenous to household decisions. Also, conditional on weather patterns, our strategy assumes that mortality risk in a given city was constant over time. In the decades around the turn of the century, however, cities were investing in public health measures and infrastructure that lowered mortality risk. A woman married in 1880 in Philadelphia was likely exposed to a very different mortality regime in the early days of her marriage than a woman married in Philadelphia in 1905. More troubling though is the application of this strategy to the census data. We only know where a couple lived on the census date. A couple which married in Boston in 1900 and moved to Chicago in 1909 will be assigned the same mortality risk as a couple who spent the entire decade in Chicago.[12]

Using instrumental variables also presents an econometric problem. There is an implied constraint between our dependent variable (CEB) and the endogenous variable (the number of children who have died). Any instrumental-variable type approach runs the risk of implying predicted values for the right-hand side variable that violate the constraint; we could, for example, have observations where the first-stage regression implies the couple had eight surviving children, although they only had six births. There are several approaches to dealing with that problem at work in the econometrics literature but for now we just report a very simple and clearly inadequate specification that relies on a tobit model of the proportion of children who died. By using the proportion rather than number of children who

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[12]The census recorded the state or country of birth of all individuals enumerated in the census. Therefore, we can identify couples who migrated across national and state borders by looking at the birthplaces of their children who were still at home on the census date. To avoid biases due to lacking data on the birthplaces of children who had left the household, we focus on couples married fewer than 15 years who had all of their surviving children still at home. About 18 percent of such couples in the urban, non-South had children born outside their current state of residence. This must be viewed as a lower bound on the degree of mobility of married couples during this era since it fails to capture movements within states. These data also reveal that geographic mobility varied by ethnicity. Among the ethnic groups under study here, the Irish were the least likely to migrate overseas or across state boundaries during marriage: only 5 percent of Irish-born women had children born outside the U.S. and 7 percent had children born in a state in the U.S. other than the state of residence. The analogous figures for English-born women were 19 and 14 percent. The mobility rates for German-born and native-born whites of native parentage were about 15 percent.

died and using the tobit model which takes into account the censoring of this variable at zero and one, this specification forces the first stage predictions to meet the constraint.

The Pooled Model

We begin by pooling the data for natives and the three immigrant groups and estimating a relatively parsimonious model of fertility which includes indicators for ethnicity. This model obscures some of the ethnic differences in fertility behavior because it does not allow ethnicity to interact with other factors. For instance, it does not allow the effects of marital duration or class to differ between the Irish and the native-born. But this model does provide a straightforward way of evaluating ethnic differences in fertility behavior relative to class differences in fertility behavior.

The basic model allows fertility behavior to vary with mortality experience, ages at marriage, marital duration, social class, and place of residence. Marital duration is entered as a third-order polynomial to allow fertility behavior to vary over time within a marriage. As noted above, the 1910 census did not record data on income or wealth. Hence, we include husband's occupational class and home ownership as proxies for social class. The place of residence variables include an indicator for living in a large city (population 500,000 or more) and indicators for census region.

The population census did not collect data on the characteristic that figures most prominently in discussions of fertility in this era: religion. Catholics, it is claimed, had larger families than Protestants. The evidence in support of this view, however, is less overwhelming than one might think. We cannot examine directly the role of religion on fertility using the census data. We can, however, ask a somewhat related question: Did a couple's fertility behavior vary with the size of the Catholic population in its area? The Census Bureau conducted a census of religious bodies in 1906 collecting information on membership and the value of church property by denomination. The ICPSR has coded all of the county-level data on membership. These data combined with data on total population from the 1910 census can be used to construct a "percent Catholic" variable. This variable could be thought of as a proxy for religious affiliation. One could think of it as representing the probability that a couple is Catholic. A more compelling justification for its inclusion, though, is that it will capture "neighborhood effects." If Catholics really did have higher fertility, the social norm in Catholic areas would be to have larger families. Couples in these areas, regardless of their own religious affiliation, might accordingly have more children ever-born.[13]

We limit the sample to couples consisting of two native-born whites of native parentage and couples in which at least one of the spouses was an Irish, German, or English immigrant. In the tables above, we considered fertility differences by the wife's nativity only. But in the estimated model, we allow for both husband's and wife's nativity to affect fertility decisions. The sample is further restricted to couples married two or more years and to couples in which the wife is age 55 or younger.[14]

It is useful to begin by considering the first stage model of child mortality to examine the power of the instruments. Table 4 presents the estimated tobit model for the proportion of children dead. The instruments are jointly significant having a F-statistic of 2.95 and corresponding probability value of 0.01. The most powerful instruments were those relating to summer temperatures. Couples who lived

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[13]Guinnane, Moehling, and Ó Gráda (2001) find that fertility behavior in suburban Dublin in 1911 varied with the fraction of couples on one's *street* who were Protestant. Couples on predominantly Protestant streets had smaller families than those who lived on Catholic streets.

[14]The estimated effects of marital duration are sensitive to the inclusion of marriages of short durations due in part to the issue of pre-marital conceptions.

in warmer climates and those who had experienced more extreme summers during their marriages were more likely to have experienced a child death. The coefficient on miles of public water mains per capita suggests the expected relationship – that cities with more extensive water distribution networks had lower mortality – but has a large standard error. Likewise, the interactions of the waterworks characteristics and weather variables are the predicted sign but not statistically significant.

The remaining results in Table 4 are interesting in their own right for what they tell us about the correlates of child mortality in the early twentieth century. There were clear class and ethnic differences in infant and child mortality. Even after controlling for all other characteristics observable in the census, the general pattern observed in Table 3 remains: first generation immigrants had much higher child mortality than the native-born.

Table 5 presents the estimated marginal effects of the fertility model first estimated without taking into account the likely endogeneity of child mortality ("No instruments") and then estimated using the two-stage procedure. The marginal effects represent the derivatives with respect to the regressors of the expected number of children ever-born evaluated at the sample means. For indicator variables such as the nativity variables, the reported effect represents the change in the expected number of children ever-born due to the discrete change from 0 to 1. For instance, the reported effect for the indicator that the wife was a first-generation Irish immigrant represents the difference in the expected number of children ever born between a couple with an Irish wife and the reference couple of two native-born whites of native parentage. The reported standard errors are the standard errors of the marginal effects estimates.[15]

[15]The standard errors for both models have been corrected for possible heteroskedasticity. However, the standard errors for the two-stage procedure have not been corrected to take into account

The first thing to note is that the instrumenting procedure has an impact only on the estimated effect of the child mortality variable. Instrumenting for the proportion of children deceased reduces the point estimate of its marginal effect and increases the standard error. To translate the marginal effect of this variable into an estimate of the "replacement effect" – the effect on the number of births of the death of one child – the marginal effect must be divided by the mean number of children ever-born. In our sample, the mean number of children ever-born is 2.7. The no-instrument model yields a statistically significant replacement effect of 0.62: for every three children who died, almost two more were born. The two stage procedure produces an estimated replacement effect of 0.39 but this effect is not statistically different from zero. The imprecision of this estimate may be evidence that there was no replacement effect during this period. The strong relationship found in the no-instrument model could be just be due to the endogeneity of child mortality. But the imprecision could also reflect the problems inherent in our instrumenting strategy. The silver lining here is that the estimated effects of the other variables are very similar in the two models. The estimated class and ethnic differences in fertility are somewhat larger in the two-stage model, but the estimates still fall within the error bounds of those of the no-instrument model. The small differences between models suggests that the bias due to the endogeneity of child mortality may be small.

In regards to the other econometric challenge, overdispersion, it is the splitting framework rather than the assumption of the more flexible negative binomial distribution that seems to improve the fit of the model. The wife being age 30 or older at marriage was a strong predictor of a couple having zero children. Identifying the probability of being in the "always zero" regime with this variable

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the use of a predicted regressor.

addresses overdispersion by accounting for the mass point at zero. The small point estimates of a indicate that little excess dispersion remains after accounting for this mass point. In other words, the negative binomial in the kernel regime collapses to the Poisson distribution.

What is clear from both models presented in Table 5 is that there were substantial ethnic differences in fertility behavior. Even after controlling for ages at marriage, marital duration, occupational status, and place of residence, immigrants had larger families than natives. Ethnic differences were even larger than class differences. *Ceteris paribus*, professional workers had 0.35 fewer children than unskilled workers; native women had 0.68 fewer children than Irish women. To truly see the impact of nativity on fertility, however, we need to consider the impact of the husband's and wife's nativity together. The estimates indicate that couples in which both husband and wife were first-generation Irish immigrants had on average 1.5 more children than native couples, holding all else equal.

But it was not just the Irish who had large families. The fertility gap between first-generation Germans and natives was almost as large as that between the first-generation Irish and the natives. First-generation German couples had 1.4 more children than native couples. Even first-generation English couples had on average nearly one more child than native couples. What appears to be exceptional to the Irish, however, was the degree to which this higher fertility persisted to the second generation. Fertility did fall between the first- and second-generation of Irish immigrants but not as much as it did between the first- and second-generations of German and English immigrants.

Although the pooled models are useful for illustrating the relative size of ethnic differences in fertility, they provide a potentially obscured view of the way ethnicity affects fertility behavior. These models allow ethnicity to have only "level effects." The implicit assumption of these models is that other factors such as marital duration and social class have the same effect regardless of ethnicity. Given the large ethnic differences in fertility levels observed, this assumption seems suspect. To fully explore ethnic variation in fertility behavior we must estimate separate models for the four ethnic groups.

Ethnic-Specific Models

The ethnic-specific models include the same basic set of regressors as the pooled models. The models for the immigrant groups, though, include three additional variables: indicators for whether the husband or wife immigrated as children (younger than age 18), and the percent of the population in the county who were first-generation immigrants of a couple's own ethnic group. These variables are intended to probe more deeply into the process of assimilation: Did immigrants who spent part of their formative years in the U.S. have lower fertility than those who arrived in the U.S. as adults? Was immigrant fertility higher in areas where immigrants were concentrated and perhaps had less contact with the native-born population?

Tables 6-9 present the fertility models estimated separately by ethnic group. The instrumenting procedure for child mortality generally had the same effect on the ethnic-specific models as it did on the pooled model: it increased the standard errors on the estimated effect of the proportion of children deceased while having little impact on the other estimates. One somewhat surprising finding is that the explanatory power of the instruments varies greatly across the four ethnic groups. The instruments are most powerful for the Irish. The p-value of the joint test of instruments is less than 0.01 for the Irish model compared to 0.10 for the native-born model. For the Germans and English, the instruments have almost no explanatory power.[16] Given these differences, it is not surprising that the differences between the no-instrument and two-stage models are most pronounced for the Irish, but even here, most of the differences are not large. In the Irish case, instrumenting leads the point estimate of the child mortality effect to become negative, although the standard error becomes quite large. Class differences also become more pronounced, but as with the pooled model, the estimates fall within the error bounds of the estimates from the no-instrument model. The most striking change is that the estimated marginal effect of percent Catholic nearly doubles in size and becomes statistically significant.

The first general conclusion that emerges from Tables 6 through 9 is that despite the large ethnic differences in fertility found in the pooled models, all of these groups were exerting some fertility control in 1910. All four groups exhibited class differentials in fertility. White collar workers had smaller families than blue collar workers, regardless of ethnicity. Moreover, the sizes of these effects were surprisingly similar across the groups. The difference in fertility between unskilled workers and professionals was 0.42 for the Irish compared to 0.37 for the native-born.

But ethnic differences in fertility were due to more than just level effects. All three of the immigrant group models exhibit deviations from the native model. But the deviations are largest for the Irish model. The effects of three variables in particular stand out when comparing the Irish model to the other models. The first is marital duration. For all four groups the number of births rose quickly during

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[16]The lack of power of the instruments for German and English immigrants may be due to the greater geographic mobility of those groups (see footnote 12). The instrumenting strategy implicitly assumes that couples spent their entire marriage in the city in which they were enumerated in the 1910 census. The larger the fraction of couples for whom that assumption is false, the smaller the explanatory power of the instruments will be. Another modeling issue that arises in the ethnic-specific models is that the instruments for identifying the "always-zero" regime are much less useful for the German and English samples than for the Irish and native-born samples.

the early years of marriage and then tapered off. But for the Irish the rise was much steeper and the tapering off came much later. This can be seen in Figure 2 which plots the expected number of children ever-born by years of marriage for the four groups. The effect of home ownership is also much different for the Irish. Owning a home increases the expected number of children ever-born by almost 0.23 for the Irish but has no effect on the other groups. This is somewhat surprising in that if one interprets home ownership as a measure of wealth, it indicates that for the Irish, fertility was increasing with wealth. The usual story is that wealth and children are substitutes and therefore the number of children should be decreasing with wealth. But this finding for the Irish suggests that wealth accumulation, at least in the form of home ownership, was complementary to having large families. Finally, the impact of the husband having no occupation reported in the census was much larger, in absolute value, for the Irish than other groups. For the Irish, it reduced the number of children ever born by 1.4.

Tables 6-9 establish that the Irish fertility model was different from the models for the other three groups, particularly the native-born, but to what extent did these differences contribute to the observed differences in fertility patterns? Part of the difference in family size between the Irish and the natives was due to differences in population characteristics and part was due to the differences in the effects of these characteristics on fertility. We want to determine the relative sizes of those two parts. The method we use is to construct counterfactuals asking: What would native fertility have been had natives had the same population characteristics as the Irish and vice versa?

Figure 3 plots the predicted cumulative distributions of children ever-born for first-generation Irish couples and native couples using the mean characteristics of these groups and both the Irish and native models.[17] The solid lines plot the predicted cumulative distributions for the factual populations: the native means were used with the native coefficients and the Irish means with the Irish coefficients. The dashed lines plot the predicted cumulative distributions for the counterfactual populations. These predicted distributions indicate that almost all of the difference in fertility between the natives and the Irish was due to differences in fertility behavior conditional on other population characteristics rather than to the differences in these other population characteristics. The distribution for the counterfactual population generated by the coefficients of the Irish model and native-born population characteristics lies only slightly above the distribution for the factual Irish population, implying that giving the Irish the same population characteristics as the native population would have had little effect on the size distribution of Irish families. Likewise, the distribution for the counterfactual population generated by the coefficients from the native model and Irish population characteristics lies only slightly below the distribution for the factual Irish population, implying that giving natives the same population characteristics as the Irish would have had little effect on the size distribution of native families.

Figures 4 and 5 repeat this exercise for German and English immigrants. For these groups as well, the deviation from native fertility patterns was driven to a large extent by differences in fertility patterns conditional on other population characteristics. But the impact of differences in population characteristics was also significant. The gap between the distribution generated by the immigrant model using immigrant characteristics and the counterfactual distribution generated by the immigrant model using native characteristics can be thought of as the difference in fertility behavior driven by differences

[17] To make the comparison explicit, we consider couples in which both spouses were first-generation immigrants who immigrated as adults. "Irish means" represent the mean characteristics for this subset of the Irish sample.

in population characteristics. The remaining gap between the counterfactual distribution and the distribution generated by the native model using native characteristics can be thought of as the difference in fertility behavior driven by differences in fertility behavior conditional on other characteristics. For both the Germans and the English, differences in fertility models accounted for larger portions of the deviation from the native distribution than did differences in population characteristics. But in contrast to what we find for the Irish, differences in population characteristics did matter. Even if the Germans and the English had adhered to the same fertility model as the natives, the Germans and the English would have had larger families.

The fertility patterns of Irish immigrants were much different than those of natives and other immigrant groups with similarly long histories of immigration to the U.S., but now we turn to the question raised by Guest (1982): Were the Irish less receptive to fertility control and slower to adapt to their new environment than other immigrant groups? We begin by looking at the same measure examined by Guest: the difference in fertility between first- and second-generation immigrants. The difference between generations of the Irish was smaller than that of the Germans but larger than that of the English. The generational differences for the English were, in fact, not statistically significant. This finding, however, must be interpreted in the broader context: the fertility of the first generation English was already much lower than that of the other first generation groups. The comparison of the Irish and Germans is more telling because of the similarity in fertility levels of the first-generations of these two groups. For both ethnic groups, the second generation clearly was exerting greater fertility control than the first, but this generational difference was larger for the Germans than for the Irish.

Another measure of adaptation is the degree to which the fertility of those who immigrated as children differed from the fertility of those who immigrated as adults. Here the Irish and Germans look very similar. For both groups, the wife having immigrated as a child lowered fertility. Interestingly, husband's age at immigration had no impact on fertility choices for either group.

Finally, at least according to the results of the two-stage model, the Irish had larger families in more Catholic counties. Unlike for the Germans and English, however, the percentage of one's countrymen in the county's population had no effect on fertility choices after controlling for the percent Catholic.

Conclusion

This study is preliminary, and we have indicated throughout avenues we intend to pursue and explore to sharpen and clarify our results. But three main features of our results stand out and are noteworthy. We began by noting that Ireland's late and feeble participation in the European fertility transition had created a scholarly consensus (not backed by any serious research) to the effect that the Irish did not limit family size because of the influence of the Roman Catholic Church. Casual references tried to buttress this view by claiming that Irish-Americans also had extremely large families. Recently several economic historians have noted that this position is inconsistent with both the data on family sizes in Ireland and with the small differences in fertility between Catholics and Protestants in Ireland. Our first finding continues the new trend that challenges the claim that the Irish did not control their fertility: Irish-Americans had smaller families than both the rural and the urban Irish and their fertility patterns show clear evidence of fertility control.

Second, we confirm that even though they were controlling their fertility, Irish-Americans still had relatively large families, compared to people born in the United States. This difference reflects class and other differences to only a very small extent. Conditional on characteristics, Irish-Americans made different fertility choices than the native-born.

Our third result deals with our “other” comparison groups, German and English immigrants to the United States. We followed these groups throughout our analysis because of a concern that focus on a single immigrant group would lead us to confuse the effects of being Irish with the effects of being an immigrant. We found that in many ways the Germans paralleled the Irish. Like the Irish, both first- and second-generation Germans had larger families than the native-born. But the Germans differed from the Irish in the sources of this distinctiveness: an important source of the higher German fertility was that they had occupational and other traits that were associated with higher fertility even in the native population.

Irish-Americans in 1910 came from a country of very high marital fertility. They reduced their family sizes in the United States, but comparatively little. And the underlying causes of their large families in the U.S. were unusual, even when compared to other high-fertility immigrants. Ireland’s reputation as a complete demographic oddity was unwarranted, as we are learning, but even when they acted like others it seems to have been for different reasons.

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Table 1.–Fertility by Place of Residence and Wife's Nativity, 1910/1911
Wife's Age at Marriage 20 to 24, Marital Durations of 25 to 29 Years

	N	Mean Children Ever-Born	% 2 or fewer children	% 6 or more children
Urban Ireland		6.91	0.13	0.66
Rural Ireland		7.69	0.10	0.76
England/Wales		5.83	0.19	0.51
United States – Urban Non-South				
Native-born, native parentage	248	3.38	0.46	0.20
Irish --1st generation	54	6.48	0.15	0.69
Irish -- 2nd generation	60	4.92	0.18	0.40
English -- 1st generation	30	5.03	0.23	0.33
English -- 2nd generation	29	3.28	0.45	0.17
German -- 1st generation	110	6.55	0.13	0.61
German -- 2nd generation	114	4.25	0.28	0.27

Source: Anderson (1998); 1910 IPUMS sample.

Table 2.-- Fertility by Wife's Nativity and Husband's Occupation, 1910
Wife's Age at Marriage 15 to 29, Marital Duration 20 to 29 Years

	N	Mean Children Ever Born	% zero children	% 2 or fewer children	% 6 or more children
Native					
professional	353	3.09	0.10	0.47	0.13
clerk	216	2.78	0.13	0.54	0.12
skilled	256	3.96	0.05	0.34	0.26
unskilled	283	4.18	0.08	0.36	0.33
agriculture	54	4.20	0.06	0.28	0.28
none reported	33	2.91	0.15	0.55	0.21
Irish – 1st generation					
professional	23	5.30	0.04	0.22	0.57
clerk	10	5.50	0.00	0.00	0.60
skilled	45	5.80	0.07	0.16	0.62
unskilled	107	5.85	0.09	0.19	0.58
agriculture	8	6.50	0.00	0.00	0.63
none reported	4	4.75	0.00	0.25	0.50
Irish – 2nd generation					
professional	67	4.72	0.04	0.21	0.34
clerk	31	3.42	0.10	0.42	0.19
skilled	82	4.74	0.07	0.21	0.37
unskilled	116	5.22	0.07	0.22	0.47
agriculture	6	4.17	0.33	0.33	0.50
none reported	6	2.00	0.17	0.50	0.00
English – 1st generation					
professional	22	4.05	0.14	0.36	0.23
clerk	4	4.50	0.00	0.25	0.25
skilled	49	4.69	0.06	0.27	0.33
unskilled	57	5.63	0.07	0.23	0.49
agriculture	2	4.00	0.00	0.50	0.50
none reported	3	6.33	0.00	0.00	0.33

Table 2. – *Continued*

	N	Mean Children Ever Born	% zero children	% 2 or fewer children	% 6 or more children
English – 2nd generation					
professional	37	3.03	0.11	0.38	0.03
clerk	29	2.41	0.17	0.59	0.14
skilled	36	4.14	0.06	0.33	0.22
unskilled	25	4.28	0.04	0.20	0.20
agriculture	1	3.00	0.00	0.00	0.00
none reported	2	2.50	0.00	0.50	0.00
German – 1st generation					
professional	66	5.23	0.03	0.20	0.39
clerk	20	3.45	0.15	0.35	0.15
skilled	109	5.78	0.06	0.13	0.56
unskilled	185	6.81	0.02	0.14	0.62
agriculture	7	6.14	0.00	0.14	0.57
none reported	16	5.69	0.00	0.13	0.50
German – 2nd generation					
professional	119	4.16	0.05	0.32	0.24
clerk	63	3.51	0.06	0.38	0.19
skilled	124	4.40	0.05	0.29	0.35
unskilled	128	4.45	0.04	0.28	0.32
agriculture	5	4.80	0.00	0.20	0.20
none reported	17	2.88	0.18	0.47	0.18

Table 3.-- Infant and Child Mortality by Mother's Nativity, 1910
Wife's Age at Marriage 20 to 24, Marital Duration 20 to 29 Years

	N	% with any dead children	ave. number of children dead	ave. proportion of children dead
Native-born, native parentage	1195	0.40	0.65	0.15
Irish --1st generation	197	0.65	1.62	0.24
Irish -- 2nd generation	308	0.49	0.99	0.18
English -- 1st generation	403	0.63	1.65	0.22
English -- 2nd generation	456	0.49	0.88	0.18
German -- 1st generation	137	0.56	1.45	0.23
German -- 2nd generation	130	0.38	0.54	0.14

Table 4.-- Tobit Model of Proportion of Children Dead, Pooled Sample

	Coefficient	St. error
Mean summer temperature	0.011	0.004
Number of hot summers during marriage[a]	0.028	0.016
Private waterworks in city[b]	-0.038	0.057
Miles of public water mains per 100,000 persons in city[b]	-3.27e-04	2.43e-04
(Private waterworks)*(Number of hot summers)	-0.030	0.021
(Miles of public water mains)*(Number of hot summers)	-9.72e-05	8.79e-05
Wife's age at marriage	-0.007	0.003
Husband's age at marriage	-0.002	0.002
Marital duration	0.066	0.011
Marital duration- sqr. /10	-0.020	0.007
Marital duration- cbd. /100	0.002	0.001
Husband's occupation:		
Professional	-0.148	0.025
Clerical	-0.133	0.027
Skilled	-0.067	0.022
Agricultural	-0.093	0.085
None reported	-0.217	0.072
Home ownership	-0.004	0.019
Wife's nativity:		
Irish – 1st generation	0.089	0.045
Irish – 2nd generation	0.094	0.031
German – 1st generation	0.106	0.039
German – 2nd generation	0.007	0.030
English – 1st generation	0.155	0.053
English – 2nd generation	-0.035	0.052
Other immigrant group	0.116	0.045
Husband's nativity:		
Irish – 1st generation	0.101	0.046
Irish – 2nd generation	0.028	0.033
German – 1st generation	0.052	0.037
German – 2nd generation	-0.009	0.030
English – 1st generation	-0.009	0.049
English – 2nd generation	-0.003	0.044
Other immigrant group	-0.005	0.042
Percent Catholic	0.201	0.109
Large city (500,000 +)	0.021	0.024
Midwest	-0.067	0.021
West	0.016	0.044
Intercept	-1.420	0.328
Sigma	0.590	0.011
No. of obs.	7,705	

[a] "Hot" summer defined as summer in which average temperature was one standard deviation or more greater than the mean summer temperature. This variable counts the number of such summers experienced in a couple's county of residence since 1895 for couples married 15 or more years and since the year at marriage for couples married 14 or fewer years.

[b]Data on waterworks pertains to 1903. Water main mileage only available for cities with public waterworks.

Table 5.-- Zero Inflated Negative Binomial Model of Children Ever-Born, Pooled Sample

			No instruments		Two stage procedure	
	Mean	St. Dev.	dy/dx	St. Err.	dy/dx	St. Err.
Proportion children dead	0.12	0.23	1.684	0.310	1.057	1.013
Wife's age at marriage	22.48	4.48	-0.064	0.008	-0.058	0.008
Husband's age at marriage	26.41	5.75	-0.020	0.005	-0.021	0.005
Marital duration	13.88	8.74	0.461	0.022	0.474	0.024
Marital duration- sqr. /10	26.92	28.97	-0.176	0.015	-0.179	0.014
Marital duration- cbd. /100	61.81	90.00	0.023	0.003	0.024	0.003
Husband's occupation:						
Professional	0.21	0.41	-0.330	0.051	-0.349	0.068
Clerical	0.17	0.37	-0.462	0.056	-0.479	0.066
Skilled	0.26	0.44	-0.035	0.046	-0.054	0.053
Agricultural	0.01	0.10	0.082	0.162	0.023	0.160
None reported	0.02	0.12	-0.562	0.120	-0.579	0.136
Home ownership	0.33	0.47	0.049	0.050	0.035	0.046
Wife’s nativity:						
Irish – 1st generation	0.08	0.27	0.597	0.130	0.680	0.130
Irish – 2nd generation	0.13	0.34	0.400	0.081	0.426	0.089
German – 1st generation	0.12	0.32	0.660	0.100	0.668	0.110
German – 2nd generation	0.19	0.39	0.196	0.074	0.172	0.073
English – 1st generation	0.04	0.20	0.486	0.137	0.525	0.155
English – 2nd generation	0.05	0.22	0.093	0.114	0.072	0.118
Other immigrant group	0.05	0.22	0.133	0.108	0.156	0.116
Husband’s nativity:						
Irish – 1st generation	0.07	0.26	0.902	0.131	0.865	0.142
Irish – 2nd generation	0.11	0.31	0.642	0.093	0.649	0.093
German – 1st generation	0.13	0.34	0.739	0.098	0.738	0.104
German – 2nd generation	0.16	0.37	0.328	0.074	0.315	0.077
English – 1st generation	0.05	0.22	0.371	0.124	0.352	0.127
English – 2nd generation	0.07	0.25	0.123	0.101	0.099	0.104
Other immigrant group	0.07	0.25	0.419	0.103	0.410	0.106
Percent Catholic	0.22	0.10	-0.113	0.225	-0.078	0.232
Large city (500,000 +)	0.43	0.50	-0.124	0.040	-0.096	0.047
Midwest	0.37	0.48	-0.025	0.043	-0.039	0.047
West	0.08	0.27	-0.251	0.075	-0.247	0.078
“Always-zero” regime						
Wife age 30 + at marriage	0.08	0.26	-0.318	0.086	-0.376	0.083
Diff. spouse's ages at marr.	3.93	4.79	-0.002	0.002	-0.001	0.003
Diff. spouse's ages at marr.-sqr./10	3.84	8.02	-0.001	0.002	-0.002	0.001
ln (alpha)			-2.459	1.251	-2.442	1.073
alpha			0.085	0.107	0.087	0.093
No. of obs.	7,705					

Notes: Sample restricted to couples married two or more years in which both spouses were native-born whites of native parentage or in which at least one spouse was an Irish, German, or English immigrant (first or second generation). See Table 4 for first stage specification.

Table 6.-- Zero Inflated Negative Binomial Model of Children Ever-Born, Native Couples

			No instruments		Two stage procedure	
	Mean	St. Dev.	dy/dx	St. Err.	dy/dx	St. Err.
Proportion children dead	0.10	0.22	1.297	0.166	2.353	1.803
Wife's age at marriage	22.03	4.49	-0.052	0.011	-0.049	0.015
Husband's age at marriage	25.93	5.88	-0.020	0.008	-0.016	0.010
Marital duration	13.36	8.82	0.343	0.035	0.339	0.044
Marital duration- sqr. /10	25.61	29.32	-0.125	0.022	-0.128	0.024
Marital duration- cbd. /100	59.14	92.04	0.016	0.004	0.017	0.004
Husband's occupation:						
Professional	0.24	0.43	-0.413	0.084	-0.373	0.106
Clerical	0.23	0.42	-0.430	0.085	-0.400	0.100
Skilled	0.24	0.43	-0.113	0.085	-0.119	0.094
Agricultural	0.01	0.10	0.287	0.210	0.236	0.244
None reported	0.01	0.10	-0.261	0.264	-0.159	0.348
Home ownership	0.33	0.47	-0.029	0.071	-0.035	0.081
Percent Catholic	0.18	0.10	-0.487	0.388	-0.435	0.393
Large city (500,000 +)	0.28	0.45	-0.084	0.078	-0.110	0.095
Midwest	0.38	0.49	-0.048	0.073	-0.059	0.076
West	0.11	0.31	-0.122	0.106	-0.115	0.109
"Always-zero" regime						
Wife age 30 + at marriage	0.07	0.25	-0.343	0.167	-0.398	0.168
Diff. spouse's ages at marr.	3.90	4.83	-2.0e-06	6.0e-05	-2.0e-03	5.4e-03
Diff. spouse's ages at marr.-sqr./10	3.86	8.09	1.4e-07	0.0e+00	-4.1e-04	2.7e-03
ln (alpha)			-2.122	1.133	-2.072	1.609
alpha			0.120	0.136	0.126	0.203
No. of obs.	2,079					

Notes: Sample restricted to couples married at least two years in which both spouses were native-born whites of native parentage. Two stage procedure uses the following instruments for the proportion of children dead: mean summer temperature, number of hot summers (one standard deviation or more above mean temperature) during a woman's marriage (since 1895), an indicator variable for private waterworks in city of residence, miles of water mains per 100,000 persons in city with public waterworks, and interactions of waterworks variables and number of hot summers.

Table 7.-- Zero Inflated Negative Binomial Model of Children Ever-Born, Irish Couples

			No instruments		Two stage procedure	
	Mean	St. Dev.	dy/dx	St. Err.	dy/dx	St. Err.
Proportion children dead	0.15	0.24	1.532	0.660	-2.117	1.552
Wife's age at marriage	23.10	4.74	-0.071	0.016	-0.076	0.015
Husband's age at marriage	26.95	5.83	-0.024	0.010	-0.023	0.010
Marital duration	13.94	8.59	0.593	0.052	0.678	0.055
Marital duration- sqr. /10	26.82	28.47	-0.223	0.037	-0.253	0.032
Marital duration- cbd. /100	60.94	88.98	0.028	0.007	0.032	0.006
Husband's occupation:						
Professional	0.17	0.38	-0.331	0.125	-0.417	0.123
Clerical	0.15	0.36	-0.297	0.113	-0.431	0.118
Skilled	0.25	0.43	-0.009	0.095	-0.152	0.111
Agricultural	0.01	0.12	-0.184	0.246	-0.182	0.236
None reported	0.01	0.11	-1.160	0.306	-1.366	0.266
Home ownership	0.28	0.45	0.298	0.099	0.227	0.096
Wife second generation	0.48	0.50	-0.377	0.136	-0.370	0.128
Husband second generation	0.41	0.49	-0.177	0.127	-0.245	0.132
Wife native	0.10	0.30	-0.740	0.179	-0.777	0.163
Husband native	0.13	0.33	-0.670	0.141	-0.682	0.145
Wife other immigrant group	0.13	0.33	-0.369	0.139	-0.393	0.141
Husband other imm. group	0.19	0.40	-0.445	0.113	-0.526	0.122
Wife age at immigration < 18	0.19	0.40	-0.268	0.111	-0.228	0.115
Husband age at imm. < 18	0.15	0.36	0.101	0.112	0.124	0.118
Percent Catholic	0.25	0.09	0.857	0.585	1.635	0.661
Percent Irish	0.04	0.02	-0.682	2.731	-1.239	2.749
Large city (500,000 +)	0.52	0.50	0.021	0.084	0.181	0.108
Midwest	0.23	0.42	-0.151	0.122	-0.283	0.129
West	0.06	0.24	-0.276	0.181	-0.310	0.181
"Always-zero" regime						
Wife age 30 + at marriage	0.10	0.30	-0.449	0.196	-0.498	0.170
Diff. spouse's ages at marr.	3.85	4.80	3.7e-04	6.2e-03	2.4e-05	6.7e-03
Diff. spouse's ages at marr.-sqr./10	3.79	7.70	-2.0e-03	3.4e-03	-2.3e-03	3.7e-03
ln (alpha)			-2.942	4.736	-2.861	3.929
alpha			0.053	0.250	0.057	0.225
No. of obs.	2,069					

Notes: Sample restricted to couples married two or more years in which at least one spouse was an Irish immigrant (first or second generation). For listing of instruments used in the two-stage procedure, see the notes to Table 6.

Table 8.-- Zero Inflated Negative Binomial Model of Children Ever-Born, German Couples

			No instruments		Two stage procedure	
	Mean	St. Dev.	dy/dx	St. Err.	dy/dx	St. Err.
Proportion children dead	0.12	0.22	2.118	0.203	1.058	1.617
Wife's age at marriage	22.31	4.22	-0.068	0.010	-0.068	0.013
Husband's age at marriage	26.38	5.56	-0.020	0.007	-0.018	0.010
Marital duration	14.10	8.78	0.455	0.036	0.462	0.038
Marital duration- sqr. /10	27.58	29.00	-0.165	0.023	-0.163	0.023
Marital duration- cbd. /100	63.48	89.26	0.021	0.004	0.021	0.004
Husband's occupation:						
Professional	0.22	0.42	-0.290	0.082	-0.334	0.117
Clerical	0.14	0.34	-0.608	0.093	-0.621	0.112
Skilled	0.28	0.45	-0.004	0.073	-0.024	0.084
Agricultural	0.01	0.08	0.080	0.316	0.009	0.372
None reported	0.02	0.14	-0.541	0.170	-0.584	0.197
Home ownership	0.38	0.48	0.019	0.068	-0.006	0.083
Wife second generation	0.47	0.50	-0.467	0.100	-0.529	0.119
Husband second generation	0.41	0.49	-0.312	0.093	-0.346	0.108
Wife native	0.10	0.30	-0.686	0.124	-0.712	0.143
Husband native	0.11	0.31	-0.679	0.106	-0.714	0.118
Wife other immigrant group	0.13	0.34	-0.515	0.102	-0.526	0.112
Husband other imm. group	0.14	0.35	-0.320	0.093	-0.337	0.108
Wife age at immigration < 18	0.18	0.39	-0.158	0.090	-0.181	0.101
Husband age at imm. < 18	0.17	0.38	-0.063	0.093	-0.087	0.099
Percent Catholic	0.23	0.08	-0.438	0.397	-0.319	0.409
Percent German	0.07	0.03	1.754	1.039	1.610	1.275
Large city (500,000 +)	0.50	0.50	-0.151	0.065	-0.123	0.076
Midwest	0.48	0.50	0.014	0.072	-0.004	0.093
West	0.06	0.24	-0.415	0.130	-0.424	0.144
"Always-zero" regime						
Wife age 30 + at marriage	0.06	0.24	-0.066	0.108	-0.143	0.147
Diff. spouse's ages at marr.	4.08	4.81	-1.2e-06	0.0e+00	-0.002	0.005
Diff. spouse's ages at marr.-sqr./10	3.97	8.49	2.1e-06	1.0e-05	-0.001	0.002
ln (alpha)			-2.528	1.563	-2.489	1.683
alpha			0.080	0.125	0.083	0.140
No. of obs.	3,063					

Notes: Sample restricted to couples married two years or more in which at least one spouse was a German immigrant (first or second generation). For listing of instruments used in the two-stage procedure, see the notes to Table 6.

Table 9.-- Zero Inflated Negative Binomial Model of Children Ever-Born, English Couples

	Mean	St. Dev.	No instruments dy/dx	No instruments St. Err.	Two stage procedure dy/dx	Two stage procedure St. Err.
Proportion children dead	0.12	0.23	1.847	0.325	2.856	2.058
Wife's age at marriage	22.68	4.51	-0.081	0.017	-0.059	0.022
Husband's age at marriage	26.49	5.61	-0.008	0.013	-0.011	0.018
Marital duration	14.18	8.67	0.528	0.058	0.512	0.083
Marital duration- sqr. /10	27.63	29.08	-0.232	0.036	-0.225	0.054
Marital duration- cbd. /100	63.57	90.32	0.036	0.007	0.034	0.010
Husband's occupation:						
Professional	0.20	0.40	-0.210	0.135	-0.122	0.223
Clerical	0.19	0.39	-0.482	0.155	-0.394	0.226
Skilled	0.28	0.45	0.004	0.131	0.024	0.197
Agricultural	0.01	0.07	0.368	0.767	0.143	0.863
None reported	0.01	0.12	-0.461	0.262	-0.273	0.380
Home ownership	0.31	0.46	-0.004	0.140	-0.002	0.128
Wife second generation	0.35	0.48	-0.235	0.159	-0.203	0.207
Husband second generation	0.48	0.50	0.141	0.136	0.086	0.151
Wife native	0.13	0.33	-0.802	0.155	-0.758	0.213
Husband native	0.18	0.38	-0.560	0.133	-0.543	0.137
Wife other immigrant group	0.23	0.42	-0.304	0.139	-0.268	0.164
Husband other imm. group	0.14	0.34	-0.122	0.163	-0.088	0.185
Wife age at immigration < 18	0.19	0.39	0.004	0.140	-0.041	0.177
Husband age at imm. < 18	0.17	0.38	0.204	0.153	0.169	0.175
Percent Catholic	0.23	0.10	-1.127	0.604	-0.914	0.633
Percent English	0.02	0.02	7.974	3.489	6.045	3.955
Large city (500,000 +)	0.43	0.49	-0.204	0.111	-0.176	0.126
Midwest	0.26	0.44	-0.214	0.124	-0.156	0.152
West	0.12	0.33	-0.426	0.173	-0.359	0.213
"Always-zero" regime						
Wife age 30 + at marriage	0.09	0.28	(a)		-0.456	0.231
Diff. spouse's ages at marr.	3.80	4.58	(a)		-0.005	0.011
Diff. spouse's ages at marr.-sqr./10	3.54	6.61	(a)		0.001	0.005
ln (alpha)			-2.288	1.919	-2.313	2.594
alpha			0.102	0.195	0.099	0.257
No. of obs.	1,112					

[a] The marginal effects estimates were derived numerically. These variables were estimated to have no marginal effects.

Notes: Sample restricted to couples married two years or more in which at least one spouse was an English immigrant (first or second generation). For listing of instruments used in the two-stage procedure, see the notes to Table 6.

Figure 1: Fertility in the 1910 Census
Wife's Age at Marriage 15 to 29, Marital Duration 20 to 29 Years

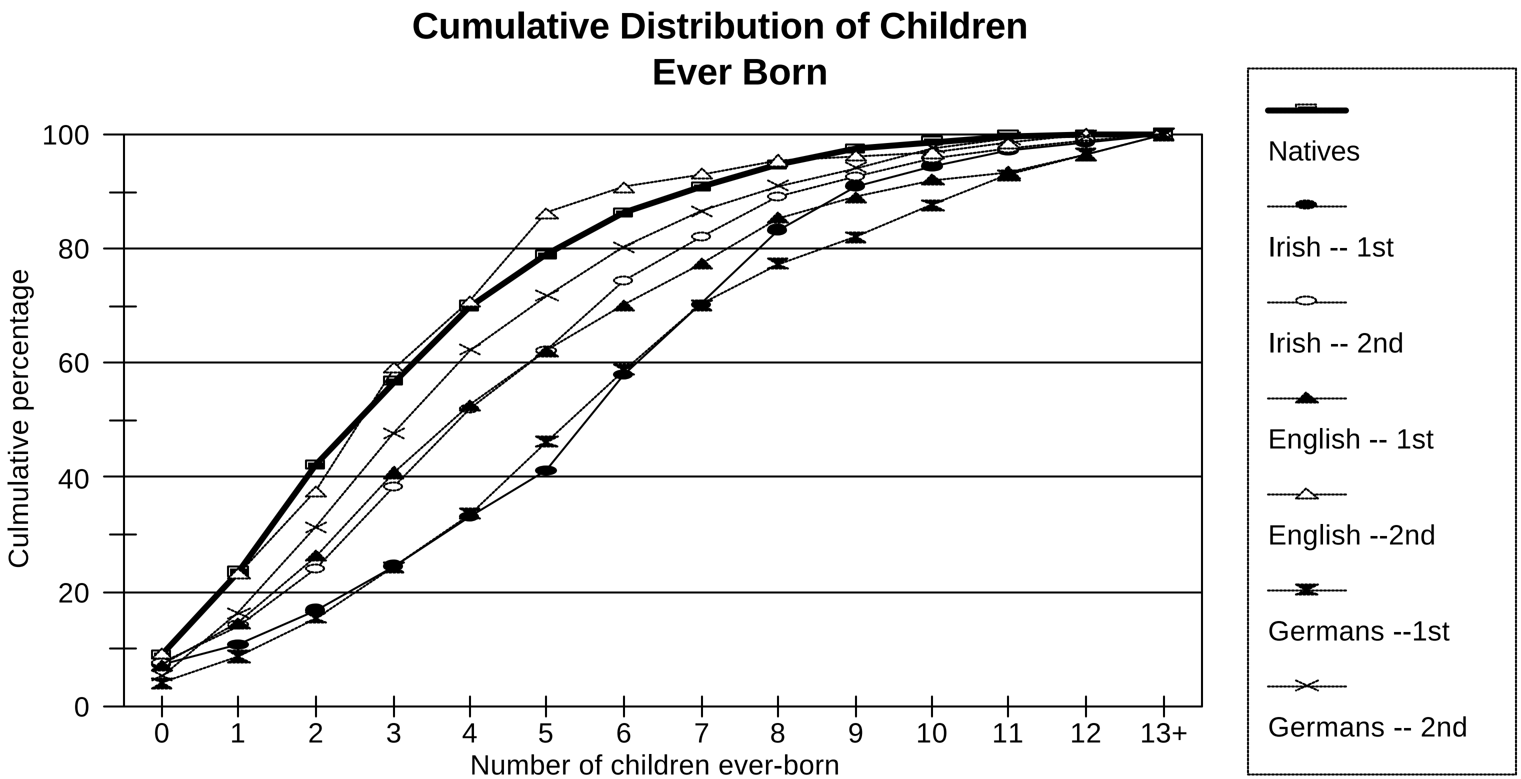
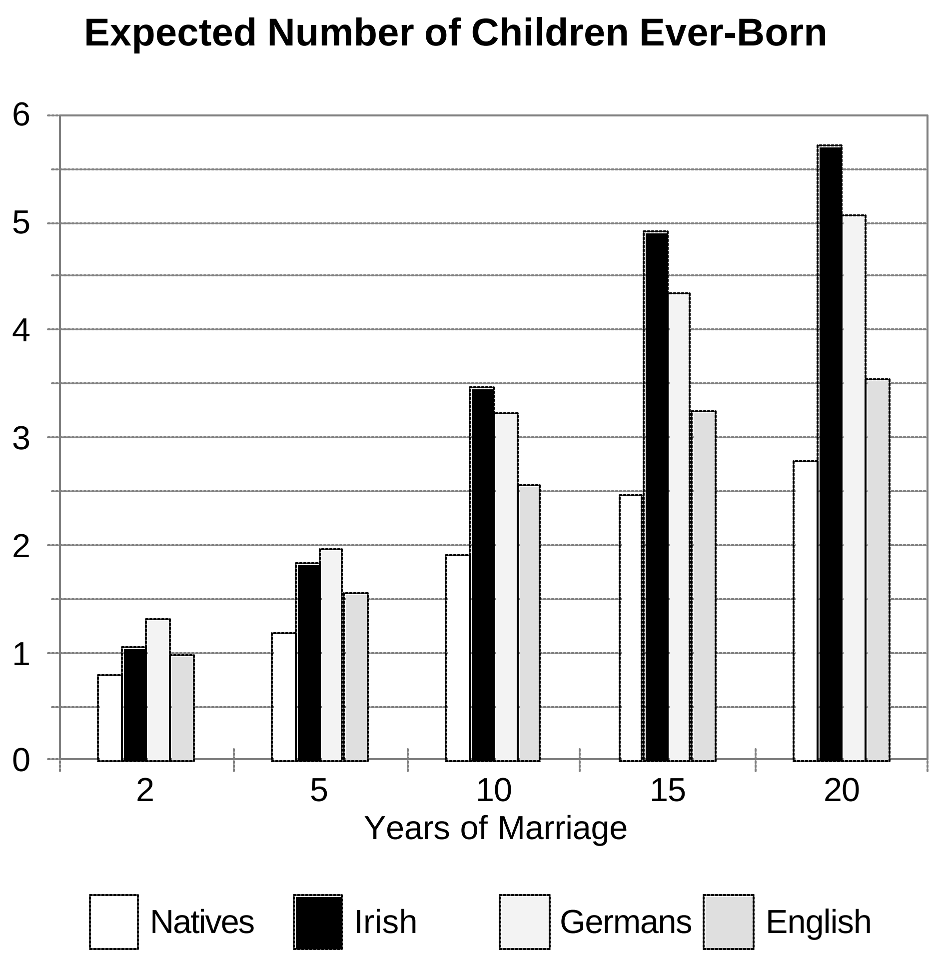
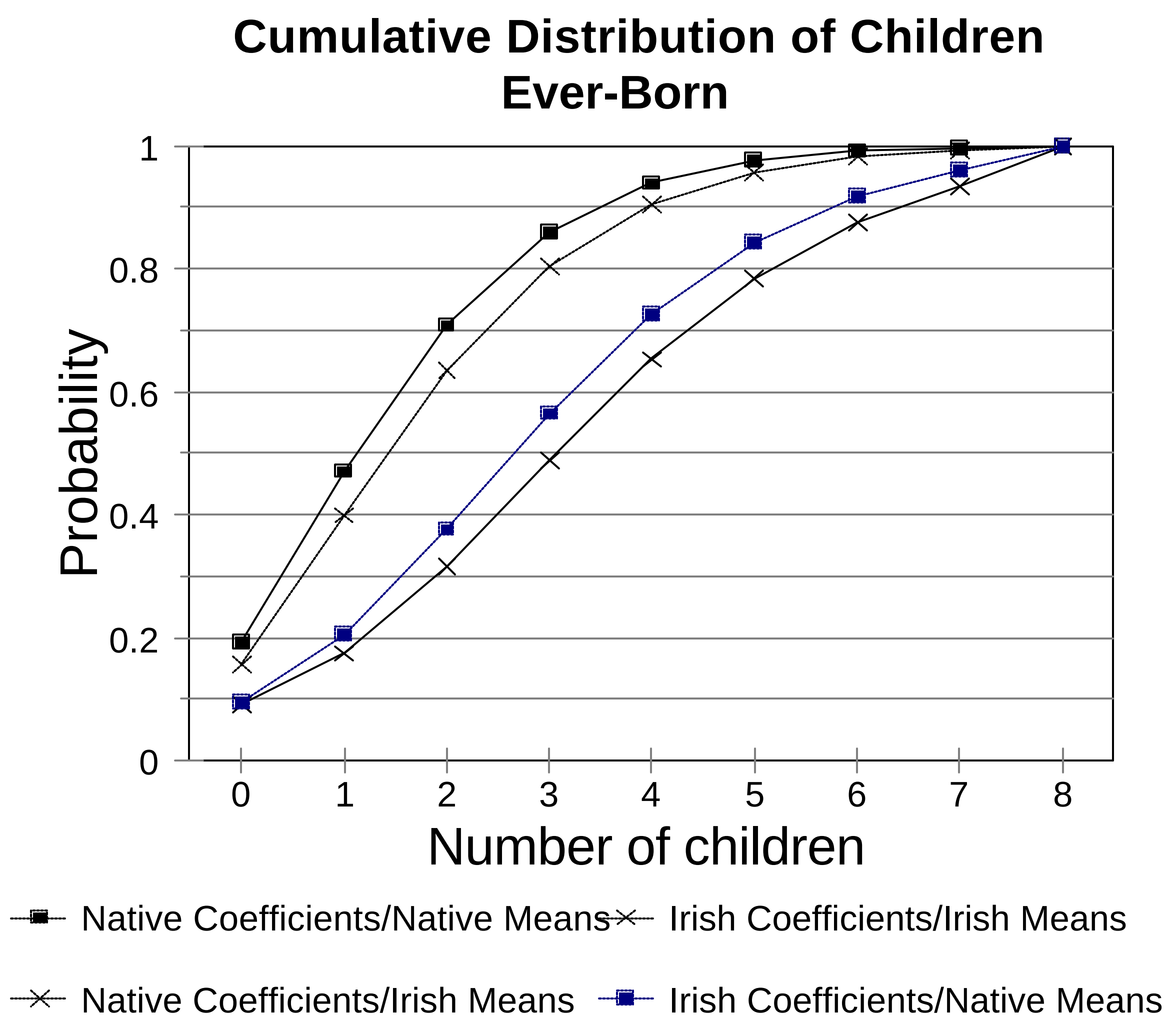


Figure 2: Ethnic Differences in Duration Effects
Predictions from Count Models



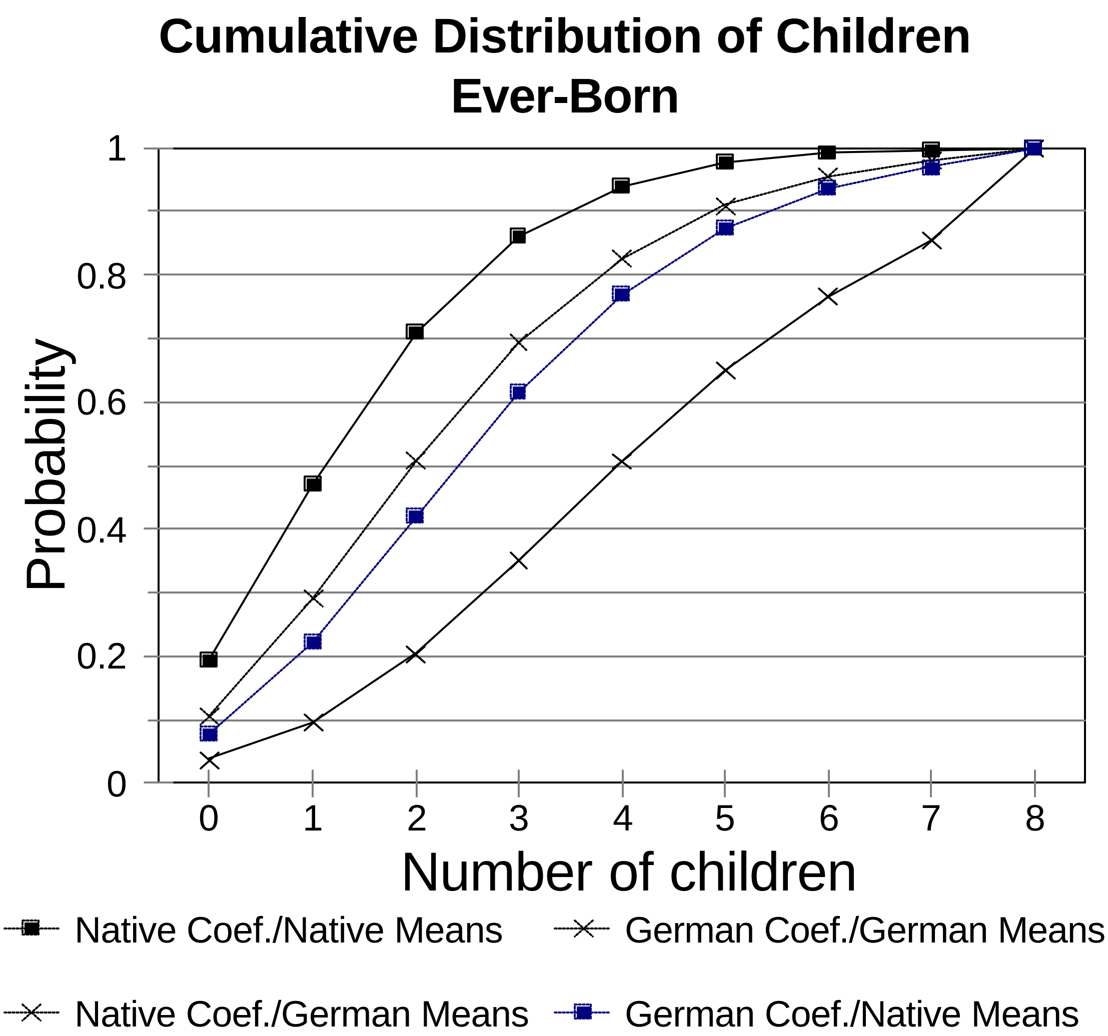
Note: For all groups, the expected number of children ever-born was calculated for a baseline couple in which the wife's age at marriage was 25, the husband's age at marriage was 27, the husband had an unskilled occupation, and which lived in small city (population of 25,000 to 499,999).

Figure 3: Native vs. Irish Fertility
Predictions from Count Models



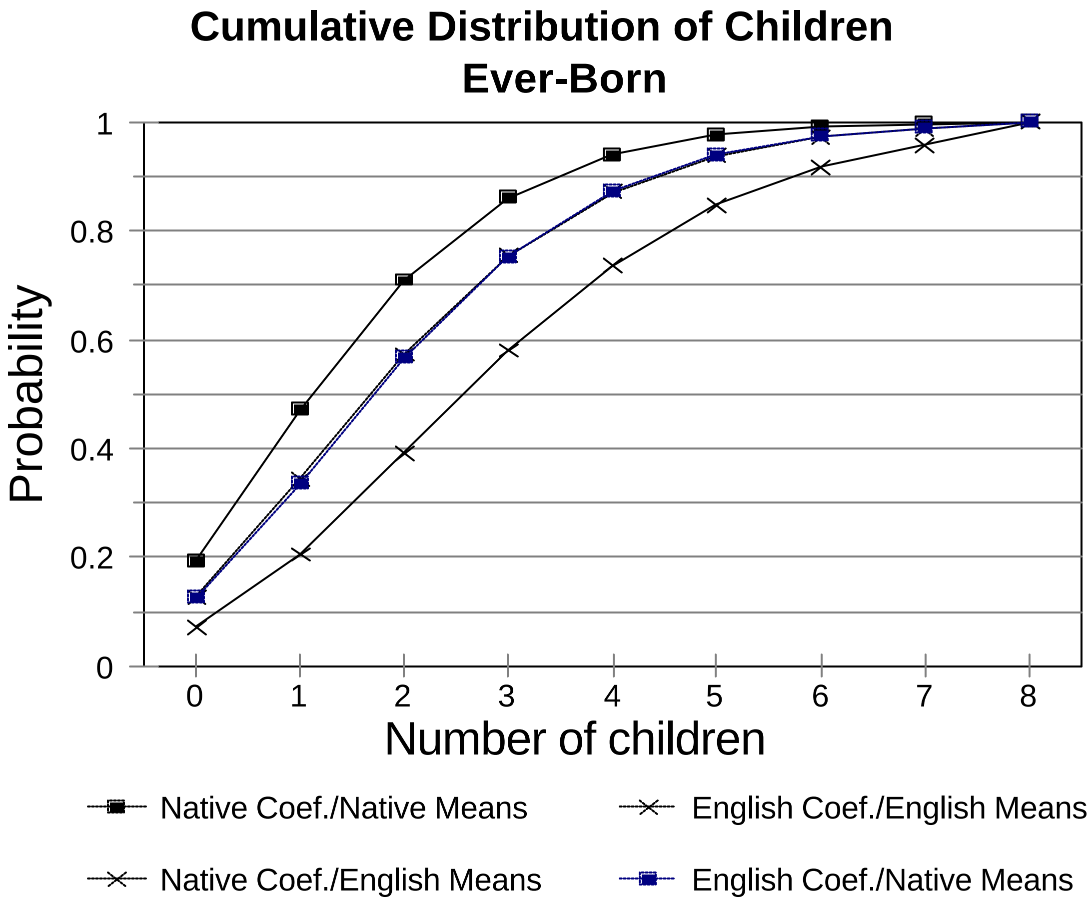
Notes: Predictions calculated using coefficients from two-stage models. Irish means represent the means for the subset of couples in which both spouses are first-generation immigrants who immigrated as adults.

Figure 4: Native vs. German Fertility Predictions from Count Models



Notes: Predictions calculated using coefficients from two-stage models. German means represent the means for the subset of couples in which both spouses are first-generation immigrants who immigrated as adults.

Figure 5: Native vs. English Fertility Predictions from Count Models



Notes: Predictions calculated using coefficients from two-stage models. English means represent the means for the subset of couples in which both spouses are first-generation immigrants who immigrated as adults.