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ABSTRACT

Are Children "Normal"?[*]

We examine Becker's (1960) contention that children are "normal." For the cross section of non-Hispanic white married couples in the U.S., we show that when we restrict comparisons to similarly-educated women living in similarly-expensive locations, completed fertility is positively correlated with the husband's income. The empirical evidence is consistent with children being "normal." In an effort to show causal effects, we analyze the localized impact on fertility of the mid-1970s increase in world energy prices – an exogenous shock that substantially increased men's incomes in the Appalachian coal-mining region. Empirical evidence for that population indicates that fertility increases in men's income.

JEL Classification: J13, J40

Keywords: economics of fertility, location choice, Appalachian fertility

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INTRODUCTION

In his influential 1960 paper, Becker sets out the basic neoclassical theory of fertility—a framework in which children are recognized as providing utility to parents in much the same way as other goods. In consumer theory, goods that have no ready substitutes are generally "normal;" increases in income induce greater consumption of these goods. Because children seemingly have few substitutes we therefore might expect desired fertility to be increasing in lifetime income *ceteris paribus*.

As Blake (1968) argues, the prediction that children are normal seems counterfactual. After all, the transition to lower fertility that occurred in many parts of the world over the past two centuries has coincided with tremendous increases in household income. Also, in many societies—both developed and developing—high-income families have fewer children than their lower-income counterparts. Jones and Tertilt (2006), for example, use Census data to show that for every birth cohort of women in the U.S., 1828 through 1958, there is a *negative* cross-sectional relationship between fertility and a proxy for husband's income.[1] Similarly, in work reported below, we find a negative relationship between husband's income and fertility for non-Hispanic white married women in the 1940-1950 birth cohorts.

Of course, in his original work on the economics of fertility, and in important subsequent work (e.g., Becker, 1965), Becker demonstrates that the neoclassical model itself provides a sensible explanation for the observed inverse relationship between *household* income and fertility. The key insight is that the underlying economic forces that lead to increasing household prosperity—increased market wages—have two offsetting effects for parents: The first is an income effect, which in isolation is expected to induce higher fertility. The second, though, is an increase in the

[1] The authors estimate an overall income elasticity of about -0.38 for the period.

value of time spent in the labor market. Because raising children is time-intensive, especially for the mother, but also possibly for the father, the "shadow price" of children increases relative to other relevant prices; this substitution effect reduces the desired level of child-bearing.[2]

In their review, Hotz, Klerman, and Willis (1997) note that there are considerable challenges to testing the central propositions of the neoclassical theory of fertility, i.e., the predicted income and substitution effects. Nonetheless, over the past several decades a number of studies have provided relevant empirical evidence. Much of this work focuses on the proposition that increases in the value of women's time reduce desired fertility. Schultz (1985) provides a well-crafted example of this type of empirical enterprize with his analysis of fertility in Sweden in the late 19th and early 20th century. The analysis exploits exogenous variation in the relative world prices of basic commodities: Schultz argues that the production of dairy products was "women's work," while the production of grains and forestry products was undertaken primarily by men. He finds that a market increase in the price of dairy products (relative to other prices) in the late nineteenth century increased the relative market value of women's time, which in turn led to a statistically significant and economically important decline in fertility.[3]

If children are normal and if men's time is relatively unimportant to the household production of children, we would expect to see a positive relationship between men's wages and fertility. In Shultz's (1985) analysis of the Swedish case, evidence on this proposition is ambiguous. More generally, our reading of the literature suggests that there is only a moderate amount of evidence

[2]In short, both fertility and income are decision variables. Even if an exogenous shock to lifetime wealth would conceptually increase fertility (i.e., children are normal), we might not observe a positive cross-sectional relationship between realized income measures and fertility. As we show below, matters are worse yet if people choose where they live, and face differing prices in those locations.

[3]Other recent evidence about the importance of the opportunity cost of women's time for fertility comes from the literature evaluating the impact of parental-leave policy on fertility. See, e.g., Lalive and Zweimuller (2009).

concerning the central proposition from the basic economic model of fertility that children are normal.[4]

It is possible of course, theoretical reasoning notwithstanding, that children simply are not normal; more precisely, fertility might not increase in response to an exogenous shock that increases men's earnings. For instance, as we have noted, an increase in male wages might have a substitution effect of its own if the father's time is sufficiently important for raising children. Alternatively, it may be that "child services" are normal, but that these "services" have both "quantity" and "quality" components (see, e.g., Becker and Lewis, 1973, and Willis, 1973), and "quality" might be increasing in income while "quantity" is not.

Before jumping to such conclusions, though, it seems to us that there is value in an empirical investigation of the simple proposition that children are normal. We focus, as a practical and theoretically defensible matter, on the relationship between fertility and the husband's earnings. Our empirical work examines U.S. fertility in the late 20th century.

Our first step is to look carefully at the cross-sectional relationship between the fertility of married non-Hispanic white women and their husbands' income in the U.S. in 1990.[5] It is true that for our study sample there is a negative correlation between completed fertility and husbands' income. Things change, though, when we take a bit of care in constructing economically sensible comparison groups. Theory tells us, in particular, that in looking for an income effect we must hold constant the opportunity cost of women's time (e.g., the wage that women could earn if they spent

[4]In his 1960 paper, Becker suggested that desired fertility might be normal even if completed fertility is not, owing to income-related differences in knowledge about contraceptives, and he presents evidence from an Indianapolis survey consistent with this conjecture. This concern is less relevant now in the U.S. than it was in 1960, because of the widespread availability of oral contraceptives. A few more recent empirical analyses of fertility do find modest (though in some instances statistically insignificant) evidence of a positive relationship between husband's income and fertility, e.g., Hotz and Miller (1988), Borg (1989), and Heckman and Walker (1990). Lindo (2010) finds negative income shocks from a husband's job displacement to be correlated with reduced fertility, but the result is not statistically significant when individual fixed effects are included.

[5]1990 is last year for which the Census has collected the "Children Ever Born" (CEB) variable, which proves to be a valuable piece of information for our analysis.

additional time in the labor market). Thus in constructing comparison groups we restrict attention to women with similar levels of education. Also, in theory we should be comparing households that face similar relevant prices, which would surely include housing prices. Our empirical work shows that there is generally a strong *positive* cross-sectional relationship between husband's income and fertility among similarly-educated women residing in similarly-expensive urban areas.

Having established basic stylized facts about the cross-sectional relationship between fertility and the husband's income, we turn to possible theoretical explanations. Specifically, we set up a standard urban model along the lines of Roback (1982). In our model, local amenities differ across locations and, therefore, so do equilibrium housing prices. We assume that housing is an input to the production of children (children need somewhere to live). In our model children are normal; taking location as given, high-income households have more children than low-income households. But households make *joint* decisions over location and family size, and all else equal a couple that lives in an expensive location will have fewer children than a couple that chooses an inexpensive location.[6] In the resulting equilibrium, the correlation between income and fertility will be positive within each location, though it need not be positive across the population as a whole.

Evidence from the cross section does *not,* however, provide definitive evidence about a positive causal relationship between husband's income and fertility. Suppose that income and fertility are independently assigned to households so that the two are not causally related. Households then can be expected to sort into expensive high-amenity locations and inexpensive low-amenity locations as follows: Large families would generally sort into expensive cities only when they are unusually wealthy, while small families would generally sort into inexpensive rural locations only when they

[6]Simon and Tamura (2009) show that there is indeed a negative correlation between the price of living space and fertility.

are unusually poor. This sorting would lead to a positive correlation between income and fertility in each location. Such a pattern cannot, obviously, be taken as evidence that children are normal.

How can one determine the causal impact of husband's income on fertility? Our idea, following in the intellectual footsteps of Schultz (1985), is to seek out a large and sustained exogenous shock to men's income (i.e., a shock that makes a meaningful difference to lifetime income) in a given location, and then evaluate the impact on fertility. Our empirical work is on fertility in the Appalachian coal-mining region from 1950 through 1990. Our focus in particular is on the increase in the price of coal that was sustained over the 1970s and the subsequent robust economic activity in the Appalachian coal-producing region (certain rural counties of West Virginia, Kentucky, Ohio, and Pennsylvania). Specifically, the coal boom greatly improved the long-run economic prospects for men in coal counties, but not in other counties in the same states. This provides us the opportunity to examine the causal effect on fertility of an increase in men's income. Evidence indicates that an increase in husband's income led to higher fertility.

1. Fertility and Income in the U.S.: Evidence and Theory

1.1. **Evidence from the Cross-Section.** We begin by looking at the cross-sectional relationship between income and fertility among non-Hispanic white married women in the U.S. in 1990. We examine data from 1990 because it is last year for which the Census collected the variable "Children Ever Born" (CEB). We look at this variable for married women aged 40 to 50, i.e., among women born in the years 1940 through 1950. In general we observe very few births among women over age 50. Further analysis of women aged 48 to 50 indicates that only 2.7 percent of these women had a child after age 40 (with most of this fertility occurring at ages 41 and 42). Thus our CEB variable is "completed fertility" for most of these women.

Table 1 presents some basic facts about fertility. Our first observation is that fertility is moderately lower among high-income families than among low-income families. It is evidence of this sort that, upon casual inspection, might lead one to believe that children are “inferior goods.” We observe other regularities: First, women with higher levels of education have fewer children than women with lower levels of education. Second, there is substantial variation across location; women who live in rural areas have more children than women who live in large cities. Third, there is variation across cohorts in completed fertility rates, with women in the more recent cohorts generally having relatively fewer children.

With these facts in mind, we turn to regression-based depictions of the basic correlates of fertility, in which we look at the relationship between fertility and the husband’s income, conditional on other important determinants.

We would also like to have some measure of permanent income exclusive of income earned by the woman.[7] We have no ideal candidate for our income variable, but as a viable measure we use the log of the husband’s current annual income. Most of the men in our sample are in their prime earnings years, i.e., in their 40s or 50s, so current income is likely a reasonably good measure of lifetime income (for example, few men in the age range are in school, are making substantial investments in on-the-job training, or are retired).

In the first column of Table 2 we present a basic regression, which has as explanatory variables only log of husband’s income and cohort indicator variables. The relationship between income and CEB is negative. As noted above, though, we want to restrict attention to women with similar levels of human capital (i.e., similar time opportunity costs). The best we can do on this account is to pool women with similar levels of education. We do this by dividing the sample of women into

[7]The mother’s income is clearly endogenous, if for no other reason than the fact that the presence of additional children has the causal effect of reducing women’s labor supply, as Angrist and Evans (1998) demonstrate.

five large groups, ranging from those with less than high school education to those with graduate education. Now we notice a positive relationship between income and CEB within most groups (the only exception being women with less than a high school degree).

Also, as we discuss below, we are concerned about the possibility that couples in the U.S. face rather different housing prices depending on where they live. We can make some headway on this account by focusing on individuals who live in metropolitan statistical areas (MSAs).

We begin, in Panel A of Table 3, with women who live in the 50 largest MSAs. We then control for differences in living costs with (1) city fixed effects or (2) MSA housing costs, using Chen and Rosenthal's (2008) quality-adjusted housing values.[8] The first pair of columns provide these estimates for the entire sample of women. Then we estimate these same regressions for women separated by education. In each case, the estimated relationship between income and CEB is virtually the same for the two regressions. For women with education less than high school, there is a modest positive relationship between husbands' income and CEB, with an implied income elasticity of approximately 0.1. For other women, the relationship is positive and highly significant with implied income elasticities of approximately 0.3 to 0.4. Panel B shows these same regressions for women in smaller MSAs. For women with less than a high school education, there is no apparent relationship between husbands' income and CEB. For all other women, the relationship is positive, with implied income elasticities again in the neighborhood of 0.3 to 0.4.

Figure 1 provides a non-parametric graphical presentation of the basic relationship between CEB and the husband's income, in this instance dividing our sample of 50 large MSAs roughly into thirds, and presenting outcomes for the least-expensive cities and most-expensive cities. We notice that fertility is generally lower for college-educated women than for women with a high school

[8]Specifically, our measure is 1000 times their index. We are grateful to Stuart Rosenthal for providing us with these data.

education. Similar to the results in Table 3, fertility is higher for women in cities with relatively lower housing costs. College educated women in low housing cost cities have on average 0.2 more children than women in expensive cities (conditional on husbands' earnings). Women with a high school education have 0.1 more children on average in cities with lower housing costs. Most important, for our purposes, CEB is generally increasing in the husband's income.[9]

1.2. **A Simple Model of Fertility and Location Choice.** From our brief look at cross-sectional data we conclude that in the U.S., fertility and husbands' income are positively correlated among women with similar levels of human capital within similar locations. We present here a simple model to help clarify the forces that might lead to this observed patterns, and to organize thoughts about the additional empirical work that follows in Section 2.

We have an equilibrium model in which households jointly choose fertility and location. As will be apparent, our model is really just an example, intended to illustrate the following important point: even when children are normal, we needn't observe a positive correlation between income and fertility across the population, although we should observe a positive correlation between income and fertility *within* location.

In our example, newly formed couples act as a unitary household whose utility is determined by three factors: (1) where the family lives—in an urban location that has a valued local amenity level, $A = A_U$, or a rural area that has a lower level of the amenity, $A = A_R < A_U$; (2) the number of children c they have; and (3) the consumption of some other good, x.

Each household i has the same tastes. Households do differ, though, by having varying levels of an exogenously given endowment of human capital, $\theta_i > 0$. For simplicity we let workers be

[9] We do not have housing cost indices for rural areas comparable to those available for MSAs. Although we do not report these results, we did try regressions for women who live in rural areas using state fixed effects (similar to using MSA fixed effects for smaller MSAs in Table 3), and found in these regressions as well that husband's income is positively correlated with CEB.

equally productive in the two locations; they supply θ_i units of effective labor at wage w. Thus lifetime income, $y_i = w\theta_i$, is independent of location.

The price of x is the same in both locations and equal to 1. Thus, as is typical in urban location models (e.g., Roback, 1982), in equilibrium housing prices must be higher in the high-amenity location; if p_U is the price of a "unit" of housing in the urban area and p_R is the price in the rural area, $p_U > p_R$ (or else everyone would choose to live in the high-amenity urban location).

In our model, couples do not derive utility directly from housing. They buy housing solely for the purpose of accommodating their family. In particular, we suppose that for each extra child a couple chooses to have, they must purchase an additional unit of housing.

We let utility be given by a simple Stone-Geary form; utility is

$$A_U(c-\alpha_c)^{\gamma}(x-\alpha_x)^{(1-\gamma)} \qquad \text{in the urban location and}$$

$$A_R(c-\alpha_c)^{\gamma}(x-\alpha_x)^{(1-\gamma)} \qquad \text{in the rural location,}$$

with $\gamma \in (0,1)$, $\alpha_c > 0$, and $\alpha_x > 0$. Utility is maximized subject to the budget constraint given by $(p_U\ c) + x = y_i$ if the household is in the urban location and by $(p_R\ c) + x = y_i$ if it is in the rural location. Indirect utility for household i then is

$$V^{iR} = \frac{\Gamma A_U}{p_U^{\gamma}}\left[w\theta_i - \alpha_c\left(p_U\right) - \alpha_x\right] \qquad \text{in the urban location,} \tag{1}$$

$$V^{iU} = \frac{\Gamma A_R}{p_R^{\gamma}}\left[w\theta_i - \alpha_c\left(p_R\right) - \alpha_x\right] \qquad \text{in the rural location,} \tag{2}$$

where Γ is the constant $\gamma^{\gamma}(1-\gamma)^{(1-\gamma)}$. Household i's location decision boils down to choosing the location that provides the higher lifetime utility, i.e., determining which of (1) or (2) is larger.[10] In general, that decision depends on the household's endowment, θ_i.

[10] We assume that income is high enough that the terms in brackets in (1) and (2) are positive.

As it turns out, the nature of our model's equilibrium is quite simple: First, as noted above, the price of housing is clearly higher in the urban location than in the rural location.[11] Second, we can show that in equilibrium there will be some cut-off value, say $\hat{\theta}$, such that relatively wealthy families ($\theta_i > \hat{\theta}$) will live in the urban location, while poorer families ($\theta_i < \hat{\theta}$) will live in the urban location.[12] This outcome is pictured in Figure 2.

Now consider the demand for children, which is given by

(3) $$c(\theta_i) = (1-\gamma)\alpha_c + \frac{\gamma\,(w\theta_i - \alpha_x)}{p_U}$$

for the wealthier urban families ($\theta_i > \hat{\theta}$) and by

(4) $$c(\theta_i) = (1-\gamma)\alpha_c + \frac{\gamma\,(w\theta_i - \alpha_x)}{p_R}$$

for the poorer rural families ($\theta_i < \hat{\theta}$). The demand for children, as a function of income, is shown in Figure 3.

There are two features of child demand that merit attention. First, as a consequence of our assumption that preferences are Stone-Geary, children are normal. In this model, lifetime wealth is simply income—the product of the wage and level of human capital. An exogenous increase in wealth—in the form of an increase in non-labor income or a positive shock to wages—increases desired family size (so long as we restrict attention to changes that do not induce the family to change location). Second, for a household that is indifferent between the rural and urban locations, i.e., a family with $\theta_i = \hat{\theta}$, fertility is lower if the couple chooses the urban location. The economic forces that drive this result are clear enough: the urban location has the advantage of having the

[11] V is increasing in A and decreasing in p. Given that $A^U > A^R$, V^{iU} would exceed V^{iR} for all households i if p_R were not lower than p_U.

[12] To see this, first note that for the "marginal" family (1) is equal to (2), from which one can show $\left(\frac{A_U}{p_U^{\gamma}} - \frac{A_R}{p_R^{\gamma}}\right)\left(w\hat{\theta} - \alpha_x\right) = \alpha_c\left(A_U p_U^{(1-\gamma)} - A_R p_R^{(1-\gamma)}\right)$. Now the right-hand side of this latter expression is clearly positive, as is the second term in parentheses on the left-hand side. So $\frac{A_U}{p_U^{\gamma}} > \frac{A_R}{p_R^{\gamma}}$, which in turn shows that $\frac{\partial V^U}{\partial \theta} > \frac{\partial V^R}{\partial \theta}$ (see (1) and (2)), as depicted in Figure 2.

higher level of local amenities, but this is offset by higher housing prices. Higher housing costs in turn induce the family to choose a smaller family size.

As for the overall relationship between income and fertility, we note that a *negative* correlation might well pertain even though there is a positive relationship between income and fertility in each of the two locations. If we are hoping to learn about the relationship between income and fertility by looking at cross-sectional evidence, it is necessary to restrict comparisons to families that live in locations are reasonably similar in housing prices (as we do in the results given in Table 3).[13]

1.3. **Implication for Empirical Evaluation of the Impact of Income on Fertility.** The basic patterns of fertility we outline in Tables 3 and 4 are consistent with the idea that husbands' income has a positive impact on fertility, as in our model above, but that evidence does not settle the issue of causality.

Suppose family size is independent of income; variation in fertility might be due to heterogeneous preferences, for example, or differences across couples in fecundity. Given expected family size, though, couples will typically choose where to live based on economic considerations. If families choose between an expensive high-amenity urban location and a less expensive low-amenity rural location, for example, it is likely that the relatively high cost of housing in the urban location is a greater deterrent to large families than to small families, and of course a greater deterrent to low-income families than high-income families.[14] As Figure 4 illustrates, when families sort along those lines (1) the high-amenity urban location disproportionately attracts high-income families,

[13] There are very large differences in housing prices across locations in the U.S. Of course, in a more general model, this same logic would lead us to worry also about locational differences in other prices, e.g., the price of education and wage rates.

[14] To our knowledge, this theoretical idea first appears in Blake's (1968) thoughtful discussion of fertility in early twentieth century Stockholm. Becker (1960) had cited evidence about the positive relationship between income and fertility in Stockholm, 1917–30. In response, Blake argues that the cross-sectional evidence in an urban area does not establish a causal relationship between income and fertility. As she states, "It seems most likely . . . that lower-income families who had more than a very small number of children would of necessity move out of Stockholm as the family grew, since they could not compete with upper-income families for scarce housing. Typically, those poor families would remain in the city when fertility was very low" (p. 11).

(2) average family size is smaller in the urban location than in the rural location, and (3) there is a positive correlation between income and family size in both locations. As we have seen, these are essentially the same predictions as in a model in which children are normal.[15]

Evidence from the cross-section, in short, cannot on its own be used to determine the causal impact of income on fertility. A more persuasive approach requires an exogenous shock to lifetime income—preferable a large shock that primarily affects men. In terms of our model, a permanent increase in the market wage, w, that pertains in one location—the rural location—would do. If our models pertains, the wage increase induces an increase in lifetime wealth. The impact on fertility is easy to find. Assume that the supply of housing in rural areas is perfectly elastic (land in rural areas might be close to free). Then for the rural location, the effect of the observed change in income, $y_i = w\theta_i$, on fertility comes from taking the derivative of (4):

$$(5) \qquad \frac{\partial c(\theta_i)}{\partial y_i} = \frac{\gamma}{p_R}.$$

In our set-up (5) also gives the relationship between c and y that one would observe in a cross-sectional sample of rural households.[16] However, given our discussion, we are comfortable making causal inference about relationship between y and c only from a localized income shock.

With these ideas in mind, we turn to our primary empirical contribution.

2. FERTILITY IN APPALACHIA: THE EFFECT OF THE COAL BOOM AND BUST 1970-1990

Our empirical work centers on the sharp run-up in the price of coal that occurred in early 1970s, the subsequent collapse in coal prices that followed in the early 1980s, and their effects. Our

[15]If sorting occurs, couples constrained to $c = 0$ would be particularly likely to live in expensive locations. Perhaps this explains why male gay couples, and childless heterosexual couples, disproportionately locate in expensive high-amenity cities like San Francisco. See Black, Gates, Sanders, and Taylor (2002).

[16]For an urban location with scarce land, it may be less plausible that the supply of housing is perfectly elastic; an increase in income shifts the demand for housing outward, raising the equilibrium price, p_U. Fertility would still increase in response to a positive income shock, but the equilibrium impact would be dampened by the increase in housing costs.

argument is that this exogenous shift caused a meaningful increase in lifetime income for men in the Appalachian coal-mining region, which allows us to identify an income effect on fertility.

2.1. **The Economic Environment.** During the 1970s a series of events, notably changes in U.S. regulatory policy and the subsequent 1974 oil embargo by the Organization of Petroleum Exporting Countries (OPEC), caused a massive increase in the real price of coal. In particular, after holding steady through most of the 1960s, the real price of coal (i.e., the ratio of the producer price index for bituminous coal to the consumer price index) rose significantly between 1969 and 1970 and then spiked dramatically, increasing by 44 percent, between 1973 and 1974. Prices stabilized for the remainder of the decade, at levels that were more than twice the 1960s level. Then the relative price of coal declined throughout the 1980s, with rapid declines occurring after 1983. By 1990 the price of coal was approximately the same as it had been in 1970.

As illustrated in Figure 5, in certain counties of Kentucky, Ohio, Pennsylvania, and West Virginia there are massive coal reserves. In many of these counties coal production plays an important role in the local economy. For instance, in 32 counties in this four-state region, more than 10 percent of total earnings were derived directly from the coal industry in 1969. In these counties the median fraction of earnings from the coal industry was 25.3 percent (the mean was 30.4 percent). Not surprisingly, in these 32 counties, there were dramatic effects on industry employment and wages owing to the massive coal-price swings. Table 4 provides a summary for the 32 counties (relative to other counties). We can divide the 1970s and 1980s into three periods: 1970 through 1977 was a boom period, with both employment and earnings per worker increasing rapidly in the coal-mining industry. Employment and earnings in mining were robust, and reasonably stable, during the peak period 1978 through 1982. Then employment and earnings declined substantially during the bust period of1983 through 1989. Figure 6 shows trends in coal prices and documents the dramatic spike in employment in coal mining.

It appears that the labor market impact of the coal boom and bust extended beyond the mining industry in these counties; there were very modest spillovers to other sectors. Black, McKinnish, and Sanders (2005) estimate that, during the coal boom, in the 32 counties, two jobs were created in construction, retail and services for every ten jobs created in the mining industry. Conversely, during the bust approximately 3.5 jobs were lost in construction, retail and services for every 10 jobs lost in mining.[17]

In short, the changes in world energy prices created a remarkable sustained period of economic prosperity in the Appalachian coal-mining region. Because mining is a heavily male occupation, this prosperity had an especially large impact on men.

2.2. **Fertility over the Economic Cycle: Evidence from Natality Files.** Our starting point is to ask a simple question for the four-state region under examination: Are observed year-to-year changes in fertility correlated with economic activity?

Our examination of the temporal association between fertility and the business cycle follows a long tradition in statistical demography. Yule (1906), for example, shows a pro-cyclical fertility pattern for nineteenth century England and Wales, a relationship that was driven in part by a pro-cyclical relationship between favorable economic circumstances and rates of marriage—and then subsequent fertility. As a second example, Galbraith and Thomas (1941) find a positive association between fertility and economic activity in the early twentieth century U.S. They show that this relationship holds not only for first births, as one would expect if the relationship were being driven by changes in the marriage rate, but also by higher-order births (e.g., third and fourth births).[18]

[17]The boom and subsequent bust appear to have had little impact on employment in manufacturing; there was no evidence that the coal boom crowded out "export sector" jobs in the local economies.

[18]Silver (1965) gives additional evidence for the U.S., using data over a longer time span.

Ben-Porath (1973) provides evidence showing fertility was pro-cyclical in Israel over the 1950–1970 period and gives a nice discussion of the economic forces that would lead to such a cyclical response. As Ben-Porath argues, the role of aggregate business activity on fertility, while "somewhat fuzzy," likely includes at least three elements: first, an economic boom or bust will typically be of uncertain duration and severity and may in some cases be taken by families as having a meaningful effect on lifetime income. As Ben-Porath notes, an economic dip can have permanent effects because "children constitute an irreversible commitment of expenditure over a fairly long period; if the depression lingers, causing a revision in the desired number of children, there will be no way back" (p. 186). Second, if households are liquidity constrained, in general there will be a stronger temporal relationship between income and current consumption, and this tie could extend to the timing of births. Third, though, to the extent that couples believe that they can time their births in relation to economic fluctuations, couples might want to have babies *during* recessions, when the opportunity cost of the mother's time is relatively low.

We are particularly interested in the fluctuations in economic activity caused by the coal boom, because these changes were large and sustained over the period we study. In coal-rich counties these swings in economic activity would be more likely than other fluctuations to be viewed as having an impact on permanent income. Also, economic activity associated with the coal boom had particularly large effects on men's income, not women's income, and therefore had a relatively smaller impact on the opportunity cost of women's time.

Table 5 presents regression results concerning county-level fertility in West Virginia, Kentucky, and Pennsylvania, using data from 1969 through 1988. Using county-level measures of fertility, based on the Detail Natality Files, our basic regression has changes in county-level birth rates as a dependent variable and as an independent variable the lagged value of difference in county-level log earnings, as well as a full complement of state-year fixed effects intended to pick up secular trends in birthrates. The practice of using lagged values for economic activity stems back to Yule (1906) and Galbraith and Thomas (1941), who typically use lags of two to three years on economic variables.[19]

Consider first the upper panel of Table 5. Column (1) shows that fertility is mildly pro-cyclical, as in previous literature. A 10 percent increase in earnings is associated with a 1 percent increase in births in the following year. It is not completely clear how one should interpret these findings. If improved economic conditions improve wages for women, income might increase but so too does the opportunity cost of children, and in any event such fluctuations are likely viewed as temporary.

Column (2) is intended to capture the contemporaneous effects of economic activity on fertility associated specifically with the coal economy. In particular, for each county for each year we calculate the value of that county's coal reserves. We then form an instrument that is equal to the change in this variable, lagged by one year.[20] The idea is to look at the effects of large, exogenous changes in earnings that apply primarily to men—shocks that might reasonably be taken to increase lifetime income. We find the contemporaneous impact of such coal-related fluctuations in income to be much larger than the effects of economic activity generally; a 10 percent increase in income associated with the coal boom results in a 7 percent increase in birth rates.

The lower panel of Table 5 repeats our analysis but focuses on higher-order births. The effect of economic activity is, not surprisingly, somewhat lower than on birth rates generally, but the general

[19]Ohio is excluded in the analysis presented in Table 5 because of a lack of consistent data on marital status over the period of study. (We also looked at total fertility rates, including Ohio for that analysis, and results are very similar.) The construction of county-level fertility rates entails the use of imprecise inter-censual county population estimates. Thus, as an alternative, we estimated our regressions using birth counts (instead of rates) in our regressions. Qualitative results were little changed.

In our analysis of Census data below, we take care to compare fertility in coal counties to non-coal counties with characteristics that are similar to the coal counties (e.g., smaller rural counties). When we replicate Table 5 using those same sample restrictions, estimates are qualitatively very similar to those reported.

[20]The additional lag here reflects the fact that it takes a year or longer for mining firms to expand production in response to changes in the market.

pattern is the same. A 10 percent increase in income due to the coal boom results in a 5 percent increase in birth rates.

Hotz, Klerman, and Willis (1997), in their review of preliminary findings similar to those in Table 5 (included in unpublished work by Black, Sanders, and Daniel, 1996, on the impact of economic growth on the poor), raised two important issues with regard to interpretation. They suggest, "First, since they are using year-to-year variation in market prices and technology over a relatively short period of time (under two decades), there is ambiguity as to whether these effects are due to timing or whether they will lead to differences in completed family size. . . . Second, there appears to be considerable in-migration in response to coal booms. . . . Migration may be correlated with unobserved taste variation for fertility. If so, then fertility rates by place of occurrence will be correlated with exogenous shifts in world prices and technology. In that case, these variables are not valid instruments."

The first argument is indeed a concern. Ideally, one would like to provide one group of families with an income shock, such as the coal boom, and then provide these families with similar environments thereafter to ascertain the impact of the sustained shock to income. Unfortunately, the coal bust followed on the heels of the boom, making inference difficult. At a minimum, additional analysis is required that looks at the impact on the *timing* of births (age-specific fertility rates), and, to the extent possible, *completed fertility* at the cohort level. We turn such analysis in the following two sub-sections.

As for migration, with our Census data we cannot perfectly identify people who moved in response to the coal boom. We can, however, provide some evidence using the 1980 Census. In particular, with the public-use data, we can identify "new resident" women in our counties, defined as women who lived in different county in 1975. When we compare such women in high-coal and low-coal counties, we find that women aged 18–24 and aged 25–34 residing in coal areas were *less* likely to be new residents than their counterparts in non-coal areas (and even these differences are small enough that they are not statistically significant). In short, it does *not* seem likely that there was an especially large influx of young women into high-coal counties, though, of course, this does not rule out the possibility of some selective net migration.[21]

One final point merits serious consideration. As we note above, there were some spillovers into the non-coal sectors associated with the coal boom and bust. Such spillovers could affect women's wages. Black, McKinish, and Sanders (2005), however, report that there was limited spillover into other sectors. For instance, they report that among men, who as potential miners should have been affected more than women, mining earnings grew between 1970 and 1980 at a rate of 0.273 log points, but non-mining earnings grew at only 0.058 log points. More importantly, Black, McKinnish and Sanders (2003) report that female employment in large coal counties actually declined between 1970 and 1980 relative to the growth in non-coal counties. Thus, any substitution effect toward employment for women induced by spillover effects appears to have been dominated by income effects.

In sum, the coal boom appears to have had a large positive impact on fertility; changes in income associated with the coal boom—income increases that are large, sustained, and focused primarily toward men—led to substantial temporal increases in fertility. We next analyze Census data to ask how these fluctuations affect cohort-level *timing* of fertility and to see whether there are discernable effects on *completed* fertility.

2.3. **Evidence on the Timing of Births for the 1946 Birth Cohorts.** As is well known, there have been large sustained swings in U.S. fertility over the past 60 years. Our goal here is to look

[21]Note that we cannot identify out-migrants. Nor can we rule out the possibility that in-migrants have systematically different tastes than other women in the counties to which they migrated.

for an effect of the coal boom independent of these secular trends, and to do so in a way that shows how the boom affected age-specific fertility rates (ASFRs) for affected women—women in coal counties—in comparison to other women in their same cohorts.

Unfortunately, Census data do not allow us to construct the age-specific fertility rates directly. For some specific cohorts, though, we can form a reasonable approximation as follows. Consider a woman age 34 in a Census year (e.g., a women born in 1946 who appears in the 1980 Census). Suppose the following assumptions pertain: (a) she did not give birth before she reached age 17, (b) none of her children died or left home before they reached age 17, and (c) she had no children after age 34. Then we can construct her complete fertility history by looking at the ages of the children in the household. In turn we can construct cohort ASFRs for ages 17 through 34 by accumulating such evidence for all women in a given cohort. Of course, our assumptions won't hold for all women, but this method does provide a consistent way of looking at fertility across different groups of women. We undertake this exercise for women who live in counties with high concentrations of coal and women who live in reasonably similar counties that have relatively little coal. For this analysis we omit counties that have a moderate level of coal mining.[22]

Figure 7 shows our findings. To set the stage, we provide, in the first panel, ASFRs as of age 34 for women born in 1936 (using 1970 Census data), separately for women in coal counties and non-coal counties in the four-state region. The ASFRs at ages 17–34 are very similar for these two groups of women. The second panel then shows ASFRs up to age 34 for women born in 1946 (using 1980 data). Again, these are calculated separately for women in coal counties and non-coal counties. Women in the 1946 cohort were age 24 in 1970, at the beginning of the coal boom, and

[22]The "treatment counties," i.e., those with substantial coal deposits, are largely rural counties with populations in 1970 ranging from approximately 9,000 to 212,000, so we limited our "comparison counties" to relatively rural counties, with populations ranging from approximately 8,000 to 225,000. A list of counties, a map showing all counties, and additional details of the sample are in Black, McKinnish, and Sanders (2005).

were age 26 in 1972 when the effects would be first seen in fertility rates (assuming a two-year lag). Notice that at precisely that age a divergence appears in the ASFR patterns for these two groups of women. At every age, 27 through 34, women in coal counties have higher cohort-specific fertility rates than women in the non-coal counties.

For the 1946 cohort, the accumulated differences in fertility between coal and non-coal counties during the coal boom were substantial enough to have an effect on completed fertility through age 34 of approximately 1/5 of a child per woman.[23]

2.4. **Evidence using Cohort-Specific Data on Children Ever Born (CEB) for Coal and Non-Coal Counties.** A disadvantage of the analysis presented in the previous section is that it exploits data from two cohorts only. Also, because of data limitations we can look at ASFRs only up to age 34 (i.e., we're are unable to study completed fertility as some births occur to women in the later 30s and 40s).

We can undertake an additional analysis, focusing on cohort-level CEB for all women in birth cohorts 1935 through 1960. The first problem for this empirical work is constructing a CEB measure for each cohort. Given that very little fertility occurs after age 40, we can get CEB for the 1935–1950 cohorts by simply using the CEB measure in the 1990 Census. Since CEB was not collected in the 2000 Census, we use a different approach. For each birth cohort of women 1951 through 1960, we can make "synthetic cohort" estimates, calculating the average CEB as of the 1990 Census and then using the 2000 Census to calculate the number of children in the household aged 0 through 10. Adding these two numbers for each cohort should give a reasonably good cohort-specific measure of CEB. We undertake this exercise for each of the 36 cohorts under study for each coal county and each non-coal county in our four-state region.

[23] In particular, the differences in fertility rates at ages 26 through 34, respectively, were 0.016, 0.025, 0.011, 0.031, 0.037, 0.020, 0.025, 0.013, and 0.003, for a total accumulated impact of 0.181.

Results are presented in Table 6. Consider the differences in CEB in the high-coal counties (the "treatment group") relative to the non-coal counties (the "control group") for women in birth cohorts 1940 through 1949. These statistics are in bold type in the third column of the table. Women in the 1940 cohort were aged 30 in 1970 at the very beginning of the coal boom and were aged 32 or 33 at a point at which it likely became apparent that the boom would be sustained. We notice that unlike the 1935–39 cohorts, women in the "treatment" high-coal counties have higher fertility than in the "control" non-coal counties. With one exception (the 1943 cohort), we notice that the same is true for each cohort through the 1949 cohort. Women in this later cohort would have been aged 34 in 1983 at the beginning of the coal bust, i.e., would have been old enough that there was little remaining chance to adjust final fertility downward. For each remaining cohort in our data—women aged 33 or younger at the beginning of the coal bust—CEB is lower in the high-coal counties than in the non-coal counties.[24]

Figure 8 illustrates. We graph the difference in CEB between the high-coal and non-coal counties, using a simple three-year moving average to smooth the series. For cohorts of women who were in their 30s during the coal boom, CEB is relatively high in coal-rich counties (in comparison with women in non-coal counties). Similarly, among women who were in the their 30s during the coal bust, CEB is relatively low in coal-rich counties. We might infer from Figure 8 a differences-in-differences estimate as follows: The boom cohorts (roughly the 1940–49 cohorts) had completed fertility that was on the order of 0.10 greater than the bust cohorts (roughly the 1950-59 cohorts), which amounts to an increase in lifetime fertility of approximately 3 percent. From Table 4 we notice similarly a differences-in-differences boom-to-bust effect of 6 percent on

[24]We do not report standard errors in Table 6, as they are very small, owing to large samples afforded by restricted-use samples of the U.S. Census. (Standard errors are in the neighborhood of 0.01–0.04.) As for statistical significance of the *differences,* note that for the 21 coefficients we estimate for the 1940 through 1960 cohorts, all but one are as predicted (positive during the coal boom and negative during the bust)—a pattern that is exceedingly unlikely if these coefficients were independent draws from a distribution with mean 0.

per worker earnings. It might be tempting therefore to assign an income elasticity of roughly 0.5. However, we cannot know the extent to which successive cohorts of individuals viewed temporal earnings changes as permanent, so this would be highly speculative.

In any event, evidence from (1) contemporaneous county-level birth records, (2) age-specific fertility patterns of affected cohorts, and (3) completed fertility (CEB) for a succession of cohorts all lead to the same conclusion: Income increases resulting from the coal boom appear to induce higher levels of fertility.

3. Concluding Remarks

Are children “normal”?

In her critique of the neoclassical theory of fertility, Blake (1968) lays out the issues clearly. She argues that the positive expected relationship between income and desired family size is a key testable prediction of the economic approach to fertility—a prediction that appears to be largely counter-factual. And she argues persuasively that where there is a positive cross-sectional association between income and fertility in specific populations, this alone cannot be taken as a causal relationship between income and fertility.

Our reading of the literature on the relationship between income and fertility suggests that only moderate progress has been made on this empirical question in the 40 years since Blake’s critique. Thus the motivation for the work presented above.

The starting point of our analysis is cross-sectional evidence from the late 20th century U.S. One innovation is to carefully control for the price of housing in the locations where women live, and when we do so we find that married couples who live in expensive locations generally have smaller families. Then we show that within location children are increasing in husbands’ income. Still, as Blake notes, that evidence cannot conclusively answer our paper’s motivating question.

As a means of potentially identifying causal effects, we examine the impact of the large increase in economic activity in Appalachian coal-mining counties that occurred during the coal boom of the 1970s. The shock caused a large and sustained increase in men's wages and thus to lifetime income. In turn, we find, fertility increased substantially in coal-rich counties relative to comparison counties. At least for the population we study, evidence suggests that fertility among married couples is increasing in men's income.

APPENDIX. DATA DESCRIPTION

A. Public Census Data. Some Census data for this paper are taken from IPUMS for the 1990 Census. The IPUMS represents an integrated data set of the Public Use Micro Samples (PUMS); see Ruggles, Sobek, Alexander, Fitch, Goeken, Hall, King, and Ronnander (2004) for details. Because Hispanics, Asians, and African Americans represent relatively small subsets of the American population, we focus on white non-Hispanic individuals.

The Census provides challenges for researchers because of item non-response on the long-form data. Respondents will occasionally not answer questions about age, race, ethnicity, or education level and will much more frequently not answer questions about hours worked or wage and salaries earnings. Our approach is to drop respondents who do not answer questions about their age, race, Hispanic status, or education.[25] (While this comprises a modest proportion of respondents, attempting to assign them a counterfactual is problematic.)

B. Data on the Coal Boom and Bust. Data on county earnings and population are taken from the Bureau of Economic Analysis's Regional Economic Information System; data are available from 1969 to 2000. Data on the number of births are taken from the *Vital Statistics*. These data are available from 1968 to 1988 (when the Center for Disease Control removed county identifiers from the smaller counties). Data on the real price of coal is the BLS producer price index for coal divided by the consumer price index. Data on coal endowments, and classification into coal and non-coal counties, are described in detail in Black, Daniel, and Sanders (2002).

C. Census Long-Form Data. For some analysis we use the Census complete long-form data from the 1960 to 2000 Censuses. While the PUMS represents a large sample of the long-form data, the

[25] The measurement of education in the Census presents some problems (see Black, Sanders, and Taylor, 2003), so our practice of aggregating women by reported education unavoidably results in a fair amount of heterogeneity within each educational group we form.

complete long-form data represents much larger samples (generally, one in six), which greatly improves the precision of estimates from small areas. These data are available only in Census Research Centers. We thank Todd Gardner of the U.S. Census Bureau for his effort on our behalf for securing the early years of the long-form data.

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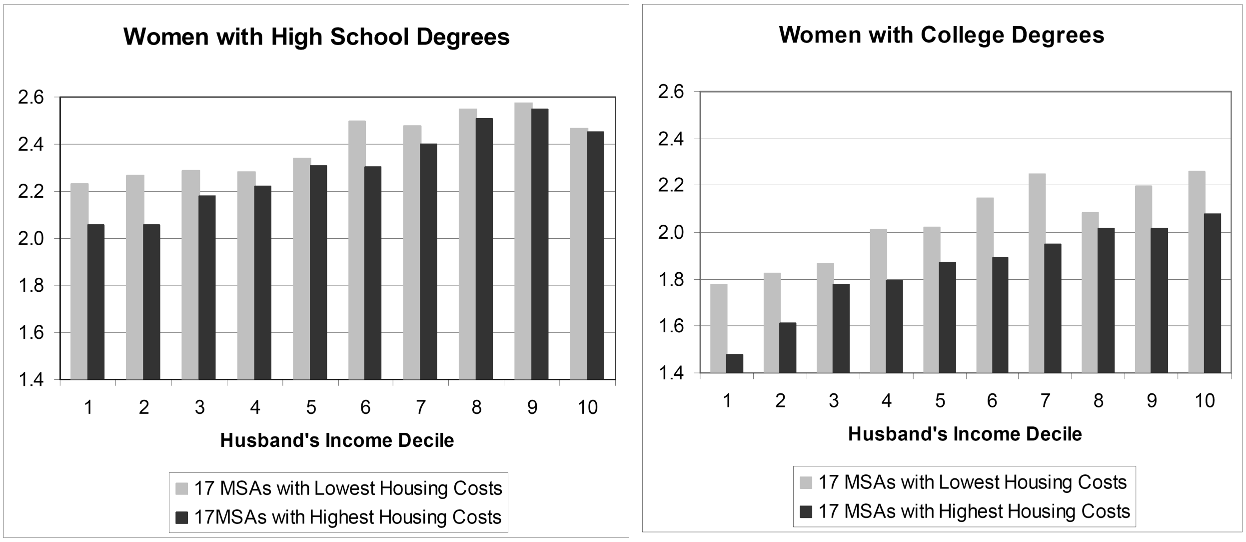
FIGURE 1. Children Ever Born for Couples in Expensive and Inexpensive MSAs, by Husband's Income



Source: Authors' calculations, PUMS from the 1990 Census.

FIGURE 2. Indirect Utility in Urban and Rural Locations

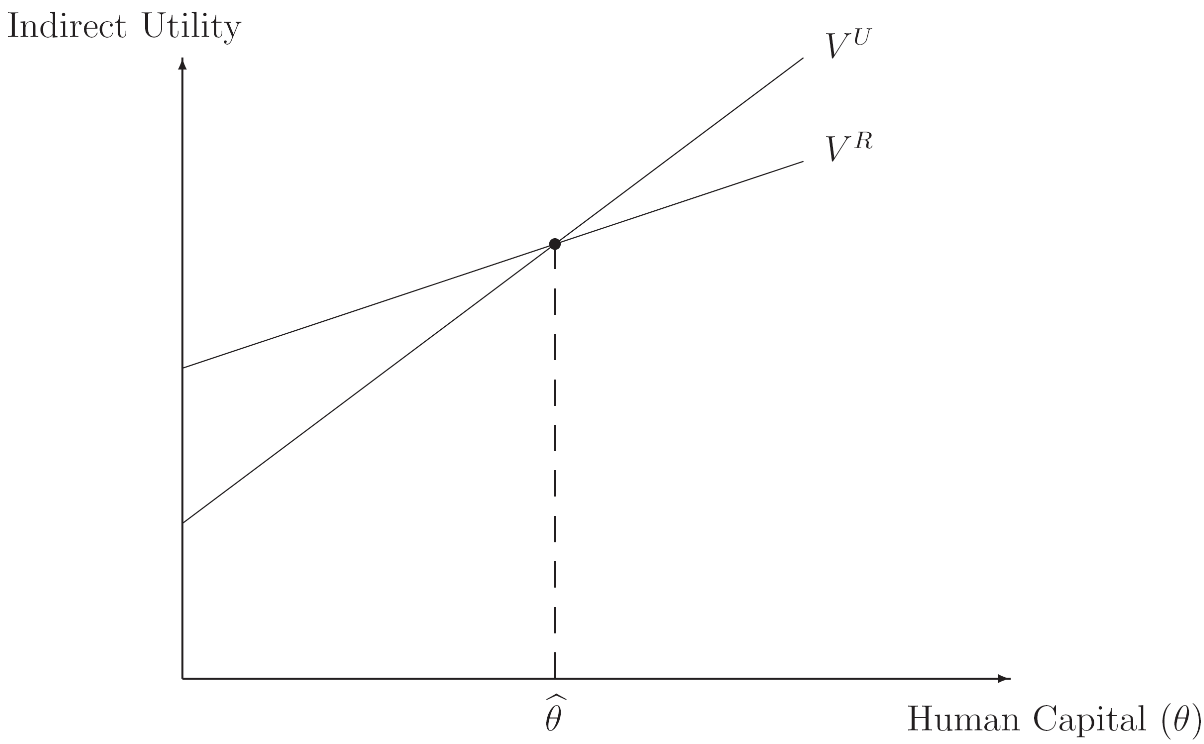


FIGURE 3. Income and the Demand for Children

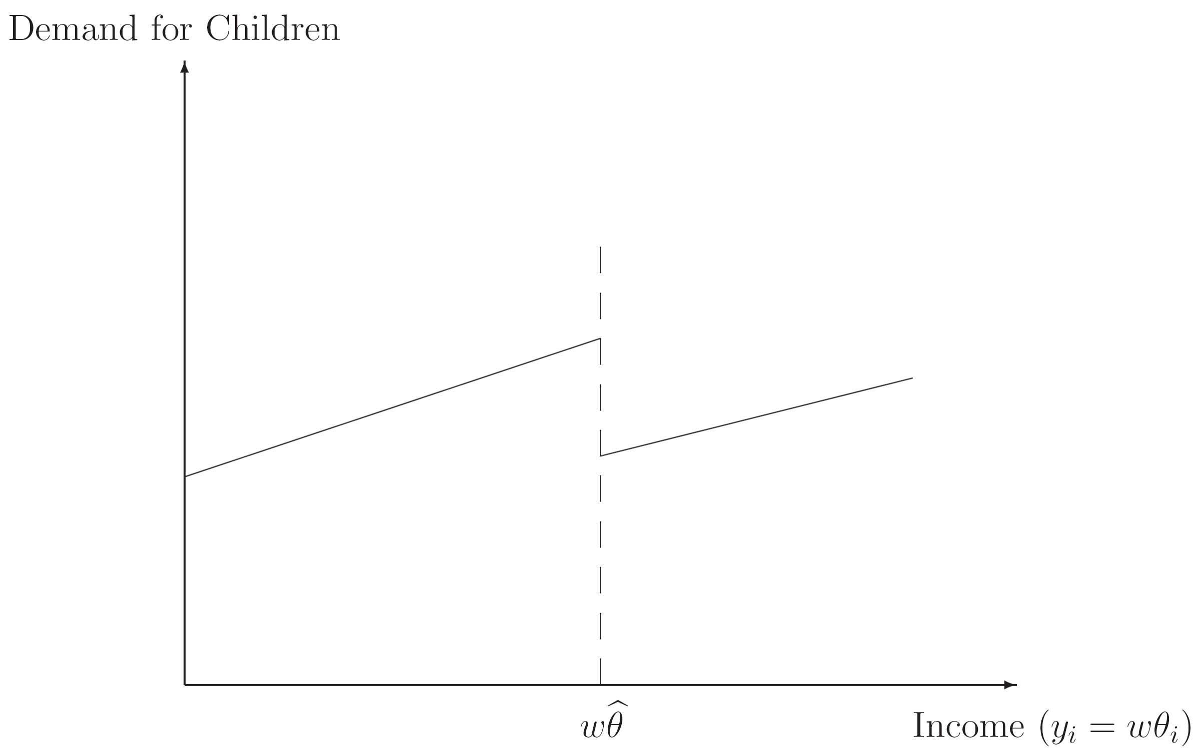


FIGURE 4. Sorting by Income and Family Size

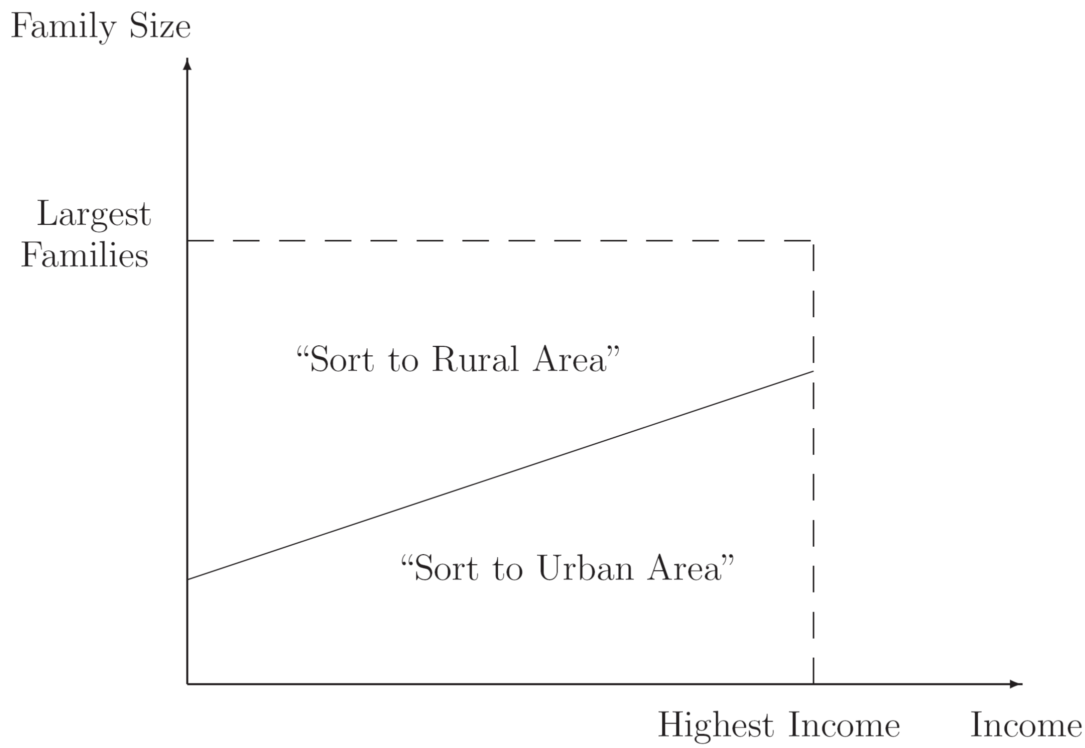
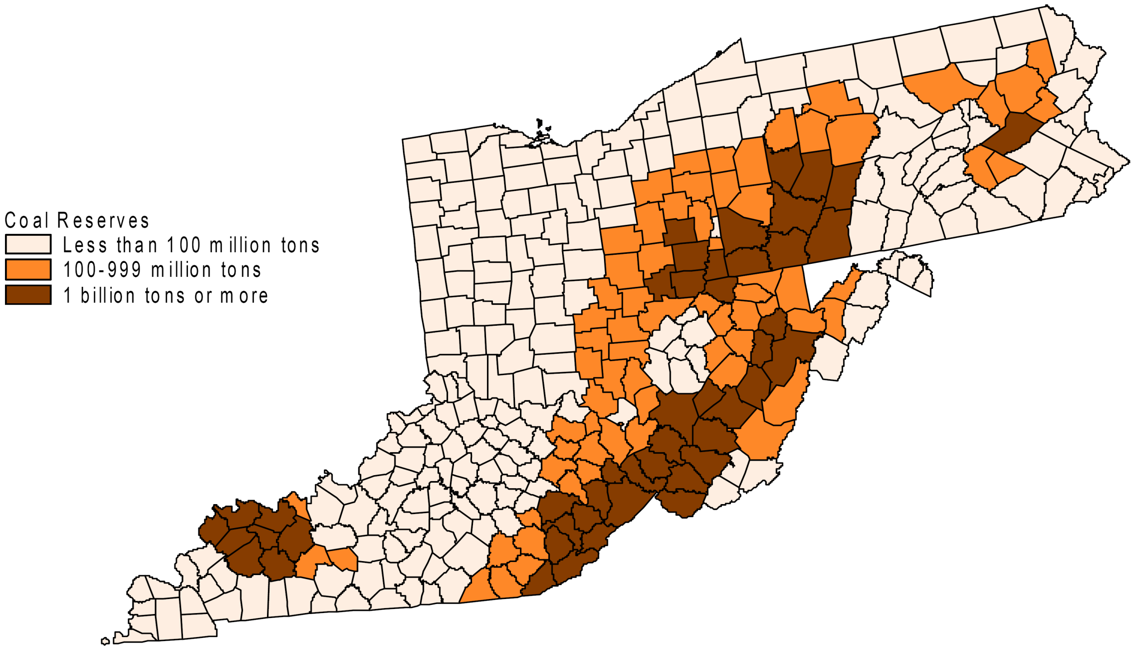
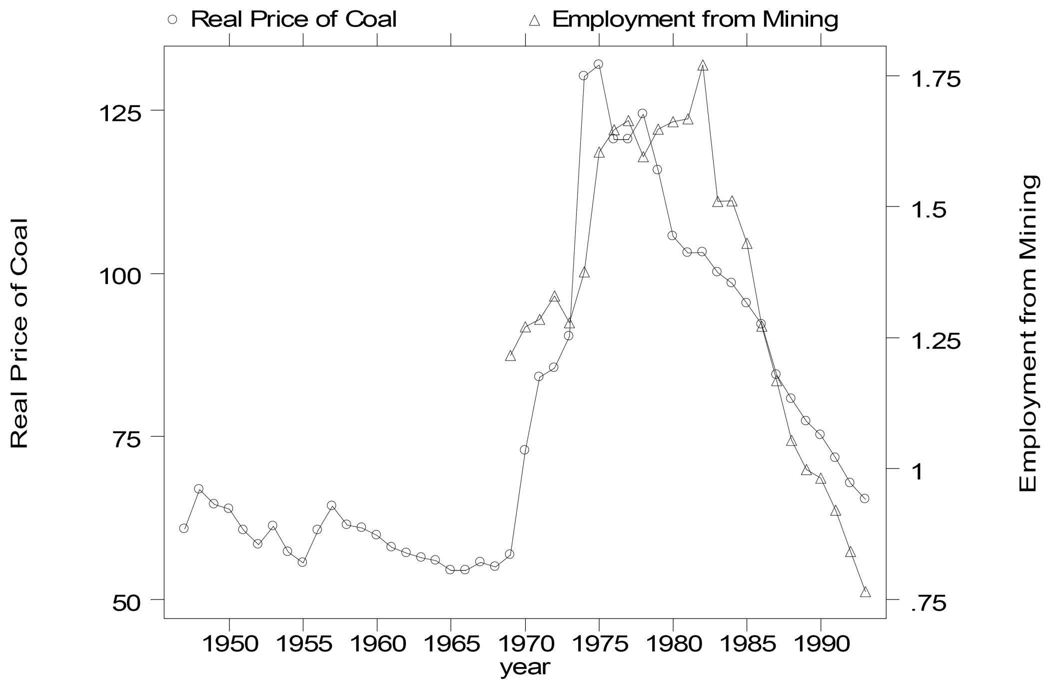


FIGURE 5. Coal Reserves in Ohio, Pennsylvania, Kentucky, and W. Virginia



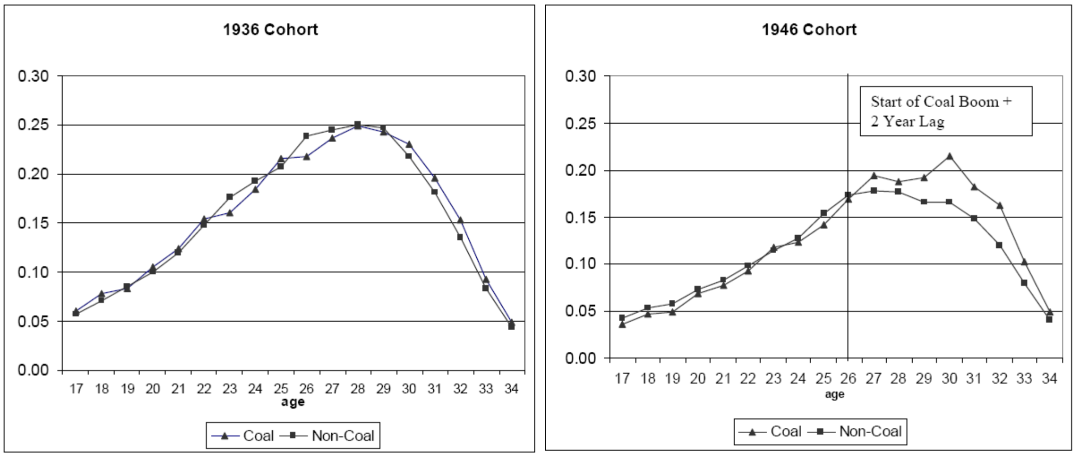
Source: Black, Daniel, and Sanders (2002).

FIGURE 6. Price of Coal and Employment from Mining



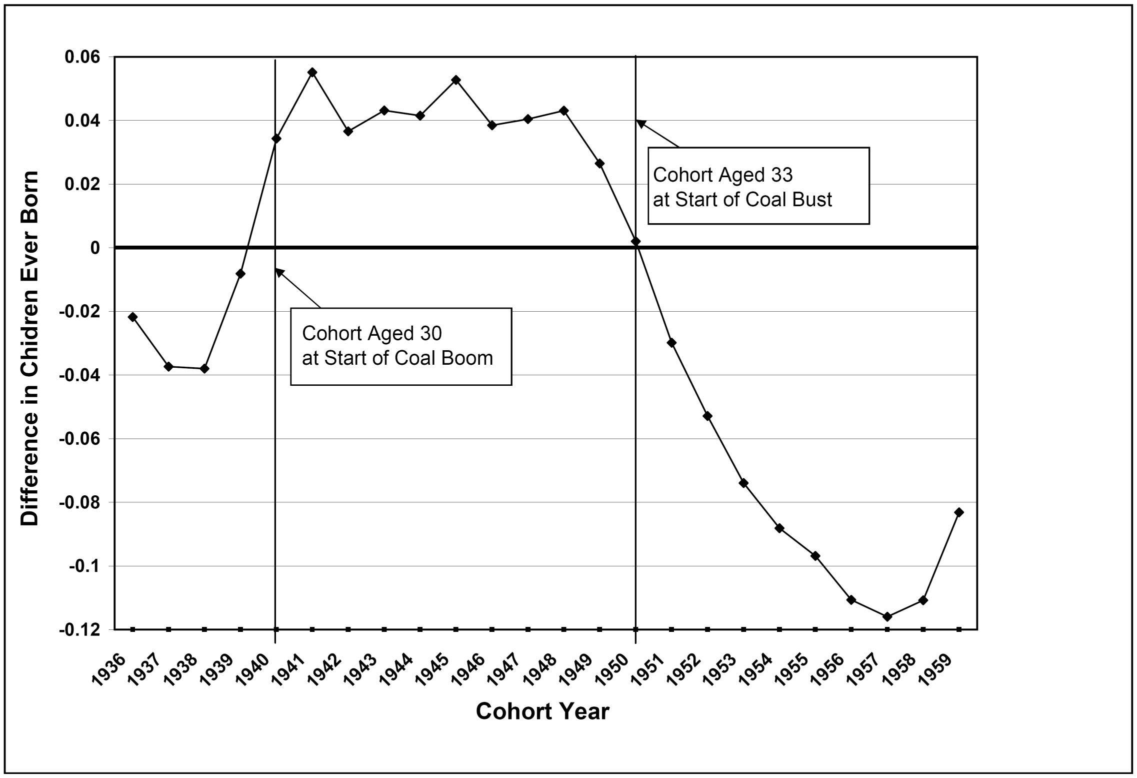
Source: Black, Daniel, and Sanders (2002).

FIGURE 7. Age-Specific Fertility Rates for Women Born in 1936 and 1946



Source: Authors' calculation, Census long-form data from the 1960 to 2000 Censuses.

FIGURE 8. Differences in Average Number of Children Ever Born Between Treatment and Comparison Counties, by Cohort Year



Source: Authors' calculation, Census long-form data from the 1960 to 2000 Censuses.

TABLE 1. Descriptive Statistics, Children Ever Born, Women Aged 40-50 in 1990

By Household Income:		
	Lowest Quartile	2.51
	Second Quartile	2.32
	Third Quartile	2.25
	Highest Quartile	2.16
By Husband's Income:		
	Lowest Quartile	2.32
	Second Quartile	2.27
	Third Quartile	2.29
	Highest Quartile	2.34
By Mother's Education:		
	High School Degree or Less	2.54
	Some College or College Degree	2.17
	Advanced Degree	1.75
By Location:		
	Rural	2.47
	Urban, other than 50 Largest MSAs	2.29
	Largest 50 MSAs	2.19
By Age Group:		
	Born 1945-50 (now aged 40-45)	2.15
	Born 1940-45 (now aged 46-50)	2.54

Source: Authors' calculations, PUMS, 1990 Census.

TABLE 2. Children Ever Born to Women Aged 40 to 50 in 1990

	all women	less than HS	exactly HS	some college	exactly BA	above BA
ln(Hus. Inc.)	-0.028	-0.059	0.062	0.058	0.132	0.147
	(0.003)	(0.010)	(0.005)	(0.005)	(0.006)	(0.008)
Implied elasticity	*-0.07*	*-0.17*	*0.15*	*0.13*	*0.27*	*0.26*
Cohort FE?	yes	yes	yes	yes	yes	yes
N	422,427	50,101	154,582	121,114	59,704	36,926
R^2	0.027	0.020	0.025	0.023	0.019	0.022

Note: Authors' calculations, PUMS, 1990 Census. Huber-Eicker-White robust standard errors reported in parentheses. The sample consists of non-Hispanic white married women aged 40 to 50 years with non-imputed data.

TABLE 3. Panel A. Children Ever Born to Women Aged 40 to 50 in 1990, 50 Large MSAs

	all women		less than HS		exactly HS		some college		exactly BA		above BA	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
ln(Hus. Inc.)	0.081	0.082	0.035	0.036	0.160	0.163	0.138	0.138	0.200	0.199	0.216	0.220
	(0.005)	(0.005)	(0.020)	(0.020)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.012)	(0.012)
Implied Elasticity	*0.18*	*0.18*	*0.10*	*0.10*	*0.37*	*0.38*	*0.30*	*0.30*	*0.39*	*0.39*	*0.37*	*0.37*
Housing Cost		-0.049		-0.053		-0.023		-0.039		-0.046		-0.042
x1,000		(0.002)		(0.007)		(0.003)		(0.003)		(0.004)		(0.004)
Cohort FE?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
MSA FE?	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
N	137,061	137,061	12,361	12,361	43,823	43,823	41,967	41,967	23,783	23,783	15,127	15,127
R^2	0.028	0.033	0.021	0.024	0.031	0.032	0.027	0.030	0.029	0.035	0.036	0.041

Note: Authors' calculations, PUMS, 1990 Census. Huber-Eicker-White robust standard errors reported in parentheses. The sample consists of non-Hispanic white married women aged 40 to 50 years with non-imputed data.

TABLE 3. Panel B. Children Ever Born to Women Aged 40 to 50 in 1990, All MSAs Except 50 Largest

	all women		less than HS		exactly HS		some college		exactly BA		above BA	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
ln(Hus. Inc.)	0.061	0.064	-0.001	0.010	0.141	0.147	0.120	0.120	0.196	0.204	0.190	0.197
	(0.006)	(0.006)	(0.020)	(0.020)	(0.010)	(0.010)	(0.001)	(0.011)	(0.012)	(0.012)	(0.016)	(0.016)
Implied Elasticity	*0.14*	*0.15*	*0.00*	*0.03*	*0.34*	*0.35*	*0.27*	*0.27*	*0.40*	*0.41*	*0.34*	*0.35*
Housing Cost		-0.042		-0.055		-0.034		-0.030		-0.037		-0.027
x1,000		(0.001)		(0.006)		(0.002)		(0.002)		(0.003)		(0.004)
Cohort FE?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
MSA FE?	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
N	122,033	122,033	12,843	12,843	42,710	42,710	36,654	36,654	18,398	18,398	11,428	11,428
R^2	0.026	0.034	0.017	0.023	0.028	0.032	0.028	0.032	0.027	0.033	0.023	0.026

Note: Authors' calculations, PUMS, 1990 Census. Huber-Eicker-White robust standard errors reported in parentheses. The sample consists of non-Hispanic white married women aged 40 to 50 years with non-imputed data.

TABLE 4. Growth in Employment, Earnings and Earnings per Worker: Difference between High-Coal and Non-Coal Counties, 1970–89

Average Annual Growth in:	Difference between Coal (“Treatment”) and Non-Coal (“Comparison”) Counties
Total Employment	
Boom, 1970–77	0.020 (0.004)
Peak, 1978–82	-0.001 (0.004)
Bust, 1983–89	-0.027 (0.004)
Total Earnings	
Boom, 1970–77	0.050 (0.007)
Peak, 1978–82	0.005 (0.007)
Bust, 1983–89	-0.055 (0.006)
Earnings per Worker	
Boom, 1970–77	0.030 (0.004)
Peak, 1978–82	0.005 (0.004)
Bust, 1983–89	-0.028 (0.004)

Source: Black, McKinish, and Sanders (2005).

TABLE 5. Changes in County-Level Marital Fertility Rates

Births	**OLS**	**IV**
	(1)	(2)
The lagged value of differences in the log of earnings in county	0.120 (0.0281)	0.745 (0.1249)
State-year fixed effects	Yes	Yes
Instruments:		
Value of coal reserves lagged one and two periods	No	Yes
First-stage F-stat for instruments	—	59
N	4,356	4,356
Higher Ordered Births	**OLS**	**IV**
The lagged value of differences in the log of earnings in county	0.068 (0.0373)	0.464 (0.2166)
State-year fixed effects	Yes	Yes
Instruments:		
Value of coal reserves lagged one and two periods	No	Yes
First-stage F-stat for instruments	—	59
N	4,356	4,356

Sources: Authors' calculations from data in *Vital Statistics* micro records from 1969 to 1988, BEA's Regional Economic Information System, and coal reserves data described in Black, Daniel, and Sanders (2003). The dependent variable is the year-to-year change in the log of *marital births divided by county population,* and the explanatory variable is the change in the log of the county's *total earnings*.

Note: Huber-Eicker-White standard errors (clustered on county) reported in parentheses. The sample consists of births to married women in Kentucky, Pennsylvania, and West Virginia; Ohio is excluded because marital status of mother is not reported in early years. Model is estimated in first-difference form.

TABLE 6. Cohort CEB for Non-Coal and High-Coal Counties

Cohort Year	**Counties with No Coal**	**High-Coal Counties**	**Difference High-Coal minus No Coal**
1935	4.120	4.097	-0.023
1936	4.041	4.040	0.000
1937	3.992	3.950	-0.042
1938	3.965	3.896	-0.070
1939	3.876	3.874	-0.002
1940	3.836	3.883	**0.047**
1941	3.702	3.759	**0.058**
1942	3.614	3.674	**0.060**
1943	3.518	3.510	**-0.008**
1944	3.440	3.518	**0.078**
1945	3.378	3.433	**0.055**
1946	3.271	3.296	**0.025**
1947	3.187	3.222	**0.035**
1948	3.155	3.216	**0.061**
1949	3.123	3.156	**0.033**
1950	3.083	3.068	-0.015
1951	3.175	3.163	-0.013
1952	3.184	3.122	-0.062
1953	3.186	3.102	-0.084
1954	3.200	3.124	-0.076
1955	3.191	3.086	-0.105
1956	3.205	3.095	-0.110
1957	3.217	3.100	-0.117
1958	3.203	3.082	-0.121
1959	3.218	3.124	-0.094
1960	3.173	3.139	-0.034

Source: Authors' calculations, Census long-form data from 1960 to 2000 Censuses. We calculate cohort-level CEB (children ever born) for all women in birth cohorts 1935 through 1960 as follows: (1) for the 1935–1950 cohorts we use the CEB measure in the 1990 Census; (2)for each of the 1951–1960 birth cohort we make "synthetic cohort" estimates, calculating the average CEB as of the 1990 Census and then using the 2000 Census to calculate the number of children in the household aged 0 through 10. We undertake this exercise for each of the 36 cohorts for each coal county and each non-coal county in our four-state region. The differences in CEB in the high-coal counties and the non-coal counties for women in birth cohorts 1940 through 1949 are in bold type. Women in the 1940 cohort were aged 30 in 1970 at the very beginning of the coal boom. Women in the 1949 cohort were aged 34 in 1983 at the beginning of the coal bust.