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13 Trading Quantity for Quality

Explaining the Decline in American Fertility in the Nineteenth Century

Jenny Bourne Wahl

> The economic transformation [that accompanied the industrial revolution] coincided with—and in part caused—a change in the quality of family life as well as the quantity of children. As the family became less an economic unit it ripened into a covenant of love and nurturance of children. . . . Families became more child-centered. . . . And as parents lavished more love on their children, they had fewer of them and devoted more resources to [them]. . . . This helps explain the . . . decline of the birth rate . . . in the nineteenth century.
>
> James McPherson, *Battle Cry of Freedom*[1]

The fertility of Americans fell throughout the nineteenth century, beginning in the northeastern states. Economic historians have attempted to explain these patterns with microeconomic models, but they have had to rely on aggregate data, principally census records, for empirical testing. The character of the available data has circumscribed inquiry about the decline of fertility and has limited scholars to speculations rooted in broad macroeconomic movements in land and labor markets.

Civil War historian James McPherson suggests a different approach: families shrank as parents focused on the quality of home life. His comments parallel a model of fertility that Gary Becker, among others, pioneered to explain the negative correlation between the quantity and quality of children per family in both cross-sectional and time-series data for the twentieth century.[2] Can this quantity-quality model help us understand shrinking family size in nine-

The author acknowledges the helpful suggestions made by Claudia Goldin and Edward Wahl. Special thanks also go to Robert Fogel, Gary Becker, and Thomas Mroz.

1. James McPherson, *Battle Cry of Freedom* (New York, 1988), pp. 34–35.

2. See particularly Gary Becker and H. Gregg Lewis, "On the Interaction between Quantity and Quality of Children," *Journal of Political Economy*, 81 (Mar./Apr. 1973), pp. S279–88; and Gary Becker and Nigel Tomes, "Child Endowments and the Quantity and Quality of Children," *Journal of Political Economy*, 84 (Aug. 1976), pp. S143–62.

teenth-century America? I conclude here that it can. Decreased infant and child mortality, more available schooling, and the separation of home and work places increased the relative price of a child, encouraging parents to have fewer children and to spend more on each child. Empirical testing with a unique, intergenerationally linked, household-level data set collected from pre-twentieth-century sources bolsters this conclusion. The quantity-quality model, supported by microeconomic data, thus offers a fresh view on declining fertility in the United States before 1900.

13.1 Evidence of the Fertility Decline in America

Demographic evidence suggests that the size of American families fell persistently after 1800. Most studies of the fertility decline rely on statistics that do not distinguish marital fertility changes from variations in nuptiality, mortality, and the age structure of the population. Yasukichi Yasuba and Richard Easterlin, for instance, point to regional differences in the child-woman ratio for nineteenth-century cross-sectional data; Easterlin speculates that the fertility decline swept westward across America as the population moved away from the Atlantic coast.[3] Warren Thompson and P. K. Whelpton, and Ansley Coale and Melvin Zelnik, establish a decrease in the period total fertility rate through the century.[4]

In a 1986 paper, I analyzed shifts in marital fertility separately from other demographic shifts.[5] The major proximate determinants of decreased fertility before 1850 were increases over time in the proportion of women who never married, in the average marriage age, and in the mortality rate.[6] But after

3. The child-woman ratio is the ratio of the number of children in a given age group to every thousand women in a given age group. The numerator includes children ages 0 to 9 or ages 0 to 4; the denominator includes women ages 15 to 44, 15 to 49, 20 to 44, or 20 to 49. Easterlin further refines his child-woman ratio to include only the children had by married farm wives aged 30 to 39. See Yasukichi Yasuba, *Birth Rates of the White Population in the United States, 1800–1860* (Baltimore, 1962); and Richard Easterlin, "Population Change and Farm Settlement in the Northern United States," *Journal of Economic History*, 36 (Mar. 1976), pp. 45–75.

4. The period total fertility rate is the sum of age-specific fertility rates for women alive at a given time multiplied by the length of the interval over which each age-specific rate was calculated. An age-specific fertility rate equals the number of children born to women in a given age interval divided by the number of woman-years lived during the interval. The interval length is usually five years. See Warren Thompson and P. K. Whelpton, *Population Trends in the United States* (New York, 1933); and Ansley Coale and Melvin Zelnik, *New Estimates of Fertility and Population in the United States* (Princeton, 1963).

5. Jenny Wahl, "New Results on the Decline in Household Fertility in the United States from 1750 to 1900," in *Long-Term Factors in American Economic Growth*, Stanley Engerman and Robert Gallman, eds. (Chicago, 1986), pp. 391–438. A couple's fertility refers to their actual childbearing experience rather than to their potential to have children.

6. For evidence on mortality, see also Robert Fogel, "Nutrition and the Decline in Mortality Since 1700: Some Preliminary Findings," in *Long-Term Factors in American Economic Growth*, Stanley L. Engerman and Robert E. Gallman, eds. (Chicago, 1986), pp. 439–556. For a discussion of average marriage age, see Michael Haines and Barbara Anderson, "New Demographic History of the Late 19th-Century United States," *Explorations in Economic History*, 25 (Oct. 1988), pp. 341–65. For additional evidence on declining marital fertility and increasing marriage ages during this period, see Warren Sanderson, "New Interpretations of the Decline in the Fertility of White Women in the United States, 1800–1920" (manuscript, Stanford University, undated).

1850, married couples began to limit the number of children they had by ending their childbearing before the wife's menopause occurred. Married couples' control of their fertility began earliest in the northeastern United States. Evidence of contraception within marriage sets the stage for analyzing the determinants of a couple's demand for children and for deciphering the connection between household fertility decisions and the aggregate fertility decline.[7]

13.2 Explanations for the Decline in Fertility

In a series of papers, Becker and others consider decisions about the number and "quality" of children as jointly determined and interactive.[8] Most empirical analyses of the quantity-quality model have focused on cross-sectional relations of fertility and wealth, yet the model is useful for examining fertility behavior over time as well. Thus far, the testing ground for the quantity-quality model has been twentieth-century data. McPherson's comments—which echo the work of John Demos and Nancy Cott, among others—suggest that an investigation of nineteenth-century data might also prove fruitful.[9]

13.2.1 A General Description of the Quantity-Quality Model

The chief characteristic of the quantity-quality model is that the cost of an additional child, holding the quality of each child constant, is greater for higher-quality children. Similarly, the cost of increasing the quality of each child, holding the number of children constant, is greater for larger families. These interactions imply that an increase in wealth would initially tend to increase the desired number of children and their quality, which in turn would raise the "prices" of each good and blunt the impact of the wealth increase. If the induced price effect exceeds the initial wealth effect on fertility, one might observe a negative relationship between family size and wealth in some wealth ranges.[10] In Becker's model and my own, the downward bias observed

7. The lack of evidence of marital fertility control for pre–1850 families does not preclude viewing their decisions to have children as economic ones. The constraints on the supply of children caused by early parental death could have been binding, for instance, so the demand for children coincided with (or fell short of) the available supply.

8. Becker and Lewis, "On the Interaction between Quantity and Quality"; Becker and Tomes, "Child Endowments"; Gary Becker, *A Treatise on the Family* (Cambridge, Mass., 1981); and Jenny Wahl, "Fertility in America: Historical Patterns and Wealth Effects on the Quantity and Quality of Children" (Ph.D. dissertation, University of Chicago, 1985), esp.chap. 3.

9. John Demos, *Past, Present, and Personal* (New York, 1986); Nancy Cott, *The Bonds of Womanhood* (New Haven, 1977).

10. For primarily twentieth-century results, see Robert Michael, "Dimensions of Household Fertility: An Economic Analysis," a paper given at the annual meeting of the American Statistical Association (New York, 1971); Warren Sanderson and Robert Willis, "Economic Models of Fertility: Some Explanations and Implications," *Annual Report of the National Bureau of Economic Research* (Cambridge, Mass., 1971); Robert Willis, "Economic Theory of Fertility Behavior," in *Economics of the Family*, Theodore W. Schultz, ed. (Chicago, 1974), pp. 25–75; and Becker and Tomes, "Child Endowments."

on the wealth effect approaches zero as wealth increases.[11] One would therefore expect to see a positive relation between fertility and wealth at the highest wealth levels.

The general quantity-quality model is formulated as follows. Children partly inherit their parents' intrinsic ability (PABLTY), so $0<c_1<1$ in equation (1). Although parents are assumed to know their children's ability (CHABLTY), ability is not perfectly observable by an outsider, so an error term σ appears in equation (1).

$$\text{(1)} \qquad \text{CHABLTY} = c_0 + c_1\text{PABLTY} + \sigma$$

Parents derive pleasure from children and from the quality of their children. Parents' demands for a particular number of children (PNUMKID) and for the quality of each child (measured by the child's wealth as an adult, or

11. Becker and Tomes in "Child Endowments," pp. S144–47, formulate a child's quality (measured as child's wealth, or CHWEALTH) as a linear function of the child's ability (CHABLTY) and parental contributions to the child's wealth (PCONTRIB):

$$\text{CHWEALTH} = \text{CHABLTY} + \text{PCONTRIB}$$

As a result, the elasticity of quality associated with parental contributions (OBSELST) exceeds the true quality elasticity (TRUELST) at lower levels of wealth, but the two converge as parental wealth (PWEALTH) increases if parental contributions to their children increase with parental wealth. That is,

$$\text{OBSELST} = (\text{CHWEALTH}/\text{PCONTRIB}) \times (\text{TRUELST}) > \text{TRUELST}$$

$$\partial(\text{CHWEALTH}/\text{PCONTRIB})/\partial\text{PWEALTH} = [(\text{PCONTRIB} - \text{CHWEALTH})\cdot(\partial\text{PCONTRIB}/\partial\text{PWEALTH})]/\text{PCONTRIB}^2 < 0, \text{ if } (\partial\text{PCONTRIB}/\partial\text{PWEALTH}) > 0$$

By the adding-up rule, the observed wealth elasticity of quantity is biased downward (and could be negative) for lower levels of parental wealth; the bias becomes smaller as parental wealth increases.

My model presumes that parents contribute to children's human capital and may leave bequests (BEQUEST) (Wahl, "Fertility in America," pp. 65–66). Human-capital investments interact with a child's ability to generate the child's lifetime earnings:

$$\text{CHWEALTH} = \text{BEQUEST} + \text{PCONTRIB}^x\text{CHABLY}^y$$
$$0 < x < 1; 0 < y < 1$$

Parents allocate expenditures on children so that the marginal dollar spent on bequests and on human-capital investments yields the same increment to a child's wealth. I assume that the marginal return to human-capital investment exceeds 1 at low levels of investment and is less than 1 at high levels. The marginal return to bequests is 1. As a result, parents of low wealth leave no bequest and the observed wealth elasticity of quality exceeds the true elasticity of quality by a constant ($1/x$) greater than 1. The observed wealth elasticity of quantity could therefore be negative in this wealth range. Where bequests exceed zero, an increase in parental wealth—with no change in child's ability—increases bequests but leaves parental contributions to human capital unchanged. The observed quality elasticity therefore exceeds the true elasticity by a fraction that approaches zero as parental wealth increases if bequests increase with parental wealth:

$$\text{OBSELST} = (\text{CHWEALTH}/\text{BEQUEST}) \times (\text{TRUELST}) > \text{TRUELST}$$

$$\partial(\text{CHWEALTH}/\text{BEQUEST})/\partial\,\text{PWEALTH} = [(\text{BEQUEST} - \text{CHWEALTH})(\partial\text{BEQUEST}/\partial\text{PWEALTH})]/\text{BEQUEST}^2 < 0, \text{ if } (\partial\text{BEQUEST}/\partial\text{PWEALTH}) > 0.$$

As in Becker and Tomes's model, the adding-up rule implies that the observed wealth elasticity of quantity will approach the true elasticity as parental wealth increases.

CHWEALTH) are thus functions of the exogenous variables, children's ability (CHABLTY) and parental wealth (PWEALTH). Equations (2) and (3) represent linear reduced-form demand equations for PNUMKID and CHWEALTH. Higher-order wealth terms in equation (2) allow one to test for a varying observed relationship between fertility and wealth in different wealth ranges.

$$\text{PNUMKID} = a_0 + a_1\text{CHABLTY} + a_2\text{PWEALTH} + a_3\text{PWEALTH}^2 + a_4\,\text{PWEALTH}^3 \tag{2}$$

$$\text{CHWEALTH} = b_0 + b_1\text{CHABLTY} + b_2\text{PWEALTH} \tag{3}$$

Because ability is not directly observable, empirical work must use proxies for children's ability. Testable equations are obtained by lagging equations (2) and (3) and substituting in equation (1):

$$\begin{aligned}\text{PNUMKID} = \alpha_0 &+ c_1\text{GPNUMKID} + a_2(\text{PWEALTH} - c_1\text{GPWEALTH}) \\ &+ a_3(\text{PWEALTH}^2 - c_1\text{GPWEALTH}^2) \\ &+ a_4(\text{PWEALTH}^3 - c_1\text{GPWEALTH}^3) + \varepsilon\end{aligned} \tag{2'}$$

$$\text{CHWEALTH} = \beta_0 + (c_1 + b_2)\text{PWEALTH} - c_1 b_2\text{GPWEALTH} + \mu \tag{3'}$$

where $\alpha_0 = a_0(1 - c_1) + a_1c_0$; $\beta_0 = b_0(1 - c_1) + b_1c_0$; $\varepsilon = a_1\sigma$; $\mu = b_1\sigma$; GPNUMKID $=$ PNUMKID$_{-1}$; and GPWEALTH $=$ PWEALTH$_{-1}$. Equations (2′) and (3′) show that grandparental wealth (GPWEALTH) and fertility (GPNUMKID) serve as proxies for children's ability.

Because the interaction of the quantity and quality of children implies that wealth and fertility might appear negatively related, the quantity-quality model makes no predictions on the signs of the wealth coefficients in equation (2′). The model does, however, generate coefficient restrictions. The coefficient on each grandparental wealth term equals the negative of the coefficient on the corresponding parental wealth term multiplied by that on GPNUMKID. Grandparental fertility has a positive coefficient, equaling the degree to which ability is inherited.

The coefficients in equation (3′) are also constrained by the quantity-quality model. The coefficient on PWEALTH is positive, equaling the sum of two positive fractions: (a) the degree to which ability is inherited and (b) parents' propensity to invest in children's wealth out of an increment in their own wealth. The coefficient on GPWEALTH is negative, equaling the negative of the product of the two fractions. The absolute value of the estimated coefficient on GPWEALTH in equation (3′) should therefore be smaller than the estimated coefficient on PWEALTH.

Empirical analyses of the relation between fertility and parental wealth often exclude grandparental variables because data are not available. How would this omission affect the coefficients on parental wealth in equation (2′)? Suppose that one's ability interacts with parental contributions to one's human capital to affect one's wealth positively. Then wealth and ability are positively related within a generation and ability is positively related across generations, implying that the covariance between CHABLTY and PWEALTH is likely to be positive. The bias from omitting grandparental variables (which stand in for CHABLTY) from equation (2′) therefore depends on the sign of a_1, the effect of CHABLTY on PNUMKID.

Two effects influence the sign of a_1. Greater ability lowers the cost to parents of providing a given amount of quality to each child, which would tend to increase PNUMKID and make a_1 positive. Greater ability also increases the productivity of investing in children, however, because ability and parental contributions interact to determine a child's wealth. This tends to increase quality, decrease PNUMKID, and make a_1 negative. If a_1 is positive, omitting the proxies for ability biases the true wealth effect upward. If a_1 is negative, the omission biases the wealth effect downward.[12]

Omitting child's ability from equation (3′) alters observed parental wealth effects on child quality. Becker shows that excluding the ability proxy (GPWEALTH) from equation (3′) biases downward the coefficient on PWEALTH.[13]

13.2.2 The Quantity-Quality Model and the Nineteeth-Century American Family

Economists have neglected the quantity-quality model as a depiction of nineteenth-century American fertility, partly because household data have been unavailable to test it. Additionally, many economists believe that nineteenth-century parents regarded their children as investment goods, begotten for their capacity to work on the family farm and to support their parents in old age.[14] Historians and sociologists have been more amenable to the idea that children had non-pecuniary value before this century; economic data explored here corroborate this view.

The quantity-quality model helps illuminate the decline in American fertility through its focus on the prices of quality and quantity and on the interaction of the two. The price of quality fell through the nineteenth century be-

12. If CHABLTY or proxies for it are omitted from equation (2′), the expected value of each coefficient on a parental wealth variable equals the following: the true coefficient, plus the product of a_1 and the ratio of the covariance of CHABLTY and the parental wealth variable to the variance of the parental wealth variable. In "Fertility in America," I assume that one's ability interacts with parents' contributions to human capital to produce one's wealth. In the linear model used by Becker and Tomes in "Child Endowments"—where a child's ability is separate from human capital investments made in him or her—an increase in CHABLTY unambiguously causes the relative price of quantity to fall, thus increasing the number of children. Because the coefficient on CHABLTY is positive, omitting grandparents' variables would bias observed wealth coefficients upward in their model.

13. Becker, *A Treatise*, pp. 168–69.

14. Roger Ransom and Richard Sutch, "Did Rising Out-Migration Cause Fertility to Decline in Rural New England?", Working Papers on the History of Saving no. 5 (University of California, Apr. 1986); and William Sundstrom and Paul David, "Old-Age Security Motives, Labor Markets, and Farm Family Fertility in Antebellum America," *Explorations in Economic History*, 25 (Apr. 1988), pp. 164–97.

cause children survived longer and public schooling became increasingly available. As Lawrence Stone notes, "very high infant and child mortality rates . . . made it folly to invest too much . . . in such ephemeral beings."[15] Better public health procedures in the latter half of the nineteenth century reduced infant and child mortality.[16] More attention to personal cleanliness and improvements in water carriage and city planning, for example, boosted the health of the population.[17] At the same time, public education became more prevalent as greater population density reduced costs of providing schools and as literacy generated urban opportunities for many, particularly those who had little hope of ever owning a farm.[18] While longer life spans raised the payoff from investing in children, cheaper access to schooling lowered the cost.[19] These effects decreased the price of child quality, inducing parents to substitute toward quality and away from the quantity of children.

While the price of quality fell, the price of the quantity of children rose through the nineteenth century. Several factors were responsible. Historians, sociologists, and economists have commented on the separation of the home from the work place that accompanied the Industrial Revolution.[20] Nancy Cott points out that the nineteenth century heralded the separation of job from

15. Lawrence Stone, *The Family, Sex, and Marriage* (New York, 1979), p. 82. Stone was referring to emotional capital invested by English parents in an earlier era; the reasoning is the same for American parents investing in a child's human capital in the first part of the 1800s. Clayne Pope, Robert Fogel, and I trace the decline in mortality through the nineteenth century. See Clayne L. Pope, chap. 9 in this volume; Fogel, "Nutrition and the Decline in Mortality"; and Wahl, "Fertility in America."

16. See Daniel Scott Smith, "Differential Mortality in the United States Before 1900," *Journal of Interdisciplinary History,* 13 (Spring 1983), pp. 735–59.

17. Richard Bushman and Claudia Bushman, "The Early History of Cleanliness in America," *Journal of American History,* 74 (Mar. 1988), pp. 1213–38; Jon Peterson, "The Impact of Sanitary Reform upon American Urban Planning, 1840–1890," *Journal of Social History,* 13 (Fall 1979), pp. 83–104. Harvey Levenstein suggests that the mid-1800s signaled an end to the practice of feeding infants cows' milk directly from the udder. ("'Best for Babies' or 'Preventable Infanticide'? The Controversy over Artificial Feeding of Infants in America, 1880–1920," *Journal of American History,* 70 [June 1983], pp. 75–94).

18. Robert Gallman reviews the relation between literacy and population density in a North Carolina county in "Changes in the Level of Literacy in a New Community of Early America," *Journal of Economic History,* 48 (Sept. 1988), pp. 567–82. Avery Guest and Stewart Tolnay, and Maris Vinovskis, note the concomitant decline in fertility, rise in schooling, and move out of agriculture. See Avery Guest and Stewart Tolnay, "Urban Industrial Structure and Fertility, The Case of Large American Cities," *Journal of Interdisciplinary History,* 13 (Winter 1983), pp. 387–409; Maris Vinovskis, "Historical Perspectives on Rural Development and Human Fertility in Nineteenth Century America," in *Rural Development and Human Fertility,* Wayne Schutjer and C. Shannon Stokes, eds. (New York, 1984), pp. 77–96.

19. Peter Lindert found that expenditures on public elementary and secondary schooling and on education in general for children aged 5 to 19 rose steadily from 1840 to 1930, with the sharpest increase taking place before 1900 (*Fertility and Scarcity in America* [Princeton, 1978]).

20. Claudia Goldin surmises that the decline in women's labor force participation with the advent of industrialization was caused in part by this separation, which removed the convenience and increased the costs of being in the labor force, especially for women with preadolescent children ("The Economic Status of Women in the Early Republic: Quantitative Methods," *Journal of Interdisciplinary History,* 16 [Winter 1986], pp. 375–404).

home, man's world from woman's world: "To render *home* happy, is woman's peculiar province; home is *her* world."[21] Carl Degler maintains that this dichotomy gave women more control over household decisions, including sex and reproduction; increasing domesticity went hand-in-hand with the notion that the individual child was a precious commodity. Nancy Dye and Daniel Blake Smith note that mothers seemed more devoted to their children in the 1800s; they illuminate the role of costs in decision-making and highlight the quantity-quality interaction. They believe that mothers had fewer children and emphasized each child's quality because mothers saw that their efforts to nurture their children paid off as babies increasingly survived infancy. Children were no longer trusted to the hands of God; their mothers' capable hands could protect them.[22] As well as watching over their children more, nineteenth-century women spent more time in religious, social, and educational activities than their mothers and grandmothers.[23] Additional children detracted from the caliber of family life, the amount of time spent nurturing each child, and the time mothers could spend in other activities. As a result, the price of the quantity of children rose through the 1800s, inducing parents to have smaller families.

Increasing real wealth over time might also have generated lower fertility because observed wealth effects do not control for the interaction between quantity and quality. If the price effect dominated the true wealth effect on quantity over some range of wealth, the desired number of children could have fallen over time as observed wealth increased. Alternatively, decreasing wealth would imply lower fertility for families in the wealth range where fertility and wealth were positively related. The increasing dispersion of wealth in the nineteenth century therefore could have produced lower fertility if those getting richer and those getting poorer reduced their family sizes.[24]

13.2.3 An Alternative Model—Richard Easterlin's Target-Bequest Model

The leading model proposed to explain the fertility decline in nineteenth-century America is that of Richard Easterlin.[25] He argues that the greater pop-

21. Cott, *The Bonds*, p. 74.

22. Carl Degler, *At Odds: Women and the Family in America from the Revolution to the Present* (New York, 1980); Nancy Dye and Daniel Blake Smith, "Mother Love and Infant Death, 1750–1920," *Journal of American History*, 73 (September 1986), pp. 329–53. Linda Pollock cites evidence that parents may have cherished children as early as the 1500s, while Philippe Ariès claims that the notion of childhood flowered during the seventeenth century. See Linda Pollock, *Forgotten Children: Parent-Child Relations from 1500–1900* (New York, 1983); Philippe Ariès, *Centuries of Childhood* (New York, 1962).

23. For a discussion of the early history of women's groups, see Anne Boylan, "Women in Groups: An Analysis of Women's Benevolent Organizations in New York and Boston," *Journal of American History*, 71 (Dec. 1984), pp. 497–523.

24. In *Fertility and Scarcity*, Lindert notes the drift toward greater wealth inequality from 1770 to 1860 and the high plateau of inequality from 1860 to 1929.

25. Easterlin, "Population Change." Other economic historians suggest that nineteenth-century children ensured old-age support for their parents. Ransom and Sutch, "Rising Out-Migration," argue that American fertility might have fallen as children migrated westward and parents realized

ulation density in the Northeast in the 1800s led northeasterners to have fewer children than frontier families. Like the quantity-quality model, Easterlin's model suggests that, all else equal, more wealth would lead to higher fertility because children are a normal good. Easterlin surmises that another instinct motivated nineteenth-century parents: parents wanted their children to have as good a start in life as they had. The prospective increase in parental wealth was the key factor indicating parents' ability to provide their children with a proper start in life. The smaller the growth in wealth expected by parents, the fewer children they would have had. Because greater population density implied lower expected growth in wealth, according to Easterlin, fertility was lower in the Northeast. As population density increased across the country, one might expect overall American fertility to fall.

Easterlin's target-bequest model resembles the quantity-quality model in important ways. Both view children as consumption goods that give parents non-monetary pleasures. Both shape parents' utility as a function of not only children but also the children's quality of life. Both conjecture that a couple's fertility is related to their wealth and to the previous generation's wealth and fertility. Yet the two models imply disparate empirical results and assign a fundamentally different role to the grandparental variables.

Because the variables each model emphasizes are the same, equations (2′) and (3′) can be used for Easterlin's target-bequest model, as well as for the quantity-quality one. The target-bequest model implies a positive parental wealth effect, a positive coefficient on GPNUMKID, and a negative grandparental wealth effect in equation (2′). The reasoning is as follows. Consider two couples having the same wealth, but different childhood living standards. The couple with the more prosperous childhood (greater GPWEALTH and smaller GPNUMKID, all else equal) will have fewer children and give more to each child. The predictions on coefficient signs in equation (2′) from the target-bequest model are therefore more restrictive than those from the quantity-quality model, which merely requires opposite signs on parental and grandparental wealth variables. Easterlin's framework also suggests a positive coefficient on GPWEALTH in equation (3′), unlike the quantity-quality model. The couple with a more prosperous childhood (greater GPWEALTH, all else equal) would provide a better lifestyle for each child.[26] According to Easter-

that their children would increasingly default on "old-age security" payments. Sundstrom and David, "Old-Age Security Motives," take a different tack. They speculate that better labor market conditions through the nineteenth century gave the young more bargaining power with their parents, which enabled youths to extract additional family wealth in exchange for providing old-age support to parents. As a result, couples began to have fewer children. The old-age security model is consistent with a panoply of signs on coefficients in equation (2′) and is empirically indistinguishable from the quantity-quality model.

26. The strength of this effect depends on the number of siblings in the family of origin. If grandparents of higher wealth had more children, the coefficient on GPWEALTH will be positive in equation (3′) as long as wealthier grandparents also provided higher living standards for each

lin, parents with greater wealth would tend to give more to their children as well. Thus, like the quantity-quality model, Easterlin's implies a positive coefficient on PWEALTH in equation (3′).

Grandparental wealth and fertility are causally related to the endogenous variables PNUMKID and CHWEALTH in Easterlin's model. In contrast, grandparental variables serve only as proxies for children's ability in the quantity-quality model.

As in the quantity-quality model, omission of grandparental variables from the target-bequest model would bias the coefficients on parental wealth variables in equations (2′) and (3′). A more prosperous childhood (greater GPWEALTH and smaller GPNUMKID) implies greater PWEALTH and smaller PNUMKID. Omission of grandparental wealth and fertility in equation (2′) would thus bias downward the coefficients on parental wealth variables. Again, this prediction is more restrictive than that of the quantity-quality model, which allows either a positive or a negative bias. A more prosperous childhood for parents causes them to contribute more to CHWEALTH as well as increasing PWEALTH. Elimination of GPWEALTH in equation (3′) would therefore bias the coefficient on PWEALTH upward in Easterlin's model, contrasting with the downward bias in the quantity-quality model.

13.3 Empirical Analysis

13.3.1 The Data Sample

Fertility data for two consecutive generations of households and wealth data for three consecutive generations are needed to estimate equations (2′) and (3′). The sample used here consists of sets of families connected by marriage through several generations. Demographic and socioeconomic characteristics are taken from a data source that links, on an individual basis, genealogical records to the decennial federal manuscript census schedules for the years 1850 to 1880.[27] Not only is the structure of the sample appropriate for estimating equations (2′) and (3′), it is also a unique, large, micro-level data set with longitudinal information antedating the twentieth century.

Each sample observation has demographic and socioeconomic data for all individuals from three generations of a single family. Genealogical data include each individual's dates and places of birth, marriage, and death, and the total number of children born to the individual and his or her spouse. Census data include wealth, occupation, literacy, school attendence, relation to the

child. Given Easterlin's assumptions about wealth effects on fertility and on bequests, this is likely to be true.

27. For a complete data description, see Jenny Bourne, Robert Fogel, Clayne Pope, and Larry Wimmer, "A Description and Analysis of the Data in the DAE/CPE Pilot Sample of Genealogies" (manuscript, University of Chicago, 1984); and Fogel, "Nutrition and the Decline in Mortality."

head of household, and residence by county, at the time of the census. By assigning personal and marriage identification numbers to individuals, the individuals are aggregated into families and families aggregated across generations. Appendix A gives more detail on the process by which data were collected.

Genealogies tend to be produced by relatively wealthy families, and average wealth is greater for this census sample than for other census samples collected. Households in my sample held an average of $4,184 in 1860 census wealth and $8,823 in 1870 census wealth. But household heads in this sample were also richer because they were older on average at the time of the census than those in other samples.[28] Fortunately, a wide range of wealth values are reported, including a good representation of families with no reported wealth.[29]

Several potential biases can be overcome by restricting the sample.[30] Only families in which childbearing was complete when the genealogy was published are included. As a result, information about fertility for a sample family is incomplete only if records are incomplete, not because children were born after the genealogy's publication date. In addition, analysis concentrates on once-married couples who had at least one child and who were at risk to bear children until the mother was age 45.[31] These constraints buttress the notion that the number of children ever born is a good proxy for the number of children demanded in the observed families. Including only once-married couples generally ensures that each child recorded is matched to its natural mother and father.[32] Omitting families with no children excludes couples in which at least

28. Households in the Vedder and Gallaway 1860 Ohio census sample held average wealth of $2,900, and those in Lee Soltow's 1860 national sample held $3,027. Households in Soltow's 1870 national sample held $3,035 on average, and those in the Hershberg and Dockhorn 1870 Philadelphia sample held $3,257 on average. Soltow's 1860 census sample of older men (aged 40 to 99 years) held average wealth of $5,264, while his older-men 1870 sample averaged $5,323. See Richard Vedder and Lowell Gallaway, "Migration in the Old Northwest," in *Essays in Nineteenth Century Economic History: The Old Northwest,* David Klingamen and Richard Vedder, eds. (Athens, Ohio, 1975); Lee Soltow, *Men and Wealth in the United States, 1850–1870* (New Haven, 1975); Theodore Hershberg and Robert Dockhorn, "Occupation Classification," *Historical Methods*, 9 (Spring/Summer 1976), pp. 59–97.

29. Soltow reports 38 percent of his overall sample in each year with zero wealth; the sample used here has 51 percent of households with zero wealth for 1860 and 43 percent for 1870.

30. Some sampling biases inherent in the sample remain in the constrained subsample. Genealogies are produced by families with higher-than-average fertility and nuptiality and lower-than-average mortality because such families are more likely to have a surviving heir compile the family's history. Moreover, the regression sample consists solely of whites, with 98 percent of adults reporting themselves as literate.

31. To ensure completed childbearing, only families in which the mother was born at least 45 years before the publication date of the genealogy are included. By age 45, secondary sterility sets in for most women. Couples in which both partners survived to the mother's forty-fifth birthday were assumed to be at risk to bear children up to that date.

32. This constraint excludes stepchildren but not adopted children. Adopted children reflect parents' inability to bear the children they want, which reinforces viewing the recorded number of children as a good proxy for the desired number.

one spouse suffered from primary sterility.[33] Eliminating families in which one parent died before the mother went through menopause helps ensure that childbearing was not curtailed before couples had the family they desired.[34]

Equations (2′) and (3′) are analyzed separately for families recorded in 1860 and for those recorded in 1870.[35] These results, contained in the following two sections, support the quantity-quality model. Equation (2′) is the focal point of the analysis; equation (3′) further demonstrates the validity of the quantity-quality model. Table 13.1 reports descriptive statistics for the variables used in the regression analyses.

13.3.2 Estimating the Fertility Equation (2′)

The Unconstrained Model

Table 13.2 compares coefficients and standard errors for two fertility regressions using the number of children ever born as the dependent variable.[36]

33. Excluding no-child families cuts out couples who could have had children but chose not to. One would like to include such couples in the regression, but they are indistinguishable from primary-sterility couples. The percentage of families with no children in the sample (4 percent) is close to the estimated primary sterility rate for the period and slightly higher than the estimated twentieth-century rate of 1.7 percent. See W. Henry Mosley, "Reproductive Impairments in the United States, 1965–1982," *Demography,* 22 (Aug. 1985), pp. 415–30. If one assumes that all childless couples suffered from primary sterility, the probability of a Type II error is small relative to the probability of a Type I error. Therefore, all childless couples are excluded from the regression analysis. I am grateful to Robert Fogel for this discussion.

34. Did parents have more children than they wanted? Available contraceptive methods certainly were fallible, yet the sample exhibited fertility control within marriage. Modeling fertility as a choice variable is therefore consistent with empirical evidence. See Wahl, "Fertility in America," esp. table 6. For analyzing equation (2′), the important question is whether knowledge of contraception was correlated with wealth; wealthier families may have been more aware of how to prevent having children. As a result, omitting contraceptive knowledge from equation (2′) could bias wealth coefficients downward because wealthy parents would have had relatively fewer children they did not want. John d'Emilio and Estelle Freedman, *Intimate Matters* (New York, 1988), pp. 59–64, note, however, that accurate information about contraception began to circulate widely by the 1830s.

Other excluded variables had little effect on the number of children. Although mother's age at marriage is omitted, women marrying later had significantly higher fertility rates within given age groups, indicating that fertility for these women might have caught up with fertility for younger brides. See Jenny Bourne, "Preliminary Analysis of Mortality and Fertility in the United States, 1650–1899" (manuscript, University of Chicago, 1983). Although infant mortality is excluded, parents attempted to "replace" dead children by increasing their fertility rates, which suggests that the number of children ever born is closely related to the number of surviving children. See Anne Williams, "Measuring the Impact of Child Mortality on Fertility: A Methodological Note," *Demography,* 14 (Nov. 1977) pp. 581–90; and Bourne, "Preliminary Analysis." Fecundity variables were not included, but studies indicate that only extreme malnutrition affects a woman's ability to conceive. See Jane Menken, James Trussell, and Susan Watkins, "The Nutrition Fertility Link: An Evaluation of the Evidence," *Journal of Interdisciplinary History,* 11 (Winter 1981), pp. 425–41. Adding these demographic variables to equation (2′) reduces the variance of the disturbance term but does not substantially affect wealth coefficients.

35. The 1850 and 1880 censuses are not used here because the former recorded only the value of real estate, while the latter recorded no wealth data. The 1860 and 1870 censuses recorded the values of both real estate and personal property.

36. The next section reports results for a nonlinear regression. Alternatively, a Poisson model could be used. See Richard Steckel's paper, chap. 12 in this volume.

Table 13.1 Descriptive Statistics for Regressions: The Linked Genealogy-Census Sample

	1860			1870		
	Mean	Standard Deviation	%	Mean	Standard Deviation	%
Quantity of Children Regression, Equation 2′: Tables 13.2 and 13.3						
Parental variables						
Total children	5.6	3.0		5.1	2.0	
Wealth instrument	$6,753.0	$2,874.0		$10,088.0	$5,710.0	
Father's age	44.0	14.0		42.0	14.0	
Grandparental variables						
Total children	8.6	3.0		8.0	3.0	
Wealth instrument	$4,645.0	$2,741.0		$12,512.0	$6,322.0	
Grandfather's age	76.0	14.0		74.0	15.0	
Quality of Children Regression, Equation 3′: Table 13.4						
Child's wealth	$2,753.0	$1,943.0		$4,730.0	$2,449.0	
Parents' wealth	$6,547.0	$2,178.0		$8,185.0	$4,283.0	
Grandparents' wealth	$7,653.0	$3,512.0		$10,363.0	$6,514.0	
Child's age	31.0	5.0		34.0	4.0	
Father's age	55.0	9.0		59.0	8.0	
Grandfather's age	87.0	6.0		87.0	6.0	
Regression to Create Parental Wealth Instrument: Table 13B.1						
Wealth	$4,507.0	$9,009.0		$9,593.0	$19,080.0	
Father's age	51.0	18.0		51.0	18.0	
Farm resident			56%			59%
Father's occupation						
Craftsman			8%			11%
None			4			1
Professional			5			6
Proprietor			5			9
Unknown			11			18
Laborer			67			55
Region of residence						
Unknown			36%			45%
Pacific			0			1
Mountain			0			0
Midwest			3			4
South			3			5
Mid-Atlantic			2			1
North-Atlantic			48			36
New England			8			8

Source: Linked geneaology-census sample.

Table 13.2 Estimating Equation 2′: Number of Children Ever Born Regressed on Parental Wealth, Grandparental Wealth, and Grandparental Fertility

	Including Grandparental Variables		Excluding Grandparental Variables	
Independent Variable	Coefficient	Standard Error	Coefficient	Standard Error
1860 Sample				
Parental variables				
Wealth/10^3	1.00	0.50	1.20	0.48
Wealth^2/10^8	−5.06	3.35	−4.41	3.44
Wealth^3/10^{13}	5.72	4.61	4.56	4.75
Grandparental variables				
Wealth/10^3	−0.20	0.54		
Wealth^2/10^8	1.42	3.02		
Wealth^3/10^{13}	−2.69	4.34		
Number of children	0.15	0.31		
Number of observations	104		104	
R^2	0.34		0.20	
F-test[a]			1.81	
1870 Sample				
Parental variables				
Wealth/10^3	0.22	0.11	0.30	0.14
Wealth^2/10^8	−0.44	0.47	−0.77	0.45
Wealth^3/10^{13}	0.16	0.17	0.31	0.16
Grandparental variables				
Wealth/10^3	−0.10	0.05		
Wealth^2/10^8	0.33	0.16		
Wealth^3/10^{13}	−0.09	0.05		
Number of children	0.23	0.27		
Number of observations	96		96	
R^2	0.30		0.13	
F-test[a]			1.90	

Sources: Linked genealogy-census sample and Table 13B.1

[a]The F-statistic tests the significance of the omission of the intergenerational variables. Its degrees of freedom are (10,83) for the 1860 regression and (10,75) for the 1870 regression.

The first regression includes grandparents' fertility and instruments for parental and grandparental wealth as independent variables, while the second omits grandparental variables.[37] Appendix B discusses how the wealth instruments were obtained.

37. The standard errors for regressions that use instrumental variables are not exact. This is caused by the failure to control for the estimation error in the predictions derived from the first-stage regressions that create the instruments (Peter Schmidt, *Econometrics* [New York, 1976], p. 160). Absence of direct measures of lifetime wealth precludes their inclusion in the regressions,

Fertility is positively related to parental wealth for most of the sample's wealth range. The relationship (displayed in Figure 13.1) is negative for the mid- to upper-wealth range, then turns positive at the highest estimated wealth levels. The pattern is congruent with the interaction between quantity and quality of children.[38] It is not consistent with Easterlin's model, which suggests a uniformly positive relationship of fertility to wealth. Additionally, empirical relationships among coefficients approximate the quantity-quality model's predictions. The coefficients on grandparental wealth terms are close to the negatives of the products of the coefficient on GPNUMKID and the respective coefficients on parental wealth terms. Only the coefficients on linear wealth terms are significant.

Omission of the grandparental variables has significant consequences for observed wealth effects on fertility. The omission biases the linear parental wealth term and increases its apparent significance.[39] The overall bias on the parental wealth effect is positive for the 1860 sample, though small. A positive bias is consistent with the quantity-quality model but not with Easterlin's model. For the 1870 sample, the bias is positive at most wealth levels but negative at the highest levels of lifetime wealth estimated for the sample.[40] Omission of grandparental variables is significant at the 90 to 95 percent level.

The Constrained Model

The quantity-quality model implies several restrictions that were not incorporated in the estimating procedure used in Table 13.2. The parameters of the constrained model are therefore estimated by nonlinear least squares (Table 13.3). If the constraints are appropriate, the estimated coefficients of the un-

so true standard errors cannot be derived. Dummy variables for farm residence for both generations were not significant.

38. The positive relation at high wealth comports with the shrinking bias in the observed elasticities discussed in the text and in footnote 11. The initial positive relation coupled with the mid-range negative relation suggests that the interaction between quantity and quality was weak at low levels of wealth and became stronger as wealth increased.

39. The bias is expected in the quantity-quality model because the instrumental wealth variables are correlated with ability. The instruments are constructed in part from occupational variables, which are related to earnings; one would expect earnings to be correlated with ability (Wahl, "Fertility in America," p. 55). Omission of the proxies for ability therefore biases the coefficients on wealth instruments. If instruments were constructed from variables uncorrelated with ability, the omission would affect standard errors but not coefficients (Schmidt, *Econometrics*, p. 40).

40. One reason for the high-end negative bias within the framework of the quantity-quality model could be that the return to investing in human capital increasingly varied through time over families of different wealths. The most likely explanation is, however, that 1870 wealth variables are not as reliable as 1860 variables. The distortion to land markets caused by the 1862 Homestead Act and the wealth transfers caused by the emancipation of slaves imply that 1870 census wealth may not be as accurate a basis for lifetime-wealth estimation as 1860 census wealth. The sample drawn here from the 1870 census also may not be representative, as it recorded a higher average wealth than other collected census samples.

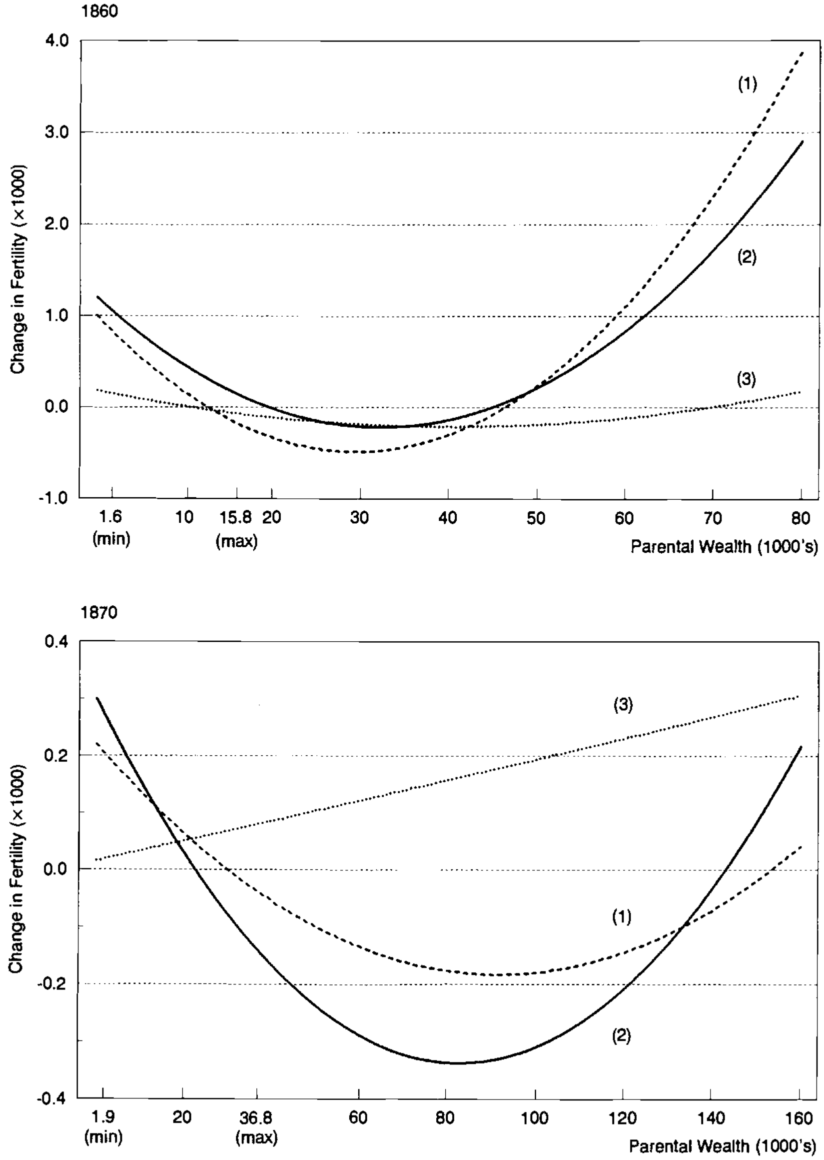

Fig. 13.1 Response of Parental Fertility to Changes in Parental Wealth

Note: This figure represents the change in the quantity of children with respect to a change in parental wealth graphed against the level of parental wealth in thousands of 1860 or 1870 dollars. Line (1) graphs the change in quantity with respect to a change in parental wealth when the number of children ever born is regressed on parental wealth, grandparental wealth, and grandparental fertility. Line (2) graphs the same derivative when the number of children ever born is regressed only on parental wealth. Both are derived from Table 13.2. Line (3) is derived from Table 13.3 and represents the derivative from a regression of the number of children ever born on parental wealth, grandparental wealth, and grandparental fertility, using the constraints on coefficients specified by the quantity-quality model. Min is the minimum wealth estimated for the sample, and max gives the maximum.

Sources: Tables 13.2 and 13.3.

Table 13.3 Estimating Equation (2′) with Quantity-Quality Coefficient Constraints: Number of Children Ever Born Regressed on Parental Wealth, Grandparental Wealth, and Grandparental Fertility

Independent Variable	1860 Coefficient	1860 Asymptotic Standard Error	1870 Coefficient	1870 Asymptotic Standard Error
Parental Wealth/10^3	0.179	0.325	0.016	0.058
Parental Wealth^2/10^8	−0.980	2.111	0.086	0.068
Parental Wealth^3/10^{13}	0.815	2.580	0.002	0.026
Grandparental fertility	0.025	0.098	0.113	0.075
Number of observations	104		96	
Chi-square test for constraincd versus unconstrained model (4 degrees of freedom)	2.91		6.41	

Note: The constraints of the quantity-quality model indicate that the coefficient on each grandparental wealth variable (linear, quadratic, and cubic) equals the negative of the product of the coefficient on the corresponding parental wealth variable and the coefficient on grandparental fertility.

Sources: Linked genealogy-census sample and Table 13B.1

constrained model provide consistent initial estimates for the constrained procedure.[41]

Although the coefficients are not the same for the constrained and unconstrained regressions, they are not significantly different. A chi-square test reveals that the difference is significant only at the 40 percent level for the 1860 sample and at the 80 percent level for the 1870 sample. As in the unconstrained regression, Figure 13.1 shows that wealth affects fertility positively for most of the relevant range of lifetime wealth, although the effect is negative in the middle-wealth range for constrained regressions using 1860 wealth. In constrained regressions using 1870 wealth, the wealth effect appears positive throughout.

13.3.3 Estimating the Wealth Equation (3′)

Table 13.4 reports the estimation of equation (3′) to show that the coefficients and the bias from omitting grandparental variables correspond to the quantity-quality model's predictions.[42] In regressions including grandparental wealth, the coefficients accord with the quantity-quality model: the parental wealth coefficient is positive, and it is opposite in sign to and larger in absolute

41. Various initial estimates result in unique coefficient estimates for 1860 data. For regressions using 1870 wealth, a second local optimum results if large starting values (0.45 to 0.75) are used to estimate the degree to which ability is inherited (coefficient c_1).

42. As in equation (2′), farm residence variables are not significant.

Table 13.4 **Estimating Equation 3′: Child's Wealth Regressed on Parental Wealth and Grandparental Wealth**

	Including Grandparental Variables		Excluding Grandparental Variables	
Independent Variable	Coefficient	Standard Error	Coefficient	Standard Error
1860 Sample				
Parental wealth	0.260	0.124	0.153	0.065
Grandparental wealth	−0.008	0.005		
Number of observations	106		106	
R^2	0.14		0.09	
1870 Sample				
Parental wealth	0.462	0.215	0.333	0.150
Grandparental wealth	−0.030	0.019		
Number of observations	125		125	
R^2	0.10		0.07	

Sources: Linked genealogy-census sample and Table 13B.1

magnitude than the grandparental wealth coefficient. These results are inconsistent with Easterlin's model, which predicts positive coefficients on both wealth variables.

Omission of grandparental wealth has effects congruent with the quantity-quality model's predictions. The omission of GPWEALTH is significant at the 70 percent level for both census years. Furthermore, the observed coefficient on PWEALTH in regressions that use three generations of wealth data is higher than the wealth coefficient found in many studies, including this one, that use only two.[43] The downward bias on the PWEALTH coefficient caused by the omission of GPWEALTH is consistent with the quantity-quality model, but not with Easterlin's model.

43. For a review of two-generation studies, see Gary Becker and Nigel Tomes, "The Rise and Fall of Families," Working Paper no. 84–10, National Opinion Research Center (Chicago, Oct. 1984). Two-generation studies using probate data find larger wealth effects. See Paul Menchik, "Inter-Generational Transmission of Inequality: An Empirical Study of Wealth Mobility," *Economica*, 46 (Nov. 1979), pp. 349–62. The size of the wealth effect in probate samples may, however, result from a selection bias. Many probate samples include only families in which fathers and sons made wills, and individuals who make wills are generally wealthy. Wealth is probably more highly correlated across generations for these families: a higher percentage of their wealth is bequeathed and bequests are not as variable as earnings. Michael Hurd and B. Gabriela Mundaca, for example, find that inherited wealth is 15 to 20 percent of wealthy individuals' total wealth, and gifts are 5 to 10 percent. ("The Importance of Gifts and Inheritances Among the Very Wealthy," a paper given at the National Bureau of Economic Research Conference on Research in Income and Wealth [Baltimore, 1987]).

13.4 Conclusion

Many scholars have modeled how nineteenth-century American families made life-cycle decisions, with an emphasis on explaining decreasing family sizes. Easterlin's target-bequest model has been the most influential for economic historians, although old-age security models and various biological and sociological models have also been proposed. Explanations of the fertility decline focus on household responses to macroeconomic phenomena, such as increasing population density and improving labor markets for youth. My work, like that of others, suggests that nineteenth-century household fertility decisions were influenced by movements in macroeconomic variables. Thus far, proposed fertility models have remained untested or have had to rely on imperfect, aggregate measures of fertility and wealth. Mine is the first to examine and test a microeconomic fertility model using wealth and fertility data for three generations of families.

The empirical analysis presented here indicates that the tradeoff between the quantity and quality of children offers a new view of the nineteenth-century American family and a promising explanation for the fertility decline through the 1800s. The quantity-quality model performs better on nineteenth-century household-level data than the leading alternative, Easterlin's model. Coefficient signs comport with the predictions of the quantity-quality model; coefficient restrictions of the quantity-quality model are not rejected at any conventional significance level; and the omission of grandparental variables from regressions is significant and biases parental wealth effects in the direction predicted by the quantity-quality model. Neither coefficient signs nor observed biases from omitting grandparental variables harmonize with the predictions of Easterlin's model.

How does the quantity-quality model help account for the decline in nineteenth-century American fertility? The model implies that fertility would have fallen if the relative price of quantity rose, either because the interaction of quantity and quality affected the prices of the two goods when wealth changed or the relative price itself initially increased. Changes in the prices of the quantity and quality of children and in the degree of dispersion of wealth, rather than increasing average wealth or changing attitudes toward offspring, provide the key.

Table 13.1 shows an increase in average lifetime wealth from the 1860 to the 1870 census.[44] Figure 13.1 shows that this increment is in the range of wealth where fertility moved with wealth, so the growth in wealth would have tended to increase rather than decrease family sizes. The distribution of wealth was, however, also more spread out for the sample in 1870—hinting

44. This results partly from inflation: the Warren-Pearson price index reveals that prices over the decade rose by 45 percent. See U.S. Bureau of the Census, *Historical Statistics of the United States from Colonial Times to 1970* (Washington, 1975).

that families, though wealthier on average, may have been in wealth ranges of lower fertility.[45] Greater dispersion of wealth implies that some families moved into higher wealth ranges, where fertility decreased as wealth increased, while some moved into lower wealth ranges, where fertility decreased as wealth decreased.

Changes in the prices of quality and quantity furnish the most likely explanation for the fertility decline. The price of quality fell over time as lifespans increased and as public education became more available, causing investment in children to become more productive. The price of quantity rose as home life became a separate entity, more children survived infancy, and women participated more in activities outside the home. Both effects increased the relative price of quantity, encouraging nineteenth-century parents to have smaller families than their ancestors.

Appendix A
Creation of the Data Sample

Step 1

Each of nine genealogies is structured as follows. The first male immigrant to the United States with a recorded departure and destination place begins the genealogy. Within the genealogies, 25 percent of individuals were born in the period 1650–1799, 50 percent were born in the period 1800–1849, and 25 percent were born in the period 1850–99.[46] A family was included in the sample only if the mother was born at least forty-five years before the publication date.[47] Publication dates include 1877 to 1970.[48]

Step 2

Each individual in the genealogies born between 1750 and 1880 was potentially matched to him- or herself in the federal census manuscript schedules

45. Figure 13.1 demonstrates the relatively narrow band within which family size fluctuated. For instance, a $1,000 increment in a family's 1860 lifetime wealth with all else constant would have increased the number of children by only half a child if initial family wealth were zero, and by only one-tenth a child if initial wealth were $1,000. The same increment would have decreased the number of children by only about one-twentieth if initial wealth were $30,000. Although one might hope to observe larger wealth effects, these results are not terribly surprising—the range of family sizes is small relative to the range of wealth for the sample.

46. The large proportion of the genealogical sample born in the nineteenth century means a high degree of potential matches with census data.

47. By including only families in which the mother was born at least forty-five years before the publication date of the genealogy, the sample includes only families that are observed for their entire potential childbearing years.

48. Publication at a fairly recent date increases a genealogy's legibility and accuracy relative to unpublished or pre-nineteenth-century genealogies.

for 1850 to 1880. Matching characteristics included name, age, region of residence, and knowledge of family structure. For successful matches, each person had both genealogical information (date and place of birth, death, and marriage; number of offspring; name of and other information on spouse; and identification numbers for own marriage and parents' marriage if present) and census information (residence, occupation, literacy, school attendence, relationship to household head, and wealth).

Step 3

Individuals (each carrying the information described in step 2) were linked to their siblings through their parents' marriage identification number, so that a single observation was formed for generation $t + 1$. Two generations were then linked together by matching the parents' marriage identification number for the generation $t + 1$ sibling group to the own-marriage identification number for generation t individuals. A nuclear family observation with information on parents and children resulted from this step.

```
   0     Generation t (parents)
 //^\\
000 00   Generation t + 1 (children)
```

The genealogical file contains 16,820 individuals from 5,632 nuclear families. Nuclear families at risk to be found in one of the censuses must have had at least one family member alive during the census year. The number of families at risk to be found in at least one census year is about 2,500; the number actually located is 2,042. The numbers of families found in each census year are 782 in 1850, 649 in 1860, 661 in 1870, and 706 in 1880.

Step 4

Nuclear families were linked through marriage identification numbers to grandparents of generation $t - 1$. The parents' marriage identification number corresponding to generation t was matched to the own-marriage identification number for generation $t - 1$. The resultant observation constitutes all census and genealogical information on one generation t individual (and his or her spouse), on one or two generation $t - 1$ individuals (and their spouses), and on all generation $t + 1$ individuals (and their spouses) born to the generation t couple. The analysis of the paper is based on the fertility and wealth of generation t.

```
  0 0    Generation t − 1 (grandparents)
  \ /
   0     Generation t (parents)
 //^\\
000 00   Generation t + 1 (children)
```

Appendix B
Creation of the Wealth Instruments

The estimation of equations (2′) and (3′) uses instruments for all wealth variables. Table 13B.1 shows coefficients and standard errors for the regression producing the instrument for parental wealth.[49] Census family wealth is regressed on the age and age squared of the father and on three dummy variables: the occupation of the father, the family's residence on a farm, and the family's region of residence. The age variables are included to account for life-cycle effects in wealth accumulation and are statistically significant.[50] Other variables are included to correct for differences in earnings and wealth profiles and to act as proxies for the number and wealth of children.

Instrumental wealth variables are created because cross-sectional wealth suffers as an independent measure of resources available to "purchase" the quantity and wealth of children. Parental wealth is directly related to the product of the number of children born and the amount already spent on each (which influences children's wealth) before the census date. Moreover, the use of cross-sectional wealth could generate a selection bias. Cross-sectional parental wealth in families with deceased grandparents at the time of observation may include a bequest, while cross-sectional wealth in families with living grandparents would not. If most sample families had living grandparents when observed, grandparental wealth and fertility could serve as components of lifetime parental wealth—that is, bequests. A regression coefficient on cross-sectional parental wealth would thus be biased. The lack of independence and the bias associated with cross-sectional wealth point to the need for an instrumental variable for lifetime parental wealth.[51]

The use of wealth instruments is critical in evaluating wealth effects. Regressions using parental wealth instruments yield very different results from those using cross-sectional parental wealth. In contrast to the generally positive relationship of fertility to estimated lifetime parental wealth, fertility is negatively related to cross-sectional wealth in all but the uppermost wealth range. Coefficients on estimated lifetime parental wealth are large compared with those on cross-sectional wealth, similar to results found by others for

49. Because parental wealth squared and wealth cubed and grandparental wealth variables are included in the fertility regression, these variables are also instrumented (Wahl, "Fertility in America").

50. Wealth increases to age 50.5 in the 1860 sample and to age 62.3 in the 1870 sample, and then falls, similar to the results of Jeremy Atack and Fred Bateman, "Egalitarianism, Inequality, and Age: The Rural North in 1860," *Journal of Economic History*, 41 (Mar. 1981), pp. 85–93; and Soltow, *Men and Wealth*.

51. Another selection bias could arise if cross-sectional grandparental wealth were used as a proxy for their lifetime wealth. Families would be included in regressions only if the grandparents were living (and thus had not made a bequest) at the time of the observation. Because even an instrument for parental wealth controls imperfectly for bequests, cross-sectional grandparental wealth could act as a proxy for a component of parental wealth. Therefore, an instrumental variable for grandparental wealth is also necessary.

Table 13B.1 Creation of Parental Wealth Instrument for Regressions of Equations (2′) and (3′)

Independent Variable	1860 Coefficient	1860 Standard Error	1870 Coefficient	1870 Standard Error
Father's age	404	157	872	318
Father's age squared	−4	2	−7	3
Nonfarm resident (dummy)	2,596	1,937	−2,588	3,697
Father's occupation (dummy)				
Craftsman	−4,369	2,362	3,176	4,603
None	−3,586	5,433	1,434	13,036
Professional	1,771	2,643	20,827	5,207
Proprietor	−297	2,285	8,142	3,555
Unknown	119	1,983	7,468	4,243
Laborer (omitted)				
Region of residence (dummy)				
Unknown	−471	1,884	5,899	4,125
Pacific	−6,068	6,596	−1,570	9,812
Mountain	−122	1,220		
Midwest	264	2,933	3,407	5,162
South	3,563	13,393	1,345	6,405
Mid-Atlantic	1,709	3,798	8,730	9,809
North-Atlantic	2,225	11,870	8,022	4,093
New England (omitted)				
Mean wealth	$4,507		$9,593	
Number of observations	408		417	
R^2	0.12		0.13	

Source: Linked genealogy-census sample.

Note: The table gives coefficients and standard errors from a regression that creates the parental wealth instrument used in regressions of equations (2′) and (3′). Similar regressions derive instrumental variables for wealth squared and wealth cubed and for grandparental wealth variables. See Jenny Wahl, "Fertility in America: Historical Patterns and Wealth Effects on the Quantity and Quality of Children" (Ph.D. dessertation, University of Chicago, 1985).

twentieth-century data.[52] Furthermore, coefficients on the estimated lifetime parental wealth linear terms are significant at the 95 percent level; coefficients on cross-sectional wealth are not significant.[53]

52. Bruce Gardner, "Economics of the Size of North Carolina Rural Families," *Journal of Political Economy,* 81 (Mar./Apr. 1973), pp. S99–122; Dennis De Tray, "Child Quality and the Demand for Children," *Journal of Political Economy,* 81 (Mar./Apr. 1973), pp. S570–95; Willis, "Economic Theory"; and Becker and Tomes, "Rise and Fall."

53. Instruments for grandparental wealth are equally important. Lifetime parental wealth had a positive effect on fertility throughout much of the range, lifetime grandparental wealth a negative effect, and grandparental fertility a positive effect. In contrast, coefficients on cross-sectional grandparental wealth terms are of the same sign as those on parental wealth terms, while the coefficient on grandparental fertility is negative. In estimating equation (3′), grandparental cross-sectional wealth suffers from the selection problem discussed in footnote 51: only families with grandparents living at the time of the observation are included. Cross-sectional grandparental wealth serves partly as a measure of the bequest expected by parents, so it is not surprising that the coefficients on parental and grandparental wealth are both positive when cross-sectional grandparental wealth is used. For all these results, see Wahl, "Fertility in America," pp. 81–87.