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THE DEMAND FOR HEALTH INPUTS AND THEIR IMPACT ON THE BLACK NEONATAL MORTALITY RATE IN THE U.S.

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ABSTRACT

Relatively high birth rates among black adolescents and unmarried women as well as inadequate access to medical care are considered primary reasons why the black neonatal mortality rate is almost double that of whites. Using household production theory, this paper examines the determinants of input utilization and estimates the impact of utilization on the survival of black infants across large counties in the U.S. in 1977. The results indicate that expanding the availability of family planning clinics increases the number of teenagers served resulting in a lower neonatal mortality rate. Accessibility to abortion services operates in a similar manner. Moreover, the use of neonatal intensive care, which is strongly related to its availability, is an important determinant of newborn survivability whereas the initiation of early prenatal care is not. Overall, the results suggest that lowering the incidence of low weight and preterm births among blacks by helping women to avoid an unwanted birth, may be the most cost-effective way of improving black infant health.

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I. Introduction

Black infants die in the first month of life at almost double the rate of white infants. Despite dramatic declines in the neonatal mortality rate for both races over the past twenty years, the gap between whites and blacks remains. In a comprehensive summary of the literature on infant health, the _Report of the Secretary's Task Force on Black and Minority Health_ (Department of Health and Human Services 1986) related the poor birth outcomes of minorities to low socioeconomic status and differential patterns of childbearing. The _Report_ concluded by recommending that efforts be increased to reduce the number of unintended pregnancies and that more prenatal and perinatal services be made accessible to high-risk women.

The Report's conclusions, like much of the literature on birth outcomes, failed to examine in a comprehensive way all the relevant etiological pathways. For instance, numerous studies have documented an association between teenage childbearing and adverse birth outcomes (Taffel 1980; McCormick et al. 1984); others have found the use of abortion and family planning services to be inversely related to the birth rates of adolescent and unmarried women (Forrest el al. 1981; Brann 1979; Berkov and Sklar 1973). Still other research has linked the availability of abortion and family planning services to lower infant death rates (Corman and Grossman 1985). Lacking, however, has been an attempt to trace out the various hypothesized pathways from availability to use and from utilization to birth outcomes.

The purpose of this paper is to apply a more unified framework to assess the relative potential of various strategies for reducing the difference in white and black infant health. In particular, to what extent do variations in the availability of abortion and family planning services alter their utilization and to what extent do these differences in utilization result in healthier black infants. Attention is also focused on how variations in schooling levels, poverty, and programs such as Aid to Families with Dependent Children (AFDC) and Medicaid affect the demand for prenatal and neonatal care and the impact of these differences on the early infant death rate among blacks.

The empirical framwork is based on the economic model of infant health developed by Rosenzweig and Schultz (1983a, 1983b). A structural relationship, or production function, exists between the use of an input, such as medical care, and the health of the offspring. Utilization of the input is constrained by its price and availability, the parents' income or command over resources, their tastes, and their expectation as to the probable birth outcome. Rosenzweig and Schultz argue that parents with poor endowed reproductive capability may attempt to offset these unfavorable prospects by utilizing more health inputs. Thus, the use of inputs not only affects the outcome, but the anticipated outcome may also affect utilization. To overcome the potential reverse causality, the production function and input demand equations are estimated jointly. The end result is a more unified approach from which to obtain unbiased estimates of various policy interventions.

Rosenzweig and Schultz (1983a, 1983b) were unable to examine black birth outcomes due to limitations in their data. Moverover, they did not control for a number of inputs that in light of the Secretary's Report, may hold the greatest potential for reducing the adverse birth outcomes of minorities. Conspicuous among them were the use of abortion and family planning services, and the application of neonatal technology to ill and premature infants.

The empirical analysis is based on a cross-section of U.S counties in 1977. The black neonatal mortality rate (deaths of black infants within the first 27 days of life per thousand live births) is the principal birth outcome and the percentage of low-birth weight births (less than 5.5 pounds) among blacks is the intermediate birth outcome. This allows the total effect of an input on neonatal mortality to be decomposed into its direct and indirect components, the latter being its effect on low birth weight.

II. Analytical Framework and Empirical Model

Economic models of the family developed by Becker and Lewis (1973) and Willis (1973) have been used by numerous authors in theoretical and empirical studies of the determinants of birth outcomes (Rosenzweig and Schultz 1982,1983a,1983b; Corman and Grossman 1985) Accordingly, I assume that the parents' utility function depends on their own consumption, the number of births, and the health of each child at birth. Moveover, the infant health production function depends on the quality and quantity of medical care, the mother's own time, and the mother's reproductive efficiency. The latter factor includes an unobserved genetic component which is frequently referred to as the infant's health endowment (Rosenzweig and Schultz 1982). Maximization of the utility function subject to the production and resource constraints yields a demand function for infant health. The interaction between the demand for and production of infant health generates the derived demands for medical care and the other inputs.

An empirical model of infant survival is complicated by the existence of intermediate birth outcomes. Specifically, there is overwhelming evidence that birth weight is the most important predictor of neonatal mortality (Institute of Medicine 1985). Furthermore, a newborn's weight is closely related to gestational age (Rosenzweig and Schultz 1982). Consequently, to understand how an input such as medical care impacts on survival, it is important to measure its indirect effects through the intervening birth outcomes and risk factors. To clarify these ideas, the empirical model can be written as follows:

$$d=f_1(n,m,a,c,b,z,e) \qquad (1)$$

$$b=f_2(m,a,c,s,r,g,z,e) \qquad (2)$$

$$g=f_3(m,a,c,s,r,z,e) \qquad (3)$$

$$r=f_4(a,c,x,z,e) \qquad (4)$$

$$n,m,a,c,s=f_j(p,y,x,z,e) \quad j=5,..9 \qquad (5)-(9)$$

The probability that an infant's health deteriorates to the point that he or she does not survive the first month of life is represented by equation (1). Equations (2) and (3) give the likelihood that a newborn is of low weight or preterm (less than 37 weeks gestation) respectively. The basic set of inputs used in the production of infant health are neonatal intensive care (n), prenatal care (m), abortion (a), organized family planning use (c), and smoking (s). The other variables are (z), a measure of environmental conditions; (r), a vector of endogenous risk factors such as age, marital status, parity, and spacing between births; (x), a demographic measure that determines the age of a mother at the time of birth; and (e), the unobserved health endowment.

Equations (1)-(4) are the production functions and they constitute the structural equations of the model. Equations (5)-(9) are the input demand functions for they relate the use of an input to its price and availability (p), income and resource constraints (y), and the other exogenous determinants mentioned previously.

The empirical focus in this paper is twofold: first, to understand the factors which determine the utilization of health inputs among blacks [equations (5)-(9)]; and second, to measure the impact of these inputs on early infant survival [equation (1)]. However, to assess the indirect effect of an input on neonatal mortality, birth weight (b) in equation (1) is replaced by its endogenous determinants.[1] In particular, substituting equation (4) into (3), equations (3) and (4) into equation (2), and this altered version of equation (2) into equation (1) yields what will be referred to in this paper as the quasi-structural production function:

$$d=f_{10}(n,a,c,m,s,x,z,e) \qquad (10)$$

The estimation of equation (10) in conjunction with equation (1) allows a more refined understanding of the mechanisms through which an input operates. For instance, evidence suggests (see above) that abortion and family planning have their primary impact of early infant survival by reducing the rates of adolescent childbearing (equation 4). Reductions in these high-risk births results in lower rates of low-weight and preterm births (equations 2 and 3) which in turn enhance the probability of survival. Therefore, equation (10) measures the total effect of an input on neonatal mortality while equation (1) captures the direct effect.

III. Empirical Implementation

A. Data and Measurement of Varibles

Table 1 contains a description of the variables used in the production functions as well as the input demand equations. The five basic inputs utilized in the production of infant health are the use of neonatal intensive facilities, prenatal care, the abortion rate, the use of family planning clinics by teenagers, and adult per capita smoking.[2] Except for smoking, all the inputs should be negatively related to the neonatal mortality rate in the quasi-structural production function (equation 10).

However, except for neonatal intensive care, the other inputs should have their primary impact on neonatal mortality through low birth weight. Nevertheless, they may evidence a sizeable direct effect if other relevant inputs are missing. For instance, early prenatal care has been linked to an increases in newborn survivability by prolonging gestation and enhancing birth weight (Harris 1982; Institute of Medicine 1985) Yet, early prenatal care may be directly related to the quality and quantity of perinatal care. If measures of the latter are lacking or insufficient, as in this study, then prenatal care may have a direct effect on neonatal mortality.[3] Finally, the natural logarithm of population density is included in the the structural equations to control for variations in urbanization. The pollution and stress associated with overcrowding and poor housing conditions has been linked to poor birth outcomes (Lave and Seskin 1973; Bakketeig et al. 1984)

With respect to the input demand equations, the use of an input should be positively related to its availability. As Corman and Grossman (1985) argue, the more available an input the lower the direct and indirect cost of obtaining it. This may be especially true of the medical resources examined in this study. Private health insurance, Medicaid and government subsidies often reduce or eliminate the fees associated with their consumption. Utilization of an input should also vary directly with income, or more broadly, the command over resources. Thus, measures of Medicaid as well as AFDC benefits per recipient are included as determinants. Finally, women with greater schooling levels may be more aware of the relationship between early prenatal care and healthy birth outcomes. Hence, even controlling for income, education may have a positive effect on the demand for prenatal care.

Counties are used as the unit of observation instead of states or

SMSA's because they are more homogenous with respect to socioeconomic characteristics and medical resources. However, small counties present two potential problems: first, people may travel outside the county for medical services and second, sparsely populated counties with few births may show large fluctuations in mortality due to random movements. To minimize these difficulties, only counties with a 1970 population of 50,000 or more in which there were at least 5,000 blacks are included in the sample. This yields a sample 357 counties which represents approximately 80 percent of the black population in the U.S.[4]

B. Estimation

Following Rosenzweig and Schultz (1983b), it is anticipated that the residuals in the structural equations will be correlated with the health inputs. This expectation is based on the assumption that individuals have some information concerning their genetic health endowment which is unknown to the researcher but which causes the parents to alter their behavior with respect to their use of inputs. For example, ultrasound and amniocentesis are direct methods of obtaining information concerning the health of the fetus. Responses to such information range from abortion to intensified prenatal and perinatal care. Such remedial behavior creates a correlation between the use of the health inputs and the unobserved endowment term imbedded in the residuals. In short, the use of health inputs may not only affect the birth outcome, but the anticipated birth outcome may also affect utilization. Because of the reverse causality, ordinary least squares may yield biased and inconsistent estimates.[5]

The need for an instumental or two-stage estimation procedure links the estimation of the production function to the input demand equations. In the first stage, family planning, abortion, neonatal intensive care, prenatal care, and birth weight are regressed on the set of reduced form determinants (see Table 1).[6] The predicted values from the input demand equations are used to obtain the structural estimates. The underlying assumption of this two-stage procedure is that the resource and availability measures vary independently of the health endowment.[7]

Finally, the infant health production functions are assumed to be linear. All regressions are weighted by the number of black births between 1976 and 1978. Work by Joyce (1985) with similar data found that a Cobb-Douglas and logistic functional form generated results with little qualitative difference.

IV. Results

Ordinary Least Squares (OLS) estimates of the input demand equations are presented in Table 2. Estimates of the structural as well as quasi-structural production functions are displayed in Table 3. These results are obtained by OLS and Two-Stage Least Squares (TSLS). The coefficients from the quasi-structural production functions measure the total effect of an input on neonatal mortality. Estimates of the direct effect of an input are from the specifications that include the percentage of low-birth weight births. Subtracting the latter coefficients from the former yields the indirect effects (through low birth weight) of an input on early infant deaths

Table 2 reveals that the hypothesized relationship between input use and input availability is well-supported by the data. Increases in family planning clinics, abortion providers, neonatal intensive care hospitals, and community health centers are strongly and positively associated with increased teenage family planning use, the abortion rate, the number of inpatient days in an NIC unit and the percentage of women who initiate prenatal care in the first trimester respectively. In short, the own shadow price effects are as hypothesized.

Schooling and poverty play a significant role in the demand for early prenatal care. The greater the percentage of black women with a high school education, the greater the percentage of women who intitate care in the first trimester. Women of childbearing age with income less than 200 percent of the poverty level are less likely to begin prenatal care in the first three months of their pregnancy.

Generous AFDC benefits are associated with a lower probability of organized teenage family planning use as well as a lower probability of abortion. The latter relationship is not statistically significant. This suggests that relatively generous AFDC programs may lower the incentives to avoid an unplanned birth.[8] At the same time, better funded AFDC programs enhance access to early prenatal care and the more costly neonatal intensive care. This latter result has important implications for the survival of black infants as will be seen when the estimates of the production function are examined below.

The Medicaid measures may be too imprecise and too highly correlated to safely interpret. Nevertheless, the null hypothesis that the coefficients of all five Medicaid variables are zero is rejected at the .01 level in all four equations.

The Wu statistic in Table 3 indicates that the null hypothesis of zero correlation between the health inputs and the error term is never accepted at conventional levels. Comparison of the estimates obtained by OLS as opposed to TSLS supports the contention of Rosenzweig and Schultz (1982, 1983a, 1983b) that direct correlation methods may mask the impact of inputs on infant health. In particular, the TSLS coefficient for teenage family planning use and neonatal intensive care is at least three time greater than its OLS counterpart. The same is true qualitatively for abortion: OLS understates its impact on neonatal mortality. Consequently, all subsequent discussion of the production function results focuses on the TSLS estimates.

Estimates of the quasi-structural production functions are as anticipated (regression 3-2). Each input has the hypothesized sign but only abortion, family planning use and neontal intensive care are statistically significant at the one percent level. The smoking measure is neither race- nor sex-specific. This may account for its lack of significance.

The most surprising result is the absence of a relationship between early prenatal care and neonatal mortality (regression 3-2). Rosenzweig and Schultz (1983a), for example, report a statisitically significant effect of prenatal care on infant mortality with individual births. However, their specification differed in several important aspects than the one presented in this paper which may account for the contrasting results. For instance, they lacked a measure of neonatal intensive care. This omission is probably serious given the evidence linking the decline in the U.S. neonatal mortality to improvements in birth weight-specific survival. Advances in the management of unhealthy neonates is considered the most compelling explanation for the improved survivability (Lee et al. 1980; McCormick 1985). The results of this study with respect to neonatal intensive care (regressions 3-2 and 3-4) are consistent with this interpretation. Second, Rosenzweig and Schultz were unable to estimate a separate production function for blacks. However, since black infants are twice as likely as white infants to be low weight or preterm, variations in the black neonatal mortality rate should be more sensitive to the utilization of such specialized neonatal care.[9]

A comparison of the estimated quasi-structural and structural equations (regressions 3-2 and 3-4) distinguishes the direct from indirect effect of an input on neonatal mortality. In particular, the abortion coefficient falls by 47 percent when the percentage of low-birth weight births is held constant. This indirect effect is as expected. By allowing women to avoid an unwanted birth, abortion improves the distribution of births among high-risk groups (Sklar and Berkov 1973; Shelton 1977; Brann 1979). This "healthier" cohort lowers the likelihood of a low-birth weight birth.

There is also evidence that abortion effects mortality directly (regression 3-4). This suggest that the process of fetal selection encouraged by abortion enhances the survivability of risk-specific births as well as reduces the incidence of low birth weight. The former effect may be the result of births being better planned or "more wanted" (see footnote 3). It is noteworthy that the "wantedness" of blacks births as measured by the National Center for Health Statistics (1985) has increased more rapidly for blacks than whites since 1973, the year the Supreme Court legalized abortion nationally.

Teenage family planning use is an important determinant of black neonatal mortality. However, it operates somewhat inconsistently for its impact on mortality increases slightly when the percentage of low-birth weight births is held constant. Put differently, the indirect effect of family planning use among adolescents is essentially zero. One explanation is that a high percentage of teenage users may be indicative of a relatively high proportion of sexually active adolescents. Even if family planning use is effective in preventing pregnancies among users, the fraction of teens who give birth may still be greater in these high-use counties than in counties where both adolescent sexual activity and organized family planning use are less frequent.

At the same time Chamie et al. (1982) report that family planning clinics in counties that serve a relatively high proportion of women at risk of pregnancy are more likely to provide supportive services such as prenatal care than clinics in counties that serve a smaller proportion of such women. Consequently, a relatively large fraction of teenage family planning users may be indicative of a population that has been integrated into a network of prenatal and perinatal care. Births to these young women may still be problematic (that is, premature or light), but with better support and care their offspring may be more likely to survive.

V. Discussion

This study has analyzed the determinants of black neonatal mortality using an economic model of infant health that emphasizes the determinants of input utilization as well as the impact of these inputs on survival. This unified approach outlines the mechanisms by which various interventions operate on neonatal mortality. For example, The Report of the Secretary's Task Force on Black and Minority Health recommended that the promotion of pregnancy planning be a primary focus of infant health policy (DHHS 1986). The estimates obtained from this study indicate that a ten percent increase in the number of family planning clinics per women aged 15 to 44 would increase adolescent utilization of family planning clinics by one percent. This in turn would result in five fewer neonatal deaths per 100,000 live births.

A more controversial finding is that the same increase in abortion availability would have a similar impact (2 deaths saved per 100,000 live births). Moreover, if more public funds were available to cover the cost of abortion for indigent women, the impact would be greater.[9] Few would argue that averting unintended pregnancies is a preferable strategy for reducing unwanted births. However, only one-third of all sexually active teenagers use contraception consistently (Zelnik and Kantner 1980). Further, contraceptive use among black teenagers is inversely related to social class and neighborhood quality (Hogan et al. 1986). In short, abortion will remain an important option for many black and minority women trying to avoid an unwanted birth.

The utilization of neonatal intensive care is shown to be a major determinant of black neonatal mortality. Such care, however, is extremely expensive. Budetti (1981) estimates the average cost per patient for such specialized care to be approximately $8,000 in 1978 dollars. When inflated by the Medical Component of the Consumer Price Index to reflect 1984 prices, this figure becomes $13,616. Clearly, in a period of fiscal constraint, the cost-effectiveness of neonatal intensive care relative to strategies designed to prevent low-birth weight births should be an important focus of future research.

Finally, a methodological note, this study supports the proposition of Rosenzweig and Schultz that the correlation between the health inputs and the unobserved endowment term tends to mask the effect of the behavioral inputs on infant health. This source of bias may become increasing more important as rapidly advancing techniques of prenatal diagnosis, such as amniocentesis and ultra sonography, are more routinely employed. Such procedures enhance the information known to parents and physicians about the health of the fetus. Decisions to abort, or to intensify prenatal and perinatal care, based on this information increase the correlation between the use of these inputs and the endowment term.

Table 1

Definitions of Varibles, Means and Standard Deviations[a]

Variable	Definitions
Birth Outcomes	
Neonatal mortality rate	Three-year average black neonatal mortality rate centered on 1977; deaths of infants less than 28 days old per 1,000 live births (x=16.39, s=3.30)
Low birth weight	Three-year average percentage of black low-birth weight (2,500 grams or less) live births centered on 1977 (x=13.02, s=1.23)
Endogenous Inputs	
Teenage family planning users[b]	Percentage of nonwhite women aged 15-19 who used organized family planning clinics in 1975 (x=24.18, s=9.66)
Abortion rate	Three-year average state-specific resident abortion rate centered on 1976; abortions performed on state residents per 1,000 women aged 15-44 (x=25.75, s=8.60)
Prenatal care[c]	Three-year average percentage of live black births for which prenatal care began in the first trimester (first three months) of pregnancy centered on 1977 (x=59.88, s=11.06)
Neonatal intensive care	Sum of state-specific hospital inpatient days in Level II, Level III, or Levels II and III neonatal intensive care units in 1979 per state-specific three-year average number of black births centered on 1977 (x=1.50, s=1.01)
Cigarettes[d]	State-specific daily number of cigarettes smoked per adult 18 years and older in 1976 (x=7.48, s=.35)
Reduced Form Determinants	
High-risk women	Ratio of nonwhite women ages 15 to 19 and 40 to 44 over the total number of nonwhite women 15 to 44 in 1975 (x=.35, s=.03)
Ln population density	The natural logarithm of the ratio of the population in 1975 to the area per square mile (x=7.315, s=1.691)

Percent poor	Percentage of black women aged 15-44 with family income less than 200 percent of the poverty level in 1980 (x=54.90, s=9.36)
High school education	Percentage of nonwhite women aged 15-49 who at least a high school education in 1970 (x=44.12, s=8.96)
Medicaid elegibility-1	Dichotomous variable that equals one if county is in state that covered first-time pregnancies under Medicaid to financially eligible women in the period 1976-1978 (x=.26, s=.44)
Medicaid elegibility-2	Dichotomous variable that equals one if county is in state that covered first-time pregnancies under Medicaid only if no husband was present or if the husband was present but unemployed and not receiving unemployment compensation in the period 1976-1978 (x=.11 s=.31)
Medicaid elegibility-3	Dichotomous variable that equals one if county is in state that covered first-time pregnancies under Medicaid only if no husband was present in the period 1976-1978 (x=.17, s=.37)
Medicaid coverage	Dichotomous variable that equals one if county is in state in which Medicaid paid for newborn care under the mother's number but allowed pregnant women to register their "unborn children" with Medicaid in 1981 (x=.94, s=.23)
Medicaid payments	State specific average annual Medicaid payment per adult recipient in AFDC families in fiscal 1976 (x=448.56, s=137.22)
Family planning clinics	Number of organized family planning clinics in 1975 per 1,000 women aged 15-44 with family income less than 200 percent of the poverty level in 1975 (x=.31, s=.22)
Community health centers	Sum of maternal and infant care (M and I) projects and community health centers (CHCs) in 1976 per 1,000 women aged 15-44 with family income less than 200 percent of the poverty level in 1975; numerator termed Bureau of Community Health Services (BCHS) projects (x=.02, s=.03)
Abortion providers	Three-year average of abortion providers centered on 1976 per 1,000 women aged 15-44 in 1975 (x=.05, s=.04)
Neonatal intensive hospitals	Sum of state-specific number of hospitals with Level II, Level III, or Levels II and III neonatal intensive care units in 1979 per 1,000 women aged 15-44 in state in 1975 (x=.01, s=.003)
AFDC payments	Three-year average AFDC monthly payment per recipient centered on 1977 (x=69.41, s=26.32)

Notes to Table 1

*All variables are calculated for counties unless otherwise specified. The mean (x) and standard deviation (s) for each variable is in parentheses. All are weighted by the three year sum of black births in 1976-1978. Data on births by weight from 1976 through 1978 are from the National Center for Health Statistics (NCHS) Natality Tape. Neonatal deaths over the same period are from the NCHS Mortality Tape. Socioeconomic characteristics are taken from the Census of Population, and data on neonatal intensive care are from the American Hospital Association and from Ross Planning Association of Ross Labratories (1982). Information relating to family planning and abortion are from the Alan Guttmacher Institute. Finally, measures pertaining to the services and programs used in the reduced form input demand equations are from Area Resource File and Corman

[b] The estimates of teenage family planning use were adjusted by the Alan Guttmacher Institute to compensate for cross-county utilization. However, in 26 counties the figures appeared abnormally high (above 50 percent or greater than 2.5 standard deviations from the mean adjusted for the outliers). In these cases the state mean was substituted.

[c] Four states, Kansas, Pennsylvania, Ohio, and Virginia have data on the percentage of women who initiated prenatal care in one of the first three months for 1978 only. Because this variable has trended upwards nationally, data for 1976 and 1977 by county in these particular states were estimated by deflating the 1978 figures by the national rates of growth between 1976 and 1978. The three-year average for the counties in these states incorporated these estimates for 1976 and 1977.

[d] The smoking variable is taken from Lewit (1982) who estimated it from a micro-level study of the demand for cigarettes (Lewit and Coate 1982). Lewit applied the coefficients of the fitted demand functions to state means of the independent variables to arrive at the figures used here. The advantage of Lewit's variable over the readily-available tax-paid sales per state is that his measure adjusts for the substantial "bootlegging" of cigarettes at both the individual and group level. Because of this smuggling, data from tax-paid sales underestimate consumption in high-tax states and overestimate it in low-tax states.

Table 2

Ordinary Least Squares Estimates of the Input Demand Equations[a]

Independent Variables	Teenage Family Planning Users*	Abortion Rate	Prenatal Care*	Neonatal Intensive Care*
Abortion providers	-10.313	25.281	11.311	4.823
	(-.69)	(3.06)	(.72)	(2.92)
Family planning clinics	10.252	2.783	3.915	-.068
	(4.29)	(2.11)	(1.56)	(-.26)
Community health centers	44.665	-12.067	26.916	.548
	(2.91)	(-1.42)	(1.67)	(.32)
Neonatal intensive hospitals	-185.631	-1034.908	480.237	105.938
	(-0.97)	(-9.93)	(2.42)	(5.07)
Medicaid elegibility-1	-.249	7.132	-4.119	-.133
	(-.14)	(7.02)	(-2.12)	(-.65)
Medicaid elegibility-2	-5.425	-.520	5.096	.823
	(-3.42)	(-.59)	(3.05)	(4.69)
Medicaid elegibility-3	1.390	-6.539	3.955	.284
	(.87)	(-7.39)	(2.34)	(1.60)
Medicaid payment/recipient	-.015	.017	-.017	.0004
	(-3.42)	(7.03)	(-3.75)	(.78)
Medicaid coverage	.406	-.193	-7.801	-.632
	(.20)	(-.17)	(-3.62)	(-2.79)
High school education*	.002	.064	.366	-.003
	(.03)	(1.24)	(3.70)	(-.33)
Percent poor*	.094	.021	-.297	-.00006
	(1.22)	(.50)	(-3.66)	(-.008)
AFDC payments	-.089	-.025	.079	.016
	(-2.19)	(-1.12)	(1.83)	(3.62)
High-risk women*	-10.279	-56.617	-4.479	-.189
	(-.43)	(-4.31)	(-.18)	(-.07)
Ln population density	1.264	-.109	-1.924	-.066
	(3.35)	(-.52)	(-4.84)	(-1.59)
Constant	24.678	43.695	77.711	.061
	(1.94)	(6.21)	(5.79)	(.04)
F	9.88	64.85	14.19	6.28
Adjusted R^2	.259	.715	.367	.172
Sample size	357	357	357	357

[a]The t-ratios are in parentheses. The critical t-ratios at the 5 percent level are 1.64 for a one-tailed test and 1.96 for a two-tailed test. The F-ratio associated with each regression is significant at th e 1 percent level. An asterisk (*) next to a variable means it is race-specific.

Table 3

Ordinary Least Squares (OLS) and Two-Stage Least Squares (TSLS) Estimates of the Black Neonatal Mortality Rate Quasi-structural and Structural Production Functions

Independent Variables	Quasi-Structural Neonatal Mortality OLS (3-1)	Quasi-Structural Neonatal Mortality TSLS (3-2)	Structural Neonatal Mortality OLS (3-3)	Structural Neonatal Mortality TSLS (3-4)
Teen family planning users*[b]	-.026	-.156	-.033	-.162
	(-1.37)	(-3.10)	(-1.86)	(-3.28)
Abortion rate[b]	-.061	-.148	-.041	-.078
	(-2.13)	(-3.26)	(-1.81)	(-1.66)
Prenatal Care*[b]	.002	-.026	.008	.067
	(.11)	(-.66)	(.49)	(1.38)
Neonatal intensive care*[b]	-.368	-1.340	-.437	-1.679
	(-2.16)	(-2.34)	(-2.74)	(-2.91)
Cigarettes[b]	.602	.856	----	----
	(1.10)	(1.47)	----	----
High-risk women*	7.240	-3.569	----	----
	(.84)	(-.33)	----	----
Birth weight*[b]	----	----	1.032	1.371
	----	----	(7.31)	(2.64)
Ln population density	.476	.564	.121	.216
	(3.68)	(3.45)	(1.01)	(1.05)
Constant	8.461	18.106	4.087	1.340
	(1.36)	(2.35)	(1.82)	(.16)
Adjusted R^2	.044		.169	
F	3.35	4.32	13.05	5.96
N	357	357	357	357
Wu test, F=	4.42		2.73[c]	

[a] Asymtotic t-ratios in parentheses. The critical asymtotic t-ratios at the 5 percent level are 1.64 for one-tailed and 1.96 for a two-tailed test. In this table and others that contain regression results, the F-ratio associated with each regression is significant at the 1 percent level unless otherwise indicated.

[b] Endogenous

[c] Significant at the 5 percent level.

Footnotes

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1 To clarify the notion of a direct and indirect effect consider the following model:

$$d = a_0 + a_1X + a_2b$$

$$b = c_0 + c_1X$$

where d is neonatal mortality, b is birth weight, and X is an input such as prenatal care. The direct effect of prenatal care on neonatal mortality is a_1. The total effect, $a_1 + c_1a_2$, is obtained by substituting for b in the mortality equation; it is the sum of the direct and indirect effects.

2 This study focuses on teenage family planning use as opposed to the utilization of family planning clinics by all women of childbearing age for several reasons. First, only the former measure is race-specific. Second, teenagers are disproportionate users of family planning clinics (Torres and Forrest 1983). Third, adolescent births and births to unmarried teenagers have well-documented, above average risks of prematurity and neonatal mortality (Taffel 1980; Elster 1984). Moreover, Forrest et al. (1981) report that for every ten adolescents enrolled in family planning clinics in 1975, three pregnancies were averted the following year. Consequently, measures of infant health may be more sensitive to organized teenage family planning use than to variations in use by all women.

3 The same argument pertains to abortion. Consider adolescents who become pregnant. Those with strong educational and employment goals may have a high propensity to abort. Subsequent pregnancies are likely to be better planned ("more wanted") and to receive large quantities of unmeasured inputs that improve survival.

4 Three-year averages are also used to attenuate the effect of random elements arising in counties with few infant deaths.

5 To test whether a significant correlation between the production function residuals and the health inputs does exist, Wu's T_2 statistic (Wu 1973) as described by Nakamura and Nakamura (1981) is applied. Where the null hypothesis of zero correlation between the error term and the regressors is rejected, two-stage least squares (TSLS) is used to estimate the birth outcome production functions.

[6] Cigarette smoking is also endogenous but is excluded from the first stage becuase the measure used is already a predicted value generated from a micro reduced form demand function for cigarettes. Technically, this procedure amounts to assuming that the quantity of cigarettes consumed depends only on the predictors employed by Lewit (income, price, education, age, sex and race) and not on the availability measures of the other inputs.

[7] Of the four structural equations presented in the text, only equations (1) and (4) satisfy the rank and order conditions for indentification. Equation (4) is not estimated in this study. With respect to equation (1), the percentage of preterm births, the percentage of births to high-risk women and smoking per capita are excluded. All three risk factors are primary correlates of low birth weight and would be expected to have little impact on neonatal mortality in a specification that controled for the percentage of low-birth weight births (Institute of Medicine 1985).

[8] Leibowitz et al. (1986), using individual data and a model that treated abortion as one of three alternatives for pregnant teenagers, found that AFDC was positively related to the decision to remain unmarried and carry the pregnancy to term. The determinants of teenage sexual activity and contraceptive use are more complicated and the link between relatively generous AFDC benefits and unmarried childbearing is less convincing (Jones et al. 1985).

[9] Corman and Grossman (1985), for instance, found that the availability of neonatal intensive care was twice as effective at reducing the early infant death rate among blacks as opposed to whites.

[10] The Hyde Ammendment, which restricted the use of federal funds for legal abortions is estimated to have prevented between 18,000 and 30,000 Medicaid-eligible women from obtaining an abortion (Henshaw et al. 1981). In fact, the nonwhite abortion rate fell on average 2.4 percent per year between 1977 and 1979 (Henshaw 1983). Based on the coefficients in the production function this would result in 20 extra black neonatal deaths per 100,000 black births.

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