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The effects of prenatal care and WIC participation on birth outcome production functions in New York City

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THE EFFECTS OF PRENATAL CARE AND WIC PARTICIPATION ON BIRTH OUTCOME PRODUCTION FUNCTIONS IN NEW YORK CITY

by

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Abstract

THE EFFECTS OF PRENATAL CARE AND WIC PARTICIPATION ON BIRTH OUTCOME PRODUCTION FUNCTIONS IN NEW YORK CITY

by

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Birthweight production functions for New York City are estimated by race/ethnicity for adult and adolescent mothers for the three year period of 1988 through 1990. In 1988 the New York City birth certificates began recording new items which include information about potential risk factors during pregnancy such as pre-pregnancy weight, pregnancy weight gain, use of substances such as drugs, alcohol, and cigarettes and employment status during pregnancy; the effects of these new inputs on the production functions are examined. Another purpose of this study is to examine the impact on the production function of participation in the WIC program. Different estimates of the production functions are shown with prenatal care and WIC participation being treated as exogenous and endogenous inputs to the production function. Equations for prenatal care demand and the probability of WIC participation are also estimated.

The main results of this study are that a delay in prenatal medical care causes a reduction in birthweight while prenatal WIC participation causes an increase in birthweight. When delay is treated

endogenously the magnitude of the effect of delay is larger than when it is treated exogenously for birth outcomes of all adults. When WIC enrollment is treated endogenously, the magnitude of the effect of WIC is smaller than when it is treated exogenously for blacks, but is larger for whites and Hispanics.

For the birth outcomes of the adolescents, prenatal care delay has a negative significant effect on birthweight when treated exogenously. When delay is treated endogenously, the magnitude of this effect greatly increases for whites and Hispanics while it is no longer significant for blacks. WIC participation has a positive significant effect on the birth outcomes of black adolescent mothers when it is treated exogenously and endogenously; it has a positive significant effect on birthweight for Hispanic adolescents only when treated exogenously, and it does not have a significant effect on the birthweight for white adolescents when treated in either manner.

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I. Introduction

The purpose of this paper is to estimate infant health production functions for New York City. The estimation will be done for white non-Hispanics, black non-Hispanics and Hispanics separately for births that occurred during the three year period of 1988 through 1990. In addition, estimation will be performed separately for adult and adolescent mothers of these three race/ethnicities. Beginning in 1988, NYC birth certificates began measuring new variables which may be potential risk factors to the pregnancy outcome. The impact of these new variables on the production function will be examined as well as the impact of other health inputs. Birthweight is the infant health measure used in this study. Birthweight is considered an important measure of infant health. The risk of infant mortality increases with decreases in birthweight, and low birthweight (weight at birth of less than 2500 grams) is a major cause of infant mortality. In addition, the effect of prenatal care on birthweight will be studied in a model that includes the new risk factor measurements and thus controls for more variables than studies performed in the past like Joyce (1994). It is thought that sample selection occurs because of the correlation between unobserved variables and prenatal care, and this study controls for more of the previously unobserved variables. Another aspect of this paper is to examine the impact on the production function of participation in the Special Supplemental Nutrition Program for Women, Infants and Children, (the WIC program). Both prenatal care and WIC participation will be treated as exogenous and endogenous inputs to the production function. When treated endogenously, equations for prenatal care demand and the probability of WIC participation are also estimated. Prenatal care and WIC participation are treated endogenously in order to control for potential selection bias in estimates of the production function due to unobservables.

The organization of this paper is as follows. In the next chapter, a discussion of the WIC program and a review of related literature is given. This is followed by a discussion of the analytical framework which is utilized. In the fourth chapter, the data that is used is described. In the fifth chapter the results of the analysis of the determinants of prenatal care and birthweight for adult women are shown. In the sixth chapter an in depth examination of the impact of prenatal participation in the WIC program for adults is given. In the seventh chapter, the analyses of the fourth through sixth chapters are applied to adolescent mothers. In the final chapter, a summary and conclusions are offered.

II. Description of the WIC program and literature review

A. Description of the WIC program

The WIC program is a federal program that provides nutrition assistance in the form of food, nutrition education and referral to health services for low-income women who are pregnant, breast-feeding and postpartum, and for infants and preschool children who are at nutritional risk. The goal of the program is to improve the health and nutrition of participants through nutrition intervention which includes providing supplemental foods and nutrition education. The creation of WIC was authorized in 1972 by an amendment to the Child Nutrition Act. When it began in 1974, it had 88,000 participants. In 1988, it had 3.6 million participants; 450,600 of these were pregnant women. 11.52% of the pregnant women were less than 18 years of age, 84.57% were between the ages of 18 and 34 and 3.91% were over 34 years of age (Williams et al. 1990). In 1990, the WIC program served 4.5 million participants of which about 612,000 were pregnant women (Abrams 1993).

While the program is federally funded, it is administered by states who set up local WIC agencies, so eligibility criteria can vary from state to state. The state either authorizes agencies or set up its own agencies who then provide services through local sites. Sites are selected on the basis of need; areas of low income, with high infant mortality rates and with low birthweight rates are targeted (Rush et al. 1986). The goal of WIC for pregnant women is to improve birth outcomes such as birthweight and gestational age and to increase weight gain during pregnancy. WIC participants are prescribed nutrient rich food which may be given by the local agency or given in the form of vouchers or checks, which specify the type and quantity of food, that can be exchanged for the food at an authorized store. The contents of a WIC package prescribed for pregnant women are generally milk, cheese, eggs, juice, peanut butter, beans and cereal (Williams et al. 1990).

To be eligible for WIC participation a pregnant woman must have a low income and be at nutritional risk. The income eligibility for New York State is having household income at or less than 185% of the federal poverty level (Williams et al. 1990). In addition, women receiving food stamps, Medicaid or AFDC are considered automatically eligible (Matsumoto 1992). There are different risk categories that must be met in order to be eligible for WIC participation. These are anthropometric risks which include having high or low pre-pregnancy weight for the woman's height and weight loss or inappropriate weight gain during the pregnancy; obstetrical risks for the current pregnancy which include being of low or high age and having gestational diabetes; obstetrical risks during previous pregnancies which include things like delivering a low birthweight or premature baby, or having a stillbirth, miscarriage or spontaneous abortion previously; medical and health risks like drug abuse, high alcohol consumption or tobacco use during this pregnancy; and dietary risks like inadequate nutrient intake and excessive calorie or caffeine intake (Williams et al. 1990). Each state may set up its own screening program which includes having height and weight measured, a test for anemia and may include other tests.

WIC participation is often associated with increased prenatal care because the WIC program tries to link participants with health care. The WIC program encourages the use of health care and local agencies are supposed to make health care available to participants (Rush et al. 1986) or provide them with referrals for health care. Agencies providing prenatal care and WIC may be located at the same site. So WIC participation may indirectly impact birthweight by improving prenatal care.

B. Literature Review

Following, a review of literature related to birth outcome production functions, prenatal medical care, and the WIC program is presented.

Rosenzweig and Schultz (1982, 1983, 1988) estimate reduced form infant health production functions and input demand functions. They suggest that health production functions and endogenous inputs to the production function have to be estimated jointly because of exogenous variations in health among households. There are exogenous health factors known to the household but not to the researcher. These cause the mother to act certain ways with respect to her prenatal behavior. For instance, if a woman had problems in a previous pregnancy, she may seek earlier prenatal care; this is adverse selection. This means there may be correlations between inputs and outcomes, so OLS would yield biased results. TSLS must be used correct for this bias. They first look at a sample of births from 1967-1969 and then at a sample from 1980. They find that prenatal care delay has no effect in OLS on birthweight but a negative effect in TSLS. This means that adverse selection is indeed present. Rosenzweig and Schultz put education in the reduced form input demand equations, not the production functions; they think that education influences the way parents perceive the relation between inputs and outputs and so the way parents choose inputs but does not directly effect the production function if all inputs to the production function are taken into account in the estimation. They look at three birth outcomes: birthweight, gestation, and birthweight normalized for gestation. Variables they assume to be endogenous are prenatal care, smoking, age and the number of previous live births (and in 1983 the number of months that the mother worked during the pregnancy).

Rosenzweig and Schultz (1991) use 1980 data on married pregnant women to discover how medical services are distributed among these women in relation to their incomes. They look at four medical treatments: amniocentesis, ultrasound, x-ray and caesarean section. Poor and rich women are effected by different government policies. Poor women are helped by programs like Medicaid, AFDC and WIC to receive medical care and food supplements. Wealthier women are affected by medical expenses being tax deductible. Rosenzweig and Schultz find that these transfers and tax subsidies reduce the implicit price of the four medical treatments paid by the higher income women and thus encourage their use by these women. So it is not that medical care is distributed only on the basis of need but more wealthy women receive more care when care is measured by these medical treatments.

Corman, Joyce and Grossman (1987) estimate race specific infant health production functions where the neonatal mortality rate is the birth outcome. They use county level data centered on 1977. The unknown exogenous health endowment may affect the way mothers choose health inputs (for instance, mothers who expect a poor outcome may use more prenatal care) and thus bias results. There may be a reverse causality between inputs and outcomes because inputs affect the birth outcome, and mothers choose their inputs based on the anticipated outcome. Low birthweight incidence is viewed as an intermediate outcome, and the authors measure how inputs act directly on mortality and indirectly on mortality through birthweight. They estimate the production function in two ways. First, they estimate the production function using two-stage least squares with prenatal care, abortion, low birthweight and neonatal intensive care use treated as endogenous. Second, they use ordinary least squares to estimate the production function with the incidence of low birthweight used as a proxy for the health endowment in order to control for it directly. Other inputs they examine include family planning clinics, WIC, Community health centers, and maternal and infant care projects. Using the Wu test, they find that low birthweight incidence is a good measure of the unknown endowment and that OLS is appropriate for examining the direct effect of an input on neonatal mortality; TSLS is appropriate for measuring the total effect of an input. The authors then use the coefficients of the production functions calculated in the two ways and use national figures for the inputs for 1964-1977 in order to estimate the changes in mortality rates over that period. Between 1964 and 1977, both black and white neonatal mortality rates had declined. They determine that abortion, prenatal care, WIC and neonatal intensive care are the four most important factors in explaining the decreasing mortality rates over that period.

Joyce (1987) investigates the way that induced abortion affects birth outcomes. He treats abortion as endogenous and estimates race specific structural infant production functions for three birth outcomes: the neonatal mortality rate, the percentage of low birthweight births and the percentage of preterm births. Joyce uses county level data with the three year average neonatal mortality rate calculated for 1976-1978 as in Corman, Joyce and Grossman (1987); however he calculates a white and a non-white abortion rate while in Corman, Joyce and Grossman (1987) a non race-specific abortion rate was used. The endogenous inputs to the production functions include neonatal intensive care, prenatal care, the abortion rate, the use of family planning clinics by teenagers and smoking. He estimates structural production functions which show the direct effect of an input on birth outcomes and quasi-structural functions which show the total effect (direct plus indirect) of an input on the outcomes. The quasi-structural production functions differ from the structural functions in that the birth outcomes appearing on the right-hand side of the production function have been replaced by the endogenous determinants of that birth outcome of the quasi-structural production functions. Joyce proposes that abortion improves birth outcomes rates in two ways: unwanted pregnancies are terminated so high-risk mothers (young or old mothers) have lower birth rates; and unterminated pregnancies are more wanted and so receive more unmeasured inputs. Joyce finds that for both races, abortion has a negative impact on low birthweight. For whites, abortion improves low birthweight and preterm birth outcomes by reducing the proportion of births to young and older women. For blacks, abortion lowers the proportion of preterm births but has no effect on low birthweight. Thus the two ways that abortion improves birth outcomes discussed above are supported by whites and blacks respectively.

Joyce (1989) used monthly time-series data on New York City for 1970-1986 to examine the impact of unemployment on infant health where infant health is measured as the percentage of low birthweight births. Joyce estimates race specific structural production functions; he has race specific measures of low birthweight, prenatal care and marital status. Two measures of employment were used: the unemployment rate for New York City as a whole, not a race or sex specific one; and the employment-population ratio for New York City as a whole. Unemployment can be thought of as a proxy for the stress of the mother and so is a component of the production function. Unemployment may negatively impact infant health directly by increasing stress and indirectly by affecting the type and amount of inputs that the mother chooses. However, employment during pregnancy, particularly during later pregnancy and at more strenuous jobs, also may increase the risk of preterm birth. Joyce finds that there is no negative relationship between unemployment and infant health; he finds no cyclical variation in the percentage of low birthweight births for blacks or whites. His results are the same using both measures of employment, having the data detrended and in levels, using different lag-lengths, and using different functional forms. He also tests for omitted variable bias and finds none.

Joyce and Mocan (1993) examine the same issue using monthly data from Tennessee for 1970-1988. They have race-specific low birthweight rates but a non-race or sex specific unemployment race. However, they break down the unemployment rate into its cyclical and trend components. This is done to distinguish between cyclical unemployment which is temporary and structural unemployment which is more long-term. Cyclical unemployment may result in a smaller income loss and no health insurance loss while structural unemployment results in a large loss of income and health insurance and so impact health investments more. Joyce and Mocan use vector autoregressions to test the reduced form relationship between birthweight and unemployment. (In vector autoregressions each variable is regressed on the lags of itself and the other variables.) They estimate reduced form production functions because it is difficult to estimate a structural one with aggregate time-series data. They too find no relationship between birthweight and unemployment. This is so using both types of unemployment and black, white or total rates of low birthweight.

Grossman and Joyce (1990) estimate race specific birthweight production functions for New York City births in 1984. They are the first to incorporate self-selection in pregnancy resolution and in prenatal care use. The births that we observe are a subset of all pregnancies, some which result in induced abortion and others which result in live births. Self-selection occurs when variables unobserved by the researcher are correlated with the outcome; it may be characterized as adverse or favorable. Pregnancy resolution can be described as favorable selection if women who anticipate an unfavorable birth outcome (because of the poor health endowment of the fetus) either abort the fetus or if women making bigger investments in the health of the baby are more likely to give birth. Adverse selection occurs if women who anticipate an unfavorable birth outcome are less likely to abort the fetus or if women making smaller investments in the health of the baby are more likely to give birth. In terms of prenatal care use, selection is adverse if women anticipating a less favorable birth outcome use more prenatal care and women anticipating a positive outcome use less care. Selection is favorable when women who begin to use care earlier also invest in healthier inputs (or avoid harmful inputs) that the researcher can not measure (like avoiding stress, better nutrition, better exercise). Grossman and Joyce first estimate the probability of giving birth using probit. They then calculate the inverse Mill's ratio for each woman who gives birth and then use that as a regressor in a prenatal care demand equation and the birthweight production function. They estimate the production function using OLS and then using TSLS treating prenatal care as endogenous. The pregnancy resolution is observed for all pregnant women (induced abortion or birth) while prenatal care use and birthweight are observed only for women who give birth. The data they used is a randomly drawn subset of live births and induced abortions to NYC residents over 19 years old. Grossman and Joyce find that there is selectivity bias in the prenatal care demand equation and the birthweight production function for blacks but not for whites. From an examination of the signs of the residual covariances, they determine that the results for blacks seem to follow the cost of contraception model in which favorable selection in pregnancy resolution and in input use occurs. For instance, women with a higher shadow price of contraception are more likely to abort; those with a lower price of contraception and whose pregnancies are more planned use more prenatal care and invest in more health inputs. Thus for blacks, abortion may be a substitute for contraception.

Joyce and Grossman (1990b) examine how the wantedness of a pregnancy affects the demand for prenatal care. They estimate race and ethnicity specific prenatal care demand functions. They control for the wantedness by including the probability of giving birth in the demand function; in other words, they correct for self-selection. As in Grossman and Joyce (1990) they estimate the probability of giving birth, given that the woman is pregnant using probit; they then calculate the inverse Mill's ratio for each woman who gives birth and insert this as a regressor in the demand equation. The data is a randomly chosen subsample of births in New York City in 1984. They perform the analysis by race/ethnicity (black non-Hispanic, white non-Hispanic or Hispanic) and by two age groups (less than 20 years and 20 years or older). They do not find evidence of selectivity bias for whites but they do find it for blacks and Hispanics. In addition, the negative coefficient on the inverse Mill's ratio for blacks and Hispanics implies that women with higher expected probability of not aborting (pregnancies that are more wanted) delay beginning prenatal medical care less.

Joyce and Grossman (1990a) use aggregate monthly data on New York City for 1972-1988 to study the relationship between induced abortion and low birthweight. They want to test whether the relationship is an inverse one which may imply that abortion is a way of preventing unwanted births. The data is race specific and the authors apply vector autoregression to the percentage of low birthweight births, the percentage of pregnancies terminated by induced abortion and the percentage of births in which care began in the first trimester. The result for whites is that there is not a significant relationship between induced abortions and low birthweight births. For blacks, the percentage of induced abortion does affect the percentage of low birthweight births. But, the reverse is not true; lagged low birthweight rates do not affect the percentage of induced abortions. This lack of feedback indicates that omitted variable bias is not causing these results. The authors also simulate responses to a change in the abortion rate with the parameters estimated using the vector autoregressions. These impulse response functions imply that a decrease in abortion rates would cause an increase in low birthweight rates for blacks.

Joyce, Racine and Mocan (1992) study the relationship between low birthweight and substance abuse in New York City; they are interested in understanding why low birthweight rates increased in the mid 1980's, particularly for blacks. They use pooled time-series data for 1980-1989 where the unit of observation is the health district. They estimate race and ethnicity specific structural production functions where the rate of low birthweight is the health outcome. The inputs to the production functions are the percentage of births to women who: were unmarried, with no or unknown prenatal care, smoked during pregnancy, who used illicit substances during pregnancy, who had more than three previous live births. Because of the possibility of measurement error in the substance abuse variable (in particular under reporting), the authors the number of deaths due to drug dependency in each health district as an instrument for substance abuse in some cases. The authors estimate the production functions controlling for time but not district effects and controlling for time and district effects. The former is treated as an upper bound of the illicit substance use effect by attributing it to district variation; the latter is treated as a lower bound since all time and district variation has been eliminated. They find that illicit substance use does have a significant positive effect on blacks in both the upper and lower bound estimates described above. Illicit substance use has a significant effect in the upper bound estimate but not the lower bound estimate for Hispanics; the same is true for whites but the upper bound estimate is very small. To further examine the impact of substance use on low birthweight, the authors use the parameters estimated to predict the annual low birthweight rate for 1985-1989 using the 1984 prenatal illicit substance use level. They find that between 1482 to 3359 excess low birthweight births occurred in 1985-1989, with about 577 to 2276 of these being born to black non-hispanic mothers. They also estimate the costs for the initial hospitalization of these excess births to range between 18 and 41 million dollars.

Joyce and Racine (1993) examine monthly data on New York City births describe the trends in the low birthweight and very low birthweight rates. This study builds upon Joyce's (1990) work. The data is from 1963-1990; Blacks and Whites include Hispanics until 1978 when Hispanic ethnicity began to be recorded separately. They use moving averages in order to eliminate seasonal variation and to smooth the data. Their findings are as follows. For Blacks, low birthweight rates fell from 15.1% to 10.5% between 1964 and 1984. Over 1985-1989 the rate rose to 13.1% (this was the highest level since 1970). The rate then decreased over 1989 and 1990 to 12.1%. The very low birthweight rate acted similarly by falling from 2.89% to 2.10% over 1964-1984; then rising to 2.77% in 1988 and falling to 2.73% in 1990. For whites, the low birthweight rate was at its highest in 1966 at 7.6%; it fell until 1985 to reach 5.7%; it rose between 1986 and 1989 to 6.5%; the very low birthweight rates stayed constant throughout the period until 1987 when it rose to 1.12% and then fell to 1.05 by the end of 1990. Hispanics, the low birthweight rate remained constant since 1978 except for falling slightly in 1985 and 1989; the very low birthweight rates decreased from 1978 to 1984 and increased from 1985 to 1990. The authors show that the increase in low birthweight rates for blacks seem to have peaked in 1988. They also calculate ratios of black to white low birthweight rates and black to hispanic low birthweight rates. The black/white rate ratio declined on average until 1984 when it was about 1.75 after which it began to rise; it reached its highest in 1988 at 2.08 and fell through 1990. The black/Hispanic was on average about 1.5; it ratio reached a low of about 1.45 in 1984 and rose after that hitting about 1.7 in 1989 and 1990. The authors propose that the rise in low birthweight rates in the mid 1980's can be attributed in part to prenatal use of cocaine and crack-cocaine.

Racine, Joyce and Anderson (1993) investigate the impact of prenatal cocaine use on birthweight; in particular they study how prenatal care for cocaine users affects birthweight. The data used is for New York City births between 1988 and 1990. There are 7934 births to mothers who admit to using cocaine during pregnancy. The authors categorize prenatal care by the number of visits: no visits, 1-3 visits, 4 or more visits, and unknown visits. They perform race/ethnicity specific regressions on two birth outcomes: they use OLS to analyze birthweight and logit to analyze the likelihood of a low birthweight birth. They control for the mother's age, parity, pre-pregnancy weight, weight gain, marital status, method of payment, working during pregnancy, and WIC participation. From the OLS regression it is found that four or more visits is associated with birthweights that are 263 grams higher than births to women with no prenatal care for blacks, and 248 grams and 317 grams higher for whites and Hispanics respectively. The authors also calculate adjusted odds ratios from the logistic regressions for low birthweight births for each level of care; four or more visits reduced the odds of having a low birthweight infant by 49%, 61%, and 63% for blacks, whites and hispanics respectively compared to births to women without prenatal care. The authors investigate the accuracy in reporting cocaine use on the birth certificate by comparing a subsample of their data born at a particular NYC municipal hospital with data from another study at this hospital. (This study by McCalla et al. (1991) in which the data used is from the same source as discussed in Joyce et al. (1994) below). In this study, women were given urine tests for the presence of cocaine and an 11.5% rate of cocaine use by mother's was found, while from the birth certificate subsample a 7.5% rate was reported. Because of this apparent under-reporting of cocaine use on the birth certificates, Racine et al. compare a regression from the hospital study with one they perform on their subsample. The results from the hospital study show that cocaine use has a negative 382 gram impact on birthweight; the results from the birth certificate subsample show that cocaine use has a negative 410 gram impact on birthweight. Since the estimates are so similar, they suggest that the birth certificate is identifying the women with more prenatal cocaine use and thus the larger (negative) effect on birthweight.

Joyce et al. (1994) estimate the impact of prenatal illicit drug use on newborn costs and lengths of hospital stay. The data was from an anonymous survey of births at a New York City municipal hospital between November of 1991 and April of 1992. Discharge abstracts for the mother and infant, urine tests and obstetric survey sheets were linked to form the dataset of 1279 mother and infant pairs. The authors used three drug use categories: cocaine only; drugs other than cocaine (marijuana, heroin or methadone), and cocaine and another drug. The authors use log linear multiple regression controlling for the mother's race, age, prenatal care, tobacco use, parity, type of delivery, and infant health at delivery (measured by birthweight prematurity and newborn infection). They perform two regressions each for newborn costs and length of stay. One measures the direct effects of illicit drug use on the outcomes by including the infant health variables; the other measures the total effect of drug use by excluding the infant health measures. The total effect of the use of drugs other than cocaine has no effect no impact on newborn costs and length of stay; the use of cocaine only increases length of stay by 27% and newborn costs by 45% compared to no prenatal drug use; the largest effects are for the use of cocaine and another drug which increases length of stay by 131% and costs by 282%. When estimating the direct effects of drug use on length of stay, only the cocaine plus another drug measure remains significant and is associated with a 63% increase in length of stay over no drug use. The authors also distinguish between how the drug use was established: unknown to physicians (discovered by the survey) or known to physicians (reported on discharge abstracts). They perform regressions including these variables. For the drug measures cocaine only and drugs other than cocaine, drug exposure known to physicians is associated with significant large increases in costs and length of stay while unknown is not; for the cocaine plus other drugs measure, both the known and unknown variables have positive significant coefficients that are similar in magnitude to each other.

Joyce (1994) investigates the effect of prenatal care on birthweight and, in particular, what degree of selection bias exists, if any. In other words, he investigates what proportion of the observed positive relationship between prenatal care and birthweight is due to medical care and what proportion is due to unmeasured characteristics or behaviors of the women. Joyce uses data on New York City births in 1984. He measures prenatal care using a modified Kessner index; the levels of care are inadequate, intermediate and adequate. He uses a switching regression model with endogenous switching. First a reduced form prenatal care demand equation is estimated using ordered probit; this is used to calculate correction factors (the inverse Mill's ratio). Then three separate production functions are estimated using OLS, one for each level of care with and without the correction factor included as a regressor. Joyce controls for marital status, education, age, being born out of the U.S., type of delivery, plurality of birth, parity, and prenatal drug and tobacco use. This procedure is done separately for white non-Hispanics, black non-Hispanics and Hispanics. Joyce finds that sample selection does occur; the coefficient on the correction factor is significant in the intermediate care regressions. The coefficient measures the covariance between the residuals in the prenatal care equation and the birthweight production function. For blacks, whites and Hispanics, the coefficients are -61, -55, and -133 respectively; this means that women with higher than expected probability of intermediate care have infants with lower than expected birthweight. Joyce calculates the change in expected mean birthweight for any woman as her level of care changes; the largest gains in birthweight occur when moving from inadequate to intermediate care (as opposed to intermediate to adequate care), and these are 140, 267 and 183 grams for blacks, whites and Hispanics, respectively. He also calculates the change in expected mean birthweight for a woman receiving a particular level of care as her level of care changes; for instance, if women who actually received intermediate care were to receive inadequate care, the birthweight of their infants would decrease by 142, 248 and 177 grams for blacks, whites and Hispanics, respectively. In general, the effects of prenatal care for women who chose a particular level of care are greater than for any woman; Joyce proposes that women may sort themselves into levels of care in an optimal way. In addition, Joyce computes the expected increase in birthweight for each level of care estimated from the OLS regression uncorrected for sample selection; changes in care from inadequate to intermediate is associated with an expected increase in birthweight of 117, 80 and 102 grams for blacks, whites and Hispanics respectively. Thus OLS underestimates the effects of prenatal care for all three race/ethnic groups; this indicates that adverse selection exists.

Frank et al. (1992) estimate a quasi-structural birthweight production function using county data for 1975-1984. Their measure of care is whether care began in the first trimester or not. They control for the use of abortion services, smoking, income and birth order. They use a fixed effect model to control for differences of health endowments of women across counties. They estimate separate functions for blacks and whites and find that for both races, beginning care in the first trimester reduces low birthweight, but it is not sufficient to explain all of the racial differences in low birthweight.

Currie and Cole (1993) look at the effect of AFDC participation on birthweight. They question whether AFDC, which transfers cash to mothers, acts positively on birthweight by enabling mothers to buy better inputs like prenatal care or acts negatively because they buy things detrimental to infant health like alcohol and cigarettes. They find that participation in AFDC is associated with undesirable maternal behaviors and so AFDC participants have lower birthweight babies. However, this effect disappears when omitted unobservable variables are controlled for by TSLS and mother fixed effects models. The fixed effects model is one in which siblings are compared; in other words, different births to the same mother are examined. Since the negative effect of AFDC participation disappears in TSLS and fixed effects models, Currie and Cole argue that the mothers who participate in AFDC are the mothers who are at highest risk of having low birthweight infants. Currie and Cole (1991) in a similar manner look at the effect on birthweight of participating in the Food Stamp Program and housing assistance (either by living in public housing or receiving a rent subsidy) during pregnancy. They do not find a statistically significant relationship between participating in these programs and birthweight.

Kallan (1993) examines the differences in low birthweight between blacks and whites but in addition to looking at low birthweight, he looks at the main causes of low birthweight, preterm birth (when the baby is born too early) and intrauterine growth retardation (IUGR) (when the fetus grows too slowly). He looks at the effect on birthweight of what he refers to as intervening variables. These include socio-demographic factors (age, marital status and education), health factors (such as parity and diabetes) and attitudes (the wantedness of the pregnancy) and behaviors (prenatal care measured by the Kessner index and smoking). He uses multinomial logit in which his three outcomes are a non-low birthweight birth, a preterm birth and an IUGR birth; he uses various subsets of the intervening variables. He finds that the model is better at explaining the race differences in IUGR births than in preterm births. He also finds that IUGR births are best explained by socio-demographic, attitude and behavior variables and that preterm births are explained at least in part by the health variables.

The following studies discussed focus on the effect on the WIC program. Devaney et al. (1992) examine the effects of WIC participation and prenatal medical care on Medicaid costs and birth outcomes in 1987 in Florida, Minnesota, North Carolina, and South Carolina and in the first half of 1988 in Texas. They discover that WIC participation is associated with higher birthweight and Medicaid cost savings for the first 60 days after birth. They estimate that WIC participation increases birthweight from 51 to 117 grams over the five states and that each dollar spent on WIC saves from $1.77 to $3.13 in medicaid costs (they perform regressions for each of the states separately). They also find that inadequate prenatal care, where the Kessner index is used to classify prenatal care, is associated with increased Medicaid costs and lower birthweight.

Buescher et al. (1993) perform a cost-benefit analysis of the effect of WIC participation on Medicaid costs for newborn medical care. They link Medicaid and WIC data files to birth certificate data for 1988 in North Carolina. They find that women participating in WIC and receiving Medicaid had lower rates of low and very low birth weight than women receiving Medicaid but not participating in WIC. They performed a logistic regression on low birthweight and very low birthweight, controlling for cigarette smoking, education, being unmarried, prenatal care, race, age and previous fetal deaths or live births who died. Women receiving Medicaid but not WIC were 1.45 times more likely to have a low birthweight birth and 2.15 times more likely to have a very low birthweight than someone receiving Medicaid and WIC. They also estimate that for each one dollar spent on WIC services $2.91 were saved in Medicaid costs for newborn medical care.

The Bureau of Nutrition of the New York State Department of Health (1990) studied the effect of WIC on birth outcomes in the second half of 1988. New York State birth certificate data was linked with WIC files in order to perform cost-benefit analysis of the WIC program. Three sets of comparison groups were constructed. These were WIC versus non-WIC participants whose births were financed by Medicaid, private insurance or self-financed. WIC participation was found to be associated with improved birth outcomes (the birth outcomes included low birthweight, very low birthweight and preterm delivery). It was estimated that $2.35 was saved in Medicaid costs for the first hospital stay of the infant for every dollar spent on WIC.

Kennedy et al. (1982) examine the impact of WIC participation on birthweight on births in Massachusetts from 1973 and 1978. They were concerned with the problem of self-selection bias in the study; they thought that women self-selected to participate in WIC so a study of only WIC women would be non-randomized. So they included a group of women who did not participate in WIC and a group who applied for WIC but were not certified but were put on a waiting list since there were no openings at the time. In total, they had 1297 observations. They found that WIC participation was associated with higher birthweight. In addition, they also included a variable for the number of monthly food vouchers each woman received, and this too was associated with higher birthweight. So, birthweight rose with each additional month that a food voucher was received.

Kotelchuck et al. (1984) used 1978 data from Massachusetts to evaluate WIC participation. They took 4126 women who participated in WIC and matched them on the basis of age, race, parity, education and marital status to 4126 women not participating in WIC. In a comparison of the two groups of women, they find that women participating in WIC have better birth outcomes including a lower incidence of low birthweight births, lower neonatal mortality, and higher gestational age, in addition to more prenatal care. WIC participation had a positive effect on birthweight as well but was only significant at the 10% level. They also find that the length of WIC participation has a positive impact on these outcomes.

Schramm (1985) examines the impact of WIC participation on Medicaid births in Missouri in 1980. He finds that WIC participation reduces Medicaid newborn costs within 30 days after birth by $100 per participant. WIC participation reduced low birthweight rates and NICU (neonatal intensive care unit) admission rates. The mean birthweight of WIC babies was only 6 grams higher than non-WIC babies. Schramm (1986) did a similar examination of 1982 Missouri data and found that WIC participation was associated a mean birthweight that was 31 grams higher than the birthweight of non-participants.

Rush et al. (1986 and 1988) examined data on over 11 million births between 1972 and 1980 in 1392 counties. Vital statistics records were aggregated by county for each year and various other county level information like population and income was attached to the data. In this way, the proportion of women in a county served by WIC was related to rates of prenatal care use and birth outcomes among other things for the same county. Two measures of WIC service within a county were used: presence of WIC, which was a dichotomous variable indicating whether the WIC program existed within a given county in a given year; and penetration of WIC which is the number of women newly certified for WIC participation in a county and year over the total number of pregnant women in the county eligible by income for WIC participation in that year. They found that WIC was associated with better prenatal care usage (more first trimester and less inadequate prenatal care), longer gestation duration, and lower preterm delivery, and that WIC was associated with an increased mean birthweight of 22.7 grams.

Rush (1986 and 1988) in another study on WIC used longitudinal data on 6563 women; 5205 were WIC participants from 174 WIC clinics; 1358 were income eligible for WIC but were not participants. They were from 55 prenatal clinics where WIC was not available to them. WIC participation was associated with better weight gain early in pregnancy, better intake of several nutrients (including protein, iron, calcium and vitamin C which are four of the five targeted nutrients of the WIC program), increased head circumference of the infant, but was not associated with any effect on birthweight. The study did find a positive effect on birthweight for WIC participation at higher quality WIC clinics; these were clinics that were assessed by state WIC directors to be of higher quality.

III. Analytical Framework

Following the lead of Becker (1965) and Michael and Becker (1973), the household production function approach to consumer behavior is employed. In particular, the approach of Grossman (1972) who first developed the idea of the health production function and the derived demand for medical services. Specifically, in the manner of Rosenzweig and Schultz (1982, 1983, 1988), Joyce (1987), Corman et al. (1987) to name a few, it is assumed that the utility function of the mother (household) depend on consumption, and the quantity of children and the quality (health) of each child.

The number of children and the health of each child are both choice variables. Birthweight can be thought of as an indicator of the health of the child. It is produced by combining inputs through a production process referred to as a structural birthweight production function; this show the direct relationship between inputs and the outcome, birthweight. The infant health production function depends on things like the mother's own time, medical care (both the quantity and quality of it), nutrition, stress of the mother, the mother's reproductive efficiency or health endowment. Some of the inputs are endogenous, such as prenatal medical care since the mother can choose how much care to receive.

Maximizing the utility function subject to production and resource constraints gives the birthweight demand function. The interaction of the birthweight demand function and the birthweight production function leads to the input demand functions for care and other (endogenous) health inputs. An attempt here will be made to treat prenatal care and WIC participation as endogenous. Reduced form demand equations for these inputs will be estimated; reduced form demand equations are determined by price, availability measures, income, education, and time costs (for example the mother being foreign born which indicates the cost of obtaining information for non-native english speaking women).

Following Joyce (1994),

(1) $B=B(M,W,E,S,X,R,h,\mu)$

(2) $M=M(S,R,P,Y,\mu)$

(3) $W=W(S,R,P,Y,\mu)$

where:

B=birthweight

M=prenatal medical care

W=prenatal WIC participation

E=other endogenous variables (age, parity, marital status, pre-pregnancy weight, pregnancy weight gain, cigarette smoking, drug use, alcohol consumption, working during pregnancy)

S=schooling

X=exogenous variables (sex of child, plurality of birth)

R=race/ethnicity of mother and whether she is foreign born

h=unmeasured behaviors (exercise, nutrition, own time of mother)

μ=reproductive efficiency/health endowment

Y=enabling variables (income, health insurance)

P=price/availability measures

Equation (1) represents the infant health production function, where B is the health outcome birthweight. The inputs to the production function include prenatal medical care, prenatal WIC participation, education, endogenous demographic and obstetrical variables, exogenous variables, race/ethnicity of the mother and country of origin, unmeasured behaviors of the mother like exercise, nutrition, and stress and the mother's reproductive efficiency or health endowment. The reduced form input demand equations for prenatal care and WIC participation are shown by equations (2) and (3) respectively. They are determined by education, price or availability measures like presence of prenatal care clinics, enabling variables like income and health insurance, race/ethnicity of the mother and country of origin, and the mother's reproductive efficiency or health endowment.

The health endowment is included in both the input demand equations and the production function because women have some knowledge of it from their own past pregnancies or family history; it directly affects the birth outcome and also the behavior of the mother during pregnancy such as in choosing care or choosing to participate in WIC if eligible. The mother has some knowledge or expectation of the birth outcome which can motivate her to choose behaviors; such as the expectation of an unfavorable birth outcome can motivate her to obtain more prenatal care, participate in WIC, and avoid stress, to name a few things. This interaction between M or W and μ (the way that μ simultaneously effects M, W and B) must be controlled for as shown by Rosenzweig and Schultz (1983, 1988) and Corman, Joyce and Grossman (1987) among others, in order to avoid biased estimates. Bias can also result from the lack of measurements of h, behaviors of the mothers that can be healthy or unhealthy.

The mother's lack of employment during pregnancy may be a proxy for stress, so that not working may have a negative impact on birthweight. But the opposite may be true because if the mother is employed at a strenuous job during pregnancy, this too can have a negative impact on her birth outcome. Weight gain during pregnancy is an indicator of nutritional status during pregnancy, and pre-pregnancy weight is a measure of nutritional status before the pregnancy. Both are positively associated with birthweight. So too little weight gain and too low pre-pregnancy weight would have negative impacts on birthweight. WIC clinics are usually located in low income, needy neighborhoods. So, WIC participation can also be thought of as a proxy for nutritional intake during pregnancy. Price/availability and income have an indirect impact on birthweight; they impact birthweight through the demand equations for prenatal care and WIC participation. Education has a direct (is present in the production function) and an indirect (is present in the demand equations) effect on birthweight. It has a direct effect when used as an indicator of the mother's efficiency in household production as shown by Grossman (1972). It has an indirect because it influences the mother's choice of inputs such as prenatal care and WIC participation.

IV. Data and Estimation

Estimation of the demand equations and production function is done separately for black non-Hispanics, white non-Hispanics and Hispanics because of observed differences in birth outcomes between the racial and ethnic groups. The data used is from New York City birth certificates. Births from 1988, 1989, and 1990 are used. Dummy variables for the years (time differences) are included in the regressions. There were 123,022 births to New York City residents in 1988, 127,955 in 1989 and 129,811 in 1990 giving 380,788 births in total over the period. Only births to black non-Hispanic, white non-Hispanic and Hispanic women were considered. Births with birthweight, age or education of the mother unknown were omitted. In addition, adults and teens are analyzed separately. Adult women are defined as women who are 20 years of age or older. This leaves 92586 black non-Hispanic births, 87920 white non-Hispanic births and 93544 Hispanic births to adult mothers. There are 16,741 births to black non-Hispanic teens, 3,910 births to white non-Hispanic teens and 16,440 births to Hispanic teens.

In addition to variables measured on the birth certificates, some area specific variables are used to supplement the data. New York City is divided into 30 health districts, and these are subdivided into about 352 health areas. 1990 census data was used to calculate black, white and Hispanic poverty rates for each health area. The poverty black poverty rate includes black non-Hispanics and black Hispanics; the white poverty rate includes white non-Hispanics and white Hispanics, and the Hispanic poverty rate includes Hispanics of all races (black, white, indian, asian and other). In addition, the female population aged 15 to 44 for each health areas was obtained from the census data. Several measures of the availability of health services were also added to the dataset. These measures include the number of prenatal care clinics and family planning clinics in 1990 and the number of abortion providers in 1983 for each health area which are divided by the number of women aged

15 to 44 from the 1990 census. An additional availability measure was whether the mother lived in a health district in which a WIC center operated in 1983 where women could enroll and receive food coupons. (As an alternate measure of this, the number of WIC sites where a pregnant woman could enroll and receive food coupons in 1994 per 10,000 women in the health area was used in the estimation. The results were virtually unchanged. In 1994, there were 102 such centers in NYC.) A complete list of the variables used in this analysis are given in Table 1.

Estimation of the production function is done under a variety of scenarios concerning the treatment of prenatal care and WIC participation. Ordinary least squares (OLS) is used to estimate the production functions when all inputs are assumed to exogenous. Two-stage least squares (TSLS) is used when only prenatal care is assumed to be endogenous. This is done to control for the potential bias that results from the interaction of the health endowment, prenatal care and birthweight and the lack of adequate measures of behaviors of the mother as discussed in the previous chapter.

When WIC participation and prenatal care are assumed to be endogenous, an approach suggested by Heckman and MaCurdy (1985) is used to estimate a heteroscedastic simultaneous system of equations. Delay is treated as it is in TSLS. WIC participation is estimated in the first stage as a linear probability model because of the dichotomous nature of the WIC variable. The predicted probability of WIC participation is then used as a regressor in the second stage (along with predicted prenatal care delay). The standard errors in the second stage are then corrected following the procedure proposed by Heckman and MaCurdy (1985).

Because WIC participation is a dichotomous variable, the variances of the disturbances in the linear probability equation are heteroscedastic. In this type of model, using weighted least squares is often suggested to obtain more efficient estimates of the standard

TABLE 1. Description of Variables

Variable name	Description
Birthweight	weight of infant in grams
Delay	prenatal care delay in months (number of months from conception until first prenatal care visit)
Enrolled in WIC	dichotomous variable equal to one if mother participated in WIC
Year=89	dichotomous variable equal to one if birth occurred in 1989
Year=90	dichotomous variable equal to one if birth occurred in 1990
Single	dichotomous variable equal to one if mother is unmarried
Education < 12	dichotomous variable equal to one if the mother's completed schooling was less than 12 years
Education > 12	dichotomous variable equal to one if the mother's completed schooling was more than 12 years
Education > 7	dichotomous variable equal to one if the mother's completed schooling was more than 7 years; this variable is used for adolescent mothers
Foreign born	dichotomous variable equal to one if mother was born out of the U.S.
LN(age)	natural log of age of mother in years
Age < 18	dichotomous variable equal to one if mother is less than 18 years of age; this variable is used for adolescent mothers
LN(pre-preg. weight)	natural log of the pre-pregnancy weight of the mother measured in pounds
Pre-preg. wt. unknown	dichotomous variable equal to one if the pre-pregnancy weight of the mother is unknown
Sex of baby is male	dichotomous variable equal to one if the sex of the baby is male
Plural birth	dichotomous variable equal to one if this was a plural birth
This is 1st live birth	dichotomous variable equal to one if the was the mother's first live birth
Private service	dichotomous variable equal to one if mother was a private physician's patient (as opposed to a general services patient)

TABLE 1. Description of Variables	
Variable name	Description
Used heroin	dichotomous variable equal to one if heroin was used during the pregnancy
Used cocaine	dichotomous variable equal to one if cocaine was used during the pregnancy
Used methadone	dichotomous variable equal to one if methadone was used during the pregnancy
Used marijuana	dichotomous variable equal to one if marijuana was used during the pregnancy
Used other drug	dichotomous variable equal to one if any other drug (such as sedatives, tranquilizers, or anitconvulsants) was used during the pregnancy
Worked	dichotomous variable equal to one if mother was employed during the pregnancy
Alcohol	dichotomous variable equal to one if more than 2 drinks per week of alcohol was consumed during the pregnancy
Tobacco	dichotomous variable equal to one if more than 1/2 pack per day of tobacco was used during the pregnancy
LN(weight gain)	Natural log of pregnancy weight gain measured in pounds
Weight gain unknown	dichotomous variable equal to one if weight gain during the pregnancy is unknown
Medicaid	dichotomous variable equal to one if primary financial coverage was medicaid
Self-financed	dichotomous variable equal to one if primary financial coverage was self
% poor in health area	percentage of people below the poverty level in 1990 in the health area by race/ethnicity
WIC center	dichotomous variable equal to one if woman resided in a health district containing a WIC center
Prenatal care clinics	the number of prenatal care clinics and/or PCAP providers in 1991 per 10,000 women aged 15-44 in the health area[1]
Family planning	number of family planning clinics in 1991 per 10,000 women aged 15-44 in the health area[1]
Abortion clinics	number of abortion providers in 1983 per 10,000 women aged 15-44 in the health area[1]

[1] The number of women aged 15-44 is from 1990 census data.

errors (for instance see Maddala 1983). In the first step, OLS is run and predicted WIC ($\hat{W}_i$) is obtained; then the following weight is then calculated: $\sqrt{(\hat{W}_i * (1-\hat{W}_i))}$. Then in the second step, the data is transformed by dividing each variable used in the regression by the weight; then OLS is run again. However, observations with values of $\hat{W}_i$ that are negative or larger than one have to be excluded from the second step. Because of the large sample size of the data and the fact that for this study, the WIC participation equation is used as an intermediate step for estimates of the production function, the non-weighted OLS estimates of the WIC equation are presented. The weighted least squares procedure was performed, and it was observed that the differences in standard errors between this model and the OLS model were very small. This is true even in the smallest sample studied here, the poor white teen sample.

In order to test for the endogeneity of prenatal care delay, a Wu test (from Wu, 1973, and described in Nakamura and Nakamura, 1981) is performed. In this test, the residuals from the prenatal care delay equation are inserted as a regressor in the OLS estimate of the birthweight production function. The coefficient on the delay residual is tested against being equal to zero using an F test. A statistically significant coefficient indicates that delay should be treated endogenously because there is a correlation between the disturbance term and prenatal care delay; delay should be treated exogenously when the coefficient is not significant. When both delay and WIC are tested for endogeneity, residuals from both the delay and WIC equations are inserted as regressors. The coefficients on the delay and WIC residuals are jointly tested against being zero. However, now the error term is heteroscedastic so an F test can not be used. The joint test is a Wald test which involves pre- and post- multiplying the appropriate portion of the variance-covariance matrix by the vector of the two coefficients. The variance-covariance matrix used is White's estimator of the matrix as shown in Greene (1993, pages 391-392). The resulting test statistic is distributed as chi-squared with two degrees of freedom.

The discussion that follows here and in the next two chapters pertains to the adult mothers. Teens will be discussed in detail in the seventh chapter.

The estimation is performed on the three racial and ethnic groups and then on a subsample of each of these groups. The subsample is based on the appropriate race specific poverty rate for the health area. The subsamples are made up of the poorest women; these are the 25% women who live in the poorest health areas. For black non-Hispanics, this subsample consists of the 23,444 women who reside in health areas where the black poverty rate is higher than 35.16%; for white non-Hispanic women, this is the 21,860 women who reside in health areas where the white poverty rate is greater than 14.43%; for Hispanic women, this is the 23,056 women who reside in health areas where the poverty rate is greater than 45.08%. Estimation is performed on the total sample and the subsample to see how parameters in the production function and input demand equations may differ for poorer women.

Prenatal care is measured by the number of months from conception that a woman delayed until she made her first visit. If no prenatal care was received or this time period was unknown, the number of months delayed was set equal to ten. A large percentage of the values of pregnancy weight gain and pre-pregnancy weight are unknown. The mean value for the appropriate race/ethnicity of the mother was used when the value was unknown, and dichotomous variables were included which were equal to one if the value was unknown.

Means and frequencies of the three racial/ethnic groups and the corresponding poor subsample are shown in Table 2. The average birthweight is largest for whites at 3370 grams. This is followed by Hispanics with an average birthweight of 3275 grams; the average birthweight for blacks is 3107 grams. 14.4% of the black births, 5.8%

of the white births and 8.3% of the Hispanic births are low birthweight births. The average prenatal care delay is 4.84 months for blacks, 4.76 for Hispanics and 3.4 months for whites. 31% of the black women and 35% of the Hispanic women enrolled in WIC while only 5% of the white women did. 62% of the black mothers are single which is the highest rate of the three race/ethnicity groups. 50% of the Hispanic mothers are single and only 12% of the white mothers are single. Five drug use measures are included on the birth certificates: heroin, cocaine, methadone, marijuana or some drug other than these. Prenatal cocaine use has been linked to poor birth outcomes in various studies such as Joyce and Racine (1993), Joyce et al. (1994) and Racine et al. (1993). The rate of cocaine use is 4.8% for blacks, 1.7% for Hispanics and less than 0.7% for whites. When examining the corresponding poor subsamples, average birthweight is lower for all race/ethnicities; it is 3359 grams for whites, 3223 grams for Hispanics and 3027 grams for blacks. The other measures discussed above all increase in the poor subsamples. Average prenatal care delay is still highest for blacks at 5.42 months; it is 5.20 months for Hispanics and 4.24 months for whites. WIC enrollment increases to 12% for whites in the poor subsample and increases to 40% for Hispanics and 35% for blacks. Cocaine use increases to 8.2% in the black poor subsample, 1.1% in the white poor subsample and 2.7% in the Hispanic poor subsample. In fact, the use of all types of drugs increases in the poor subsamples except for the use of other drugs for whites which decreases from 1.3% to 1.0% in the poor subsample. The average age of the mothers decreases in all of the poor subsamples compared to the entire race/ethnicity samples. The percentage of mothers who worked during the pregnancy are 31%, 35% and 19% for blacks, whites and Hispanics respectively; these rates fall to 21%, 22% and 12% for the corresponding poor subsamples.

The method of financing of the birth is measured by three dichotomous variables: self-financed, Medicaid or another third party

TABLE 2. Means and frequencies for adults by race/ethnicity for entire samples and poor subsamples	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All	Poor Subsample	All	Poor Subsample	All	Poor Subsample
Number of observations	92586	23444	87920	21860	93544	23056
Birthweight	3107	3027	3370	3359	3275	3223
Delay	4.84	5.43	3.41	4.24	4.76	5.20
Delay unknown	0.18	0.24	0.09	0.14	0.15	0.19
No prenatal care	0.02	0.03	0.01	0.01	0.01	0.02
Enrolled in WIC	0.31	0.35	0.05	0.12	0.35	0.40
Year=88	0.32	0.32	0.33	0.34	0.31	0.31
Year=89	0.34	0.34	0.34	0.34	0.34	0.33
Year=90	0.33	0.34	0.33	0.32	0.35	0.36
Single	0.62	0.75	0.12	0.18	0.50	0.61
Education (in years)	12.3	11.9	13.5	12.6	11.4	10.9
Education < 12	0.24	0.33	0.08	0.15	0.36	0.49
Education = 12	0.44	0.45	0.43	0.56	0.43	0.36
Education > 12	0.32	0.22	0.49	0.29	0.21	0.15
Foreign born	0.40	0.18	0.25	0.34	0.70	0.65
Age (in years)	27.7	27.0	29.5	28.7	27.2	26.6
LN(age)	3.30	3.28	3.37	3.34	3.29	3.26
Pre-preg. weight (lbs.)	148.0	147.8	139.1	141.0	137.7	138.8
Pre-preg. wt. unknown	0.40	0.48	0.36	0.42	0.42	0.55
LN(pre-preg. weight)	4.98	4.98	4.92	4.94	4.91	4.92
Sex of baby is male	0.51	0.51	0.51	0.52	0.51	0.51
Plural birth	0.03	0.03	0.03	0.03	0.02	0.02
# previous live births	1.36	1.65	1.05	1.78	1.19	1.41
This is 1st live birth	0.35	0.28	0.47	0.37	0.37	0.32
Private service	0.33	0.20	0.83	0.71	0.23	0.13

TABLE 2. Means and frequencies for adults by race/ethnicity for entire samples and poor subsamples						
	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All	Poor Subsample	All	Poor Subsample	All	Poor Subsample
Used heroin	0.005	0.009	0.002	0.004	0.006	0.010
Used cocaine	0.048	0.082	0.007	0.011	0.017	0.027
Used methadone	0.006	0.010	0.003	0.006	0.007	0.012
Used marijuana	0.016	0.027	0.002	0.003	0.005	0.007
Used other drug	0.014	0.016	0.013	0.010	0.008	0.009
Worked	0.31	0.21	0.35	0.22	0.19	0.12
Alcohol	0.03	0.04	0.01	0.01	0.01	0.01
Tobacco	0.12	0.18	0.07	0.06	0.05	0.07
Weight gain	28.7	28.4	29.5	28.9	29.0	28.7
LN(weight gain)	3.29	3.28	3.34	3.31	3.31	3.31
Weight gain unknown	0.43	0.51	0.39	0.45	0.44	0.58
Self-financed	0.13	0.14	0.13	0.16	0.14	0.15
Medicaid	0.50	0.63	0.13	0.27	0.58	0.70
Other 3rd party	0.37	0.23	0.73	0.57	0.27	0.15
% poor in health area	25.37	42.84	12.35	26.46	33.92	51.41
WIC center	0.56	0.67	0.28	0.42	0.45	0.79
Prenatal care clinics	1.05	1.83	0.61	1.11	0.83	1.34
Family planning clinics	0.89	1.49	0.42	0.67	0.74	1.16
Abortion providers	0.49	0.36	0.58	0.44	0.51	0.40

payer. For blacks and Hispanics more births are financed by Medicaid while for whites more births are financed by some other third party. For blacks 50% of the births are Medicaid financed, 37% by an other third party and 13% being self-financed. For whites, 73% of the births are financed by a third party while 13% are financed by self and Medicaid each. For Hispanics, 58% of the births are Medicaid financed and 27% are financed by some other third party and 14% are self-financed. Beginning in 1990 in New York State, the Medicaid eligibility threshold for pregnant women increased to 185% of the Federal poverty level; is was 81% of poverty during 1988 and 1989. This may impact estimation of the demand equations and may appear through the time dummies.

Education is measured by two dichotomous variables; one indicates whether the mother received less than twelve years of schooling and the other indicates whether the mother received more than twelve years of schooling. The omitted category is exactly twelve years of education. So, these variables can be viewed as the mother having a less than high school education and a more than high school education. 24% of the black mothers, 8% of the white mothers and 36% of the Hispanic mothers received less than twelve years of schooling. 32% of the black mothers, 49% of the white mothers and 21% of the Hispanic mothers completed more than twelve years of schooling.

WIC participation may indirectly impact birthweight by its association with better prenatal care. It may effect both the timing and quality of care. A comparison of the average prenatal care delay for women who participated in WIC and women who did not is now discussed. For blacks, the average delay of WIC participants is 4.66 months while for non-participants it is 4.92 months. The difference is more striking in the poor black subsample in which the average delay of WIC participants is 4.88 months and the average delay of non-participants is 5.73 months. Hispanics behave in a similar manner. For

Hispanics, the average delay of WIC participants is 4.52 months while for non-participants it is 4.90 months; in the poor Hispanic subsample the average delay of WIC participants is 4.70 months and the average delay of non-participants is 5.54 months. For whites the average delay of participants is higher than non-participants. This may be due to the small number of white WIC participants which may imply that the WIC participants are just much worse off financially than the non-participants. Also, most whites had other third party financing for the birth as opposed to blacks and Hispanics which use more Medicaid financing. For whites, the average delay of WIC participants is 4.66 months while for non-participants it is 3.34 months; in the poor white subsample the average delay of WIC participants is 4.76 months, and the average delay of non-participants is 4.17 months.

As mentioned previously, in 1988 the New York City birth certificates began recording new items which include information about potential risk factors during pregnancy such as: pre-pregnancy weight, pregnancy weight gain, use of substances such as drugs, alcohol, and cigarettes and employment status during pregnancy. In the next chapter of this paper, the determinants of birthweight and prenatal care delay will be examined. The production function will be estimated with and without the potentially endogenous variables pregnancy weight gain, drug, alcohol and cigarette use and employment during pregnancy. Prenatal care delay will be treated as exogenous and endogenous. In the fifth chapter, WIC participation will be studied. WIC participation will also be treated as both exogenous and endogenous.

V. Determinants of Birthweight and Prenatal Care Delay for Adults

Estimates of the prenatal care demand equations are given in table 3. Estimation is done by OLS and results are given separately for blacks, whites and Hispanics and their corresponding poor subsamples. Estimates of the birthweight production functions are given in tables 4, 5 and 6 for blacks, whites and Hispanics respectively. The first four columns in each of these tables pertain to the full samples while the last four pertain to the poor subsamples. Columns 1, 2, 5 and 6 show the results when prenatal care is treated exogenously, and OLS is used to estimate the production functions. Columns 3, 4, 7, 8 show the results when prenatal care is treated endogenously, and TSLS is used to estimate the production functions. Columns 1, 3, 5 and 7 show the production functions using what will be called the full set of health inputs. Columns 2, 4, 6 and 8 show the production functions using what will be called a limited set of health inputs; the "new" input measures which are the potentially endogenous measures of drug, alcohol and tobacco use, weight gain during pregnancy and the working status of the mother are eliminated from the limited set. To summarize the set up of the tables, the estimates of the production functions are:

column 1: entire sample, OLS, full set of inputs
column 2: entire sample, OLS, limited set of inputs
column 3: entire sample, TSLS, full set of inputs
column 4: entire sample, TSLS, limited set of inputs
column 5: poor subsample, OLS, full set of inputs
column 6: poor subsample, OLS, limited set of inputs
column 7: poor subsample, TSLS, full set of inputs
column 8: poor subsample, TSLS, limited set of inputs

The prenatal care demand equations are discussed first. Having received more than twelve years of education as compared to exactly

TABLE 3. Prenatal Care Delay Demand Equations for Adults by Race/Ethnicity

	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All (1)	Poor Subsample (2)	All (3)	Poor Subsample (4)	All (5)	Poor Subsample (6)
Constant	3.867	4.443	2.803	3.336	3.621	3.834
	(109.29)	(25.18)	(124.05)	(53.23)	(101.06)	(15.83)
Year=89	0.181	0.285	0.037	0.185	0.158	0.262
	(7.60)	(5.64)	(1.82)	(4.03)	(6.78)	(5.32)
Year=90	0.133	0.295	0.225	0.591	0.182	0.369
	(5.52)	(5.84)	(10.80)	(12.67)	(7.86)	(7.59)
Prenatal care clinics	-0.015	-0.012	-0.105	-0.086	-0.009	-0.030
	(1.33)	(0.92)	(10.15)	(4.02)	(0.81)	(1.65)
Education < 12	0.422	0.459	0.453	0.509	0.124	0.439
	(16.75)	(9.57)	(13.70)	(9.01)	(5.69)	(10.00)
Education > 12	-0.415	-0.470	-0.447	-0.498	-0.462	-0.158
	(17.77)	(8.64)	(24.02)	(10.98)	(18.27)	(2.58)
% poor in health area	0.018	-0.001	0.024	0.008	0.012	0.012
	(20.84)	(0.27)	(24.40)	(3.92)	(15.57)	(2.70)
Medicaid	1.039	1.053	1.494	1.220	0.934	0.609
	(44.74)	(19.72)	(53.42)	(25.48)	(39.29)	(10.53)
Self-financed	1.652	1.773	0.914	1.208	1.321	1.175
	(51.87)	(24.78)	(35.89)	(22.00)	(42.08)	(15.96)
Foreign Born	-0.362	-0.554	0.349	0.228	-0.077	-0.292
	(16.89)	(10.12)	(17.34)	(5.61)	(3.69)	(7.03)
WIC center	-0.294	-0.009	0.115	-0.058	-0.013	-0.071
	(14.51)	(0.20)	(5.70)	(1.31)	(0.64)	(1.45)
Family planning clinics	0.010	-0.002	0.056	0.031	0.001	0.049
	(0.76)	(0.13)	(3.83)	(1.02)	(0.08)	(2.47)
Abortion providers	0.017	0.017	0.022	0.006	-0.019	-0.063
	(1.72)	(0.80)	(3.40)	(0.26)	(2.05)	(2.51)
F ratio	701.3	120.4	887.9	170.7	394.3	52.0
R-squared	0.0833	0.0581	0.1081	0.0857	0.0482	0.0264

Absolute values of *t*-statistics are in parentheses.

TABLE 4. Birthweight Production Functions for All Black Adults and the Poor Black Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Black Non-Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	72.0	851.4	49.0	924.3	185.0	860.0	319.9	1148.6
	(0.96)	(11.41)	(0.63)	(11.78)	(1.20)	(5.57)	(1.94)	(6.74)
Delay	-13.0	-20.3	-16.4	-42.6	-16.2	-25.0	-47.6	-83.8
	(18.05)	(27.82)	(4.26)	(10.90)	(11.93)	(18.08)	(5.26)	(8.95)
Year=89	11.7	17.3	12.6	22.0	24.3	34.6	33.7	51.9
	(2.31)	(3.35)	(2.48)	(4.18)	(2.40)	(3.30)	(3.19)	(4.64)
Year=90	6.3	16.8	6.8	20.7	6.5	22.7	16.6	42.4
	(1.25)	(3.22)	(1.32)	(3.92)	(0.64)	(2.18)	(1.56)	(3.77)
Single	-67.8	-89.0	-69.0	-89.0	-63.2	-90.5	-61.5	-87.5
	(14.44)	(18.51)	(14.55)	(18.20)	(6.15)	(8.58)	(5.86)	(7.88)
Education < 12	-4.8	-40.9	1.4	-24.0	-31.2	-73.0	-9.6	-35.7
	(0.90)	(7.46)	(0.24)	(4.06)	(3.21)	(7.33)	(0.88)	(3.08)
Education > 12	23.4	43.0	17.5	25.4	30.2	50.6	8.9	10.7
	(4.62)	(8.39)	(3.25)	(4.58)	(2.73)	(4.49)	(0.73)	(0.83)
Foreign born	128.4	172.0	123.5	159.6	125.5	176.7	105.1	142.9
	(28.35)	(37.82)	(25.72)	(32.65)	(11.16)	(15.41)	(8.62)	(11.13)
LN(age)	-139.5	-211.2	-133.9	-208.8	-237.0	-338.9	-236.3	-346.9
	(11.44)	(17.00)	(10.98)	(16.70)	(9.73)	(13.65)	(9.56)	(13.40)
LN(pre-preg. weight)	551.2	605.3	554.8	612.8	604.9	692.3	610.2	704.4
	(42.69)	(45.89)	(42.96)	(46.18)	(22.76)	(25.41)	(22.66)	(24.83)
Pre-preg. wt. unknown	46.1	-45.9	38.6	-67.7	79.4	-53.6	68.8	-83.3
	(4.43)	(10.37)	(3.71)	(15.47)	(3.89)	(6.12)	(3.33)	(9.30)
Sex of baby is male	107.6	109.9	107.3	109.3	106.2	109.0	105.4	107.7
	(26.18)	(26.00)	(26.09)	(25.70)	(12.91)	(12.84)	(12.64)	(12.17)
Plural birth	-951.0	-931.2	-947.2	-924.8	-981.4	-961.0	-980.8	-959.3
	(78.91)	(75.17)	(78.58)	(74.23)	(42.30)	(40.15)	(41.72)	(38.46)

TABLE 4. Birthweight Production Functions for All Black Adults and the Poor Black Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Black Non-Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	-79.4	-61.1	-74.0	-53.0	-81.2	-60.7	-75.4	-51.5
	(17.07)	(12.81)	(15.92)	(11.06)	(8.32)	(6.05)	(7.63)	(4.93)
Private service	29.8	56.6	34.1	53.8	37.0	70.7	29.2	53.0
	(5.82)	(10.99)	(6.13)	(9.40)	(3.24)	(6.13)	(2.37)	(4.08)
Used heroin	-197.8		-207.3		-142.3		-152.2	
	(6.78)		(7.11)		(3.19)		(3.37)	
Used cocaine	-260.4		-278.8		-242.7		-261.3	
	(23.94)		(25.74)		(14.41)		(15.39)	
Used methadone	-120.1		-125.1		-71.0		-76.9	
	(4.31)		(4.49)		(1.69)		(1.81)	
Used marijuana	-62.8		-68.7		-41.4		-47.1	
	(3.63)		(3.97)		(1.54)		(1.73)	
Used other drug	-192.2		-202.3		-175.1		-191.2	
	(11.03)		(11.61)		(5.26)		(5.67)	
Worked	27.6		27.3		28.4		21.8	
	(5.59)		(5.45)		(2.52)		(1.87)	
Alcohol	-104.9		-109.7		-135.2		-140.1	
	(7.57)		(7.92)		(5.92)		(6.06)	
Tobacco	-151.6		-153.6		-147.6		-149.0	
	(20.45)		(20.69)		(12.08)		(12.03)	
LN(weight gain)	258.9		261.9		248.7		253.1	
	(50.82)		(51.41)		(24.71)		(24.83)	
Weight gain unknown	-135.4		-142.9		-190.3		-200.8	
	(13.09)		(13.82)		(9.28)		(9.67)	
F-ratio	812.9	955.3	799.5	897.9	236.9	276.1	226.1	238.5
R-squared	0.1741	0.1262	0.1717	0.1196	0.1954	0.1416	0.1881	0.1247
Wu test[a]	2.57	7.92			4.46	7.63		

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

TABLE 5. Birthweight Production Functions for All White Adults and the Poor White Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All White Non-Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	-299.0	661.2	-272.5	704.3	-280.4	565.1	-300.4	568.4
	(4.10)	(9.40)	(3.66)	(9.80)	(1.97)	(4.11)	(2.05)	(4.01)
Delay	-7.8	-10.1	-16.5	-21.5	-5.2	-7.7	-3.1	-9.5
	(10.57)	(13.54)	(4.87)	(6.27)	(3.88)	(5.69)	(0.45)	(1.36)
Year=89	7.5	12.4	8.2	13.4	4.7	11.2	5.0	12.7
	(1.71)	(2.80)	(1.88)	(3.02)	(0.53)	(1.25)	(0.56)	(1.41)
Year=90	11.7	19.3	13.7	22.0	17.0	28.3	15.7	29.5
	(2.67)	(4.32)	(3.07)	(4.84)	(1.90)	(3.12)	(1.57)	(2.93)
Single	-75.7	-90.9	-75.7	-91.3	-107.4	-132.0	-108.0	-132.3
	(13.03)	(15.52)	(12.94)	(15.47)	(9.99)	(12.20)	(10.00)	(12.18)
Education < 12	-13.2	-24.4	-4.4	-13.1	1.4	-8.7	2.2	-4.8
	(1.88)	(3.42)	(0.59)	(1.75)	(0.13)	(0.78)	(0.19)	(0.40)
Education > 12	15.9	31.3	7.6	20.7	-4.3	14.8	-5.2	10.9
	(3.84)	(7.71)	(1.65)	(4.49)	(0.48)	(1.70)	(0.52)	(1.09)
Foreign born	12.1	24.7	16.9	31.0	17.4	34.0	17.4	35.6
	(2.81)	(5.69)	(3.68)	(6.72)	(2.18)	(4.25)	(2.12)	(4.30)
LN(age)	-27.4	-32.7	-27.2	-32.6	86.5	67.9	88.1	69.1
	(2.51)	(2.95)	(2.48)	(2.94)	(4.32)	(3.35)	(4.39)	(3.40)
LN(pre-preg. weight)	606.6	567.0	606.5	566.7	549.3	518.1	548.9	517.5
	(49.64)	(45.90)	(49.57)	(45.78)	(22.06)	(20.56)	(22.04)	(20.54)
Pre-preg. wt. unknown	-21.3	-30.3	-28.7	-39.0	-14.2	-36.5	-19.8	-44.7
	(2.76)	(7.71)	(3.72)	(10.06)	(1.00)	(4.68)	(1.40)	(5.82)
Sex of baby is male	118.2	122.4	117.9	122.0	121.0	124.5	120.5	123.9
	(33.16)	(33.83)	(33.04)	(33.68)	(16.78)	(17.00)	(16.71)	(16.91)
Plural birth	-957.2	-928.8	-957.7	-929.3	-957.0	-939.8	-957.2	-940.2
	(88.90)	(85.20)	(88.85)	(85.09)	(41.90)	(40.59)	(41.90)	(40.60)

TABLE 5. Birthweight Production Functions for All White Adults and the Poor White Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)								
	All White Non-Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	-86.1	-71.3	-86.0	-71.0	-77.6	-65.9	-76.4	-64.1
	(22.43)	(18.73)	(22.35)	(18.59)	(9.64)	(8.18)	(9.48)	(7.95)
Private service	46.1	61.8	47.4	63.9	36.3	53.3	42.5	60.6
	(8.03)	(10.69)	(7.76)	(10.37)	(3.68)	(5.37)	(4.16)	(5.88)
Used heroin	-182.5		-185.8		-205.6		-208.8	
	(4.34)		(4.42)		(3.39)		(3.44)	
Used cocaine	-271.9		-280.8		-279.9		-287.5	
	(11.22)		(11.59)		(7.17)		(7.38)	
Used methadone	-186.2		-190.9		-170.1		-174.2	
	(5.30)		(5.43)		(3.39)		(3.48)	
Used marijuana	-42.8		-43.4		-73.0		-72.1	
	(1.12)		(1.14)		(1.09)		(1.08)	
Used other drug	-84.7		-87.5		-97.3		-98.9	
	(5.39)		(5.56)		(2.74)		(2.79)	
Worked	5.6		5.5		0.8		2.5	
	(1.34)		(1.31)		(0.09)		(0.26)	
Alcohol	158.6		160.8		42.8		44.3	
	(9.04)		(9.16)		(1.06)		(1.10)	
Tobacco	-133.7		-134.0		-173.1		-172.6	
	(17.62)		(17.64)		(10.35)		(10.31)	
LN(weight gain)	238.4		240.1		206.0		207.7	
	(44.26)		(44.57)		(19.60)		(19.78)	
Weight gain unknown	-38.3		-37.7		-60.5		-60.4	
	(5.06)		(4.98)		(4.30)		(4.30)	
F-ratio	623.6	848.8	618.7	835.8	158.8	214.0	158.2	211.7
R-squared	0.1455	0.1191	0.1445	0.1175	0.1486	0.1206	0.1481	0.1195
Wu test*	3.86	4.88			0.12	0.84		

Absolute values of *t*-statistics are in parentheses.
* The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

TABLE 6. Birthweight Production Functions for All Hispanic Adults and the Poor Hispanic Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	178.4	1019.1	213.9	1071.4	94.7	828.0	192.9	1010.9
	(2.42)	(14.04)	(2.78)	(14.04)	(0.60)	(5.32)	(1.12)	(5.84)
Delay	-9.4	-13.5	-24.1	-32.6	-8.9	-13.9	-32.4	-54.3
	(14.26)	(20.25)	(5.64)	(7.54)	(6.96)	(10.68)	(2.74)	(4.45)
Year=89	7.9	11.2	10.5	14.7	15.0	15.6	21.8	27.1
	(1.74)	(2.41)	(2.29)	(3.12)	(1.61)	(1.64)	(2.20)	(2.64)
Year=90	10.6	16.8	13.6	20.9	27.9	31.4	36.6	46.5
	(2.37)	(3.67)	(2.97)	(4.46)	(3.05)	(3.36)	(3.61)	(4.42)
Single	-52.2	-70.6	-51.5	-70.6	-61.0	-81.1	-61.3	-82.1
	(13.57)	(18.06)	(13.23)	(17.79)	(7.73)	(10.08)	(7.68)	(9.94)
Education < 12	-28.8	-43.0	-22.7	-35.2	-23.3	-41.3	-10.1	-19.4
	(6.77)	(9.93)	(5.15)	(7.82)	(2.78)	(4.82)	(0.99)	(1.84)
Education > 12	6.4	13.9	-3.8	0.4	21.7	30.5	15.9	20.9
	(1.27)	(2.74)	(0.70)	(0.07)	(1.88)	(2.59)	(1.34)	(1.69)
Foreign born	103.1	132.9	101.8	132.2	110.3	144.8	103.0	133.9
	(24.31)	(31.19)	(23.92)	(30.85)	(13.38)	(17.39)	(11.68)	(14.79)
LN(age)	-50.2	-84.5	-45.6	-78.4	-68.6	-121.5	-64.3	-117.0
	(4.64)	(7.67)	(4.20)	(7.08)	(3.10)	(5.40)	(2.89)	(5.08)
LN(pre-preg. weight)	518.4	518.6	521.2	523.2	553.6	573.4	554.2	575.1
	(39.98)	(39.24)	(40.07)	(39.39)	(19.70)	(19.99)	(19.55)	(19.60)
Pre-preg. wt. unknown	2.9	-52.1	-5.1	-65.3	-26.9	-50.7	-33.7	-63.8
	(0.32)	(13.37)	(0.56)	(16.96)	(1.46)	(6.43)	(1.82)	(8.02)
Sex of baby is male	107.6	109.1	107.7	109.3	113.2	116.8	113.3	117.2
	(29.55)	(29.32)	(29.48)	(29.22)	(15.20)	(15.31)	(15.09)	(15.02)
Plural birth	-972.8	-944.8	-971.1	-941.9	-948.6	-928.5	-947.0	-925.8
	(78.85)	(74.98)	(78.47)	(74.38)	(38.02)	(36.38)	(37.65)	(35.48)

TABLE 6. Birthweight Production Functions for All Hispanic Adults and the Poor Hispanic Adult Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Hispanics				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	-78.4	-65.3	-77.2	-63.1	-72.0	-55.5	-70.5	-52.8
	(19.41)	(15.92)	(19.03)	(15.28)	(8.45)	(6.41)	(8.21)	(5.96)
Private service	12.1	20.3	8.9	17.1	3.6	16.7	1.2	12.5
	(2.46)	(4.10)	(1.65)	(3.11)	(0.31)	(1.42)	(0.10)	(1.01)
Used heroin	-166.9		-175.4		-177.8		-188.8	
	(6.30)		(6.60)		(4.26)		(4.49)	
Used cocaine	-298.3		-311.0		-276.6		-287.3	
	(19.26)		(20.06)		(11.00)		(11.36)	
Used methadone	-215.6		-217.5		-193.0		-193.8	
	(8.95)		(9.00)		(5.28)		(5.26)	
Used marijuana	-96.0		-97.0		-83.0		-83.1	
	(3.50)		(3.53)		(1.83)		(1.82)	
Used other drug	-97.0		-102.4		-146.6		-154.3	
	(4.82)		(5.07)		(3.62)		(3.78)	
Worked	-17.4		-17.8		-5.2		-5.6	
	(3.45)		(3.51)		(0.43)		(0.46)	
Alcohol	-101.7		-104.3		-190.3		-195.0	
	(4.68)		(4.78)		(4.94)		(5.02)	
Tobacco	-189.6		-191.8		-197.0		-199.0	
	(21.82)		(22.01)		(12.67)		(12.70)	
LN(weight gain)	232.1		234.8		209.9		211.8	
	(47.12)		(47.57)		(20.01)		(20.03)	
Weight gain unknown	-88.7		-90.1		-53.2		-54.9	
	(9.70)		(9.82)		(2.86)		(2.93)	
F-ratio	642.0	761.8	630.9	729.3	169.5	198.5	165.1	183.5
R-squared	0.1414	0.1024	0.1394	0.0984	0.1501	0.1076	0.1468	0.1003
Wu test*	4.84	6.22			2.37	3.83		

Absolute values of *t*-statistics are in parentheses.
* The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

twelve years has a negative significant[1] effect on prenatal care delay in all specifications of the prenatal care demand function. Having received less than twelve years of education as compared to twelve years has a positive significant effect on delay in all race/ethnicities. These results are as anticipated; the more education, the less delay. Compared to an other third party payer, medicaid and self-financing of the birth have positive significant effects on delay in all race/ethnicities. Self-financing has a larger effect on delay than Medicaid financing for blacks; the coefficient on self-financing is 1.652 while the coefficient on Medicaid is 1.039. The opposite is true for whites and Hispanics. Self-financing is associated with a 0.914 and a 1.321 month increase in delay compared to other third party for whites and Hispanics respectively, and Medicaid financing is associated with a 1.494 month for whites and a 0.934 month for Hispanics increase in delay compared to other third party financing.

The mother being born out of the United States has a significant negative impact on prenatal care delay for blacks; blacks born out of the U.S. delay care .362 months less than native born blacks. The same is true for Hispanics, but the impact is a much smaller one of only a reduction of .077 months. For whites, being foreign born has a positive significant effect on delaying care of .349 months. The race/ethnicity specific poverty rate has a positive significant effect on delay for blacks, whites and Hispanics with a coefficient of .018, .024, and .012 for the three groups respectively. Examination of the time dummies reveals that compared to 1988, births in both 1989 and 1990 are associated with positive impacts on delay. This is true for all race/ethnicities with the exception of whites and the coefficient on 1989 which is significant only at the 10% level. So, births in 1988 are

[1] Here and in the rest of the text, significance refers to being statistically significant at the 5 percent level for a two-tailed *t* test. The critical asymptotic *t* values at the 5 percent and 10 percent levels are 1.960 and 1.645, respectively, for a two-tailed test.

associated with less prenatal care delay than in 1989 and 1990.

The availability measures have varied impacts on delay depending on the race/ethnicity of the mother. For blacks and Hispanics, the presence of prenatal care clinics have a small negative effect on prenatal care delay that is not significant only at the 20% level. For whites, prenatal care clinics have a negative significant effect on prenatal care delay meaning the more clinics, the less women delay care. The presence of a WIC center in the health district where the woman resided has a negative significant effect on delay of 0.294 months for blacks. This means that if there was a WIC center, women delayed care less by .294 months. WIC centers may have an impact on prenatal care because they sometimes are at sites where prenatal care is also provided and also WIC centers may provide referrals for health care. The presence of a WIC center has a positive significant effect on delay of .115 months for whites which means that women delayed care more if a WIC center was present. WIC centers are located in the more needy areas and it may be that in comparing districts where white women reside those areas without WIC centers are wealthier and better-off where women don't need to use WIC for health care referrals. The presence of a WIC center in the district has no impact on delay for Hispanics. Family planning clinics have no effect on prenatal care delay for blacks and Hispanics. These have a small positive effect on delay for whites of .056 months. Abortion providers have a positive effect on delay for blacks significant at the 10% level; they have a significant positive effect on prenatal care delay for whites with a coefficient of .022; they have a small negative effect on prenatal care delay for Hispanics with a coefficient of 0.019 which is significant at the 5% level.

The overall ability of the overall model to explain prenatal care delay is best for whites with an R-squared of .108; this is followed by blacks with an R-squared of .083. The model has the lowest explanatory ability for Hispanics with an R-squared of .048.

A discussion of the results of the production function estimates by OLS with the full set of inputs and prenatal care treated exogenously will be presented first. Prenatal care delay has a negative significant impact on birthweight for all three race/ethnicities. This means, the longer the delay is before the first medical care visit, the lower is the infant's birthweight. Specifically, for blacks, a one month delay causes a 13.0 gram reduction in birthweight. For whites and Hispanics, a one month delay causes a 7.8 gram and a 9.4 gram decrease in birthweight respectively. The mother being unmarried also has a significant negative effect on birthweight. This effect is largest for whites and smallest for Hispanics with a coefficient of -75.7 for whites, -67.8 for blacks and -52.2 for Hispanics. It could be the additional stress associated with being an unwed mother is felt more by whites. Only 12% of the white births were to single mothers; 50% of the Hispanic births and 62% of the black births were to single mothers.

Compared to having a high school education, for blacks, having less than 12 years of education has a negative insignificant effect on birthweight and having more than a high school education has a positive significant effect on birthweight. The same is true for whites. For Hispanics, having less than a high school education has a significant negative effect on birthweight while having more than a high school education does not have a significant effect on birthweight. The mother being foreign born has a positive significant effect across race/ethnicities. This effect is largest for blacks with a 128.4 gram increase in birthweight for infants to mothers born out of the U.S. For Hispanics the increase is 103.1 grams and to whites the increase is 12.1 grams.

The natural log of the age of the mother has a negative significant effect for all race/ethnicities. This means older mothers have lighter babies. A 1% increase in the mother's age will cause a .140 gram for blacks, a .027 gram for whites and a .050 gram decrease for Hispanics in birthweight. Another way to interpret the coefficient on LN(Age) is to evaluate the change in birthweight for a specific change in age at the mean age for each race/ethnicity. In other words, a one year increase in the age of the mother is associated with a decrease in birthweight of 5.0 grams for blacks, 0.9 grams for whites, and 1.8 grams for Hispanics evaluated at their mean ages. The natural log of pre-pregnancy weight has a large positive impact on birthweight across race/ethnicities. Evaluated at their respective mean pre-pregnancy weights, a one pound increase in pre-pregnancy weight is associated with an increase in birthweight of 3.7 grams for blacks, 4.4 grams for whites and 3.8 grams for Hispanics. Unknown pre-pregnancy weight has a positive significant impact of 46.1 grams on birthweight for blacks. Unknown pre-pregnancy weight has a negative significant impact of 21.3 grams for whites; it has no effect on birthweight for Hispanics.

As expected, the sex of the infant being male has a positive significant effect on birthweight for blacks, whites and Hispanics; male babies are generally larger than female ones. Also as expected, if the birth was a plural birth, the birthweight of the infant was significantly lower than if it was a singleton birth. Plural birth has a negative impact of 951.0 grams, 957.2 grams and 972.8 grams for blacks, whites and Hispanics respectively. The effect on birthweight of this being the first live birth of the mother is negative and significant; the effect is -79.4 grams, -86.1 grams and -78.4 grams for blacks, whites and Hispanics respectively. The impact on birthweight if the infant was delivered by the mother's private physician compared to being a general services patient is positive and significant for all racial/ethnic groups. Being a private physician's patient is associated with a 29.8, 46.1 and 12.1 gram increase for blacks, whites and Hispanics respectively. This measure is treated exogenously throughout this study, but it should by noted that being a private physician's patient is a potentially endogenous variable. If the mother has a private physician, she generally has had an ongoing relationship with her prenatal care provider which may influence her prenatal behavior.

For blacks, all of the five drug use measures have negative significant effects on birthweight. The drug with the largest impact is cocaine which is associated with a 260.4 decrease in birthweight. The same is true for Hispanics; all drug measures have a negative significant effect on birthweight. This effect is largest for cocaine use with a 298.3 gram decrease on birthweight. For whites, all of the drug measures except for marijuana use have a negative significant effect on birthweight; marijuana use has an insignificant effect. Cocaine use is associated with a 271.9 gram decrease in birthweight which is again the drug measure with the largest impact on birthweight.

Alcohol consumption during pregnancy has negative significant effects of 104.9 grams for blacks and 101.7 grams for Hispanics on birthweight. However for whites, alcohol consumption has a positive significant effect of 158.6 grams on birthweight. Tobacco smoking has a negative significant effect on birthweight for all race/ethnicities. This effect is largest for Hispanics as it is associated with a 189.6 gram decrease in birthweight for them. It causes a 151.6 gram reduction in birthweight for blacks and a 133.7 gram reduction in birthweight for whites. Being employed during the pregnancy has a mixed effect on birthweight. For blacks, being employed has a positive significant impact of 27.6 grams. For Hispanics, this has a negative significant impact of 17.4 grams on birthweight. For whites, working during pregnancy has no effect on birthweight. The natural log of weight gain during pregnancy has a large positive effect on birthweight. The coefficients on it are 258.9, 238.4, and 232.1 for blacks, whites and Hispanics respectively. Once again, it is useful to evaluate the meaning of a coefficient on a natural log of an independent variable by calculating the change in the dependent variable evaluated at the mean of the independent variable. In this case, a one pound increase in weight gain evaluated at the mean weight gain is associated with a 9.0 gram increase in birthweight for blacks, a 8.1 gram increase in birthweight for whites and a 8.0 increase in birthweight for Hispanics.

A comparison of the effects of prenatal care on birthweight in the production functions estimated by OLS with the full set of health inputs and by OLS with the limited set of inputs (columns 1 and 2) shows that the effect of delay is larger in magnitude in the limited input model. For blacks, a one month increase in delay results in a 20.3 gram decrease in birthweight in the limited input model and a 13.0 decrease in the full input model. For whites, the decrease in birthweight is 10.1 grams in the limited input model and 7.8 grams in the full model; for Hispanics the reductions in birthweight are 9.4 grams and 13.5 grams for the limited and full input models respectively. Thus, the magnitude of the effect of prenatal care delay on birthweight becomes larger if the new inputs are not controlled for and are omitted from the regressions. So prenatal care delay is capturing some of the effect of these inputs in the limited input model.

In the limited input model, the effects of the inputs are on average larger in magnitude then in the full input model. Some exceptions to this follow. For blacks, having less than twelve years of education did not impact birthweight in the full input model; in the limited input model, this has a negative significant impact of 40.9 grams on birthweight as compared to having a high school education. In addition, the birth being a plural birth decreases in magnitude for blacks in the limited input model. Plural birth is associated with a 951.0 gram reduction in birthweight in the full input model; it is associated with a 931.2 gram reduction in the limited input model. For whites, having less than twelve years of education behaves in the same manner has for blacks; it has an insignificant effect in the full input model and is associated with a significant 24.4 gram reduction in birthweight in the limited input model. The effects of pre-pregnancy weight, plural birth, and this being the first live birth of the mother all decrease slightly in magnitude for whites in the limited input sample. For Hispanics, the effects of all variables increase in magnitude in the limited input sample except for plural birth and being the first birth.

A comparison of the production function estimates by OLS using the full set of inputs on the entire samples versus the poor subsamples reveals that the prenatal care delay has a larger negative effect on birthweight in the poor subsample for blacks but a smaller negative effect in the poor white and Hispanic subsamples. In the poor white subsample, a one month prenatal care delay results in a decrease in birthweight of 5.2 grams as opposed to a 7.8 gram reduction for the entire white sample. For Hispanics, the effect of delay was similar in both samples; a delay of one month results in decreases in birthweight of 8.9 grams in the poor subsample and 9.4 grams in the entire sample. For blacks, a one month delay in the poor subsample has a -16.2 gram impact on birthweight and in the entire sample a -13.0 gram impact.

The most notable differences between estimate using OLS on the entire black sample versus the poor subsample is that having less than a high school education is insignificant in the entire sample and has a negative significant effect in the poor subsample of 31.2 grams. Also, the effect of the log of age is much larger in magnitude. A 1 year increase in age results in a reduction of birthweight by 8.8 grams evaluated at the mean age of the poor black subsample (27.0 years) while a 1 year increase in age results in a 5.0 reduction in birthweight for the entire sample evaluated at the mean age (27.7 years). In addition, marijuana and methadone use no longer have significant effects on birthweight in the poor subsamples.

For whites, the most notable differences between estimate of the production function for the entire sample and the poor subsample include having more than a high school education is not significant in the poor subsample. Also, the log of age has a positive significant effect in the poor subsample as opposed to a negative effect in the entire sample (so an increase in age of 1 year results in a 3.0 gram increase in birthweight evaluated at the mean age of the poor sample as opposed to a 0.9 gram decrease in birthweight evaluated at the mean of the entire sample. In addition, alcohol consumption has a positive significant effect on birthweight in the entire sample but has no effect in the poor subsample. For Hispanics, the most notable differences between estimates using the entire sample and the poor subsample are that having a private physician and working during pregnancy are not significant in the poor subsample.

When prenatal care delay is treated endogenously, TSLS is used to perform the estimation of the production function. The discussion of the TSLS estimates of the production function will focus on the effects of prenatal care. For the three race/ethnic groups, the impact of delay on birthweight becomes larger in magnitude when using TSLS as opposed to OLS. When using the full set of inputs, an increase in prenatal care delay of one month results in a reduction of birthweight by 16.4, 16.5 and 24.1 for blacks, whites and Hispanics respectively when using TSLS. When using OLS, the corresponding reductions in birthweight are 13.0, 7.8 and 9.4 grams. Thus, OLS underestimates the effect of prenatal care. The largest gains to delaying care less are for Hispanics; the TSLS estimate of delay is over two and a half times larger than the OLS estimate. The gains to delaying care less are almost identical for blacks and whites which is interesting because in the OLS estimates, the effect of delay was 1.7 times larger for blacks than whites.

When examining the estimates of the production functions with limited inputs, the TSLS estimates are of the impact of delay are 42.6, 21.5 and 32.6 gram reductions in birthweight for blacks, whites and Hispanics, respectively. Using OLS, the corresponding estimates are

20.3, 10.1 and 13.5 grams reductions in birthweight. So, using TSLS in the limited input sample results in a doubling of the effect of delay on birthweight compared to using OLS.

When prenatal care is treated endogenously on the poor subsamples, delay still has a negative effect on birthweight. However, this effect is not significant for the poor white subsample in both the full and limited input models. For the poor black subsample, the effect of delay, in both the full and limited input models, is about three times larger in the TSLS estimates than in the OLS estimates. A one month increase in the initial prenatal care visit results in a reduction in birthweight of 47.6 and 83.8 grams for the full input and limited input models respectively. For the poor Hispanic subsample, the TSLS estimates of the effect of delay are over three and a half times larger than the corresponding OLS estimates. A one month increase in delay is associated with a 32.4 and 54.3 gram reduction in birthweight for the full and limited input models respectively.

The Wu test indicates that at the five percent significance level, for all three race/ethnicities, prenatal care delay should be treated endogenously in the limited input models. For whites and Hispanics, the same is true for the full input model; however, for blacks the test indicates that prenatal care should not be treated endogenously in the full input model. Thus for blacks, the inclusion of the potential risk factors in the production function reduces the potential bias in the estimate of the impact of delay on the production function due to unobservables. The poor subsamples behave in a different manner. For the poor white subsample, in both the full and limited input models, the Wu test indicates that delay should be treated as exogenous in the production function. For the poor black subsample, in both the full and limited input model, the test indicates that delay should be treated as endogenous in both the full and limited input model. Delay should be treated endogenously in the limited input model and exogenously in the full input model for the poor Hispanic subsample.

VI. The Effects of WIC Participation on Birthweight for Adults

In this chapter, the impact of WIC on the birthweight production function will be examined. WIC participation will be treated both exogenously and endogenously. Because WIC participation is a dichotomous variable, when participation is treated endogenously, a linear probability model is used to estimate the WIC demand equations using OLS. Then, following the procedure shown by Heckman and MaCurdy (1985), the predicted probability of WIC participation is used as a regressor in the production function which is estimated using OLS, and the standard errors are corrected. Estimates of the probability of WIC enrollment equations are given in table 7. Results are given separately for blacks, whites and Hispanics and their corresponding poor subsamples.

Estimates of the birthweight production functions which include the measure of WIC enrollment are given in tables 8 - 13. Tables 8, 9 and 10 are estimates for the entire samples of blacks, whites and Hispanics respectively. Tables 11, 12 and 13 are the corresponding tables for the poor subsamples. WIC participation is treated exogenously in the first three columns of each table which estimate the production function by OLS. Prenatal care is treated endogenously and WIC participation exogenously in the next three columns, which estimate the production functions using TSLS. In the last three columns of each table, both prenatal care and WIC are treated endogenously and the production functions are estimated using the Heckman and MaCurdy approach. The three columns for each estimation method vary by the inputs included in the production function. Columns 1, 4 and 9 include the full set of health inputs. Columns 2, 5 and 8 include all inputs except for weight gain during pregnancy (this will be referred to as the no weight gain model). Because of the potential correlation between weight gain during pregnancy and WIC enrollment and because both may

TABLE 7. WIC Enrollment Probability Equations for Adults by Race/Ethnicity

	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All (1)	Poor Subsample (2)	All (3)	Poor Subsample (4)	All (5)	Poor Subsample (6)
Constant	0.034	0.095	-0.013	0.012	-0.036	0.322
	(6.64)	(3.73)	(7.44)	(1.83)	(6.60)	(8.53)
Year=89	0.011	0.019	0.000	-0.005	0.035	0.037
	(3.34)	(2.56)	(0.17)	(1.15)	(9.94)	(4.86)
Year=90	0.023	0.020	0.003	-0.005	0.027	0.021
	(6.56)	(2.76)	(1.58)	(1.06)	(7.66)	(2.80)
Prenatal care clinics	0.014	0.015	-0.008	-0.012	0.001	0.008
	(8.79)	(7.88)	(9.44)	(5.44)	(0.46)	(3.00)
Education < 12	0.008	-0.014	0.084	0.109	0.069	0.004
	(2.34)	(1.99)	(32.10)	(18.84)	(20.60)	(0.58)
Education > 12	-0.022	-0.007	0.009	0.020	0.016	-0.020
	(6.46)	(0.85)	(6.33)	(4.29)	(4.27)	(2.10)
% poor in health area	0.001	0.000	0.001	-0.001	0.002	-0.005
	(9.36)	(0.10)	(8.40)	(3.37)	(18.02)	(7.32)
Medicaid	0.369	0.352	0.293	0.318	0.376	0.364
	(110.86)	(45.86)	(131.85)	(64.56)	(103.54)	(40.45)
Self-financed	0.092	0.098	0.013	0.023	0.109	0.110
	(20.24)	(9.52)	(6.40)	(3.99)	(22.75)	(9.54)
Foreign Born	0.077	0.068	0.024	0.039	0.035	0.031
	(25.11)	(8.58)	(15.21)	(9.37)	(11.13)	(4.73)
WIC center	0.009	-0.012	0.010	0.025	0.005	0.035
	(3.07)	(1.92)	(6.51)	(5.41)	(1.73)	(4.51)
Family planning clinics	-0.007	-0.008	0.006	0.013	0.002	-0.008
	(3.96)	(3.19)	(5.41)	(4.06)	(1.27)	(2.46)
Abortion providers	-0.006	-0.003	0.001	0.000	-0.001	-0.001
	(4.23)	(1.11)	(1.70)	(0.02)	(0.64)	(0.25)
F ratio	1437.0	234.0	2257.7	515.6	1544.4	200.7
R-squared	0.1570	0.1070	0.2356	0.2207	0.1654	0.0946

Absolute values of *t*-statistics are in parentheses.

TABLE 8. Birthweight Production Functions for All Black non-Hispanic Adults Including WIC Enrollment	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	69.0	1036.5	841.6	73.5	1064.3	951.6	54.6	1051.7	934.5
	(0.92)	(14.04)	(11.29)	(0.94)	(13.80)	(12.10)	(0.69)	(13.67)	(11.88)
Enrolled in WIC	46.4	53.1	60.7	56.9	65.2	79.9	27.5	44.2	55.2
	(9.34)	(10.54)	(11.90)	(11.45)	(12.95)	(15.58)	(1.61)	(2.55)	(3.13)
DELAY	-12.3	-13.8	-19.4	-19.9	-24.2	-47.3	-19.2	-24.8	-48.4
	(17.04)	(18.88)	(26.40)	(5.15)	(6.19)	(12.04)	(4.41)	(5.61)	(10.83)
Year=89	10.8	15.6	16.2	12.3	17.8	21.4	12.7	18.4	22.2
	(2.14)	(3.05)	(3.12)	(2.42)	(3.45)	(4.07)	(2.50)	(3.57)	(4.23)
Year=90	4.1	9.2	13.7	4.7	10.3	17.6	5.8	11.2	18.8
	(0.80)	(1.79)	(2.63)	(0.92)	(1.99)	(3.33)	(1.12)	(2.14)	(3.52)
Single	-70.3	-71.9	-92.2	-71.2	-72.6	-91.8	-70.0	-71.6	-91.0
	(14.96)	(15.09)	(19.16)	(15.00)	(15.07)	(18.71)	(14.68)	(14.80)	(18.45)
Education < 12	-6.3	-14.9	-42.8	1.5	-5.3	-23.4	1.9	-4.6	-22.9
	(1.18)	(2.74)	(7.79)	(0.26)	(0.90)	(3.95)	(0.33)	(0.78)	(3.78)
Education > 12	24.7	33.1	45.0	17.3	24.0	25.3	17.2	23.8	25.1
	(4.89)	(6.46)	(8.79)	(3.22)	(4.38)	(4.55)	(3.22)	(4.38)	(4.54)
Foreign born	126.9	124.5	169.8	120.2	116.1	154.3	121.3	116.2	155.0
	(28.03)	(27.11)	(37.35)	(24.97)	(23.77)	(31.40)	(24.16)	(22.78)	(30.07)
LN(age)	-136.7	-157.6	-206.5	-131.4	-152.1	-203.7	-132.9	-153.7	-206.3
	(11.22)	(12.76)	(16.63)	(10.77)	(12.30)	(16.25)	(10.68)	(12.19)	(16.15)
LN(pre-preg. weight)	545.6	531.2	597.9	547.4	532.6	601.7	554.2	539.9	611.7
	(42.23)	(40.56)	(45.31)	(42.32)	(40.60)	(45.16)	(43.42)	(41.58)	(46.28)
Pre-preg. wt. unknown	53.0	-36.5	-32.9	47.5	-48.5	-49.0	38.6	-63.4	-67.5
	(5.09)	(8.00)	(7.22)	(4.56)	(10.73)	(10.78)	(3.36)	(14.27)	(15.13)
Sex of baby is male	107.6	110.6	109.9	107.3	110.3	109.2	107.3	110.3	109.3
	(26.19)	(26.55)	(26.01)	(26.08)	(26.43)	(25.63)	(26.11)	(26.45)	(25.64)
Plural birth	-950.8	-931.1	-931.0	-947.2	-926.9	-925.0	-947.4	-927.0	-925.1
	(78.93)	(76.25)	(75.21)	(78.57)	(75.79)	(74.06)	(71.19)	(67.87)	(66.66)

TABLE 8. Birthweight Production Functions for All Black non-Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
This is 1st live birth	-78.0	-74.1	-59.2	-72.8	-68.4	-51.6	-73.7	-69.2	-52.4
	(16.76)	(15.70)	(12.42)	(15.67)	(14.51)	(10.75)	(15.71)	(14.57)	(10.84)
Private service	44.7	49.4	76.4	49.4	53.7	75.2	37.2	41.1	60.2
	(8.34)	(9.09)	(14.13)	(8.62)	(9.23)	(12.75)	(6.22)	(6.79)	(9.74)
Used heroin	-197.3	-200.7		-205.8	-210.4		-206.9	-211.7	
	(6.77)	(6.79)		(7.06)	(7.11)		(6.30)	(6.36)	
Used cocaine	-257.4	-275.5		-273.5	-293.6		-278.2	-298.9	
	(23.67)	(24.99)		(25.22)	(26.70)		(23.87)	(25.28)	
Used methadone	-119.9	-136.3		-124.2	-141.2		-125.5	-143.0	
	(4.30)	(4.82)		(4.45)	(4.99)		(4.08)	(4.58)	
Used marijuana	-62.0	-61.3		-67.2	-67.1		-68.6	-68.9	
	(3.59)	(3.50)		(3.88)	(3.82)		(3.82)	(3.79)	
Used other drug	-190.2	-195.9		-199.1	-206.0		-202.0	-209.1	
	(10.92)	(11.09)		(11.43)	(11.65)		(9.84)	(10.07)	
Worked	29.3	37.3		28.4	36.1		28.5	36.7	
	(5.92)	(7.43)		(5.67)	(7.09)		(5.64)	(7.17)	
Alcohol	-104.6	-111.6		-109.0	-116.8		-109.9	-117.9	
	(7.55)	(7.94)		(7.86)	(8.30)		(7.41)	(7.80)	
Tobacco	-151.4	-160.5		-152.8	-162.0		-153.6	-162.9	
	(20.42)	(21.36)		(20.58)	(21.51)		(20.42)	(21.24)	
LN(weight gain)	257.9			260.4			261.7		
	(50.64)			(51.10)			(44.52)		
Weight gain unknown	-131.8			-137.9			-142.6		
	(12.74)			(13.32)			(12.50)		
F-ratio	784.6	717.1	902.4	772.6	701.1	850.0	767.5	693.7	833.2
R-squared	0.1749	0.1512	0.1276	0.1726	0.1484	0.1211	0.1717	0.1470	0.1190
Wu test[a] (Delay only)	3.42	4.27	9.04						
Wu test[b] (Delay & WIC)	13.07	17.90	77.90						

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 9. Birthweight Production Functions for All White non-Hispanic Adults Including WIC Enrollment

	OLS (1)	OLS (2)	OLS (3)	TSLS (4)	TSLS (5)	TSLS (6)	DELAY and WIC Endogenous (7)	DELAY and WIC Endogenous (8)	DELAY and WIC Endogenous (9)
Constant	-304.7	701.6	657.0	-263.7	758.2	713.2	-246.8	773.2	717.5
	(4.17)	(10.00)	(9.33)	(3.54)	(10.57)	(9.91)	(3.17)	(10.46)	(9.70)
Enrolled in WIC	26.9	23.1	22.7	41.1	39.8	40.3	86.1	78.6	43.8
	(3.15)	(2.67)	(2.61)	(4.65)	(4.45)	(4.49)	(2.37)	(2.14)	(1.19)
DELAY	-7.8	-9.2	-10.1	-20.4	-24.2	-25.3	-26.2	-29.2	-26.4
	(10.50)	(12.26)	(13.49)	(5.84)	(6.83)	(7.15)	(5.01)	(5.53)	(4.99)
Year=89	7.3	13.5	12.3	8.1	14.4	13.3	8.2	14.5	13.4
	(1.68)	(3.06)	(2.78)	(1.85)	(3.27)	(2.99)	(1.87)	(3.27)	(3.00)
Year=90	11.4	19.3	19.0	14.3	22.8	22.5	15.2	23.6	22.7
	(2.60)	(4.35)	(4.26)	(3.18)	(5.02)	(4.95)	(3.34)	(5.14)	(4.94)
Single	-76.8	-77.0	-91.8	-76.5	-76.7	-92.1	-76.9	-76.9	-91.9
	(13.19)	(13.09)	(15.65)	(13.06)	(12.94)	(15.59)	(11.06)	(10.95)	(12.93)
Education < 12	-15.8	-17.0	-26.6	-5.7	-5.1	-14.4	-7.8	-7.0	-14.9
	(2.22)	(2.38)	(3.70)	(0.77)	(0.68)	(1.93)	(0.99)	(0.88)	(1.87)
Education > 12	15.9	22.8	31.5	5.4	10.3	18.5	2.3	7.7	18.0
	(3.86)	(5.48)	(7.74)	(1.15)	(2.20)	(3.98)	(0.44)	(1.48)	(3.51)
Foreign born	11.5	12.6	24.1	17.7	19.9	31.9	18.8	20.9	32.0
	(2.66)	(2.88)	(5.56)	(3.86)	(4.29)	(6.88)	(4.04)	(4.43)	(6.83)
LN(age)	-26.3	-31.0	-31.7	-26.3	-30.9	-31.7	-26.7	-31.4	-32.3
	(2.41)	(2.80)	(2.87)	(2.39)	(2.79)	(2.85)	(2.38)	(2.76)	(2.85)
LN(pre-preg. weight)	605.7	561.9	566.3	605.5	561.4	565.7	606.3	562.1	566.6
	(49.56)	(45.63)	(45.82)	(49.43)	(45.45)	(45.64)	(48.47)	(44.62)	(44.95)
Pre-preg. wt. unknown	-20.6	-34.3	-29.6	-27.5	-41.5	-37.5	-28.0	-42.5	-38.7
	(2.66)	(8.61)	(7.50)	(3.56)	(10.51)	(9.61)	(3.55)	(10.56)	(9.72)
Sex of baby is male	118.2	121.2	122.4	117.8	120.9	122.0	117.9	120.9	122.0
	(33.15)	(33.65)	(33.83)	(32.99)	(33.46)	(33.63)	(32.96)	(33.44)	(33.68)
Plural birth	-957.4	-926.7	-928.9	-957.9	-927.1	-929.5	-957.8	-927.0	-929.3
	(88.91)	(85.30)	(85.21)	(88.78)	(85.10)	(85.01)	(74.97)	(71.45)	(71.46)

TABLE 9. Birthweight Production Functions for All White non-Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
This is 1st live birth	-85.6	-74.4	-70.8	-85.5	-74.2	-70.6	-85.7	-74.4	-70.9
	(22.29)	(19.20)	(18.59)	(22.20)	(19.08)	(18.45)	(22.07)	(19.01)	(18.49)
Private service	51.0	49.0	66.0	52.0	50.2	68.4	51.3	49.2	65.9
	(8.57)	(8.15)	(11.00)	(8.40)	(8.01)	(10.95)	(7.56)	(7.19)	(9.63)
Used heroin	-182.1	-179.9		-184.7	-182.9		-186.3	-184.4	
	(4.34)	(4.24)		(4.39)	(4.29)		(3.88)	(3.82)	
Used cocaine	-271.4	-290.7		-279.4	-300.2		-280.9	-301.7	
	(11.21)	(11.87)		(11.52)	(12.24)		(10.03)	(10.61)	
Used methadone	-187.4	-203.8		-192.0	-209.4		-191.1	-208.5	
	(5.33)	(5.74)		(5.46)	(5.88)		(4.83)	(5.25)	
Used marijuana	-42.7	-46.8		-43.3	-47.5		-44.0	-48.2	
	(1.12)	(1.22)		(1.13)	(1.23)		(1.00)	(1.08)	
Used other drug	-84.5	-76.6		-87.3	-79.9		-87.8	-80.3	
	(5.38)	(4.82)		(5.55)	(5.01)		(4.74)	(4.24)	
Worked	5.8	12.2		5.4	11.8		5.5	11.8	
	(1.40)	(2.91)		(1.29)	(2.79)		(1.32)	(2.82)	
Alcohol	158.4	174.8		160.4	177.3		160.8	177.7	
	(9.03)	(9.86)		(9.13)	(9.97)		(7.70)	(8.22)	
Tobacco	-133.7	-135.9		-134.4	-136.7		-134.8	-137.1	
	(17.63)	(17.73)		(17.67)	(17.79)		(16.66)	(16.72)	
LN(weight gain)	238.6			240.2			240.2		
	(44.30)			(44.55)			(38.05)		
Weight gain unknown	-38.1			-37.3			-38.0		
	(5.04)			(4.92)			(4.94)		
F-ratio	599.1	553.2	792.7	593.6	545.7	779.6	590.3	542.7	777.8
R-squared	0.1456	0.1265	0.1192	0.1445	0.1250	0.1174	0.1438	0.1243	0.1172
Wu test[a] (Delay only)	4.76	5.56	5.68						
Wu test[b] (Delay & WIC)	23.19	30.92	31.34						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 10. Birthweight Production Functions for All Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	167.5	1073.4	1000.4	235.3	1155.7	1093.1	259.3	1188.4	1133.6
	(2.28)	(14.92)	(13.78)	(3.05)	(15.26)	(14.26)	(3.18)	(15.01)	(14.13)
Enrolled in WIC	27.2	32.7	35.6	37.7	44.7	50.8	66.6	77.6	94.0
	(6.38)	(7.59)	(8.18)	(8.74)	(10.24)	(11.48)	(4.20)	(4.82)	(5.76)
DELAY	-9.0	-10.3	-13.0	-29.8	-33.2	-40.2	-36.1	-40.4	-50.0
	(13.52)	(15.31)	(19.26)	(6.89)	(7.57)	(9.14)	(6.92)	(7.63)	(9.28)
Year=89	6.6	8.9	9.4	9.6	12.3	13.4	9.6	12.3	13.5
	(1.44)	(1.94)	(2.02)	(2.09)	(2.63)	(2.83)	(2.07)	(2.62)	(2.82)
Year=90	8.8	11.1	14.5	12.4	15.0	19.2	11.9	14.5	18.6
	(1.97)	(2.43)	(3.15)	(2.70)	(3.21)	(4.07)	(2.56)	(3.06)	(3.89)
Single	-53.1	-56.0	-71.8	-51.9	-54.7	-71.0	-53.5	-56.6	-73.4
	(13.82)	(14.39)	(18.37)	(13.30)	(13.84)	(17.80)	(13.42)	(14.01)	(17.80)
Education < 12	-31.4	-34.2	-46.4	-24.8	-26.9	-38.0	-26.6	-29.0	-40.7
	(7.35)	(7.91)	(10.66)	(5.60)	(6.01)	(8.38)	(5.83)	(6.27)	(8.66)
Education > 12	6.1	13.8	13.7	-7.2	-0.9	-4.1	-10.4	-4.6	-8.6
	(1.22)	(2.72)	(2.69)	(1.30)	(0.15)	(0.74)	(1.84)	(0.79)	(1.48)
Foreign born	102.4	100.1	131.9	100.7	98.1	130.5	99.0	96.2	128.1
	(24.15)	(23.33)	(30.95)	(23.58)	(22.69)	(30.29)	(22.52)	(21.56)	(28.58)
LN(age)	-47.2	-52.9	-80.4	-43.1	-48.0	-74.9	-45.0	-50.3	-77.1
	(4.36)	(4.83)	(7.29)	(3.96)	(4.35)	(6.72)	(3.98)	(4.39)	(6.65)
LN(pre-preg. weight)	516.2	488.2	515.9	518.1	490.0	519.0	519.5	491.6	521.0
	(39.81)	(37.26)	(39.03)	(39.70)	(37.13)	(38.88)	(38.83)	(36.21)	(37.96)
Pre-preg. wt. unknown	8.4	-45.6	-43.3	2.9	-52.0	-51.4	-4.6	-64.0	-65.4
	(0.91)	(11.32)	(10.72)	(0.32)	(12.91)	(12.70)	(0.47)	(16.28)	(16.50)
Sex of baby is male	107.6	109.0	109.2	107.8	109.2	109.4	107.8	109.2	109.5
	(29.57)	(29.59)	(29.34)	(29.42)	(29.42)	(29.11)	(29.31)	(29.28)	(28.87)
Plural birth	-972.0	-948.1	-943.9	-970.1	-945.6	-940.7	-971.5	-947.2	-942.5
	(78.80)	(76.03)	(74.94)	(78.16)	(75.28)	(73.94)	(67.76)	(65.30)	(64.07)

TABLE 10. Birthweight Production Functions for All Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
This is 1st live birth	-77.1	-71.5	-63.6	-75.9	-70.0	-61.5	-76.3	-70.4	-61.6
	(19.08)	(17.49)	(15.49)	(18.66)	(16.99)	(14.81)	(18.59)	(16.96)	(14.68)
Private service	22.3	30.3	33.7	19.3	27.4	30.9	15.4	22.7	26.7
	(4.30)	(5.78)	(6.45)	(3.48)	(4.89)	(5.48)	(2.74)	(3.99)	(4.61)
Used heroin	-165.9	-169.5		-173.1	-177.9		-174.3	-179.3	
	(6.26)	(6.32)		(6.49)	(6.59)		(5.85)	(5.96)	
Used cocaine	-296.7	-308.9		-307.4	-321.4		-309.5	-324.1	
	(19.16)	(19.71)		(19.76)	(20.40)		(16.73)	(17.29)	
Used methadone	-216.3	-234.6		-217.8	-236.6		-218.3	-237.3	
	(8.98)	(9.63)		(8.99)	(9.64)		(7.88)	(8.51)	
Used marijuana	-95.4	-101.2		-95.8	-101.7		-96.9	-103.2	
	(3.48)	(3.65)		(3.47)	(3.64)		(3.23)	(3.42)	
Used other drug	-95.8	-92.0		-100.6	-97.4		-101.5	-98.5	
	(4.76)	(4.52)		(4.97)	(4.75)		(4.21)	(4.06)	
Worked	-16.8	-13.4		-18.1	-14.7		-15.6	-11.8	
	(3.33)	(2.62)		(3.54)	(2.84)		(3.05)	(2.26)	
Alcohol	-101.1	-109.8		-103.3	-112.4		-104.0	-113.4	
	(4.65)	(4.99)		(4.73)	(5.08)		(4.08)	(4.33)	
Tobacco	-189.8	-191.0		-191.9	-193.3		-191.9	-193.4	
	(21.86)	(21.73)		(21.96)	(21.84)		(20.58)	(20.35)	
LN(weight gain)	231.3			233.5			234.5		
	(46.96)			(47.15)			(39.89)		
Weight gain unknown	-87.3			-87.6			-90.5		
	(9.55)			(9.52)			(9.13)		
F-ratio	618.2	560.9	716.0	605.3	545.2	683.1	596.6	534.6	662.7
R-squared	0.1418	0.1212	0.1030	0.1393	0.1182	0.0987	0.1375	0.1162	0.0961
Wu test[a] (Delay only)	5.93	6.48	7.62						
Wu test[b] (Delay & WIC)	37.91	45.42	64.41						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 11. Birthweight Production Functions for the Poor Subsample of Black non-Hispanic Adults Including WIC Enrollment

	OLS (1)	OLS (2)	OLS (3)	TSLS (4)	TSLS (5)	TSLS (6)	DELAY and WIC Endogenous (7)	DELAY and WIC Endogenous (8)	DELAY and WIC Endogenous (9)
Constant	165.4	1026.2	828.7	328.2	1214.4	1150.0	321.5	1216.3	1152.2
	(1.08)	(6.75)	(5.37)	(1.99)	(7.41)	(6.70)	(1.97)	(7.56)	(6.80)
Enrolled in WIC	63.6	70.3	78.0	79.9	88.7	105.6	37.2	49.6	69.6
	(6.73)	(7.35)	(8.02)	(8.39)	(9.18)	(10.44)	(1.06)	(1.40)	(1.91)
DELAY	-15.0	-16.7	-23.3	-50.7	-55.2	-87.6	-50.1	-55.2	-89.1
	(10.91)	(12.01)	(16.73)	(5.59)	(5.99)	(9.29)	(5.18)	(5.63)	(8.83)
Year=89	22.1	28.8	31.7	32.0	39.7	49.6	33.6	41.6	52.0
	(2.18)	(2.81)	(3.03)	(3.02)	(3.69)	(4.40)	(3.20)	(3.90)	(4.66)
Year=90	2.7	9.7	17.9	13.2	21.0	37.5	15.8	23.8	41.0
	(0.27)	(0.95)	(1.72)	(1.23)	(1.94)	(3.31)	(1.46)	(2.18)	(3.58)
Single	-65.4	-67.7	-93.2	-63.2	-65.5	-89.3	-62.8	-65.5	-90.1
	(6.37)	(6.51)	(8.84)	(6.00)	(6.13)	(7.99)	(5.94)	(6.09)	(7.96)
Education < 12	-32.2	-41.1	-74.1	-8.9	-16.1	-34.3	-8.4	-15.4	-33.4
	(3.31)	(4.17)	(7.45)	(0.81)	(1.44)	(2.94)	(0.74)	(1.34)	(2.78)
Education > 12	32.2	37.2	53.5	9.3	12.5	11.6	8.5	11.4	10.3
	(2.91)	(3.32)	(4.75)	(0.76)	(1.00)	(0.89)	(0.70)	(0.93)	(0.80)
Foreign born	124.4	126.3	174.9	101.9	101.9	137.9	102.3	101.7	137.3
	(11.07)	(11.09)	(15.28)	(8.33)	(8.19)	(10.65)	(8.15)	(7.96)	(10.23)
LN(age)	-231.8	-252.1	-331.1	-230.8	-251.2	-337.0	-235.6	-256.8	-345.1
	(9.52)	(10.22)	(13.35)	(9.31)	(9.98)	(12.92)	(9.19)	(9.86)	(12.75)
LN(pre-preg. weight)	598.2	596.0	684.0	601.0	598.9	690.9	609.6	608.1	703.5
	(22.51)	(22.13)	(25.12)	(22.23)	(21.81)	(24.16)	(23.45)	(22.73)	(25.22)
Pre-preg. wt. unknown	89.9	-37.7	-34.2	82.5	-52.8	-54.3	68.8	-76.8	-83.2
	(4.40)	(4.16)	(3.77)	(3.97)	(5.77)	(5.75)	(3.08)	(8.68)	(9.15)
Sex of baby is male	106.3	109.3	109.1	105.6	108.5	107.9	105.3	108.2	107.6
	(12.94)	(13.11)	(12.87)	(12.63)	(12.77)	(12.11)	(12.62)	(12.76)	(12.06)
Plural birth	-979.6	-959.7	-959.0	-978.6	-958.2	-956.8	-980.7	-960.3	-959.2
	(42.26)	(40.86)	(40.12)	(41.50)	(40.01)	(38.09)	(39.89)	(38.15)	(36.65)

TABLE 11. Birthweight Production Functions for the Poor Subsample of Black non-Hispanic Adults Including WIC Enrollment

	OLS (1)	OLS (2)	OLS (3)	TSLS (4)	TSLS (5)	TSLS (6)	DELAY and WIC Endogenous (7)	DELAY and WIC Endogenous (8)	DELAY and WIC Endogenous (9)
This is 1st live birth	-79.6	-77.0	-58.6	-74.1	-70.8	-49.9	-74.9	-71.7	-50.4
	(8.15)	(7.78)	(5.84)	(7.47)	(7.04)	(4.75)	(7.39)	(6.98)	(4.69)
Private service	58.0	61.3	97.0	52.6	56.0	83.9	33.9	36.3	62.3
	(4.90)	(5.11)	(8.10)	(4.15)	(4.34)	(6.26)	(2.57)	(2.73)	(4.48)
Used heroin	-139.7	-139.9		-147.6	-149.0		-151.3	-153.2	
	(3.13)	(3.10)		(3.26)	(3.23)		(3.19)	(3.20)	
Used cocaine	-239.1	-245.7		-254.3	-263.0		-260.3	-269.8	
	(14.20)	(14.40)		(14.91)	(15.19)		(14.84)	(15.12)	
Used methadone	-68.8	-81.3		-73.3	-86.6		-77.5	-91.6	
	(1.64)	(1.91)		(1.72)	(2.00)		(1.78)	(2.07)	
Used marijuana	-42.0	-40.5		-47.0	-46.2		-47.1	-46.3	
	(1.57)	(1.49)		(1.72)	(1.67)		(1.71)	(1.66)	
Used other drug	-172.1	-182.2		-185.8	-197.6		-190.7	-203.1	
	(5.18)	(5.40)		(5.50)	(5.75)		(5.33)	(5.60)	
Worked	31.2	44.5		24.0	37.1		24.0	37.9	
	(2.77)	(3.90)		(2.05)	(3.13)		(2.02)	(3.15)	
Alcohol	-135.2	-145.9		-139.4	-150.9		-140.0	-151.7	
	(5.93)	(6.31)		(6.01)	(6.40)		(5.74)	(6.12)	
Tobacco	-147.7	-159.7		-148.6	-161.0		-149.2	-161.9	
	(12.10)	(12.92)		(11.96)	(12.77)		(12.23)	(13.00)	
LN(weight gain)	247.6			251.1			253.0		
	(24.62)			(24.56)			(22.21)		
Weight gain unknown	-183.9			-191.4			-200.4		
	(8.96)			(9.17)			(8.98)		
F-ratio	229.7	215.3	262.6	218.6	202.6	226.8	216.1	199.0	218.9
R-squared	0.1969	0.1745	0.1440	0.1892	0.1660	0.1268	0.1874	0.1635	0.1229
Wu test[a] (Delay only)	4.82	5.14	8.09						
Wu test[b] (Delay & WIC)	23.12	26.10	63.49						

Absolute values of t-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 12. Birthweight Production Functions for the Poor Subsample of White non-Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-288.4	589.5	556.2	-285.5	609.4	584.3	-283.3	609.9	571.8
	(2.02)	(4.31)	(4.04)	(1.95)	(4.33)	(4.12)	(1.89)	(4.23)	(3.96)
Enrolled in WIC	36.7	37.4	39.3	41.1	43.3	46.9	34.2	29.9	6.9
	(3.04)	(3.06)	(3.20)	(3.33)	(3.48)	(3.75)	(0.84)	(0.73)	(0.17)
DELAY	-5.0	-6.2	-7.6	-7.6	-11.2	-14.7	-7.8	-10.5	-10.4
	(3.76)	(4.59)	(5.57)	(1.08)	(1.57)	(2.05)	(0.88)	(1.17)	(1.16)
Year=89	4.3	10.6	10.8	5.4	12.4	13.2	5.8	12.7	12.9
	(0.48)	(1.20)	(1.21)	(0.60)	(1.38)	(1.46)	(0.64)	(1.39)	(1.40)
Year=90	16.3	22.9	27.6	18.0	26.2	32.3	18.4	26.1	30.2
	(1.82)	(2.55)	(3.05)	(1.80)	(2.60)	(3.19)	(1.73)	(2.44)	(2.81)
Single	-109.4	-109.0	-134.0	-109.4	-108.9	-133.9	108.8	-108.0	-132.5
	(10.16)	(10.04)	(12.37)	(10.12)	(9.98)	(12.31)	(7.37)	(7.31)	(8.72)
Education < 12	-2.2	-1.3	-12.5	0.9	3.5	-6.2	0.6	3.4	-5.1
	(0.20)	(0.12)	(1.12)	(0.08)	(0.30)	(0.52)	(0.05)	(0.28)	(0.41)
Education > 12	-4.0	7.8	15.5	-7.9	1.8	7.9	-8.2	2.1	10.3
	(0.44)	(0.86)	(1.77)	(0.78)	(0.18)	(0.79)	(0.77)	(0.19)	(0.97)
Foreign born	16.0	14.5	32.4	17.2	16.5	35.3	17.3	16.6	35.6
	(2.01)	(1.80)	(4.05)	(2.10)	(1.99)	(4.27)	(2.05)	(1.95)	(4.16)
LN(age)	88.6	84.6	70.3	89.4	85.2	70.8	88.3	84.0	69.2
	(4.42)	(4.19)	(3.47)	(4.45)	(4.21)	(3.48)	(4.41)	(4.16)	(3.42)
LN(pre-preg. weight)	547.2	505.6	515.8	546.7	504.7	515.0	548.1	506.2	517.4
	(21.97)	(20.19)	(20.47)	(21.95)	(20.15)	(20.42)	(21.45)	(19.66)	(20.04)
Pre-preg. wt. unknown	-11.5	-35.9	-33.2	-16.6	-41.6	-40.3	-18.6	-45.0	-44.5
	(0.81)	(4.53)	(4.22)	(1.17)	(5.32)	(5.20)	(1.30)	(5.74)	(5.73)
Sex of baby is male	120.9	123.3	124.4	120.4	122.7	123.7	120.5	122.9	123.9
	(16.76)	(16.94)	(16.98)	(16.70)	(16.87)	(16.88)	(16.76)	(16.94)	(16.95)
Plural birth	-957.2	-933.0	-940.0	-957.6	-933.4	-940.6	-957.3	-933.0	-940.2
	(41.92)	(40.56)	(40.61)	(41.92)	(40.56)	(40.59)	(33.67)	(32.53)	(32.72)

TABLE 12. Birthweight Production Functions for the Poor Subsample of White non-Hispanic Adults Including WIC Enrollment									
	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
This is 1st live birth	-76.2	-66.9	-64.3	-75.3	-65.8	-62.8	-76.1	-66.7	-64.0
	(9.46)	(8.25)	(7.97)	(9.34)	(8.10)	(7.77)	(9.38)	(8.20)	(7.95)
Private service	44.1	39.5	61.8	48.9	44.6	67.9	44.4	39.4	61.0
	(4.33)	(3.84)	(6.01)	(4.70)	(4.25)	(6.47)	(4.02)	(3.55)	(5.43)
Used heroin	-202.7	-196.6		-205.2	-199.5		-209.5	-203.9	
	(3.34)	(3.22)		(3.38)	(3.26)		(3.11)	(3.02)	
Used cocaine	-278.5	-306.6		-285.3	-315.2		-287.5	-317.5	
	(7.14)	(7.80)		(7.32)	(8.02)		(6.28)	(6.98)	
Used methadone	-170.8	-183.2		-174.2	-187.2		-174.1	-187.2	
	(3.41)	(3.62)		(3.48)	(3.70)		(3.15)	(3.36)	
Used marijuana	-73.3	-67.2		-72.3	-65.9		-72.5	-66.0	
	(1.10)	(1.00)		(1.08)	(0.98)		(1.12)	(1.01)	
Used other drug	-96.3	-94.3		-97.7	-96.0		-99.3	-97.6	
	(2.71)	(2.63)		(2.75)	(2.68)		(2.33)	(2.27)	
Worked	1.7	11.4		2.9	12.7		3.0	12.8	
	(0.18)	(1.17)		(0.30)	(1.30)		(0.30)	(1.29)	
Alcohol	43.0	52.5		44.4	54.3		44.3	54.1	
	(1.07)	(1.29)		(1.10)	(1.33)		(1.02)	(1.23)	
Tobacco	-173.6	-174.6		-173.2	-174.2		-172.9	-173.8	
	(10.38)	(10.36)		(10.35)	(10.33)		(9.64)	(9.61)	
LN(weight gain)	205.9			207.4			207.7		
	(19.60)			(19.75)			(18.54)		
Weight gain unknown	-59.9			-59.7			-60.9		
	(4.26)			(4.24)			(4.33)		
F-ratio	152.9	146.7	200.5	152.4	145.7	198.3	151.9	145.3	197.6
R-squared	0.1490	0.1338	0.1210	0.1485	0.1331	0.1199	0.1482	0.1327	0.1195
Wu test[a] (Delay only)	0.73	1.14	1.50						
Wu test[b] (Delay & WIC)	0.54	1.38	3.11						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 13. Birthweight Production Functions for the Poor Subsample of Hispanic Adults Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	75.9	887.4	804.0	183.5	1013.5	996.2	172.6	1004.7	985.0
	(0.48)	(5.78)	(5.17)	(1.07)	(6.01)	(5.74)	(1.00)	(5.94)	(5.70)
Enrolled in WIC	34.5	35.5	39.2	41.1	42.8	50.1	75.6	77.4	94.8
	(4.14)	(4.23)	(4.60)	(4.93)	(5.07)	(5.77)	(2.58)	(2.63)	(3.17)
DELAY	-8.3	-9.1	-13.1	-33.5	-3[illegible]	-55.6	-33.8	-37.2	-56.7
	(6.44)	(7.00)	(10.07)	(2.83)	(3.08)	(4.55)	(2.80)	(3.05)	(4.56)
Year=89	13.3	13.4	13.6	20.2	20.9	25.1	19.3	20.2	24.3
	(1.43)	(1.42)	(1.43)	(2.03)	(2.09)	(2.44)	(1.91)	(1.98)	(2.32)
Year=90	25.8	25.6	29.0	34.7	35.4	44.1	33.2	33.9	42.5
	(2.82)	(2.77)	(3.09)	(3.41)	(3.45)	(4.19)	(3.18)	(3.23)	(3.95)
Single	-61.6	-63.4	-81.7	-61.8	-63.7	-82.5	-64.2	-66.1	-85.8
	(7.81)	(7.97)	(10.17)	(7.73)	(7.89)	(9.98)	(7.75)	(7.89)	(9.83)
Education < 12	-24.2	-27.9	-42.4	-10.4	-12.8	-19.8	-10.7	-13.0	-20.1
	(2.88)	(3.29)	(4.94)	(1.03)	(1.24)	(1.87)	(1.04)	(1.26)	(1.89)
Education > 12	22.9	29.2	32.0	17.1	22.8	22.4	18.4	24.2	24.5
	(1.98)	(2.50)	(2.71)	(1.43)	(1.90)	(1.81)	(1.57)	(2.05)	(2.02)
Foreign born	109.3	108.9	143.6	101.5	100.4	131.8	100.0	98.9	129.7
	(13.26)	(13.11)	(17.23)	(11.49)	(11.25)	(14.51)	(11.20)	(10.96)	(14.03)
LN(age)	-65.3	-72.1	-117.3	-61.0	-67.5	-112.4	-63.0	-69.6	-114.4
	(2.95)	(3.24)	(5.21)	(2.74)	(3.00)	(4.87)	(2.76)	(3.03)	(4.85)
LN(pre-preg. weight)	550.7	528.1	570.4	550.4	527.5	570.6	553.3	530.3	574.4
	(19.60)	(18.66)	(19.89)	(19.39)	(18.42)	(19.40)	(19.91)	(18.77)	(19.96)
Pre-preg. wt. unknown	-18.9	-36.6	-39.1	-23.6	-42.6	-47.8	-32.1	-55.5	-63.4
	(1.02)	(4.44)	(4.72)	(1.26)	(5.14)	(5.67)	(1.68)	(7.10)	(7.98)
Sex of baby is male	113.1	114.7	116.7	113.2	114.9	117.1	113.3	114.9	117.1
	(15.19)	(15.27)	(15.30)	(15.07)	(15.13)	(14.97)	(15.05)	(15.11)	(14.92)
Plural birth	-946.5	-929.0	-926.2	-944.6	-926.7	-922.9	-948.0	-930.2	-927.2
	(37.95)	(36.95)	(36.29)	(37.52)	(36.45)	(35.29)	(32.92)	(32.01)	(31.23)

TABLE 13. Birthweight Production Functions for the Poor Subsample of Hispanic Adults Including WIC Enrollment									
	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
This is 1st live birth	-70.1	-67.3	-53.3	-68.4	-65.4	-50.3	-69.0	-66.0	-50.5
	(8.22)	(7.82)	(6.14)	(7.96)	(7.53)	(5.66)	(8.02)	(7.62)	(5.68)
Private service	15.7	21.3	30.6	14.9	20.5	29.3	11.0	16.3	25.7
	(1.30)	(1.75)	(2.51)	(1.21)	(1.64)	(2.30)	(0.88)	(1.29)	(1.97)
Used heroin	-177.4	-171.9		-187.4	-182.9		-188.4	-183.9	
	(4.25)	(4.09)		(4.45)	(4.30)		(4.08)	(3.95)	
Used cocaine	-275.3	-283.3		-284.6	-293.5		-285.8	-294.8	
	(10.95)	(11.18)		(11.24)	(11.47)		(10.39)	(10.67)	
Used methadone	-192.0	-202.5		-192.5	-203.2		-194.6	-205.3	
	(5.25)	(5.49)		(5.22)	(5.45)		(4.73)	(4.93)	
Used marijuana	-81.2	-87.6		-80.8	-87.3		-83.4	-90.0	
	(1.79)	(1.92)		(1.77)	(1.89)		(1.66)	(1.81)	
Used other drug	-143.4	-146.2		-149.9	-153.2		-152.3	-155.7	
	(3.54)	(3.58)		(3.67)	(3.71)		(3.02)	(3.09)	
Worked	-3.5	-2.3		-4.1	-2.9		0.1	1.5	
	(0.29)	(0.19)		(0.33)	(0.24)		(0.01)	(0.12)	
Alcohol	-189.2	-200.1		-193.2	-204.5		-193.7	-205.2	
	(4.91)	(5.15)		(4.97)	(5.21)		(4.45)	(4.67)	
Tobacco	-197.6	-199.7		-199.4	-201.8		-198.9	-201.3	
	(12.71)	(12.74)		(12.71)	(12.73)		(12.02)	(12.03)	
LN(weight gain)	209.7			211.4			211.7		
	(20.00)			(19.97)			(17.54)		
Weight gain unknown	-50.4			-51.5			-55.9		
	(2.71)			(2.75)			(2.91)		
F-ratio	163.5	157.6	186.8	159.2	152.5	172.8	157.9	151.0	169.8
R-squared	0.1508	0.1360	0.1084	0.1474	0.1321	0.1011	0.1463	0.1310	0.0995
Wu test[a] (Delay only)	2.48	2.70	3.96						
Wu test[b] (Delay & WIC)	7.68	8.82	18.15						

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

be proxies for nutritional intake during pregnancy, some estimation is done including WIC but excluding weight gain. Columns 3, 6 and 9 use only the limited set of inputs discussed in the previous chapter. A discussion of the linear probability of WIC enrollment equation is given first.

The variable with the largest effect on the probability of WIC enrollment is if the birth is Medicaid financed. As mentioned previously, income eligibility for WIC and Medicaid are linked; a woman receiving Medicaid is automatically eligible for WIC. Thus, one would expect a strong positive effect of Medicaid on the probability of using WIC. This is observed for all three race/ethnicities; the probability of WIC enrollment increases by .369, .293 and .376 for blacks, whites and Hispanics respectively if the birth is Medicaid financed as opposed to other third party financed. Self-financing of the birth as opposed to other third party financing also has a significant positive effect on the probability of WIC enrollment across race/ethnicities although not in as large as magnitude as Medicaid financing. Women with third party financing are generally better off financially then women with Medicaid or self-financing or are not as likely to be eligible for or to need the benefits of WIC. Mothers who are foreign born have a higher probability of WIC enrollment than those who or born in the U.S. Some possible explanations of this may include that foreign born mothers are worse off financially and nutritionally and so have more need of WIC, or it may be that foreign born mothers are more aware of the importance of nutrition during pregnancy and seek out the services of WIC.

Having received less than twelve years of education as compared to twelve years of education has a significant positive effect on the probability of WIC enrollment across race/ethnicities. This effect is largest for whites and smallest for blacks. Having received more than twelve years compared to twelve years of education has a negative significant effect on probability of WIC enrollment for blacks and a positive significant effect for whites and Hispanics. The race specific poverty rate has a very small positive significant effect on probability of WIC enrollment for blacks, whites and Hispanics. The availability of prenatal care clinics in the health area has a small positive significant effect on the probability of WIC enrollment for blacks, a small negative significant effect on whites and an insignificant effect for Hispanics. The availability of family planning clinics has a small negative significant effect on the probability of WIC participation for blacks, a small positive significant effect for whites and an insignificant effect for Hispanics. The availability of abortion providers has a small negative effect on WIC participation for blacks and an insignificant effect for whites and Hispanics. The presence of a WIC center in the health district has positive significant effects on WIC participation for all race/ethnicities although the significance level for Hispanics is only 10%. For whites, the year dummies are not significant so the probability of WIC participation for whites does not depend on the year of the birth. For blacks and Hispanics, both year dummies have positive significant effects on the probability of WIC enrollment, so mothers who gave birth in 1989 and 1990 are more likely to have participated in WIC compared to mothers who gave birth in 1988.

The discussion of the production function estimates that follow will focus on the effects of prenatal care delay, WIC participation and weight gain during pregnancy. For the most part, the other health inputs behave as they did in the discussion of the health inputs in the previous chapter. Before proceeding, a brief comment on the WIC variable used will be offered. A woman is categorized as having enrolled in WIC whether she enrolled in her last month of pregnancy or early in her pregnancy. Obviously, those who participate early in pregnancy will receive more benefits than those who enroll later (at the very least these benefits include food items but also the benefits may include education and health referrals). The timing of enrollment can not be determined from the birth certificate data. Studies by Kennedy et al. (1982) and Kotelchuck et al. (1984) have found that improvement to birth outcomes increase with the length of time of participation.

In the estimates of the production function that treat delay and WIC exogenously and use the full set of inputs (column 1 in tables 8 - 10), a delay in the initial prenatal care visit of one month results in a reduction of birthweight of 12.3, 7.8 and 9.0 grams for blacks, whites and Hispanics respectively. These results are very similar to the results for the full input model discussed in the previous chapter that exclude the WIC measure. In fact, the 7.8 gram reduction for whites is the same in both cases; the black and Hispanic reductions are slightly smaller in magnitude than in the previous model. Compared to these estimates, the estimates of the effect of prenatal care delay from OLS are underestimated. Enrollment in WIC has a positive significant effect on birthweight. For blacks, enrollment in WIC is associated with a 46.4 gram increase in birthweight compared to mothers who did not enroll in WIC; for whites the increase is 26.9 grams, and for Hispanics it is 27.2 grams. Thus, the impact of WIC enrollment is greatest for blacks. The natural log of weight gain also has a positive significant effect on birthweight which is 257.9 grams for blacks, 238.6 grams for whites and 231.3 grams for Hispanics. A comparison of these results with the OLS estimates on the limited input sample (column 3 in tables 8 - 10) reveal the magnitude of the effects of both delay and WIC enrollment increase in the limited input sample. The reduction in birthweight from a one month delay and the increase in birthweight due to WIC enrollment are 19.4 and 60.7 grams for blacks, 10.1 and 22.7 grams for whites and 13.0 and 35.6 grams for Hispanics. When all of the inputs except weight gain during pregnancy are included in the production function (column 2 table 11 - 13), the impact of delay on birthweight increases slightly in magnitude compared to the full input model; a one month delay results in a reduction of birthweight of 13.8, 9.2 and 10.3 grams for blacks, whites and Hispanics respectively. The impact of WIC enrollment also increases slightly in this model for blacks and Hispanics. Enrollment in WIC leads to an increase in birthweight of 53.1 and 32.7 grams for blacks and Hispanics. WIC enrollment is associated with a 23.1 gram increase in birthweight for whites in the model without weight gain; this is slightly lower than the 26.9 gram increase in the full input model.

When delay is treated endogenously and the full set of inputs are included in the production function (column 4 tables 8 - 10) the impacts of the three variables delay, WIC and weight gain are still significant and are larger in magnitude than their impacts in the OLS estimates. In the TSLS estimates, an increase in delay by one month results in a 19.9 gram reduction in birthweight for blacks, a 20.4 gram reduction for whites and a 29.8 reduction for Hispanics. So, in the TSLS estimates, the effect of delay is largest for Hispanics and smallest for blacks whereas in the OLS estimates, the effect of delay is largest for blacks and smallest for whites. The effect of WIC participation is an increase in birthweight of 56.9, 41.1 and 37.7 grams for blacks, whites and Hispanics respectively. When the production functions are estimated by TSLS and weight gain is excluded as an input, the effects of delay and WIC enrollment are still statistically significant. A one month increase in delay is associated with decreases in birthweight of 24.2 grams for both blacks and whites and a decrease in birthweight of 33.2 grams for Hispanics. The impact of WIC enrollment is an increase in birthweight of 65.2, 39.8 and 44.7 grams for blacks, whites and Hispanics respectively. In the limited input model estimated by TSLS, for whites, there is only a small difference in the effects of delay and WIC on birthweight compared to the no weight gain model; the coefficients of delay and WIC are -25.3 and 40.3. For Hispanics, there is a somewhat larger impact of these two variables in the limited input model; the coefficients of delay and WIC are -40.2 and 50.8. For blacks, there is a large increase in magnitude in the limited input model. The coefficients of delay and WIC are -47.3 and 79.9; this coefficient on delay is almost twice as large as the TSLS estimated no weight gain model and is two and a half times larger than the limited input model estimated by OLS.

When both delay and WIC enrollment are treated endogenously, in the full input model which includes weight gain, the impact of WIC enrollment on birthweight varies by race/ethnicity. For blacks, WIC enrollment has a positive but not significant effect on birthweight. For whites, the impact of WIC is statistically significant, and it more than triples in magnitude compared to the full input model estimated by OLS; WIC enrollment is associated with a 86.1 gram increase in birthweight. For Hispanics, WIC enrollment also has a positive significant effect on birthweight; it is associated with a 66.6 gram increase in birthweight. Thus for whites and Hispanics, OLS underestimates the gains to prenatal WIC participation; for blacks, OLS overestimates such gains. In the model without weight gain with delay and WIC treated endogenously, WIC enrollment has a positive significant effect on birthweight for all three race/ethnicities. For blacks and Hispanics, the effect is larger in this model than in the full input model while the reverse is true for whites. WIC enrollment results in an increase of birthweight of 44.2, 78.6 and 77.6 grams for blacks, whites and Hispanics respectively. In the limited input model with delay and WIC treated endogenously, WIC enrollment does not have a significant impact on birthweight for whites. For blacks and Hispanics, in this specification the impact of WIC is the largest of the three specifications treated delay and WIC endogenously. For blacks and Hispanics, respectively, the impact of WIC enrollment is an increase in birthweight of 55.2 and 94.0 grams.

Prenatal care delay has been treated three ways; it has been treated exogenously, as the only endogenous variable and endogenously at the same time as WIC enrollment. In all specifications, prenatal care delay has a negative significant effect on birthweight. When comparing production functions using the same set of inputs estimated by OLS and TSLS, the effect of delay is larger in magnitude when treated endogenously. When comparing the three different specifications of inputs: the full input model, the model excluding only weight gain and the limited input model, in all three methods of estimation (OLS, TSLS and delay and WIC both treated endogenously) the magnitude of the impact of delay in the full input model is the smallest; this is followed by the model excluding weight gain; the largest impact of delay occurs in the limited input model. The only time this is not true is for whites when both delay and WIC enrollment are endogenous; in this case, the magnitude of the effect of delay in the limited input model is smaller by 2.8 grams than the model which excludes only weight gain. This is as expected; as more variables are excluded from the production function, prenatal care delay is picking up the effects of these variables as they influence delay. This same behavior is observed for WIC enrollment for blacks and Hispanics but only for whites when both WIC and delay are treated as endogenous; the magnitude of the WIC effect is largest in the limited input model and smallest in the full input model. For whites however, in the OLS and TSLS estimates, the magnitude of the effect of WIC participation is largest in the model without weight gain and is smallest in the limited input model.

When comparing production functions using the same set of inputs treating only delay endogenously and treating delay and WIC endogenously, the difference in the impact of delay varies by race/ethnicity. For blacks, the impact of delay on birthweight is the same whether delay is treated endogenously by itself or with WIC. This is true in the three different specifications of inputs: the full input model, the model excluding only weight gain and the limited input model. In the full input model, the effect of delay on birthweight is -19.9

when delay is endogenous and -19.2 when delay and WIC are endogenous. In the model excluding weight gain, the corresponding effects of delay are -24.2 and -24.8; in the limited input model the corresponding effects are -47.3 and -48.4. The magnitude of the effect of delay on birthweight changes only slightly when comparing specifications with only delay or both delay and WIC being treated endogenously. For whites, this is true only in the limited input model in which the effect of delay increases slightly when both delay and WIC are treated endogenously (the coefficient is -26.4) compared to only delay being treated as endogenous (the coefficient is -25.3). In the full input model and the model exclusive of weight gain, the effect of delay increases in magnitude when both delay and WIC are treated exogenously compared to when only delay is treated endogenously. In the full input model, the effect of delay on birthweight is -20.4 when delay is endogenous and -26.2 when delay and WIC are endogenous; in the model excluding weight gain, the corresponding effects of delay are -24.2 and -29.2. For Hispanics, in all three health input specifications, the magnitude of the effect of delay on birthweight is larger when both WIC and delay are treated endogenously. In the full input model, the effect of delay on birthweight is -29.8 when delay is endogenous and -36.1 when delay and WIC are endogenous. In the model excluding weight gain, the corresponding effects of delay are -33.2 and -40.4; in the limited input model the corresponding effects are -40.2 and -50.0.

An examination of the effects of prenatal care delay and WIC participation on birthweight for the poor adult subsamples is now presented. For the poor black subsample (table 11), delay has a significant negative effect in all of the nine estimated production function. In the OLS estimates, the magnitude of this effect is slightly larger than for the entire black subsample, but when only delay and delay and WIC are treated endogenously, the effect of delay is much larger in magnitude than in the entire black sample. The effect of a one month increase in delay results in a decrease in birthweight of 15.0, 50.7 and 50.1 grams in the full input model when estimated by OLS, TSLS and the Heckman and MaCurdy method, respectively. WIC enrollment has a larger effect on birthweight for the poor black subsample than for the entire black sample. This effect is significant in all specifications when WIC enrollment is treated exogenously, but when WIC enrollment is treated endogenously, the effect is significant only in the limited input model and then only at the 10% level. For the poor white subsample, neither delay nor WIC enrollment has a significant effect on birthweight when both are treated endogenously. In the OLS estimation, both delay and WIC have significant effects on birthweight. The effects of delay are smaller than the corresponding effects for the entire white sample; the effects of WIC enrollment are larger than the corresponding effects for the entire white subsample. The same is true for the effects of WIC enrollment in the TSLS estimation. However, in the TSLS estimation, delay has a significant effect only in the limited input specification; this effect is smaller than the effect of the corresponding estimation on the entire white sample. The effects of delay and WIC participation are significant in all nine estimates of the production functions for the poor Hispanic subsample (table 13). The effects of delay are very similar in magnitude as they are in the entire Hispanic sample. The same is true for the effect of WIC participation.

The Wu test for the endogeneity of prenatal care delay alone indicates that at the five percent significance level, prenatal care delay should be treated endogenously for whites and Hispanics in all three input models, the full, no weight gain and limited input models. For blacks, prenatal care delay should be treated endogenously in the no weight gain and limited input models but should be treated exogenously in the full input model. Thus the TSLS gives the appropriate estimates for whites and Hispanics and OLS gives the appropriate estimates for blacks. This is the same as the results in the previous chapter in which WIC participation was omitted from the production functions. So for blacks, the new measurements of drug use, alcohol consumption, cigarette smoking and working during pregnancy are effectively controlling for the health endowment. The Wu test on the poor subsamples reveals that delay should be treated endogenously for the poor black subsample in all three input models and should be treated exogenously for the poor white subsample in all three input models. For the poor Hispanic subsample, the hypothesis of no correlation could be rejected only in the limited input model.

The test for the joint endogeneity of delay and WIC reveals that for all three race/ethnicities and all three input models, delay and WIC should be treated endogenously. The same is true for the poor subsamples of blacks and Hispanics. However, in the white poor subsample, for all three input models, the null hypothesis of no correlation could not be rejected, so delay and WIC should be treated exogenously.

VII. Adolescent Mothers

In this chapter, births to adolescent mothers are considered. The analysis is analogous to the discussion in the previous two chapters with adult mothers. This chapter is divided into three sections. The first will discuss the data used. The second section is analogous to the fifth chapter for adult mothers; this section discusses the determinants of birthweight and prenatal care delay. The third section is analogous to the chapter six; it contains a discussion on the effect of WIC participation of adolescent mothers on birthweight.

A. Data

Adolescent mothers are women less than twenty years of age (they are also referred to as teens). There are 16,741 births to black adolescents, 3,910 births to white adolescents and 16,440 births to Hispanic adolescents used in the estimation. Poor subsamples which contain the 25% mothers who live in the poorest health areas are constructed. For blacks, this subsample consists of the 4124 mothers who live in health areas with poverty rates above 38.58%; for whites this is the 980 mothers who live in health areas with the poverty rate above 23.44%; and for Hispanics, the subsample is made up of the 4113 mothers who live in health areas with the poverty rate above 47.99%. The variables used are the same as those used for adults with two exceptions which follow from the rationale set forth by Joyce and Grossman (1990b). Instead of measuring the impact of age on birthweight using the natural log of age, a dichotomous variable is used that is equal to one if the age of the mother is less than 18 years. This is because we are examining mothers with a much smaller range of ages. Also, education is not measured as dichotomous variables indicating less than or more than high school education. There may be a reverse causality between the birth and years of education because the time spent pregnant could potentially affect the years of education received by these young mothers; so a measure of education is needed that will detect mothers who left school before becoming pregnancy. A dichotomous variable that is equal to one if the mother has completed eight or more years of schooling is constructed.

Means and frequencies of the three race/ethnicities and the corresponding poor subsamples are shown in Table 14. The number of births to white teens is more than four times less than the number of births to Hispanic and black teens. The average birthweight is largest for whites at 3245 grams. This is followed by Hispanics with an average birthweight of 3173 grams and blacks with an average birthweight of 3064 grams. The average prenatal care delay is higher for adolescents than for adults; it is 5.46 months for blacks, 5.39 for Hispanics and 5.08 months for whites. 39% of the black teens and 43% of the Hispanic teens and 20% of the white teens enrolled in WIC. For white teens, this is a much larger enrollment rate than for white adults which was only 5%. More than half of the teens are unmarried which is not surprising since teen pregnancies are usually unplanned and to unmarried mothers. In fact, 93% of the black, 77% of the Hispanic and 55% of the white teen mothers are single. 50% of the Hispanic mothers are single and only 12% of the white mothers are single. In all three race/ethnicities, the primary method of payment is Medicaid. This is highest for Hispanics, with 74% of births followed by blacks with 69% of births and whites with 49% of the births being medicaid financed. For all three race/ethnicities, this is the first live birth for over 75% of the teen mothers. When examining the corresponding poor subsamples, average birthweight and prenatal care delay only slightly change. A comparison of the average delay of WIC versus non-WIC participants shows that for black, white and Hispanic teens, WIC participants delay care less. The average delay for WIC participants is 5.08, 4.87 and 4.84 months for

TABLE 14. Means and frequencies for teens by race/ethnicity for entire samples and poor subsamples

	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All	Poor Subsample	All	Poor Subsample	All	Poor Subsample
Number of observations	16741	4124	3910	980	16440	4113
Birthweight	3064	3058	3245	3203	3173	3143
Delay	5.46	5.66	5.08	5.04	5.39	5.61
Delay unknown	0.20	0.24	0.17	0.18	0.18	0.22
No prenatal care	0.02	0.02	0.01	0.02	0.02	0.02
Enrolled in WIC	0.39	0.42	0.20	0.27	0.43	0.39
Year=88	0.33	0.33	0.34	0.37	0.31	0.31
Year=89	0.34	0.35	0.35	0.34	0.34	0.34
Year=90	0.33	0.32	0.31	0.29	0.35	0.35
Single	0.93	0.95	0.55	0.55	0.77	0.82
Education (in years)	10.77	10.60	10.93	10.79	10.11	9.87
Education >= 8	0.99	0.98	0.97	0.97	0.93	0.93
Education < 8	0.01	0.02	0.03	0.03	0.07	0.07
Foreign born	0.15	0.06	0.22	0.20	0.41	0.37
Age (in years)	17.52	17.47	17.96	17.97	17.60	17.49
Age < 18	0.42	0.44	0.29	0.29	0.40	0.44
Age = 18 or 19	0.58	0.56	0.71	0.71	0.60	0.56
Pre-preg. weight (lbs.)	139.0	139.0	135.4	135.2	130.4	130.2
Pre-preg. wt. unknown	0.43	0.54	0.47	0.51	0.48	0.64
LN(pre-preg. weight)	4.92	4.93	4.90	4.90	4.86	4.86
Sex of baby is male	0.52	0.52	0.51	0.52	0.51	0.50
Plural birth	0.02	0.02	0.01	0.01	0.01	0.01
# previous live births	0.28	0.31	0.20	0.20	0.28	0.31
This is 1st live birth	0.78	0.76	0.83	0.83	0.77	0.75
Private service	0.15	0.12	0.37	0.35	0.08	0.07

TABLE 14. Means and frequencies for teens by race/ethnicity for entire samples and poor subsamples

	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All	Poor Subsample	All	Poor Subsample	All	Poor Subsample
Used heroin	0.001	0.0045	0.002	0.001	0.002	0.002
Used cocaine	0.011	0.017	0.013	0.011	0.010	0.011
Used methadone	0.001	0.002	0.001	0.003	0.001	0.001
Used marijuana	0.012	0.015	0.010	0.007	0.006	0.007
Used other drug	0.010	0.007	0.008	0.005	0.007	0.003
Worked	0.07	0.06	0.10	0.09	0.06	0.04
Alcohol	0.005	0.006	0.012	0.009	0.004	0.003
Tobacco	0.07	0.08	0.10	0.05	0.04	0.04
Weight gain	28.3	28.1	29.8	28.7	29.2	29.2
LN(weight gain)	3.28	3.28	3.34	3.31	3.32	3.33
Weight gain unknown	0.45	0.56	0.48	0.52	0.50	0.66
Self-financed	0.13	0.12	0.17	0.17	0.15	0.16
Medicaid	0.69	0.74	0.49	0.57	0.74	0.76
Other 3rd party	0.18	0.14	0.33	0.26	0.11	0.08
% poor in health area	28.53	45.55	17.10	35.91	37.97	53.63
WIC center	0.631	0.751	0.329	0.530	0.513	0.738
Prenatal care clinics	1.193	1.734	0.644	1.421	0.974	1.367
Family planning clinics	1.003	1.420	0.460	0.925	0.860	1.214
Abortion providers	0.488	0.401	0.445	0.609	0.504	0.273

blacks, whites and Hispanics respectively; the average delay of non-participants corresponding to these is 5.71, 5.13 and 5.81 months.

B. Determinants of Birthweight and Prenatal Care Delay

Table 15 contains the estimates of the prenatal care delay demand equation for black, white and Hispanic teens and their corresponding poor subsamples. Tables 16, 17 and 18 contain estimates of birthweight production functions for blacks, whites and Hispanics respectively. The setup of these tables is the same as tables 4 - 6 for adults. The first four columns are estimates for the entire sample while the last four columns are estimates for the poor subsamples. A breakdown of the columns of the tables are repeated below.

column 1: entire sample, OLS, full set of inputs
column 2: entire sample, OLS, limited set of inputs
column 3: entire sample, TSLS, full set of inputs
column 4: entire sample, TSLS, limited set of inputs
column 5: poor subsample, OLS, full set of inputs
column 6: poor subsample, OLS, limited set of inputs
column 7: poor subsample, TSLS, full set of inputs
column 8: poor subsample, TSLS, limited set of inputs

The prenatal care demand equations are discussed first. Having received at least eight years of education as compared to less than eight years of education has a negative significant effect on prenatal care delay in all estimates of the prenatal care demand function except for the poor Hispanic teen subsample. So, the more education, the less prenatal care delay. This effect is largest for the poor white teen subsample in which having at least eight years of schooling results in a decrease in delay of 1.8 months. Compared to an other third partypayer, self-financing of the birth has a positive significant

TABLE 15. Prenatal Care Delay Demand Equations for Teens by Race/Ethnicity

	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All (1)	Poor Subsample (2)	All (3)	Poor Subsample (4)	All (5)	Poor Subsample (6)
Constant	5.208	6.924	4.990	6.782	4.762	5.389
	(25.08)	(11.01)	(17.21)	(10.00)	(35.58)	(7.34)
Year=89	0.272	0.342	0.131	0.181	0.291	0.472
	(4.89)	(2.92)	(1.15)	(0.80)	(5.17)	(3.99)
Year=90	0.439	0.546	0.297	0.377	0.465	0.715
	(7.76)	(4.55)	(2.51)	(1.60)	(8.27)	(6.04)
Prenatal care clinics	0.039	0.034	-0.143	-0.090	-0.019	-0.028
	(1.59)	(0.89)	(2.57)	(1.04)	(0.73)	(0.75)
Education > 7	-0.637	-0.788	-0.663	-1.798	-0.229	-0.282
	(3.34)	(2.13)	(2.48)	(3.24)	(2.55)	(1.48)
% poor in health area	0.015	-0.027	0.001	-0.014	0.007	0.003
	(7.60)	(2.53)	(0.23)	(1.18)	(3.53)	(0.25)
Medicaid	0.352	0.290	0.874	0.615	0.241	-0.033
	(5.71)	(2.03)	(8.16)	(2.70)	(3.20)	(0.18)
Self-financed	1.335	1.406	0.950	0.949	1.006	0.619
	(15.79)	(7.41)	(6.72)	(3.15)	(11.04)	(2.97)
Foreign Born	-0.068	-0.141	0.038	0.016	0.073	0.104
	(1.04)	(0.71)	(0.33)	(0.07)	(1.54)	(1.04)
WIC center	-0.308	0.081	0.005	-0.056	-0.030	-0.262
	(6.30)	(0.69)	(0.05)	(0.23)	(0.62)	(2.36)
Family planning clinics	-0.048	-0.052	0.136	0.184	-0.006	0.009
	(1.63)	(1.05)	(1.82)	(1.65)	(0.22)	(0.23)
Abortion providers	0.030	0.012	-0.010	-0.327	-0.004	0.073
	(1.28)	(0.25)	(0.22)	(3.35)	(0.17)	(1.09)
F ratio	42.8	9.3	9.7	4.2	24.6	6.6
R-squared	0.0274	0.0242	0.0268	0.0458	0.0162	0.0174

Absolute values of *t*-statistics are in parentheses.

TABLE 16. Birthweight Production Functions for All Black Teens and the Poor Black Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Black Non-Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	46.4	607.8	74.4	724.8	-252.4	193.6	-249.7	310.6
	(0.29)	(3.76)	(0.43)	(4.09)	(0.71)	(0.54)	(0.66)	(0.80)
Delay	-8.4	-11.5	-15.8	-32.5	-9.3	-11.8	-13.4	-35.7
	(5.47)	(7.33)	(1.55)	(3.12)	(3.12)	(3.89)	(0.62)	(1.60)
Year=89	4.5	11.8	6.5	17.6	-1.7	5.8	0.1	14.5
	(0.41)	(1.06)	(0.58)	(1.52)	(0.08)	(0.26)	(0.01)	(0.61)
Year=90	7.9	20.5	11.1	29.8	-9.4	7.1	-6.3	21.0
	(0.72)	(1.82)	(0.94)	(2.45)	(0.42)	(0.31)	(0.25)	(0.81)
Single	-23.4	-39.2	-26.0	-42.8	-4.4	-9.5	-4.9	-10.9
	(1.33)	(2.18)	(1.48)	(2.36)	(0.11)	(0.23)	(0.12)	(0.26)
Education > 7	18.2	16.8	11.3	-0.2	7.3	-3.7	2.5	-25.9
	(0.49)	(0.44)	(0.30)	(0.01)	(0.11)	(0.05)	(0.04)	(0.35)
Foreign born	34.3	46.8	32.6	44.2	22.2	52.2	20.7	49.2
	(2.72)	(3.65)	(2.59)	(3.42)	(0.59)	(1.36)	(0.55)	(1.27)
Age < 18	-34.9	-32.2	-38.1	-36.2	-47.2	-37.8	-50.5	-42.0
	(3.73)	(3.39)	(4.07)	(3.80)	(2.52)	(1.97)	(2.70)	(2.18)
LN(pre-preg. weight)	439.3	509.9	441.6	511.7	490.7	595.7	494.2	601.6
	(14.16)	(16.12)	(14.21)	(16.06)	(7.08)	(8.39)	(7.13)	(8.40)
Pre-preg. wt. unknown	24.4	-45.7	23.5	-54.0	-37.2	-58.5	-38.3	-67.9
	(1.04)	(4.91)	(1.00)	(5.81)	(0.76)	(3.13)	(0.78)	(3.63)
Sex of baby is male	95.6	102.2	95.9	102.6	94.7	101.0	97.1	104.2
	(10.72)	(11.19)	(10.74)	(11.17)	(5.28)	(5.47)	(5.41)	(5.60)
Plural birth	-1005.5	-980.3	-1000.4	-973.6	-902.3	-892.8	-894.8	-883.4
	(30.58)	(29.14)	(30.41)	(28.78)	(12.98)	(12.48)	(12.88)	(12.25)

TABLE 16. Birthweight Production Functions for All Black Teens and the Poor Black Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Black Non-Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	-17.6	6.8	-9.5	17.9	-24.8	10.2	-14.9	22.5
	(1.56)	(0.60)	(0.84)	(1.56)	(1.13)	(0.45)	(0.68)	(1.01)
Private service	22.3	32.3	24.9	33.2	24.5	49.1	29.6	53.1
	(1.75)	(2.49)	(1.92)	(2.50)	(0.87)	(1.70)	(1.05)	(1.82)
Used heroin	-574.7		-580.5		-1218.3		-1243.7	
	(2.95)		(2.98)		(2.86)		(2.91)	
Used cocaine	-267.5		-276.1		-326.5		-336.4	
	(5.94)		(6.13)		(4.43)		(4.56)	
Used methadone	-338.0		-340.1		-203.2		-197.1	
	(2.60)		(2.62)		(0.95)		(0.92)	
Used marijuana	-13.5		-17.6		6.1		-3.7	
	(0.31)		(0.40)		(0.08)		(0.05)	
Used other drug	-154.0		-156.5		-132.1		-137.9	
	(3.43)		(3.48)		(1.25)		(1.30)	
Worked	-18.6		-18.7		-71.1		-67.3	
	(1.07)		(1.07)		(1.80)		(1.70)	
Alcohol	-46.9		-53.0		-74.3		-74.8	
	(0.73)		(0.82)		(0.60)		(0.61)	
Tobacco	-120.3		-121.3		-192.5		-192.3	
	(6.36)		(6.40)		(5.60)		(5.59)	
LN(weight gain)	288.8		290.6		316.1		317.1	
	(25.34)		(25.49)		(12.85)		(12.88)	
Weight gain unknown	-113.0		-118.9		-75.6		-82.0	
	(4.83)		(5.09)		(1.53)		(1.66)	
F-ratio	98.5	106.1	97.1	101.5	25.4	23.3	24.9	22.0
R-squared	0.1193	0.0762	0.1179	0.0731	0.1246	0.0686	0.1228	0.0649
Wu test[a]	0.93	2.26			0.27	1.15		

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

TABLE 17. Birthweight Production Functions for All White Teens and the Poor White Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All White Non-Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	-538.7	36.0	-167.1	392.4	495.4	1095.8	815.9	1421.7
	(1.64)	(0.11)	(0.44)	(1.07)	(0.80)	(1.78)	(1.17)	(2.04)
Delay	-5.6	-8.4	-75.7	-74.9	-6.4	-9.6	-53.4	-57.1
	(1.82)	(2.71)	(3.14)	(3.10)	(1.11)	(1.66)	(1.39)	(1.47)
Year=89	-0.6	6.1	10.4	17.0	46.2	45.5	57.2	57.1
	(0.03)	(0.29)	(0.46)	(0.75)	(1.17)	(1.14)	(1.36)	(1.35)
Year=90	41.2	45.9	64.6	68.3	108.5	119.8	129.6	141.1
	(1.91)	(2.11)	(2.65)	(2.79)	(2.65)	(2.90)	(2.83)	(3.06)
Single	-61.3	-74.9	-58.2	-73.2	-52.1	-66.7	-48.9	-65.2
	(3.09)	(3.76)	(2.74)	(3.45)	(1.25)	(1.60)	(1.13)	(1.50)
Education > 7	42.4	46.0	-10.8	-5.2	-78.3	-50.3	-179.8	-153.7
	(0.87)	(0.93)	(0.20)	(0.09)	(0.81)	(0.52)	(1.40)	(1.19)
Foreign born	-44.7	-39.5	-37.3	-32.5	-91.5	-84.7	-90.6	-84.5
	(2.01)	(1.76)	(1.55)	(1.36)	(2.12)	(1.94)	(2.02)	(1.87)
Age < 18	-26.3	-23.2	-26.8	-24.3	-44.9	-28.7	-45.5	-30.2
	(1.33)	(1.17)	(1.27)	(1.15)	(1.16)	(0.73)	(1.13)	(0.74)
LN(pre-preg. weight)	639.8	654.7	644.2	659.8	405.6	434.5	404.8	436.3
	(9.99)	(10.12)	(9.38)	(9.59)	(3.32)	(3.50)	(3.19)	(3.39)
Pre-preg. wt. unknown	5.1	-46.5	-1.0	-56.3	79.7	-17.8	79.7	-28.1
	(0.13)	(2.57)	(0.02)	(2.98)	(1.09)	(0.52)	(1.05)	(0.80)
Sex of baby is male	76.3	75.7	77.0	77.0	77.7	88.2	79.1	90.2
	(4.43)	(4.34)	(4.17)	(4.15)	(2.37)	(2.65)	(2.32)	(2.62)
Plural birth	-959.4	-933.6	-960.4	-931.9	-846.0	-787.5	-842.6	-779.9
	(10.45)	(10.48)	(9.76)	(9.84)	(4.37)	(4.00)	(4.19)	(3.82)

TABLE 17. Birthweight Production Functions for All White Teens and the Poor White Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All White Non-Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	9.0	19.7	12.5	25.6	26.1	43.5	28.6	47.8
	(0.38)	(0.83)	(0.50)	(1.01)	(0.59)	(0.96)	(0.62)	(1.02)
Private service	54.0	48.7	28.1	26.2	77.9	57.5	62.1	42.4
	(2.72)	(2.44)	(1.20)	(1.12)	(1.82)	(1.34)	(1.33)	(0.91)
Used heroin	76.4		88.5		-821.6		-788.2	
	(0.32)		(0.34)		(1.30)		(1.20)	
Used cocaine	-122.6		-133.4		-110.1		-131.5	
	(1.44)		(1.46)		(0.59)		(0.68)	
Used methadone	753.2		749.1		1219.0		1212.6	
	(2.30)		(2.14)		(3.22)		(3.09)	
Used marijuana	-184.7		-185.1		-65.0		-65.0	
	(1.92)		(1.79)		(0.31)		(0.30)	
Used other drug	-28.7		-25.9		-160.5		-154.5	
	(0.30)		(0.25)		(0.70)		(0.65)	
Worked	-24.9		-30.4		-65.6		-61.8	
	(0.85)		(0.97)		(1.12)		(1.01)	
Alcohol	-178.4		-174.2		-384.2		-365.2	
	(2.06)		(1.88)		(1.88)		(1.72)	
Tobacco	-84.5		-85.8		-56.6		-59.5	
	(2.76)		(2.61)		(0.71)		(0.72)	
LN(weight gain)	202.7		205.9		246.4		250.4	
	(8.25)		(7.84)		(5.08)		(4.99)	
Weight gain unknown	-90.4		-91.9		-164.3		-172.3	
	(2.30)		(2.18)		(2.23)		(2.26)	
F-ratio	19.0	24.6	16.8	22.0	5.1	5.4	4.8	5.0
R-squared	0.1011	0.0758	0.0907	0.0683	0.1098	0.0683	0.1033	0.0634
Wu test[a]	3.34	3.26			1.35	1.39		

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

TABLE 18. Birthweight Production Functions for All Hispanic Teens and the Poor Hispanic Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)								
	All Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
Constant	20.0	603.7	234.6	894.7	-447.9	276.6	-208.6	594.9
	(0.13)	(3.84)	(1.31)	(4.90)	(1.17)	(0.73)	(0.48)	(1.35)
Delay	-4.7	-7.5	-43.4	-59.3	-7.7	-9.6	-50.0	-65.0
	(3.21)	(5.08)	(3.14)	(4.15)	(2.74)	(3.35)	(1.49)	(1.88)
Year=89	4.6	8.5	15.6	23.2	-14.0	-10.0	5.7	15.9
	(0.45)	(0.81)	(1.39)	(2.01)	(0.67)	(0.47)	(0.21)	(0.58)
Year=90	1.4	5.7	17.9	27.9	-13.9	-10.3	15.1	27.8
	(0.14)	(0.55)	(1.50)	(2.26)	(0.66)	(0.48)	(0.48)	(0.86)
Single	-36.5	-46.0	-36.9	-47.0	-29.9	-39.1	-30.9	-40.5
	(3.72)	(4.61)	(3.68)	(4.53)	(1.35)	(1.73)	(1.36)	(1.72)
Education > 7	14.1	27.8	0.2	9.2	37.2	58.2	20.4	36.5
	(0.86)	(1.67)	(0.01)	(0.51)	(1.10)	(1.70)	(0.55)	(0.95)
Foreign born	52.9	55.0	57.1	60.4	43.2	50.9	48.6	58.1
	(6.09)	(6.23)	(6.33)	(6.50)	(2.40)	(2.79)	(2.56)	(2.96)
Age < 18	-41.3	-39.0	-41.3	-39.3	-60.7	-62.5	-62.8	-65.2
	(4.76)	(4.43)	(4.65)	(4.29)	(3.45)	(3.50)	(3.48)	(3.49)
LN(pre-preg. weight)	498.9	538.2	497.1	536.3	564.4	602.6	562.2	600.2
	(15.89)	(16.85)	(15.48)	(16.15)	(7.39)	(7.77)	(7.16)	(7.39)
Pre-preg. wt. unknown	-9.2	-66.6	-12.8	-72.3	-31.9	-76.3	-35.2	-82.3
	(0.46)	(7.74)	(0.62)	(8.21)	(0.77)	(4.18)	(0.83)	(4.34)
Sex of baby is male	89.8	91.6	89.7	91.6	104.4	106.8	105.0	107.7
	(10.88)	(10.89)	(10.63)	(10.48)	(6.15)	(6.19)	(6.02)	(5.96)
Plural birth	-998.2	-989.8	-995.6	-985.8	-964.6	-937.5	-961.7	-933.7
	(27.77)	(27.01)	(27.08)	(25.90)	(12.87)	(12.30)	(12.48)	(11.70)

TABLE 18. Birthweight Production Functions for All Hispanic Teens and the Poor Hispanic Teen Subsample; Prenatal Care Delay Treated as Exogenous (in OLS) and Endogenous (in TSLS)

	All Hispanic Teens				Poor Subsample			
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)	OLS (5)	OLS (6)	TSLS (7)	TSLS (8)
This is 1st live birth	-38.2	-15.3	-36.1	-11.4	-34.9	-18.0	-29.4	-11.2
	(3.75)	(1.48)	(3.48)	(1.07)	(1.72)	(0.87)	(1.41)	(0.52)
Private service	5.5	17.1	4.8	16.7	40.0	50.6	46.1	58.5
	(0.36)	(1.11)	(0.31)	(1.04)	(1.23)	(1.52)	(1.37)	(1.68)
Used heroin	-22.1		-22.8		186.9		181.7	
	(0.19)		(0.19)		(0.78)		(0.74)	
Used cocaine	-336.0		-336.0		-352.7		-351.1	
	(7.71)		(7.54)		(3.93)		(3.80)	
Used methadone	-178.1		-178.6		76.1		68.7	
	(1.45)		(1.42)		(0.28)		(0.24)	
Used marijuana	-38.1		-41.3		-143.6		-153.9	
	(0.71)		(0.75)		(1.36)		(1.42)	
Used other drug	-129.4		-126.3		-281.7		-287.4	
	(2.52)		(2.40)		(1.86)		(1.85)	
Worked	-1.0		0.2		-27.9		-25.4	
	(0.06)		(0.01)		(0.61)		(0.54)	
Alcohol	-12.4		-17.1		-5.9		-20.8	
	(0.18)		(0.24)		(0.04)		(0.12)	
Tobacco	-145.3		-144.4		-146.6		-146.8	
	(6.86)		(6.66)		(3.44)		(3.35)	
LN(weight gain)	247.3		248.6		290.5		292.1	
	(22.09)		(21.75)		(10.27)		(10.05)	
Weight gain unknown	-93.8		-93.6		-79.5		-81.4	
	(4.63)		(4.52)		(1.89)		(1.89)	
F-ratio	89.6	102.6	85.7	94.6	21.1	24.1	19.8	21.5
R-squared	0.1116	0.0751	0.1072	0.0696	0.1062	0.0711	0.1000	0.0639
Wu test[a]	2.95	3.88			0.63	1.03		

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

effects on delay in all race/ethnicities. The same is true for Medicaid financing except for the poor Hispanic subsample in which Medicaid financing does not impact delay. Medicaid financing has the largest impact on white teens; Medicaid financing as opposed to an other third party results in an increase in delay of 0.87 and 0.62 months for the entire white teen sample and the poor subsample respectively. Self-financing has the largest impact on blacks; self-financing as opposed to other third party financing results in a 1.3 and a 1.4 month delay for the black teen sample and its poor subsample. Self-financing has a larger effect on delay than Medicaid financing for all three race/ethnicities.

The mother being born out of the United States does not have a significant impact on prenatal care delay for any race/ethnicity The race/ethnicity specific poverty rate has a positive significant effect on delay for blacks, and Hispanics but does not impact delay for white teens. Examination of the time dummies reveals that compared to 1988, births in both 1989 and 1990 are associated with positive impacts on delay. This is true for all race/ethnicities with the exception of whites and the coefficient on 1989 which is not significant. This follows the same time pattern as the adult prenatal care delay equations. Again, for the most part, births in 1988 are associated with less prenatal care delay than in 1989 and 1990.

The availability measures have varied impacts on delay. The presence of prenatal care clinics has a significant negative effect on prenatal care delay for the entire white teen sample; thus, the more clinics, the less white teens delay care. In all other samples, prenatal care clinics do not have a significant effect on delay for teens. The presence of a WIC center in the health district where the woman resided has a negative significant effect on delay for the entire black teen sample. This means that if there was a WIC center in the health district, the black teen delayed care less by .308 months. The presence of a WIC center does not effect delay in any of the other samples. Family planning clinics have a positive effect on delay significant at the 10% level for the two white samples; they do not have a significant effect on delay for blacks and Hispanics. Abortion providers only have a significant effect on the poor white subsample; in this case, the presence of abortion providers has a negative impact on prenatal care delay. This could imply that the poor white teens delay care less when there are more abortion clinics because they would terminate the pregnancy if it were unwanted.

A discussion of the results of the production function estimates by OLS with the full set of inputs and prenatal care treated exogenously will be presented first. Prenatal care delay has a negative effect on birthweight; this effect is highly significant for blacks and Hispanics and is significant at the 10% level for whites. A one month increase in the initial prenatal care visit results in a reduction in birthweight of 8.4, 5.6 and 4.7 grams for black, white and Hispanic teens respectively. Schooling does not have a significant effect on birthweight across race/ethnicities. Being a single mother has a negative significant effect on birthweight for whites and Hispanics, but does not significantly impact birthweight for black teens. The mother being born out of the U.S. has a positive significant impact on birthweight for Hispanics, a negative significant effect on birthweight for whites and does not significantly effect birthweight for blacks. The mother being less than eighteen years old has a negative significant effect on birthweight for blacks and Hispanics but does not have a significant effect for whites.

The natural log of pre-pregnancy weight has a large positive significant effect on birthweight. The coefficients of 439.3, 639.8 and 498.9 for blacks, whites and Hispanics respectively mean that an increase in pre-pregnancy weight by one pound, results in an increase in birthweight of 3.2, 4.7 and 3.8 grams for blacks, whites and

Hispanics respectively evaluated at the appropriate mean pre-pregnancy weight. As for adults, the sex of the baby being male has a positive impact on birthweight across race/ethnicities. A plural birth has a very large negative effect on birthweight for teens as well as adults. This birth being the first live birth of the mother has a significant effect only for Hispanic teens; the effect is negative meaning that this being the first birth is associated with a reduction in birthweight of 38.2 grams. If the mother is the patient of a private physician at delivery, birthweight is higher than if the mother is a general services patient. However, this effect is significant for whites, is significant at the 10% level for blacks and is not significant for Hispanics.

For black teens, all of the five drug measures except for marijuana use have significant negative effects on birthweight; the use of heroin during pregnancy has the largest effect with a 574.7 gram decrease in birthweight associated with it. For white teens, the use of marijuana has a negative impact on birthweight which is significant at the 10% level; the use of methadone has a large positive significant effect on birthweight. The other drug measures do not have a significant effect on white teens. For Hispanic teens, only cocaine use and other drug use have significant effects on birthweight; these effects are that cocaine use and other drug use are associated with decreases in birthweight of 336.0 and 129.4 grams respectively. Working during pregnancy does not significantly effect birthweight for any race/ethnicity. Alcohol consumption during pregnancy has a significant effect on birthweight only for white teens; it is associated with a decrease in birthweight of 178.4 grams. Tobacco smoking during pregnancy has a significant negative effect on birthweight across race/ethnicities. Smoking is associated with a decrease in birthweight of 120.3, 84.5 and 145.3 grams for blacks, whites and Hispanics respectively. The natural log of weight gain during pregnancy has a significant positive effect on birthweight for the three race/ethnicities. Evaluated at their respective mean weight gains, the coefficient on the log of weight gain implies that for a one pound increase in weight gain during the pregnancy, birthweight will increase by 10.2, 6.8 and 8.5 grams for blacks, whites and Hispanics respectively.

The discussion of the other specifications of the production functions will focus on the effect of prenatal care delay on birthweight. A comparison of the effects of prenatal care on birthweight in the production functions estimated by OLS with the full set of health inputs and by OLS with the limited set of inputs (columns 1 and 2) shows that the effect of delay is larger in magnitude in the limited input model. For black teens, the effect of an increase in delay of one month on birthweight is a decrease of 11.5 grams; for whites this decrease is 8.4 grams, and for Hispanics it is 7.5 grams. The effect of delay is significant across race/ethnicities (the effect of delay on birthweight was significant only at the 10% level for whites in the full input model). When prenatal care is treated endogenously in the full input model (column 3) the effect of delay on birthweight increases over nine times in magnitude than in the corresponding OLS model (column 1) for whites and Hispanics. When the production function is estimated by OLS, the impact of delay is -5.6 for whites and -4.7 for Hispanics; when estimated by TSLS the corresponding impacts of delay are -75.7 and -43.4 grams and are statistically significant. However for black teens, in the TSLS estimation, the effect of delay almost doubles in magnitude (from -8.4 to -15.8), but it is no longer statistically significant in the TSLS model. When the limited input model is estimated by TSLS (column 4), the effect of delay on birthweight is significant across race/ethnicities. The effect of delay only slightly changes for whites; the coefficient of delay is -74.9. For blacks and Hispanics, the effect of delay still increases in magnitude to a 32.5 and 59.3 gram reduction in birthweight for blacks and Hispanics, respectively, for a one month increase in delay.

Examination of the coefficients on delay for the poor subsamples reveal that the effects of delay increase in magnitude for the poor teens. However, for the poor blacks, delay is statistically significant only in the two OLS models; in the full input and limited input models estimated by OLS a one month increase in delay results in a 9.3 and 11.8 gram reduction in birthweight respectively. For the poor white teens, prenatal care is only statistically significant in the limited input model estimated by OLS and is only significant at the 10% level in this case. For the poor Hispanic teens, delay has a significant effect on birthweight in the OLS models; the coefficients on delay are -7.7 and -9.6 grams in the full and limited input models respectively. Delay has a significant impact at the 10% level also in the estimate of the limited input model by TSLS for the poor Hispanics. The effect of delay is much larger in magnitude; a one month increase in delay results in a decrease of 65.0 grams in birthweight.

The Wu test for the endogeneity of prenatal care delay indicates that at the five percent significance level, the only instance in which the null hypothesis of no correlation could be rejected was for Hispanic teens in the limited input model. For black and white teens in the full input and limited input models and for Hispanic teens in the full input model, prenatal care delay should be treated exogenously. Thus, the new potential risk factors effectively control for the health endowment in the production function. The hypothesis of no correlation could be accepted in all three poor teen subsamples and in both the full and limited input models.

C. The Effect of WIC Participation on Birthweight

In this section, the impact of WIC on the birthweight production function will be examined. WIC participation will be treated both exogenously and endogenously as discussed in chapter VI. Estimates of the probability of WIC enrollment equations for teens are given in table 19. Results are given separately for blacks, whites and Hispanics and their corresponding poor subsamples. Estimates of the birthweight production functions which include the measure of WIC enrollment are given in tables 20 - 25. Tables 20, 21 and 22 contain estimates for the entire samples of blacks, whites and Hispanics respectively and tables 23, 24 and 25 contain estimates for their corresponding poor subsamples. The format of these tables is exactly the same as those discussed in chapter VI which is now summarized:

column 1: OLS, full set of inputs
column 2: OLS, no weight gain
column 3: OLS, limited set of inputs
column 4: TSLS, full set of inputs
column 5: TSLS, no weight gain
column 6: TSLS, limited set of inputs
column 7: Delay and WIC both endogenous, full set of inputs
column 8: Delay and WIC both endogenous, no weight gain
column 9: Delay and WIC both endogenous, limited input set

A discussion of the linear probability of WIC enrollment equation is presented first. As for adults, the variable with the largest effect on the probability of WIC enrollment is Medicaid financing as opposed to other third party financing of the birth. Medicaid has a positive significant effect on the probability across race/ethnicities on the entire samples and the poor subsamples. Self-financing also has a positive effect on the probability of WIC enrollment. Having received at least eight years of schooling has a significant negative effect on the probability of WIC enrollment the entire samples of whites and Hispanics. The mother being foreign born increases the probability of WIC enrollment for the entire samples of blacks, whites and Hispanics

TABLE 19. WIC Enrollment Probability Equations for Teens by Race/Ethnicity						
	Black Non-Hispanics		White Non-Hispanics		Hispanics	
	All (1)	Poor Subsample (2)	All (3)	Poor Subsample (4)	All (5)	Poor Subsample (6)
Constant	0.102	0.322	0.056	0.159	0.179	0.394
	(3.09)	(3.32)	(1.54)	(1.69)	(8.13)	(3.43)
Year=89	0.003	-0.030	0.009	-0.034	0.014	-0.010
	(0.29)	(1.65)	(0.62)	(1.08)	(1.47)	(0.52)
Year=90	0.033	-0.013	0.050	0.022	0.014	-0.019
	(3.67)	(0.71)	(3.35)	(0.69)	(1.51)	(1.02)
Prenatal care clinics	0.015	0.029	-0.023	-0.025	0.001	0.011
	(3.81)	(4.97)	(3.26)	(2.06)	(0.29)	(1.88)
Education > 7	-0.003	0.053	-0.086	-0.087	-0.059	-0.011
	(0.11)	(0.92)	(2.56)	(1.12)	(4.00)	(0.36)
% poor in health area	0.001	-0.005	0.002	-0.002	0.000	-0.005
	(4.82)	(2.84)	(4.20)	(0.94)	(0.48)	(2.72)
Medicaid	0.303	0.308	0.292	0.345	0.351	0.298
	(31.08)	(14.03)	(21.64)	(10.88)	(28.29)	(10.63)
Self-financed	0.049	0.067	0.037	0.076	0.100	0.120
	(3.64)	(2.29)	(2.09)	(1.81)	(6.64)	(3.67)
Foreign Born	0.068	-0.029	0.037	0.039	0.016	0.009
	(6.56)	(0.96)	(2.51)	(1.15)	(2.07)	(0.59)
WIC center	0.005	0.015	0.056	0.117	0.020	0.074
	(0.70)	(0.81)	(4.07)	(3.50)	(2.46)	(4.23)
Family planning clinics	-0.005	-0.021	0.029	0.022	0.001	-0.011
	(1.06)	(2.83)	(3.06)	(1.39)	(0.15)	(1.73)
Abortion providers	-0.007	0.001	-0.008	-0.008	0.002	-0.016
	(1.79)	(0.16)	(1.52)	(0.57)	(0.49)	(1.49)
F ratio	136.1	29.2	63.5	16.9	115.0	18.2
R-squared	0.0822	0.0725	0.1519	0.1610	0.0715	0.0464

Absolute values of *t*-statistics are in parentheses.

TABLE 20. Birthweight Production Functions for All Black non-Hispanic Teens Including WIC Enrollment

	OLS (1)	(2)	(3)	TSLS (4)	(5)	(6)	DELAY and WIC Endogenous (7)	(8)	(9)
Constant	46.2	702.3	600.5	68.4	758.2	705.8	-8.3	681.3	628.2
	(0.29)	(4.36)	(3.72)	(0.39)	(4.32)	(3.99)	(0.05)	(3.93)	(3.59)
Enrolled in WIC	28.3	44.0	46.9	32.5	48.9	52.3	148.3	166.0	170.5
	(2.85)	(4.35)	(4.62)	(3.28)	(4.84)	(5.15)	(3.86)	(4.23)	(4.33)
Delay	-8.0	-9.4	-10.8	-14.3	-20.5	-29.8	-10.0	-16.4	-25.9
	(5.18)	(5.99)	(6.84)	(1.40)	(1.97)	(2.86)	(0.93)	(1.49)	(2.35)
Year=89	4.1	9.4	11.0	5.7	12.4	16.2	3.4	10.2	14.1
	(0.37)	(0.85)	(0.99)	(0.51)	(1.09)	(1.41)	(0.30)	(0.88)	(1.21)
Year=90	6.2	13.9	17.6	8.8	18.5	25.8	-0.2	9.5	16.8
	(0.56)	(1.23)	(1.56)	(0.74)	(1.53)	(2.11)	(0.02)	(0.75)	(1.31)
Single	-24.7	-35.5	-41.1	-27.3	-38.6	-44.7	-30.5	-41.8	-48.1
	(1.40)	(1.98)	(2.28)	(1.55)	(2.15)	(2.47)	(1.80)	(2.42)	(2.76)
Education > 7	18.4	12.4	17.1	12.4	2.7	1.6	16.0	6.4	5.3
	(0.49)	(0.33)	(0.45)	(0.32)	(0.07)	(0.04)	(0.41)	(0.16)	(0.13)
Foreign born	34.0	33.9	46.3	32.4	31.9	43.8	28.6	27.7	39.7
	(2.70)	(2.65)	(3.61)	(2.57)	(2.48)	(3.39)	(2.31)	(2.19)	(3.13)
Age < 18	-35.4	-40.8	-32.9	-38.4	-44.4	-36.8	-37.9	-43.7	-36.4
	(3.77)	(4.27)	(3.47)	(4.11)	(4.65)	(3.86)	(4.00)	(4.53)	(3.78)
LN(pre-preg. weight)	437.1	491.0	505.7	439.0	492.8	507.0	440.4	495.7	510.3
	(14.08)	(15.58)	(15.99)	(14.13)	(15.60)	(15.93)	(14.98)	(16.35)	(16.69)
Pre-preg. wt. unknown	30.9	-36.9	-30.9	31.1	-42.1	-37.0	24.0	-56.9	-53.2
	(1.31)	(3.73)	(3.14)	(1.32)	(4.26)	(3.75)	(0.96)	(6.02)	(5.64)
Sex of baby is male	95.6	100.3	102.1	95.9	100.7	102.5	96.0	100.9	102.7
	(10.72)	(11.04)	(11.19)	(10.74)	(11.06)	(11.17)	(10.73)	(11.05)	(11.17)
Plural birth	-1004.3	-985.0	-978.5	-999.3	-979.1	-972.1	-998.1	-978.0	-971.0
	(30.54)	(29.41)	(29.10)	(30.39)	(29.20)	(28.78)	(23.19)	(22.40)	(22.26)
This is 1st live birth	-17.1	-5.0	7.5	-9.2	4.2	17.9	-7.7	5.9	20.0
	(1.51)	(0.43)	(0.66)	(0.82)	(0.37)	(1.57)	(0.68)	(0.51)	(1.72)

TABLE 20. Birthweight Production Functions for All Black non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	29.8	39.2	44.6	33.5	42.6	46.9	50.5	58.4	62.9
	(2.29)	(2.96)	(3.36)	(2.54)	(3.16)	(3.46)	(3.53)	(4.01)	(4.30)
Used heroin	-577.8	-599.6		-583.7	-606.7		-583.3	-605.1	
	(2.97)	(3.02)		(3.00)	(3.05)		(2.78)	(2.92)	
Used cocaine	-264.8	-285.8		-272.6	-294.6		-273.7	-297.3	
	(5.88)	(6.23)		(6.05)	(6.41)		(5.30)	(5.72)	
Used methadone	-339.8	-346.3		-342.1	-348.9		-344.3	-350.8	
	(2.62)	(2.62)		(2.63)	(2.63)		(1.90)	(2.09)	
Used marijuana	-13.1	-32.5		-17.0	-36.9		-17.0	-37.4	
	(0.30)	(0.73)		(0.39)	(0.82)		(0.43)	(0.92)	
Used other drug	-151.4	-146.1		-153.5	-148.1		-153.9	-149.5	
	(3.37)	(3.19)		(3.41)	(3.23)		(3.00)	(2.79)	
Worked	-18.8	-12.2		-18.8	-12.3		-13.2	-5.9	
	(1.08)	(0.69)		(1.08)	(0.69)		(0.74)	(0.32)	
Alcohol	-47.8	-54.2		-53.7	-61.3		-51.8	-59.0	
	(0.74)	(0.82)		(0.83)	(0.93)		(0.87)	(0.99)	
Tobacco	-120.0	-124.4		-121.0	-125.2		-121.8	-126.3	
	(6.35)	(6.46)		(6.39)	(6.48)		(6.73)	(6.77)	
LN(weight gain)	286.9			288.4			289.8		
	(25.14)			(25.25)			(21.20)		
Weight gain unknown	-110.2			-115.4			-118.2		
	(4.71)			(4.94)			(4.79)		
F-ratio	94.7	71.5	100.2	93.6	69.8	96.5	92.9	69.0	95.1
R-squared	0.1197	0.0860	0.0773	0.1185	0.0842	0.0747	0.1177	0.0832	0.0737
Wu test[a] (Delay only)	0.83	1.31	2.09						
Wu test[b] (Delay & WIC)	10.47	11.56	14.14						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 21. Birthweight Production Functions for All White non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-542.9	142.8	30.3	-145.1	543.8	417.6	-195.0	471.7	367.1
	(1.65)	(0.44)	(0.09)	(0.38)	(1.46)	(1.12)	(0.50)	(1.22)	(0.94)
Enrolled in WIC	15.5	17.0	20.2	31.6	34.6	38.1	-34.4	-59.1	-29.4
	(0.68)	(0.74)	(0.88)	(1.27)	(1.39)	(1.53)	(0.40)	(0.69)	(0.34)
Delay	-5.5	-7.6	-8.2	-80.7	-82.2	-80.9	-69.1	-65.4	-69.2
	(1.76)	(2.43)	(2.63)	(3.27)	(3.31)	(3.27)	(2.38)	(2.27)	(2.38)
Year=89	-1.2	7.0	5.4	10.0	18.5	16.6	10.3	18.8	16.9
	(0.06)	(0.34)	(0.26)	(0.44)	(0.81)	(0.73)	(0.46)	(0.85)	(0.76)
Year=90	40.0	45.2	44.4	63.9	68.9	67.6	64.8	70.0	68.5
	(1.85)	(2.07)	(2.03)	(2.59)	(2.78)	(2.73)	(2.69)	(2.91)	(2.83)
Single	-61.7	-63.4	-75.4	-58.6	-61.0	-73.5	-57.6	-59.6	-72.7
	(3.11)	(3.17)	(3.78)	(2.73)	(2.82)	(3.43)	(2.71)	(2.81)	(3.41)
Education > 7	43.5	39.1	47.4	-12.3	-16.7	-7.2	-8.4	-11.0	-3.1
	(0.89)	(0.79)	(0.96)	(0.22)	(0.30)	(0.13)	(0.15)	(0.19)	(0.05)
Foreign born	-45.2	-50.2	-40.2	-37.7	-43.2	-33.1	-37.0	-42.2	-32.2
	(2.03)	(2.23)	(1.80)	(1.55)	(1.77)	(1.36)	(1.56)	(1.79)	(1.36)
Age < 18	-26.6	-27.7	-23.6	-27.1	-29.0	-24.7	-26.9	-28.8	-24.3
	(1.35)	(1.39)	(1.19)	(1.27)	(1.35)	(1.16)	(1.29)	(1.38)	(1.16)
LN(pre-preg. weight)	639.4	636.0	654.1	643.6	640.6	659.0	644.4	641.5	660.0
	(9.98)	(9.84)	(10.11)	(9.28)	(9.17)	(9.47)	(9.32)	(9.16)	(9.35)
Pre-preg. wt. unknown	7.4	-51.9	-43.6	3.7	-58.5	-50.6	-1.8	-64.7	-56.7
	(0.18)	(2.80)	(2.37)	(0.09)	(2.97)	(2.59)	(0.04)	(3.46)	(3.04)
Sex of baby is male	76.2	73.1	75.6	76.7	74.0	76.7	77.1	74.4	77.0
	(4.42)	(4.21)	(4.34)	(4.11)	(3.94)	(4.09)	(4.23)	(4.08)	(4.20)
Plural birth	-960.7	-923.7	-935.4	-963.6	-924.9	-935.7	-959.6	-919.9	-931.4
	(10.46)	(9.98)	(10.50)	(9.69)	(9.25)	(9.76)	(8.69)	(8.37)	(9.10)
This is 1st live birth	8.8	18.2	19.5	11.9	23.1	24.7	12.5	23.8	25.5
	(0.37)	(0.76)	(0.82)	(0.47)	(0.90)	(0.97)	(0.49)	(0.94)	(1.00)

TABLE 21. Birthweight Production Functions for All White non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	57.8	50.9	53.7	33.3	28.5	32.3	25.7	18.7	24.1
	(2.80)	(2.45)	(2.59)	(1.39)	(1.18)	(1.35)	(1.06)	(0.78)	(1.00)
Used heroin	74.7	149.8		86.5	161.6		89.4	165.4	
	(0.31)	(0.62)		(0.33)	(0.62)		(0.39)	(0.77)	
Used cocaine	-121.4	-147.4		-130.8	-159.5		-134.3	-163.8	
	(1.42)	(1.71)		(1.41)	(1.71)		(1.35)	(1.67)	
Used methadone	743.9	699.9		730.2	683.4		754.2	712.9	
	(2.27)	(2.12)		(2.06)	(1.91)		(2.09)	(1.93)	
Used marijuana	-185.1	-208.8		-186.0	-210.3		-185.0	-209.0	
	(1.92)	(2.15)		(1.78)	(2.00)		(1.48)	(1.68)	
Used other drug	-28.7	-20.4		-25.2	-17.9		-27.2	-20.9	
	(0.30)	(0.21)		(0.24)	(0.17)		(0.28)	(0.21)	
Worked	-24.9	-19.7		-30.6	-25.7		-30.9	-26.4	
	(0.85)	(0.67)		(0.97)	(0.81)		(0.99)	(0.84)	
Alcohol	-180.3	-164.5		-177.7	-161.8		-174.3	-158.2	
	(2.09)	(1.89)		(1.90)	(1.72)		(1.36)	(1.27)	
Tobacco	-83.7	-80.6		-84.4	-81.4		-86.4	-84.0	
	(2.73)	(2.61)		(2.54)	(2.44)		(2.49)	(2.40)	
LN(weight gain)	202.6			205.3			205.5		
	(8.24)			(7.74)			(7.29)		
Weight gain unknown	-90.4			-91.8			-91.6		
	(2.30)			(2.15)			(2.27)		
F-ratio	18.2	16.3	22.9	15.9	14.3	20.1	16.5	15.1	20.8
R-squared	0.1012	0.0846	0.0760	0.0894	0.0747	0.0674	0.0927	0.0786	0.0696
Wu test[a] (Delay only)	3.50	3.51	3.44						
Wu test[b] (Delay & WIC)	12.90	13.79	12.66						

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 22. Birthweight Production Functions for All Hispanic Teens Including WIC Enrollment

	OLS (1)	OLS (2)	OLS (3)	TSLS (4)	TSLS (5)	TSLS (6)	DELAY and WIC Endogenous (7)	DELAY and WIC Endogenous (8)	DELAY and WIC Endogenous (9)
Constant	14.5	684.4	594.1	221.5	921.1	871.2	230.2	929.3	884.9
	(0.09)	(4.36)	(3.77)	(1.24)	(5.12)	(4.78)	(1.28)	(5.12)	(4.81)
Enrolled in WIC	14.0	18.3	22.3	15.5	21.0	25.3	3.9	10.1	8.5
	(1.55)	(1.99)	(2.42)	(1.69)	(2.24)	(2.67)	(0.11)	(0.27)	(0.22)
Delay	-4.4	-6.3	-7.0	-41.7	-48.5	-56.4	-42.8	-49.4	-58.1
	(2.98)	(4.21)	(4.72)	(3.02)	(3.44)	(3.95)	(2.95)	(3.36)	(3.89)
Year=89	4.0	6.9	7.5	14.5	18.8	21.3	15.3	19.7	22.7
	(0.39)	(0.67)	(0.71)	(1.30)	(1.65)	(1.85)	(1.34)	(1.70)	(1.92)
Year=90	0.5	0.7	4.2	16.3	18.6	25.2	17.5	19.7	27.0
	(0.05)	(0.06)	(0.40)	(1.37)	(1.52)	(2.04)	(1.39)	(1.53)	(2.07)
Single	-36.9	-39.6	-46.6	-37.3	-40.4	-47.5	-37.1	-40.3	-47.3
	(3.76)	(3.97)	(4.66)	(3.72)	(3.95)	(4.59)	(3.43)	(3.65)	(4.19)
Education > 7	14.7	28.5	28.7	1.4	13.4	11.1	0.5	12.7	9.9
	(0.90)	(1.72)	(1.72)	(0.08)	(0.76)	(0.62)	(0.03)	(0.74)	(0.57)
Foreign born	52.9	47.0	54.9	56.9	51.4	60.1	57.0	51.5	60.3
	(6.09)	(5.33)	(6.22)	(6.32)	(5.61)	(6.49)	(6.35)	(5.63)	(6.51)
Age < 18	-41.6	-43.4	-39.4	-41.6	-43.6	-39.7	-41.3	-43.3	-39.4
	(4.79)	(4.92)	(4.47)	(4.69)	(4.82)	(4.35)	(4.65)	(4.78)	(4.29)
LN(pre-preg. weight)	498.1	522.4	536.9	496.3	520.6	534.9	497.1	521.7	536.3
	(15.87)	(16.41)	(16.80)	(15.48)	(15.93)	(16.16)	(15.75)	(16.07)	(16.30)
Pre-preg. wt. unknown	-6.0	-63.1	-59.8	-9.0	-66.9	-64.1	-12.7	-73.7	-72.3
	(0.29)	(6.96)	(6.60)	(0.43)	(7.24)	(6.89)	(0.61)	(8.41)	(8.18)
Sex of baby is male	89.9	90.2	91.8	89.8	90.2	91.7	89.7	90.1	91.6
	(10.89)	(10.77)	(10.90)	(10.66)	(10.49)	(10.53)	(10.65)	(10.49)	(10.51)
Plural birth	-998.0	-990.1	-989.4	-995.5	-986.7	-985.6	-995.6	-986.8	-985.7
	(27.76)	(27.14)	(27.00)	(27.12)	(26.35)	(25.98)	(22.59)	(21.79)	(21.59)
This is 1st live birth	-37.8	-23.4	-14.8	-35.8	-20.1	-11.1	-36.0	-20.3	-11.3
	(3.71)	(2.26)	(1.43)	(3.46)	(1.91)	(1.05)	(3.46)	(1.92)	(1.05)

TABLE 22. Birthweight Production Functions for All Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	10.2	19.0	24.5	9.9	19.5	25.0	5.3	14.1	18.0
	(0.66)	(1.21)	(1.55)	(0.63)	(1.21)	(1.53)	(0.32)	(0.83)	(1.05)
Used heroin	-18.5	-60.0		-18.7	-61.4		-22.8	-67.1	
	(0.16)	(0.51)		(0.16)	(0.51)		(0.19)	(0.58)	
Used cocaine	-335.1	-345.3		-334.9	-346.0		-336.0	-347.5	
	(7.69)	(7.81)		(7.53)	(7.63)		(6.62)	(6.70)	
Used methadone	-180.0	-197.3		-180.8	-198.5		-178.7	-195.8	
	(1.46)	(1.58)		(1.44)	(1.55)		(1.33)	(1.46)	
Used marijuana	-38.1	-42.6		-41.1	-46.9		-41.3	-47.2	
	(0.71)	(0.78)		(0.75)	(0.84)		(0.63)	(0.71)	
Used other drug	-127.0	-117.1		-123.6	-113.4		-126.1	-116.6	
	(2.47)	(2.24)		(2.35)	(2.12)		(1.73)	(1.55)	
Worked	-1.4	-0.3		-0.3	1.1		0.4	2.3	
	(0.08)	(0.02)		(0.02)	(0.06)		(0.02)	(0.12)	
Alcohol	-11.8	-12.4		-16.1	-18.3		-17.1	-19.5	
	(0.17)	(0.17)		(0.22)	(0.25)		(0.23)	(0.25)	
Tobacco	-144.7	-146.9		-143.8	-146.0		-144.4	-146.9	
	(6.83)	(6.83)		(6.64)	(6.61)		(6.44)	(6.40)	
LN(weight gain)	247.0			248.2			248.6		
	(22.07)			(21.74)			(18.82)		
Weight gain unknown	-92.6			-92.3			-93.6		
	(4.57)			(4.46)			(4.46)		
F-ratio	86.0	69.2	95.7	82.5	65.5	88.9	82.2	65.1	88.1
R-squared	0.1117	0.0849	0.0754	0.1076	0.0807	0.0704	0.1073	0.0803	0.0698
Wu test[a] (Delay only)	2.86	3.21	1.53						
Wu test[b] (Delay & WIC)	8.37	10.62	0.13						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 23. Birthweight Production Functions for the Poor Subsample of Black non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-259.2	372.4	179.3	-266.3	430.7	280.1	-409.4	283.9	111.3
	(0.73)	(1.04)	(0.50)	(0.71)	(1.13)	(0.72)	(1.11)	(0.76)	(0.30)
Enrolled in WIC	16.7	25.9	30.2	20.5	29.4	34.1	181.3	195.2	227.1
	(0.84)	(1.28)	(1.48)	(1.03)	(1.45)	(1.66)	(2.35)	(2.48)	(2.86)
DELAY	-9.1	-9.9	-11.5	-11.7	-23.1	-32.8	-0.8	-12.1	-19.9
	(3.05)	(3.25)	(3.76)	(0.54)	(1.05)	(1.47)	(0.04)	(0.51)	(0.82)
Year=89	-1.4	1.1	6.2	0.0	6.1	14.1	0.6	7.0	15.1
	(0.07)	(0.05)	(0.28)	(0.00)	(0.26)	(0.59)	(0.03)	(0.29)	(0.62)
Year=90	-9.9	-0.6	5.9	-7.8	7.4	18.4	-16.0	-0.8	8.8
	(0.45)	(0.03)	(0.26)	(0.31)	(0.29)	(0.71)	(0.61)	(0.03)	(0.32)
Single	-5.3	-10.6	-11.1	-6.0	-11.6	-12.5	-8.6	-14.1	-15.8
	(0.13)	(0.26)	(0.27)	(0.15)	(0.28)	(0.30)	(0.21)	(0.34)	(0.37)
Education > 7	6.3	6.9	-5.5	2.5	-6.0	-25.7	2.6	-5.9	-25.2
	(0.09)	(0.10)	(0.08)	(0.04)	(0.08)	(0.35)	(0.04)	(0.09)	(0.38)
Foreign born	23.3	31.8	54.1	22.2	29.8	51.6	30.4	37.9	60.8
	(0.62)	(0.83)	(1.40)	(0.59)	(0.78)	(1.33)	(0.81)	(1.01)	(1.61)
Age < 18	-47.5	-51.9	-38.5	-50.9	-55.5	-42.7	-50.0	-54.3	-41.8
	(2.54)	(2.72)	(2.01)	(2.72)	(2.91)	(2.22)	(2.64)	(2.82)	(2.15)
LN(pre-preg. weight)	490.6	565.9	594.9	493.9	569.9	600.5	497.4	573.8	604.7
	(7.08)	(8.04)	(8.38)	(7.12)	(8.07)	(8.40)	(7.90)	(8.68)	(9.03)
Pre-preg. wt. unknown	-32.2	-61.9	-48.1	-32.1	-68.2	-55.9	-32.3	-76.4	-65.8
	(0.65)	(3.11)	(2.41)	(0.65)	(3.43)	(2.79)	(0.64)	(4.12)	(3.52)
Sex of baby is male	95.0	97.8	101.4	97.3	100.3	104.5	96.7	99.6	103.6
	(5.29)	(5.34)	(5.49)	(5.42)	(5.47)	(5.62)	(5.35)	(5.40)	(5.55)
Plural birth	-902.0	-895.4	-892.3	-894.6	-887.4	-883.1	-898.7	-891.9	-888.1
	(12.98)	(12.64)	(12.48)	(12.88)	(12.50)	(12.27)	(8.40)	(8.25)	(8.26)
This is 1st live birth	-24.5	-15.2	10.6	-14.7	-5.0	22.6	-12.9	-3.1	24.8
	(1.11)	(0.68)	(0.47)	(0.68)	(0.23)	(1.02)	(0.58)	(0.13)	(1.07)

TABLE 23. Birthweight Production Functions for the Poor Subsample of Black non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	29.2	44.7	57.6	35.4	49.7	62.8	59.8	73.8	91.1
	(1.02)	(1.53)	(1.96)	(1.23)	(1.69)	(2.11)	(1.95)	(2.39)	(2.95)
Used heroin	-1214.8	-1184.2		-1238.4	-1212.5		-1233.6	-1208.8	
	(2.85)	(2.72)		(2.90)	(2.78)		(2.49)	(2.31)	
Used cocaine	-325.0	-350.7		-334.4	-359.8		-328.6	-354.3	
	(4.41)	(4.66)		(4.53)	(4.77)		(3.69)	(3.94)	
Used methadone	-205.4	-154.3		-199.9	-149.3		-204.5	-154.0	
	(0.96)	(0.71)		(0.94)	(0.68)		(1.02)	(0.79)	
Used marijuana	7.1	-9.4		-2.5	-18.7		-4.0	-20.9	
	(0.09)	(0.12)		(0.03)	(0.24)		(0.05)	(0.27)	
Used other drug	-131.0	-149.0		-136.5	-154.7		-137.5	-156.0	
	(1.24)	(1.38)		(1.29)	(1.43)		(1.03)	(1.12)	
Worked	-71.4	-65.9		-67.7	-61.9		-62.0	-55.4	
	(1.81)	(1.64)		(1.71)	(1.53)		(1.50)	(1.30)	
Alcohol	-74.8	-87.9		-75.5	-88.1		-77.8	-90.5	
	(0.61)	(0.70)		(0.61)	(0.70)		(0.58)	(0.67)	
Tobacco	-192.5	-197.1		-192.5	-196.7		-191.7	-195.8	
	(5.60)	(5.62)		(5.59)	(5.59)		(5.53)	(5.41)	
LN(weight gain)	315.4			316.2			316.2		
	(12.82)			(12.84)			(10.79)		
Weight gain unknown	-74.7			-80.8			-86.3		
	(1.51)			(1.64)			(1.72)		
F-ratio	24.3	18.4	21.8	24.0	17.8	20.7	23.7	17.7	20.7
R-squared	0.1247	0.0896	0.0691	0.1230	0.0873	0.0657	0.1217	0.0868	0.0658
Wu test[a] (Delay only)	0.21	0.69	1.05						
Wu test[b] (Delay & WIC)	4.57	5.15	7.26						

Absolute values of *t*-statistics are in parentheses.
[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.
[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 24. Birthweight Production Functions for the Poor Subsample of White non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	446.2	1085.8	1028.2	801.5	1435.6	1394.8	852.2	1486.1	1460.7
	(0.72)	(1.77)	(1.67)	(1.14)	(2.06)	(1.99)	(1.36)	(2.30)	(2.25)
Enrolled in WIC	62.3	68.0	78.7	70.6	79.4	89.7	83.2	55.4	81.8
	(1.54)	(1.66)	(1.93)	(1.67)	(1.86)	(2.11)	(0.69)	(0.45)	(0.67)
DELAY	-5.4	-8.7	-8.2	-57.4	-60.0	-62.2	-61.4	-60.8	-65.0
	(0.93)	(1.49)	(1.41)	(1.48)	(1.53)	(1.58)	(1.60)	(1.57)	(1.67)
Year=89	44.7	54.5	44.5	56.5	66.7	57.2	60.9	70.1	61.0
	(1.13)	(1.36)	(1.12)	(1.34)	(1.56)	(1.34)	(1.49)	(1.72)	(1.49)
Year=90	103.8	120.8	114.4	126.5	143.3	137.9	129.1	146.6	140.8
	(2.53)	(2.92)	(2.77)	(2.74)	(3.08)	(2.96)	(2.66)	(3.03)	(2.88)
Single	-52.2	-61.7	-67.1	-48.2	-59.2	-64.5	-52.9	-62.9	-69.4
	(1.26)	(1.47)	(1.61)	(1.11)	(1.35)	(1.47)	(1.10)	(1.29)	(1.41)
Education > 7	-70.3	-83.6	-40.5	-181.3	-194.1	-156.1	-189.4	-199.0	-163.4
	(0.73)	(0.85)	(0.42)	(1.40)	(1.48)	(1.19)	(1.57)	(1.65)	(1.34)
Foreign born	-92.1	-94.4	-85.8	-90.8	-94.0	-85.2	-93.2	-95.5	-87.2
	(2.13)	(2.15)	(1.97)	(2.01)	(2.05)	(1.86)	(2.20)	(2.24)	(2.01)
Age < 18	-48.0	-40.9	-32.5	-48.3	-42.4	-33.8	-47.0	-40.0	-31.6
	(1.24)	(1.04)	(0.83)	(1.19)	(1.03)	(0.82)	(1.17)	(1.00)	(0.78)
LN(pre-preg. weight)	408.7	439.9	438.1	407.8	440.9	439.5	401.6	436.0	433.3
	(3.35)	(3.56)	(3.53)	(3.19)	(3.41)	(3.38)	(3.55)	(3.68)	(3.64)
Pre-preg. wt. unknown	93.3	-9.2	0.5	95.4	-15.1	-5.7	84.1	-33.7	-25.8
	(1.27)	(0.26)	(0.01)	(1.24)	(0.41)	(0.15)	(1.09)	(0.96)	(0.73)
Sex of baby is male	75.9	80.8	86.1	76.8	82.5	87.4	78.0	84.4	89.1
	(2.31)	(2.43)	(2.59)	(2.24)	(2.38)	(2.51)	(2.25)	(2.43)	(2.56)
Plural birth	-844.3	-800.3	-786.0	-842.2	-793.8	-780.5	-843.2	-793.7	-780.4
	(4.36)	(4.08)	(4.00)	(4.16)	(3.88)	(3.79)	(3.53)	(3.41)	(3.29)
This is 1st live birth	25.2	39.8	42.2	27.0	43.3	45.6	29.3	45.8	48.7
	(0.57)	(0.88)	(0.94)	(0.58)	(0.92)	(0.97)	(0.55)	(0.86)	(0.91)

TABLE 24. Birthweight Production Functions for the Poor Subsample of White non-Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	96.1	72.9	81.0	80.4	58.7	66.2	71.5	43.9	51.5
	(2.16)	(1.63)	(1.82)	(1.67)	(1.21)	(1.36)	(1.30)	(0.81)	(0.95)
Used heroin	-771.8	-737.4		-738.2	-683.4		-774.5	-729.8	
	(1.22)	(1.15)		(1.11)	(1.02)		(3.51)	(3.53)	
Used cocaine	-94.2	-135.5		-110.1	-161.9		-119.9	-179.1	
	(0.50)	(0.72)		(0.57)	(0.82)		(0.61)	(0.91)	
Used methadone	1165.8	1148.8		1155.4	1128.9		1200.4	1185.0	
	(3.07)	(2.99)		(2.91)	(2.81)		(6.18)	(6.59)	
Used marijuana	-64.6	-115.3		-65.0	-115.8		-63.9	-115.9	
	(0.31)	(0.54)		(0.29)	(0.52)		(0.27)	(0.46)	
Used other drug	-139.8	-127.7		-130.0	-117.3		-148.0	-140.3	
	(0.61)	(0.55)		(0.54)	(0.48)		(1.62)	(1.86)	
Worked	-60.7	-50.8		-56.2	-45.0		-59.7	-49.6	
	(1.03)	(0.85)		(0.91)	(0.72)		(0.87)	(0.69)	
Alcohol	-397.7	-381.9		-381.8	-360.3		-369.4	-344.0	
	(1.94)	(1.84)		(1.78)	(1.66)		(1.49)	(1.35)	
Tobacco	-59.3	-42.2		-62.2	-46.0		-61.1	-43.7	
	(0.75)	(0.53)		(0.75)	(0.55)		(0.75)	(0.55)	
LN(weight gain)	244.6			247.4			251.5		
	(5.04)			(4.89)			(3.90)		
Weight gain unknown	-162.7			-169.2			-174.7		
	(2.21)			(2.21)			(2.25)		
F-ratio	5.0	4.1	5.3	4.6	3.8	4.9	4.5	3.6	4.6
R-squared	0.1120	0.0858	0.0719	0.1044	0.0795	0.0664	0.1009	0.0764	0.0622
Wu test[a] (Delay only)	1.47	1.47	1.53						
Wu test[b] (Delay & WIC)	2.49	2.36	2.61						

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

TABLE 25. Birthweight Production Functions for the Poor Subsample of Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-449.3	365.0	276.5	-218.7	634.1	587.9	-381.0	457.3	432.3
	(1.18)	(0.96)	(0.73)	(0.50)	(1.46)	(1.33)	(0.80)	(0.97)	(0.91)
Enrolled in WIC	3.0	-3.2	0.5	7.0	1.3	5.4	95.6	98.9	90.1
	(0.16)	(0.17)	(0.02)	(0.36)	(0.07)	(0.27)	(0.86)	(0.87)	(0.79)
DELAY	-7.7	-8.7	-9.6	-48.6	-55.4	-64.0	-25.7	-30.5	-42.2
	(2.69)	(3.02)	(3.31)	(1.45)	(1.62)	(1.84)	(0.60)	(0.70)	(0.96)
Year=89	-14.1	-12.6	-10.0	5.0	9.3	15.4	-5.3	-2.0	5.5
	(0.67)	(0.59)	(0.47)	(0.19)	(0.34)	(0.56)	(0.19)	(0.07)	(0.19)
Year=90	-14.0	-16.0	-10.3	14.0	16.0	27.0	-2.3	-1.8	11.4
	(0.66)	(0.75)	(0.48)	(0.45)	(0.50)	(0.83)	(0.06)	(0.05)	(0.30)
Single	-30.0	-30.3	-39.1	-31.0	-31.5	-40.5	-32.7	-33.3	-42.2
	(1.35)	(1.35)	(1.73)	(1.36)	(1.36)	(1.72)	(1.50)	(1.52)	(1.90)
Education > 7	37.1	54.1	58.2	20.8	35.6	36.8	27.7	43.0	43.4
	(1.10)	(1.58)	(1.70)	(0.56)	(0.94)	(0.96)	(0.76)	(1.14)	(1.14)
Foreign born	43.1	42.6	50.9	48.4	48.6	58.0	45.2	45.1	54.9
	(2.40)	(2.34)	(2.79)	(2.55)	(2.51)	(2.96)	(2.43)	(2.38)	(2.85)
Age < 18	-60.7	-65.3	-62.5	-62.8	-67.8	-65.2	-62.7	-67.7	-65.2
	(3.45)	(3.67)	(3.50)	(3.48)	(3.68)	(3.50)	(3.56)	(3.78)	(3.60)
LN(pre-preg. weight)	564.1	588.7	602.5	561.7	586.0	599.7	563.0	586.8	600.9
	(7.38)	(7.62)	(7.76)	(7.16)	(7.33)	(7.40)	(7.52)	(7.78)	(7.91)
Pre-preg. wt. unknown	-31.1	-77.1	-76.2	-33.3	-81.1	-80.5	-34.4	-81.1	-82.0
	(0.75)	(4.00)	(3.95)	(0.78)	(4.08)	(4.00)	(0.78)	(4.43)	(4.45)
Sex of baby is male	104.4	106.6	106.8	105.0	107.3	107.7	105.0	107.3	107.7
	(6.15)	(6.21)	(6.19)	(6.02)	(6.04)	(5.96)	(6.15)	(6.19)	(6.12)
Plural birth	-964.4	-937.7	-937.5	-961.3	-933.9	-933.4	-962.3	-934.7	-934.3
	(12.86)	(12.36)	(12.29)	(12.49)	(11.91)	(11.71)	(9.23)	(8.70)	(8.71)
This is 1st live birth	-34.8	-25.4	-18.0	-29.3	-19.2	-11.1	-28.7	-18.5	-10.4
	(1.71)	(1.24)	(0.87)	(1.41)	(0.91)	(0.52)	(1.37)	(0.87)	(0.48)

TABLE 25. Birthweight Production Functions for the Poor Subsample of Hispanic Teens Including WIC Enrollment

	OLS			TSLS			DELAY and WIC Endogenous		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Private service	40.7	46.2	50.7	47.5	54.0	59.6	49.8	57.6	62.1
	(1.24)	(1.38)	(1.51)	(1.40)	(1.56)	(1.70)	(1.62)	(1.82)	(1.94)
Used heroin	187.1	190.6		182.3	185.2		182.2	185.6	
	(0.78)	(0.79)		(0.74)	(0.74)		(0.87)	(0.88)	
Used cocaine	-352.6	-352.7		-351.0	-350.7		-353.2	-352.9	
	(3.93)	(3.88)		(3.81)	(3.73)		(4.09)	(4.05)	
Used methadone	76.2	102.4		69.2	94.7		69.7	95.6	
	(0.28)	(0.37)		(0.24)	(0.33)		(0.32)	(0.43)	
Used marijuana	-143.4	-184.3		-153.3	-195.9		-153.4	-195.5	
	(1.36)	(1.72)		(1.41)	(1.77)		(1.17)	(1.56)	
Used other drug	-281.4	-231.0		-286.6	-236.5		-282.8	-232.0	
	(1.86)	(1.51)		(1.84)	(1.49)		(1.06)	(0.84)	
Worked	-27.9	-31.8		-25.6	-29.1		-23.4	-27.0	
	(0.61)	(0.68)		(0.54)	(0.60)		(0.55)	(0.64)	
Alcohol	-5.8	7.7		-20.3	-8.6		-21.0	-8.8	
	(0.03)	(0.04)		(0.12)	(0.05)		(0.16)	(0.07)	
Tobacco	-146.5	-168.4		-146.5	-168.5		-147.0	-168.8	
	(3.44)	(3.90)		(3.34)	(3.78)		(3.19)	(3.60)	
LN(weight gain)	290.6			292.4			292.0		
	(10.27)			(10.07)			(9.21)		
Weight gain unknown	-79.3			-81.0			-81.8		
	(1.89)			(1.88)			(1.84)		
F-ratio	20.2	16.8	22.4	19.0	15.5	20.1	19.6	16.1	21.0
R-squared	0.1062	0.0829	0.0711	0.1003	0.0767	0.0641	0.1034	0.0797	0.0669
Wu test[a] (Delay only)	0.54	0.64	0.94						
Wu test[b] (Delay & WIC)	2.45	3.02	3.56						

Absolute values of *t*-statistics are in parentheses.

[a] The critical $F(1,\infty)$ at the 5 percent level is 3.84 and at the 1 percent level is 6.63.

[b] The critical $\chi^2(2)$ at the 5 percent level is 5.99 and at the 1 percent level is 9.21.

but does not have a significant effect in the poor subsamples. The poverty rate has a small positive significant effect on black and white teens but not for Hispanic teens. The time dummy for 1989 does not have a significant effect on the probability of WIC enrollment while the time dummy for 1990 has a positive effect which is significant for blacks and whites and insignificant for Hispanics. This means there is a higher probability of WIC enrollment if the birth is in 1990 as opposed to 1988 or 1989 for black and white teens and no difference in probability for the three years for Hispanics. The only time dummy that has a significant effect on the probability of WIC enrollment in the poor samples is that the time dummy for 1989 has a negative effect significant at the 10% level for blacks. Thus, among the poor teens, there is no difference in the probability of WIC enrollment for the three years for white and Hispanic teens and a lower probability of WIC enrollment for poor black teens in 1989.

The number of prenatal care clinics has a positive significant effect on the probability of WIC enrollment for the entire black teen sample and the poor subsample. The number of prenatal care clinics has a negative significant effect on the probability of WIC enrollment for the entire and poor samples of white teens. The number of prenatal care clinics does not have a significant impact on the probability of WIC enrollment for the entire Hispanic teen sample but does have a positive effect on the poor Hispanic teen subsample at the 10% level. This means that the more that prenatal care clinics are available, the more likely black teens and poor Hispanic teens are to enroll in WIC and the less likely white teens are to enroll in WIC. The presence of a WIC center in the health district of residence has a positive significant effect on the probability of WIC enrollment for whites and Hispanics but does not have a significant effect on the probability of WIC enrollment for blacks. The availability of family planning clinics has a significant effect on WIC enrollment only for the poor black teen subsample and the entire white teen sample. This effect is negative for poor black teens and positive for white teens; the more that family planning clinics are available, the less likely poor black teens are to enroll in WIC and the more likely white teens are to enroll in WIC. The availability of abortion providers has a significant impact on the probability of WIC enrollment only for the entire black teen sample; this effect is negative and significant only at the 10% level.

The discussion of the production function estimates that follow will focus on the effects of prenatal care delay and WIC participation on the production function. In the three specifications of the production function which include WIC participation, are estimated by OLS (WIC enrollment and delay are treated exogenously), and are performed on the entire teen samples (tables 20 - 22), the effect of prenatal care delay on birthweight is negative and significant, although for white teens in the full input model, the level of significance is only 10%. For black, white and Hispanic teens, this effect is largest in magnitude in the limited input specification and smallest in the full input specification. The effect of a one month increase in prenatal care delay results in a decrease in birthweight of 8.0, 5.5 and 4.4 grams for blacks, whites and Hispanics respectively in the full input model and in a corresponding decrease in birthweight of 10.8, 8.2 and 7.0 grams in the limited input model. The effect of delay is largest in magnitude for black teens and smallest for Hispanic teens. The effect of WIC enrollment in these OLS estimates of the production function is positive. The effect is significant for blacks in the three specifications; it is not significant for whites in any specification and is significant for Hispanics in the specification excluding weight gain and in the limited input specification. The impact of WIC enrollment behaves as the impact of delay does and is largest in magnitude in the limited input model and smallest in magnitude in the full input model. For blacks, WIC enrollment is associated with a 28.3

gram increase in birthweight in the full input model, a 44.0 gram increase in the model excluding only weight gain, and a 46.9 gram increase in the limited input model. The corresponding increases in birthweight for Hispanics are 14.0, 18.3 and 22.3.

In the production functions estimated by TSLS in which prenatal care delay is treated endogenously, delay has a negative impact on birthweight that is larger in magnitude than the OLS estimates. For blacks, delay does not have a significant effect in the full input model but does have one in the other two models. Once again, the effect is largest in magnitude for the limited input model and smallest in the full input model. The impact of a one month delay in the initial prenatal care visit is a reduction in birthweight of 14.3, 20.5 and 29.8 grams for the full input, no weight gain, and limited input models respectively. This is about double the impact of the OLS estimates. For white teens, the impact of delay in the TSLS estimates is over ten times larger in magnitude than in the OLS estimates. The impact of delay is statistically significant in all three specifications. For whites, the impact of a one month delay is a reduction in birthweight of 80.7, 82.2 and 80.9 grams for the full input, no weight gain, and limited input models respectively. The effect of delay is largest in magnitude in the no weight gain model. For Hispanic teens, the effect of delay on birthweight is over eight times larger in the TSLS estimates compared to the OLS estimates and is statistically significant as well. The effect of a one month delay is a reduction in birthweight of 41.7, 48.5 and 56.4 grams for the full input, no weight gain, and limited input models respectively. The effect is largest in magnitude in the limited input model. The effect of WIC participation on birthweight in the TSLS estimates follows the same pattern as it did in the OLS estimates. WIC participation still does not have a significant effect on birthweight for white teens. It has a positive significant effect on birthweight for blacks that is slightly larger in magnitude than the

OLS estimates. For black teens, WIC participation is associated with an increase in birthweight of 32.5, 48.9 and 52.3 grams for the full input, no weight gain, and limited input models respectively. For the Hispanic teens, WIC participation is still significant only in the no weight gain and limited input specifications. The effect of WIC participation is again somewhat larger than in the OLS estimation. For Hispanics, WIC participation is associated with an increase in birthweight of 15.5, 21.0 and 25.3 grams for the full input, no weight gain, and limited input models respectively.

In the estimates of the production functions in which both prenatal care delay and WIC participation are treated endogenously, for blacks and whites, the impact of delay on birthweight is larger in magnitude than the OLS estimates but smaller in magnitude than the TSLS estimates. For Hispanics, the estimates of the impact of delay on birthweight when both delay and WIC are treated endogenously are slightly larger in magnitude than the TSLS estimates and at least eight times larger than the OLS estimates. For blacks, when both WIC and delay are endogenous, delay only has a significant impact in the limited input model; in this case, a one month increase in delay results in a 25.9 gram decrease in birthweight. For whites, the effect of delay on birthweight is statistically significant in the three input models. For white teens, the effect of a one month delay is a reduction in birthweight of 69.1, 65.4 and 69.2 grams for the full input, no weight gain, and limited input models respectively. Please note that for white teens, the impacts of delay in the full input and the limited input specifications are virtually identical; this is true in the TSLS estimates of the production function as well. For Hispanics, the effect of a one month delay is a reduction in birthweight of 42.8, 49.4 and 58.1 grams for the full input, no weight gain, and limited input models respectively; these three estimates are statistically significant. In these estimates with WIC and delay both treated endogenously, the effect of WIC participation on birthweight for whites and Hispanics is not statistically significant in any of the three input specifications. For blacks however, the impact of WIC enrollment is significant in all three specifications and is in fact over triple in magnitude the OLS and TSLS estimates. For black teens, WIC participation is associated with an increase in birthweight of 148.3, 166.0 and 170.5 grams for the full input, no weight gain, and limited input models respectively.

An examination of estimates of the production functions on the poor teen subsamples show that they are, in general, not as influenced by prenatal care delay and prenatal WIC participation. For the poor black teen subsample, prenatal care delay has a significant effect on birthweight only in the OLS estimates of the production function. These effects are of similar magnitude as the effects of delay on the entire black teen subsample. For the poor black teens, the effect of a one month delay is a reduction in birthweight of 9.1, 9.9 and 11.5 grams for the full input, no weight gain, and limited input models respectively. In addition, WIC enrollment has a significant effect on birthweight only in the production function estimates with both delay and WIC enrollment treated endogenously. And in these estimates, the effect of WIC participation is very large; they are in fact larger in magnitude than the corresponding estimates for the entire black teen sample. For the poor black teens, WIC participation is associated with an increase in birthweight of 181.3, 195.2 and 227.1 grams for the full input, no weight gain, and limited input models respectively. For the poor white teen subsample, prenatal care delay does not have a significant effect in any of the nine estimates of the production function shown in table 24. The effect of WIC enrollment on birthweight is significant in only some of the production function estimates. WIC enrollment has a significant effect at the 10% level in the OLS estimates of the no weight gain and limited input specifications in which the effects of WIC enrollment are 68.0 and 78.7 grams respectively. In the TSLS estimates of the poor white teen production functions, WIC enrollment is significant at the 10% level in the full input and no weight gain specification and is highly significant in the limited input specification. The effect of WIC enrollment in these TSLS estimates are an increase in birthweight of 70.6, 79.4 and 89.7 grams for the full input, no weight gain, and limited input models respectively. In the nine production functions estimated for the poor Hispanic teens, WIC enrollment does not have a significant effect on birthweight. Prenatal care delay has a negative significant effect in the OLS estimates and a negative significant effect at the 10% level in the TSLS estimate of the limited input specification. The effect of a one month delay is a reduction in birthweight of 7.7, 8.7 and 9.6 grams for the full input, no weight gain, and limited input models respectively estimated by OLS and a reduction in birthweight of 64.0 grams in the limited input model estimated by TSLS.

The Wu test for the endogeneity of prenatal care delay indicates that at the five percent level, for all race/ethnicities, in the full, no weight gain and limited input models, delay should be treated exogenously because the hypothesis of no correlation could be accepted in all of these cases. The same is true for all three poor teen subsamples. The test for the endogeneity of delay and WIC participation indicates that for all race/ethnicities and in all three input models, delay and WIC should both be treated as endogenous. However, examination of this test on the poor teen subsamples reveals that the only case where the joint endogeneity of WIC and delay could be accepted was for the poor black teen subsample in the limited input model. In the three input models of the poor white and poor Hispanic teen subsamples and in the full and no weight gain models of the poor black teen subsample, delay and WIC should be treated exogenously.

VIII. Summary and Conclusions

Birthweight production functions for New York City were estimated by race/ethnicity for adult and adolescent mothers for the three year period of 1988 through 1990. Estimation was done for the entire samples of black non-Hispanic, white non-Hispanic and Hispanic women and also done separately for subsamples of women living in the poorest health areas. Prenatal care demand equations and linear probability of WIC participation equations were also estimated. Prenatal care and WIC participation were treated both exogenously and endogenously in the production functions. When treated exogenously, estimation of the production function was performed using OLS. When treated endogenously, estimation was performed using a modified TSLS method. In the first stage, a prenatal care delay demand equation and a linear probability WIC participation equation were estimated. In the second stage, predicted values of delay and WIC were inserted as regressors in the production function, and OLS was used for estimation with the standard errors corrected according to the method proposed by Heckman and MaCurdy (1985). The rationale for treating prenatal care delay and WIC participation endogenously was to control for potential bias in production function estimates that may result from unobservables, such as the health endowment, which affects birthweight directly and also influences the behavior of the mother in choosing the timing of prenatal care and whether or not to participate in WIC.

The main results of this study are that a delay in the initiation of prenatal medical care causes a reduction in birthweight while prenatal WIC participation causes an increase in birthweight. For the birth outcomes of the adult mothers, these results are statistically significant in most of the specifications of the production functions. When both prenatal care delay and WIC participation are treated exogenously and all new measures to the production function are included in the estimation, the impact of an increase in delay of one month is a 12.3, 7.8 and 9.0 gram reduction in birthweight for black, white and Hispanic adult mothers, respectively, while WIC participation is associated with a corresponding 46.4, 26.9 and 27.2 gram increase in birthweight. When both prenatal care delay and WIC participation are treated endogenously, the impact of an increase in delay of one month is a 19.2, 26.2 and 36.1 gram reduction in birthweight for black, white and Hispanic adult mothers, respectively; WIC participation is associated with a corresponding 27.5, 86.1 and 66.6 gram increase in birthweight although this result for blacks is not statistically significant. When delay is treated endogenously, the magnitude of the effect of delay increases for blacks, whites and Hispanics. When WIC enrollment is treated endogenously, the magnitude of the effect of WIC decreases for blacks, but increases for whites and Hispanics.

The effects of delay and WIC on the production function are larger in magnitude for the poor black subsample than for the entire black sample. The effects of delay on birthweight are smaller in magnitude for the poor white subsample than for the entire white subsample; in fact, delay is not statistically significant when treated endogenously for the poor white sample. The effect of WIC enrollment on birthweight for the poor white sample is slightly larger than for the entire white sample when WIC is treated exogenously but is smaller when WIC is treated endogenously. For Hispanics, the effects of delay and WIC on birthweight are of similar magnitude for both the entire Hispanic sample and the poor Hispanic subsample.

Prenatal WIC participation does not have a significant effect on the birth outcomes of adolescent white mothers; it does have a significant positive effect on birthweight for black adolescents. The effect of WIC on birthweight for Hispanics is positive but is significant only when WIC participation is treated exogenously. The effect of prenatal care delay on birthweight for black teens is negative and significant when delay is treated exogenously but is not always significant when it is treated endogenously. For white and Hispanic teens, delay has a somewhat small negative significant effect on birthweight when delay is treated exogenously; this effect increases in magnitude by about ten times for whites and eight times for Hispanics when delay is treated endogenously. WIC and delay do not have a significant effect on birthweight for the poor white teen subsample. WIC participation has a very large positive effect on birthweight for the poor black teen subsample when WIC is treated endogenously but WIC has an insignificant effect when treated exogenously. The reverse is true in terms of the effect of delay on birthweight. Delay has a negative significant effect when treated exogenously and an insignificant effect when treated endogenously for the poor black teen subsample. WIC enrollment does not have a significant effect on birthweight for the poor Hispanic teen subsample; delay has a significant negative effect only when it is treated exogenously.

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