# Does Participation in Multiple Welfare Programs Improve Birth Outcomes?*

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First Draft: October 12, 2000
This Draft: December 30, 2000

* Support for this research was provided by the Joint Center for Poverty Research USDA Small Grants Program. We would like to thank participants at the USDA Small Grants Conference and the Southern Economic Association Meetings as well as seminar participants at the University of Colorado for comments. All remaining errors are our responsibility

## Executive Summary

The U.S. has relatively high rates of low weight births, preterm births, and infant mortality when compared to other western industrial countries. A number of Federal programs—WIC, Food Stamps, Medicaid, and AFDC—have provided benefits to help improve the birth outcomes for the children of the participants. In spite of the fact that many women participate in more than one of these programs, previous research only considers participation in one program at a time. Such analysis may lead to misleading conclusions if women participate in multiple programs and some programs are effective and others are not. Additionally, such analysis ignores the possibility of synergies among programs. In this paper we examine whether participation in more than one program improves birth outcomes. We allow for possible synergies among programs and attempt to control for non-random selection into the programs.

Our analysis uses data from the National Maternal and Infant Health Survey. These data were collected in 1988 and contain information about welfare program participation, birth outcomes, and socio-demographic characteristics of mothers and families for almost 19,000 women. We restrict our analysis to 3,451 low-income, single women who had complete information for all relevant variables.

We use a number of techniques to evaluate the impact of program participation on birth outcomes. These approaches include simple descriptive statistics where we compare average birth outcomes for women who participate in different combinations of programs; ordinary least squares regressions where we control for observed characteristics but not for the selection of women into the various programs; and a more complicated model of the decision to participate in each of the four programs and the resulting birth outcome. Highlights of our findings include the following.

- The descriptive analysis shows that WIC recipients can expect better birth outcomes than non-recipients. Women who participate in the other programs can generally expect worse birth outcomes than non-participants—suggesting possible adverse selection into these programs.
- After controlling for observed characteristics such as age and education, WIC participation continues to improve birth outcomes by approximately 230 grams on average.
- When allowing for synergies among programs, WIC continues to be effective. While there appear to be some synergies, the is no consistent pattern across all bundles of choices.
- The positive results for WIC become statistically insignificant after controlling for non-random selection into the programs.

Further work will refine the methodology for determining which women are eligible for which programs and attempt to better understand the participation decisions for the possible bundles of programs.

## I. Introduction

Of all the children born in 1998, 7.6 percent weighed less than 2,500 grams and were therefore classified as low birth weight (Ventura et al. 2000). Epidemiological evidence suggests that having a birth weight below this critical level leads to health and developmental problems throughout the child's life. These problems are not only devastating to the children and families involved but are extremely costly to society at large. Also striking are the racial differences in birth outcomes. Approximately 6.5 percent of the children born to non-Hispanic white women and Hispanic women had a low birth weight in 1998 (Ventura et al. 2000). In sharp contrast, 13.2 percent of the children born to non-Hispanic black women were low birth weight. Similar differences are found when examining other negative birth outcomes such as very low birth weight (less than 1,500 grams), preterm delivery (less than 35 weeks), and infant and neonatal mortality.

A number of Federal assistance programs provide substantial resources to recipients in an attempt to combat these problems. Some of these programs are specifically targeted toward pregnant women and improving birth outcomes of their children while others are more general but include needy pregnant women among their eligible pool. Two of the programs, the Special Supplemental Food and Nutrition Program for Women, Infants, and Children (WIC) and Food Stamps, provide food or food vouchers to recipients; Medicaid provides free health care including prenatal care; and cash assistance from the Temporary Assistance for Needy Families (TANF) or its precursor, Aid to Families with Dependent Children (AFDC), may help improve birth outcomes if the money is used to purchase additional food or prenatal care. Whether these programs effectively improve birth outcomes is still very much an open question.

A relatively large literature has examined the effect of participation in welfare programs on birth outcomes. This literature has generally focused on one program at a time despite the fact that many individuals are eligible for and participate in multiple welfare programs simultaneously. While this focus is understandable because of the difficulties associated with program evaluations of this type, the resulting estimates of the effectiveness of welfare programs in improving birth outcomes present only part of the picture. This is true for at least two reasons. First, the resulting estimates may be biased measures of the effectiveness of any one program. If, for example, most women who participate in AFDC also receive food stamps and food stamps have a positive effect on birth outcomes but AFDC does not, then omitting Food Stamp participation from the econometric analysis may lead to the conclusion that AFDC has a positive effect on birth outcomes when in actuality it does not. Second, there may be synergies among different groups of programs that may depend on the nature and magnitude of the benefits offered. For example, one might imagine that WIC alone and Medicaid alone are not effective but WIC and Medicaid together are effective. Understanding these synergies is potentially important for evaluating the impact of an individual program and also for program design.

In this paper, we extend the previous analysis to the case where women may participate in any combination of WIC, AFDC, Food Stamps, and Medicaid. We examine the effect of participation in each of these programs separately and different bundles of programs. Most prior models posit a relationship between a birth outcome (e.g., birth weight) and participation in a welfare program. The empirical analysis frequently takes the form of an ordinary least squares (OLS) regression. In the background is a behavioral model where women are concerned about the health of their child and make decisions to influence this outcome given their private knowledge of their reproductive health. Reproductive health also clearly affects the birth outcome itself. Because reproductive health is typically unobserved to researchers, it is part of the error term in the OLS equation. The econometric problem occurs because welfare participation, a regressor in the OLS equation, is then correlated with the error term in the OLS equation because the welfare participation decision also depends upon reproductive health. The resulting estimate of the effect of welfare participation on the birth outcome is then biased.

A number of approaches may be used to reduce the impact of non-random selection. The most commonly used technique is Two Stage Least Squares (2SLS). When using 2SLS, a first stage equation is used to predict the likelihood of participation in the welfare program, and this predicted probability is used in the second stage regression. This technique requires that one have variables that explain welfare program participation but not the birth outcome. Most researchers rely on state-to-state variation in welfare program generosity or rules. Studies using this technique in the birth outcomes literature include Brien and Swann (1999) and Currie and Cole (1993).

A second technique that may be used is "fixed effects." To use this method, one must assume that the unobserved variable responsible for the selection is unchanging over the mother's life. For the sample of women who have had at least two births, one can then identify the effect of welfare participation from the data on women who started or stopped participating in the program(s).

Finally, one can model the birth outcome and the welfare participation decision(s) jointly. This is the approach that we follow in this paper. In principle one can write down the utility maximization problem and derive the appropriate econometric model. In practice, however, this is quite complicated. In this paper we approximate the solution to the economic model through a set of equations describing the birth outcome and the participation decision for each program. To account for non-random selection, we allow the error terms in the equations to be correlated.

Until recently, this technique has been computationally infeasible for a model of participation in four programs. Recent developments in simulation techniques make estimation of this model possible.

The paper is organized as follows. The next section briefly describes the structure of each of the welfare programs. Section III places the paper in the context of previous research. The data are discussed in Section IV. The analysis uses nationally representative data from the 1988 National Infant and Maternal Health Survey (NMIHS). Section V presents a descriptive analysis of birth outcomes, and OLS results are presented in Section VI. The econometric model and results for the joint estimation is discussed in Section VII. Finally, Section VIII concludes.

## II. Description of the Welfare Programs

The analysis in this paper focuses on four federally-funded welfare programs: AFDC, Medicaid, Food Stamps, and WIC.[1] In this section we describe the relevant features of each of these programs.

### *Aid to Families with Dependent Children*

The AFDC program and its cash benefits to low-income families was for many years the focal point of the U.S. welfare system. The program did not provide direct benefits to improve birth outcomes, but participation in this program could potentially improve the health of pregnant women and their babies if the cash benefit was used to purchase nutritious food or prenatal care.

AFDC was a means-tested program targeted primarily toward single-parent families. Each state set its own cash benefit level and income eligibility cutoff. An applicant had to pass a number of tests to be considered income eligible for AFDC. First, her gross income had to be

[1] Although the AFDC program has been replaced with the TANF program, we provide details for AFDC because it was the relevant program at the time of our data (1988).

less than 185 percent of the state-set need standard. Second, her counted income (gross income less various allowed deductions) had to be less than the state-set payment standard.[2]

In addition to the income eligibility requirements, the family was required to be demographically eligible. In general, only single-parent families were eligible. There were, however, two notable exceptions to this rule. First, the AFDC-Unemployed Parent program made AFDC benefits available to two parent families under a more restrictive requirement. Second, as of 1988, pregnant women without children were eligible for AFDC in thirty-one states and the District of Columbia (Currie and Cole, 1993).

AFDC participants who chose not to work received the cash benefit available in their state. If the mother chose to work, the cash benefit was reduced as earned income increased. The rate at which benefits were reduced was known as the benefit reduction rate and was set by the Federal government.

***Medicaid***

The Medicaid program provides health insurance to low-income women, infants, and children. Both prenatal care visits and the actual birth of the child may be paid for by this program. From its inception in 1966 until the early 1980's, eligibility for Medicaid was closely related to participation in AFDC. In the 1980's Congress passed several pieces of legislation that broke this link.[3] The Omnibus Budget Reconciliation Act of 1986 gave states the option of covering all pregnant women and infants in families with income less than 100 percent of poverty, the Omnibus Budget Reconciliation Act of 1987 extended the income cutoff to 185 percent of poverty, and the Medicare Catastrophic Coverage Act of 1988 made coverage of pregnant women and infants living in families with income below the poverty line mandatory.

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[2] There is also an asset test that is not being discussed.

[3] See Hill (1992), Currie and Gruber (1996), or Currie (1995) for a more detailed discussion of the Medicaid

While all of these expansions were not fully phased in by 1988, the relevant year for the primary data in our proposed analysis, many women in our data were likely to be eligible for (and chose to participate in) Medicaid in 1988 regardless of whether they were eligible for (or chose to participate in) AFDC.[4]

***Food Stamps***

The Food Stamp program is a means tested program that provides recipients with vouchers that may be used at stores to purchase food items. Unlike AFDC, there is no family composition requirement and the benefit levels do not vary by state. In 1988, a family of four was eligible for $290 worth of food stamp coupons each month if the family had no earned income, and this amount was reduced by 30 cents for each dollar of earned income. As with Medicaid, AFDC recipients are categorically eligible to receive Food Stamps. Assuming that recipients do not simply reduce their food purchases by the amount of the voucher, participation will increase expenditures on food although there is no guarantee that recipients will purchase nutritious food with the voucher.

***Special Supplemental Food and Nutrition Program for Women, Infants and Children***

The WIC program was enacted in 1974 to provide food vouchers, nutritional education, and health screening and referrals to low-income women, infants, and children who are "nutritionally needy." Eligibility for WIC is more restrictive than food stamps for two reasons. First, WIC serves only infants, children less than six years of age, and pregnant and breastfeeding women. Second, WIC recipients must have some type of nutritional risk in order to be eligible for the program.[5]

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eligibility expansions.

[4] Hill (1992) provides detailed information on state-by-state implementation dates.

[5] The definition of nutrition risk includes identifiable medical conditions like anemia as well as behavioral factors like alcohol and drug use.

WIC recipients receive three types of benefits. First, they receive food vouchers. The WIC food vouchers are more restrictive than those issued by the Food Stamp program because they may only be used to purchase a limited number of healthy foods. In addition to the food vouchers, the program also provides nutritional and behavioral counseling. The counseling may take the form of literature distributed at the time of a woman's visit to the clinic or an individual consultation with a nutritionist. Pregnant women receive advice about foods that promote the development of a healthy baby, guidelines for adequate prenatal care, and behaviors that they should avoid. Finally, although the WIC program does not provide health care services, recipients may be referred to a health care provider or for other social services.

## III. Previous Literature

Since the focus of this project is the effect of multiple program participation on birth outcomes, two literatures are relevant. The first of these examines the effect of individual welfare programs on birth outcomes, and the second explores participation in multiple welfare programs.

### *A. Welfare Participation and Birth Outcomes*

A number of studies examine the effect of WIC participation on birth outcomes.[6] As part of the National WIC Evaluation, Rush (1988) analyzes data from a large, nationally representative sample of WIC recipients and non-participants. Using OLS regression models he finds weak effects of WIC on a variety of birth outcomes—an effect he attributes in part to potential non-random selection. Using similar econometric methods, Gordon and Nelson (1995)

[6] We focus on studies that use nationally representative data to examine the effect of WIC participation on birth outcomes. See Currie (1995) for a more complete list of studies. Kennedy et. al. (1982), Kotelchuck et al. (1984), and Stockbauer (1987) all use state-level data on individuals, and Corman et al. (1987) use county-level aggregate data. Additionally, Devaney et al. (1992) and Schramm (1985) use state-level administrative data to examine the

use data from the NMIHS to conclude that WIC participation results in increased birth weights and gestational length, but they find no evidence of a reduction in infant or neonatal mortality. Finally, in our earlier work (Brien and Swann 1999), we examine the effect of WIC participation on a number of birth outcomes including birth weight, low birth weight, gestational age at birth, preterm birth, infant mortality, and neo-natal mortality. Like Gordon and Nelson (1995), we use NMIHS data, estimate OLS regressions, and find a beneficial effect of WIC. We extend this analysis and control for selection into the WIC program by using both 2SLS and fixed effects models. Unlike most of the papers using 2SLS, we utilize state-to-state variation in WIC program rules in addition to state-to-state variation in program generosity as instruments in our first stage equations. Our results that control for selection suggest that WIC participation has a positive effect for black infants, but we find no effect for white infants. In that paper, we hypothesize that one reason we find stronger effects for blacks than whites is that blacks are more likely than whites to participate in programs in addition to WIC.

Currie and Gruber (1996) exploit expansions in Medicaid eligibility to examine the effect of program eligibility on birth outcomes. Using aggregate data they find that the expansions of the Medicaid program led to small reductions in the likelihood of low weight births and larger reductions in infant mortality. Using data from the NMIHS, Kaestner, et al. (1997) narrow the analysis to the question of whether participation in (rather than eligibility for) Medicaid improves an array of infant and child health measures. The authors use 2SLS to control for selection in their birth outcomes analysis and find no significant effect of Medicaid participation on either birth weight or the probability of a low weight birth.

Finally, Currie and Cole (1993) examine the effect of participation in the AFDC program on birth weight. Because of the possibility of non-random selection into the program, they use

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effect of WIC participation on Medicaid costs.

both OLS and 2SLS. They instrument for AFDC participation using state-to-state variation in welfare generosity. After controlling for selection, they find a positive effect of AFDC for income eligible whites but no statistically significant effect for blacks.

### *B. Multiple Program Participation*

It is widely recognized that many welfare recipients participate in multiple programs. Moffitt (1992) cites data showing that, in 1984, 26.4 percent of non-elderly, single-parent families participate in AFDC, Food Stamps, and Medicaid while, for example, only 3.6 percent of such families participate exclusively in the Food Stamps program. More recently, the U.S Bureau of the Census (1995b) shows that 22 percent of WIC recipients participate in the Food Stamp program in addition to WIC and 35 percent of WIC recipients participate in both the Food Stamp program and AFDC. U.S. Bureau of the Census (1995a) shows that 75 percent of food stamp recipients participate in at least one other program in addition to Food Stamps.

In spite of these facts, none of the papers discussed above models or controls for participation in welfare programs other than the one under consideration. Even outside of the infant health literature, the number of papers examining such participation is relatively small. Fraker and Moffitt (1988) model hours of work jointly with participation in the Food Stamp and AFDC programs. Their model is most similar to the one estimated in this paper. Moffitt and Wolfe (1990) examine the relationship between Medicaid and AFDC participation. They are particularly interested in the relationship between participation in one or both of those program and work behavior. Blank and Ruggles (1993) focus on the Food Stamp and AFDC programs. They use reduced form hazard rate models to attempt to understand the relationship between spells of eligibility and actual participation in the programs. Schoene (1993) models joint participation in the AFDC, Food Stamp, and Public Housing programs using a model that explicitly incorporates the program rules, and she finds substantial effects of welfare participation on labor supply. Keane and Moffitt (1998) also use a structural econometric model to examine the effect of Food Stamps, AFDC, and Public Housing on labor supply and find that multiple program participation has significant effects on labor supply. Thus, the main focus of this line of research has pertained to the effect of multiple program participation on hours of work rather than on infant health outcomes.

## IV. Data

### *A. Background on the NMIHS*

The primary data for this analysis come from the NMIHS. Compiled by the National Center for Health Statistics, these data were collected to examine the determinants of adverse pregnancy outcomes and are based on a sample of birth and death certificates in 48 states and the District of Columbia. Women who were selected for the sample were sent a detailed questionnaire regarding their behavior during and after a 1988 pregnancy outcome.[7] The data files contain information from these questionnaires as well as the data on the original birth and death certificates of the child. In many cases, information about the pregnancy outcome (e.g. birth weight, gestational length) can be obtained from both sources.

The questionnaire data include detailed demographic and anthropometric information on the mother (e.g., age, race, education, marital history, height, and weight), information on the mother's behavior and living arrangements during and after the pregnancy (e.g., prenatal care, drug and alcohol use, and the number of persons in household), household income, information about the child's father (e.g., height and weight), and, essential for this study, information about

[7] The median interval between the pregnancy outcome and the survey was 16 months. The response rate for the questionnaire was 74 percent for the live birth mothers, 65 percent for the infant death mothers, and 69 percent for

participation in various welfare programs.

The main NMIHS data consist of three separate subsamples: 9,953 women who experienced a live birth in 1988 (the live birth sample), 5,332 women who had a child in 1988 but subsequently died (the infant death sample), and 3,309 women who experienced a fetal death in 1988 (the fetal death sample). The live birth file contains an oversample of blacks and low-weight births. The NMIHS contains sampling weights, which are used in our analysis, to account for this non-random sampling.

Our analysis does not use the fetal death sample. In addition to this restriction, a number of other observations were dropped because of missing data or because they were outliers. A listing of these variables (in the order in which they were dropped) is given in Table 1. Some observations are missing information on birth weight, delivery date, marital status, information about WIC and Medicaid participation, information about smoking, drinking, and prenatal care, and about birth order. We reject women less than 15 years of age as outliers since they were not included in the original NMIHS sample plan. We also reject women with extremely short or long gestations or with extreme combinations of birth weight and gestation. Consequently, we are left with 12,337 observations.

### *B. Determining Program Eligibility*

All of the programs are means-tested, but the specific cut-offs differ by program, and each of the programs has its own non-income related requirements. Most obviously, AFDC has a demographic requirement that recipients be single parents; Medicaid eligibility has historically been tied to participation in AFDC; and the WIC eligibility requires that the recipient be at "nutritional risk." With detailed data on income, health status, and marital status, it would be possible to apply the relevant program eligibility rules used by welfare caseworkers and

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fetal death mothers.

determine eligibility for each of the programs. Unfortunately, our data are not sufficiently detailed to make such fine calculations. Consequently, to approximate a sample of women who are likely to be eligible for the full bundle of programs, we restrict our sample to low-income, single women. Missing from our analysis are women who are married and participate in WIC or food stamps.

To determine whether each woman is single, we consider her marital status at the time of the birth and assume that women who are single at that time are eligible for welfare. While this measure is the best we can achieve with the NMIHS, it is worth noting its shortcomings. First, in 1988 married women may receive WIC, food stamps, and, in many states, Medicaid. Second, some women may marry before the birth of the child. Thus, these women may have been eligible for welfare during most of the pregnancy (and in fact they may have participated), but our measure will classify them as ineligible. Finally, some women may divorce after becoming pregnant but before the birth. These women will be classified as being eligible when in fact they may not have been.

As noted above, income eligibility varies by program, with the most strict being the AFDC program and least strict being WIC. The NMIHS has a number of income variables that can be used to determine eligibility. Unfortunately, all of these variables contain information about income received in the twelve months prior to the birth rather than a month-by-month accounting of income during the pregnancy, as would be done in the field to determine income eligibility. Thus, any income eligibility measurement is somewhat crude. We use two of the income variables to determine income eligibility for welfare. First, for those women who report wage income (at the family level) in the twelve months prior to the birth, we compare the reported wage income to 185 percent of the poverty guideline for the appropriate family size and state for 1988. If reported income is less than 185 percent of the poverty guideline, the family is assumed to be eligible for welfare. For those women for whom the wage income variable is missing, we use a bracketed total family income variable. We compared the income at the low end of the bracket with 185 percent of poverty and applied the same criteria as above. To account for the possibility of measurement error, a variable indicating that the bracketed data were used to determine eligibility is included in the analysis.[8]

The concern about using relatively crude eligibility criteria is that we are mis-categorizing some women as eligible when in fact the are not and that we are categorizing some women as ineligible when they are. Because we do not have data on actual eligibility, we cannot completely assess the accuracy of our methodology. However, Table 2 attempts to provide some evidence on this point. Table 2 compares participation rates for those who are deemed eligible with those who are considered ineligible. As we might expect from previous work, participation rates for those who are eligible range from about 45% for food stamps to 66% for Medicaid. Because our sample includes only single women, the participation rates in the second column of Table 2 would not be zero even if we had accurate income information. For AFDC and food stamps the participation rates are relatively low – about three or four percent. The participation rates for WIC and Medicaid are somewhat higher, but this is consistent with the omission of married women from the eligible sample.

Tables 3 and 4 further describe the basic sample. Table 3 highlights the importance of participation in multiple welfare programs. We see, for example, that 21 percent of the eligible pool participated in all four of the welfare programs under study and that 17 percent participated in both WIC and Medicaid. Table 4 presents the sample means of the covariates that will be

[8] There are also state-to-state differences in whether pregnant women are covered by AFDC and the degree to which Medicaid expansions had been implemented by 1988. Consequently, we are in the process of refining the eligibility

used in the analysis and the variables used to explain program participation.

## V. Descriptive Analysis

In this section, we begin our exploration of the effect of welfare on birth outcomes. Perhaps the simplest way to examine this issue is to ask whether average birth outcomes are better for women who participate in various combinations of program. Table 5 presents average birth outcomes broken down by participation in each of the four welfare programs.

Perhaps the most striking aspect of Table 5, is the fact that women who participate in WIC can, on average, expect significantly improved birth outcomes relative to eligible women who do not participate. For example, birth weights for WIC participants are about 200 grams higher on average than non-participants, and rates of pre-term birth are about six percentage points lower. In contrast, for each of the other programs the mean birth weight of the eligible non-participants is lower than the eligible participants.

Table 6 takes the analysis a step further and examines average birth outcomes across the whole menu of program combinations. The first aspect of this table that is crucial to keep in mind is the cell sizes for some of the program combinations. Specifically, a number of cells have around fifty observations, and there are only eighteen observations for the food stamps only choice.

With that caveat in mind, the results are somewhat similar to Table 5. First, the choices involving WIC participation have on average better birth outcomes than other choices. The choices W, WM, and WA each of significantly higher birth weights than "None". A number of choices, e.g., F, M, WF, MA, and FMA, have significantly lower birth weights than the women who participate in no programs. Although the choices with poor birth outcomes for birth weight

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measures.

also tend to have poor outcomes for low weight births, a number of the program bundles show more positive effects when the outcome is low weight births. For example, the choices, FM, FA, WFM, WFA, WMA, and WFMA all have birth weights near the no program average of 3,140, but each of these choices has a rate of low-weight births that is three to five percentage points lower than the no program average. This result suggests that welfare participation may result in larger improvements at the lower tail of the birth outcomes distribution than near the middle.

Of course the open question at this point is whether controlling for either observed or unobserved characteristics changes these conclusions. To examine whether the observed characteristics differ significantly over the choices, Table 7 presents means for some of the explanatory variables for four of the choices. We see that there are dramatic differences in the observed characteristics across these choices. For example, respondents who participate in only the food stamp program are much less likely to be young and much more likely to be black than other women. Because they are less likely to be young, they have more children than the other women are much less likely to be having a first birth in 1988. WIC only recipients are more likely to be white than the other welfare recipients; they are somewhat more likely than non-recipients to be young and more likely to have less than a high school education; and they are much more likely than the other women to be experiencing a first birth in 1988. In order to further explore the effect of observed characteristics on birth outcomes, we now turn to OLS regressions.

## VI. Controlling for Observed Characteristics: OLS Estimation

As noted in the introduction, many researchers use OLS regressions in their analysis of birth outcomes. While the possibility of selection is an obvious concern, we continue our analysis with such models so that we can understand how much of the differences in average birth outcomes are due to differences in observed characteristics.

### *A. Basic Model*

Table 8 presents results of OLS models with indicators for participation in each of the four welfare programs. The assumption in this analysis is that the effect of each program is additive with no interactions or synergies. Results are presented for the whole eligible sample and separately for whites and blacks.

Results for the pooled sample suggest that women who participate in the WIC program can expect higher birth weights for their infants than women who do not. The dependent variable is birth weight in 1000's of grams so the coefficient estimate of 0.230 for "WIC" in column 1 indicates that WIC participation results in an increase in birth weight of 230 grams. The estimated effect is somewhat larger for whites (306 grams) and smaller for blacks (154 grams).

None of the other programs appear to be having statistically significant beneficial effect on birth weight. The effects for Medicaid are statistically significant for the combined group and for whites, and the estimated coefficients indicate that Medicaid participation actually *reduces* birth weight. Given the *a priori* belief that participation in any of these programs is not likely to reduce birth weights, there are at least two explanations for this result. First, the Medicaid variable collected by the NMIHS asks whether Medicaid paid for prenatal care or the delivery. Consequently, it may be the case that, for many of these women, Medicaid paid only for the delivery. Thus, Medicaid may be proxying for poorer than average economic status which may be related to the birth outcome. Related to this is the possibility of selection into the Medicaid program. Because Medicaid, unlike the other programs, provides direct access to health care, it may be the case that women with poorer than average health choose to participate in Medicaid. In this case, Medicaid participation would be proxying for the unobserved health effect which could result in a negative coefficient estimate. Models presented below that control for selection will address these points.

The remainder of the coefficients show that birth weights are lower for the children of women with lower levels of education; boys are heavier than girls; taller mothers give birth to heavier babies, and babies with heavier fathers tend to weigh more.

The other columns in Table 8 show the results of probit estimation where the dependent variable is equal to one if a low weight birth occurs and equal to zero otherwise. The estimates in Table 8 are the actual probit coefficients so there is not a straightforward behavioral interpretation. However, the same basic results are found here as well. In the combined sample we find that WIC has a positive effect on birth outcomes (i.e., participating in WIC lowers the likelihood of a low weight birth) and participating in Medicaid increases the likelihood of a low weight birth (though the effect is only marginally significant). Of the other variables, education seems to play the largest role in explaining low weight births although its effects are not statistically significant for blacks.

### *B. Detailed Welfare Variables*

The results presented in Table 8 assume that the effects of multiple program participation are additive across programs. Thus, the effect of participating in WIC and Medicaid is the sum of the two individual effects. An alternative approach allows for interactions among the programs. In this case, the effect of participating in WIC and Medicaid is the effect of WIC plus the effect of Medicaid plus any interaction effect. Allowing for general interactions, we estimate the following model

(1) $h = aX + b_w W + b_a A + b_f F + b_m M + b_{wf} WF + b_{wm} WM + \cdots + b_{wma} WMA + b_{wfma} WFMA + w_h$

In this case, the effect of participating in only in the WIC program is $b_w$, and the effect of participating in WIC and Medicaid is $b_w + b_m + b_{wm}$. Consequently, the marginal effect of participating in Medicaid for someone who participates in WIC is $b_m + b_{wm}$, and the term $b_{wm}$ accounts for any synergy between WIC and Medicaid.

The same basic ideas apply when examining the effects of moving from two to three (or three to four) programs. For example, the effect of participating in WIC, food stamps, and Medicaid is $b_w + b_f + b_m + b_{wf} + b_{wm} + b_{fm} + b_{wfm}$. Because the effect of participating in WIC and Medicaid is $b_w + b_m + b_{wm}$, the marginal effect of food stamps is $b_f + b_{wf} + b_{fm} + b_{wfm}$, and there are now three terms that capture various program synergies.

The results of this exercise are presented in Table 9. The impact of participating exclusively in one of the programs can be seen by the coefficient estimates on the main effects (no interactions). In general, participating only in WIC has a beneficial impact on the birth outcomes—increasing birth weight and decreasing the probability of a low weight birth. Food Stamps *only* is estimated to have a detrimental effect on the birth outcomes. The impact of program synergies can be observed by size and significance of interaction terms. For example, for the full sample we find that participating in Medicaid and Food Stamps has a positive and significant impact on birth weight. Additionally the combinations of FM and FA appear to have positive effects in the joint sample and for whites though only FM is significant for blacks.[9] Interestingly, the bundle of all programs is marginally significant in the joint sample though it is not significant for either whites or blacks individually – though it is almost significant for blacks. The estimated effects of the non-welfare variables are similar to those reported in Table 8.

There are a number of ways one can think about the results in Table 9. In addition to understanding whether there are synergies (as captured by the interaction effects), one may also be interested in the effect of participating in each bundle of programs rather than participating in no programs and in the effect of adding one of the programs to an existing bundle of programs. These effects are summarized in Table 10.

The first column of Table 10 ("Bundle Effect") measures the effect on birth weight of the bundle of programs given in the left margin relative to participation in no programs. For example, women participating in WIC and Medicaid can expect an increase in the birth weight of their children of about 170 grams, and women participating in all four programs can expect an increase in birth weight of about 111 grams. As discussed above, program combinations with WIC tend to have positive and statistically significant effects on birth weight.

The remainder of Table 10 explores the effects of adding an additional program to some existing bundle of programs. The first row just reproduces the single program effects from Table 9 and the first column of Table 11. The numbers in the second row show the marginal effect on birth weight of adding Food Stamps, Medicaid, and AFDC for a woman who is already participating in WIC. In general, the model suggests that these women will do worse if they add these additional programs. The numbers in parenthesis are the statistical significance for a test that the effect is zero. Thus, a number less than 0.05 indicates that we reject the hypothesis that the effect is zero at conventional levels. In general the table shows positive and significant effects for adding WIC to other programs and positive but not significant effects for adding Food Stamps and AFDC.

[9] The choice of FA was dropped from the analysis do to a small cell size.

## VII. A Joint Model of Birth Outcomes and Welfare Participation

### *A. The Econometric Model*

The theoretical basis for this analysis stems from economic models of household decision making in which the mother's utility depends on the health of her children. Choices are limited by income, time, and technology constraints. The health of a child (e.g., birth weight) is assumed to be produced via a health production function where participation in WIC, AFDC, Food Stamps, and Medicaid are inputs into the production of child health.

Let $h$ denote the health outcome of interest; let $X$ be a vector of exogenous determinants of the health outcome; and let $W$, $A$, $F$, and $M$ be policy variables that equal one if the mother participates in WIC, AFDC, the Food Stamp program, or Medicaid, respectively, and zero otherwise. The health production function is assumed to be linear in the inputs. It is also assumed to depend upon the woman's, the child's, and the family's characteristics and a random shock that captures determinants of the health outcome that are unobserved to the econometrician. Thus, the health production function is specified as

$$h = \alpha X + \beta_w W + \beta_a A + \beta_f F + \beta_m M + \omega_h \qquad (2)$$

where $\alpha$ is a conformable vector of parameters, the $\beta$'s are scalar parameters, and $\omega_h$ is the random shock to the health outcome. Components of $X$ include biological characteristics such as mother's height and the sex of the child and socio-demographic characteristics such as mother's education that may affect the mother's ability to use the inputs efficiently.

While we do not specify the utility maximization problem, we assume that each woman makes choices about participation in each of the welfare programs in order to maximize her utility. We also assume that, as a result of this utility maximization process, there exists a latent value of each of the welfare programs. The equations determining these latent values are given by

(3) $$W^{*} = g_{w} Z_{w} + w_{w},$$

(4) $$A^{*} = g_{a} Z_{a} + w_{a},$$

(5) $$F^{*} = g_{f} Z_{f} + w_{f}, \text{ and}$$

(6) $$M^{*} = g_{m} Z_{m} + w_{m}.$$

In these equations $Z_j$ is a vector of explantory variables relevant for program $j$, $g_j$ is a conformable vector of parameters, and $w_j$ is a random shock for program $j$. An eligible woman is assumed to participate in each program if the latent value of participation is positive. Thus, for example, $W = 1$ if $W^{*} > 0$.

The underlying economic model places some important demands on the econometric model. First, because each of the welfare participation decisions is made to maximize utility, they are not independent, and the econometric model should allow these choices to be correlated. Secondly, the economic model allows for the possibility that each woman knows more about her health than we do. This knowledge will then affect her participation decisions and it will likely affect the birth outcome as well. Consequently, the econometric model should also allow for correlation between the welfare participation decisions and the birth outcome. To allow for these effects, we assume that $w = [w_w, w_f, w_a, w_m, w_h]' \sim N(0, \Omega)$. We are not able to identify the variance terms associated with each of the discrete choices and set those elements of $\Omega$ equal to one.

Let $q$ denote the parameters to be estimated. Given the assumption about the joint distribution of the errors, the sample likelihood is

$$(7) \qquad L(q) = \sum_{i=1}^{N} \log \int_{l_w}^{u_w} \int_{l_f}^{u_f} \int_{l_a}^{u_a} \int_{l_m}^{u_m} f(w_{iw}, w_{if}, w_{ia}, w_{im}, w_{ih}, \Omega) dw_{iw} dw_{if} dw_{ia} dw_{im}$$

where $f()$ is the five dimensional normal density function and

$$\begin{aligned} l_j &= -\infty, \quad if \quad j = 0, \\ &= -g_j Z_j, \quad if \quad j = 1; \quad and \\ u_j &= -g_j Z_j, \quad if \quad j = 0, \\ &= \infty, \quad if \quad j = 1, \end{aligned}$$

for j = w, f, a, and m.[10]

There are two sources of identification in this model. First, the model is technically identified through functional form and distributional assumptions. Second, we include in each of X, and $Z_j$, j=W, F, M, and A, at least one variable that does not appear in any of the other equations. In each of the welfare participation equations we include region dummies to capture regional variations in welfare generosity and at least one variable that captures the state-specific generosity of the program. In the birth weight equation, we include the sex of the child, the mother's height, and the father's weight.

It is not possible to evaluate the four-dimensional integral to compute the likelihood function analytically, but there are a number of different ways to simulate $f()$.[11] Since it has proven to be effective in a number of studies (Börsch-Supan and Hajivassiliou 1993; Geweke, Keane, and Runkle 1994, 1996; Hajivassiliou, McFadden, and Ruud 1996), we use the GHK simulator (Geweke 1991, Hajivassiliou 1990, and Keane 1994). The GHK simulator involves computing marginal probabilities of univariate normal random variables, taking draws from truncated univariate normal distributions, and computing conditional distributions.

[10] The likelihood function given in the text is correct when the birth outcome is continuous. When the birth outcome is discrete, e.g., low birth weight, there is a fifth integral in the likelihood function. Given this change, the analysis is conceptually similar.

The steps for our problem are as follows. 1) Compute the marginal probability of the WIC participation decision, $\hat{p}_w^r$. 2) Take a random draw, $w_w^r$, from the truncated normal distribution consistent with the observed WIC participation decision. 3) Compute the distribution of $w_f$ conditional on $w_w^r$ and from this distribution obtain the probability of food stamp participation, $\hat{p}_f^r$. 4) Repeat this process for AFDC, Medicaid, and the health outcome (where for the health outcome we are computing a probability density rather than the probability of a choice).

The simulated likelihood function is then

(8)
$$L(q) = \sum_{i=1}^{N} \log \frac{1}{R} \sum_{r=1}^{R} \hat{p}_w^r \hat{p}_f^r \hat{p}_m^r \hat{p}_a^r \hat{p}_h^r .$$

and this function is maximized using a standard Gauss-Newton updating rule.[12]

The econometric model allows for two important effects. First, we estimate a full covariance matrix (subject to the restriction on the variance terms for the binary choices). Thus, we estimate, for example, the correlation between the errors in equation (2) and equation (3), and we are able to ascertain whether there is statistically significant selection into the WIC program and whether the selection is adverse or favorable. Furthermore, we estimate potentially different correlations for different programs. It is possible that we will find selection for health-related programs like Medicaid or WIC but not for AFDC – or that there is adverse selection for some programs and favorable selection for others. Secondly, the structure allows for the fact that participation in one program is not independent of participation in other programs because we will also estimate the correlation between the errors in equations (3) through (6).

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[11] See Stern (1997) for an introduction to simulation.
[12] Experimentation with simpler bivariate probit models showed that 100 simulation draws replicated the computable analytic results. Analysis with the complete model suggests, however, that some changes occur when

### *B. Results*

The results from the joint analysis for birth outcomes using the full sample are presented in Table 11. Beginning first with the full sample results for birth weight, we see that the WIC coefficient is no longer statistically significant and is a little smaller in magnitude than in the basic model (Table 8). The estimated effect of food stamps has changed signs is now positive though small and not statistically significant. Most of the other coefficients are similar to the results in Table 8. For example, the effects of education are now slightly larger and more statistically significant.

The benefit of the joint estimation is that one obtains estimates of the covariance matrix terms. These estimates are presented at the bottom of Table 11. Standard errors are not presented in order for the table to fit on one page.[13] First, the covariances between each pair of welfare programs are positive. What this means is that, even after controlling for observed characteristics such as race and education, women who participate in one program are more likely to participate in others. The effect is strongest for AFDC and Food Stamps and lowest for WIC and Food Stamps.

Of more interest are the covariances between birth weight and the welfare programs. None of these covariances are statistically significant which, perhaps surprisingly, suggests that there is not selection into the welfare programs. The fact three of the four covariances are negative suggests that any selection that exists for food stamps, Medicaid, and AFDC is adverse. In other words, women who participate in these programs are more likely to have unobserved characteristics that put them at risk for poorer than average birth outcomes. The covariance for

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200 draws of the errors are used. Further testing will be required to determine the minimum acceptable number of draws for the full model.

[13] Note also that the results from the program participation equations are not presented in order to save space – and because the focus of the paper is on the birth outcome.

WIC is 0.007 suggests that there is favorable selection for WIC where women with better than average unobservables participate in WIC. However, this effect is very small and is not statistically significant.

The results for low birth weight are similar. WIC and food stamps are estimated to reduce the likelihood of low weight births though neither is statistically significant. Medicaid participation is estimated to increase the likelihood of a low-weight birth, and this effect is statistically significant. This effect is also significantly larger than the result reported in Table 8.

The fact that the estimated effect becomes larger can be explained by examining the covariances. For the low birth weight results for the full sample, the estimated covariance between Medicaid participation and low birth weight is estimated to be -0.432. This means that women who are more likely to participate in Medicaid (after controlling for observed characteristics) are less likely to have a low weight birth. The basic model does not account for this and the less negative effect of Medicaid is also picking up this negative correlation which biases the estimated effect of Medicaid.

The remainder of Table 11 examines these models separately by race. Participation in each of the welfare programs is estimated to have a statistically insignificant effect on birth weights for blacks. Compared to Table 8, the magnitude of the WIC coefficient is almost the same size. However, the coefficient on Food Stamps has changed signs and is about two thirds the size of the WIC. As noted above, this change results from allowing for correlation between the error in the food stamp equation and the birth weight equation. The covariance between the errors in these equations is estimated to be -0.02.

There are similar results for whites.[14] Specifically, neither the covariances between the

[14] The results for whites, particularly for low birth weight, should be treated with some caution as achieving convergence has been difficult due to the smaller sample size for whites.

birth outcomes and program participation nor the programs themselves are significant. One interesting thing to note is that the correlations between birth weight and program participation suggests adverse selection while the correlations between low birth weight and program participation suggests favorable selection. This suggests that these programs may have different effects on the lower tail of the distribution and on mean birth weight.

## VIII. Discussion and Conclusion

The goal of this paper has been to better understand whether participation in multiple welfare programs improves birth outcomes. The results of our preliminary work is mixed. On the one hand, participation in WIC appears to have a positive effect on birth weights in almost all contexts and a number of the program combinations have positive effects. On the other hand, food stamps and Medicaid tend to have negative effects though the joint model suggests that the negative effect for food stamps may be a result of selection. Future work will focus on refining the eligibility measure, better understanding selection into the programs, and exploring the possibility of allowing for synergies in the context of the joint model.

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**Table 1: Missing Values and Outliers**

| Variable | Missing/Outlier | Remaining |
|---|---|---|
| Initial NMIHS Sample | | 18,594 |
| Fetal Death Sample | 3,309 | 15,285 |
| **Missing Values** | | |
| Birth Weight | 695 | 14,590 |
| Delivery Date | 505 | 14,085 |
| Marital Status | 3 | 14,082 |
| WIC | 53 | 14,029 |
| AFDC Amount | 804 | 13,225 |
| FSP Amount | 357 | 12,868 |
| Medicaid | 179 | 12,689 |
| Smoking | 73 | 12,616 |
| Drinking | 38 | 12,578 |
| Prenatal Care | 82 | 12,496 |
| Birth Order | 37 | 12,459 |
| **Outliers** | | |
| Mother's Age < 15 yrs | 24 | 12,435 |
| Gestational Age < 17 wks | 15 | 12,420 |
| Birth weight > 5000 g & Gestational Age < 30 wks | 19 | 12,401 |
| Birth weight >= 1500 g & Gestational Age <= 20 wks | 22 | 12,379 |
| Birth weight >= 2500 g & Gestational Age <= 25 wks | 27 | 12,352 |
| Gestational Age > 50 wks | 15 | 12,337 |

**Table 2: Participation Rates**

| | Sample | |
|---|---|---|
| Program | Eligible | Ineligible |
| AFDC | 46.21 | 3.10 |
| FSP | 41.72 | 4.72 |
| WIC | 69.16 | 19.10 |
| Medicaid | 63.74 | 10.56 |

**Table 3: Sample Means: Birth Outcomes and Program Participation**

| Variable | Eligible Sample | Total Sample |
|---|---|---|
| *Birth Outcomes* | | |
| Birth Weight | 3164.754 | 3384.492 |
| Low Birth Weight | 0.126 | 0.062 |
| Gestational Age | 38.842 | 39.344 |
| Preterm Birth | 0.149 | 0.080 |
| Infant Mortality | 0.029 | 0.016 |
| Neonatal Mortality | 0.015 | 0.007 |
| *Program Participation* | | |
| WIC only | 0.123 | 0.104 |
| Food Stamps only | 0.002 | 0.003 |
| Medicaid only | 0.059 | 0.022 |
| AFDC only | 0.009 | 0.001 |
| WIC & FSP | 0.011 | 0.001 |
| WIC & Medicaid | 0.165 | 0.046 |
| WIC & AFDC | 0.012 | 0.001 |
| FSP & Medicaid | 0.010 | 0.003 |
| FSP & AFDC | 0.026 | 0.001 |
| Medicaid & AFDC | 0.018 | 0.001 |
| WIC, FSP, & Medicaid | 0.044 | 0.011 |
| WIC, FSP, & AFDC | 0.055 | 0.003 |
| FSP, Medicaid, & AFDC | 0.060 | 0.005 |
| WIC, Medicaid, & AFDC | 0.073 | 0.005 |
| WIC, FSP, Medicaid, & AFDC | 0.210 | 0.014 |
| Sample Size | 3,451 | 8,886 |

**Table 4: Sample Means: Socio-demographic Variables and Instruments**

| Variable | Eligible Sample | Total Sample |
|---|---|---|
| *Socio-demographic Variables* | | |
| Age < 20 | 0.308 | 0.079 |
| Black | 0.450 | 0.093 |
| Education < HS | 0.444 | 0.138 |
| Education = HS | 0.416 | 0.391 |
| First Birth | 0.378 | 0.341 |
| Birth Order | 2.416 | 2.271 |
| Northeast Region | 0.164 | 0.184 |
| North Central Region | 0.247 | 0.258 |
| West Region | 0.187 | 0.208 |
| Bracketed Income | 0.190 | 0.197 |
| Boy | 0.515 | 0.519 |
| Mom's Height (inches) | 64.178 | 64.584 |
| Dad's Weight (pounds) | 169.557 | 177.165 |
| *Instruments* | | |
| AFDC Benefits (AFDC) | 421.968 | 447.988 |
| FSP recipients/1000 pop (FSP) | 80.093 | 74.933 |
| Easy Income Determination (WIC) | 0.470 | 0.470 |
| Brand Restrictions (WIC) | 0.622 | 0.614 |
| Medicaid Benefit Levels (Med.) | 246.920 | 256.100 |
| Sample Size | 3,451 | 8,886 |

Notes: "Bracketed Income" equals one if the bracketed income variable was used to determine eligibility and equal to zero otherwise. The instruments are included in the equations listed in parenthesis.

**Table 5: Average Birth Outcomes by Program Choice**

| Birth Outcome | WIC Yes | WIC No | Medicaid Yes | Medicaid No | Food Stamps Yes | Food Stamps No | AFDC Yes | AFDC No |
|---|---|---|---|---|---|---|---|---|
| Birth Weight | 3221.604 | 3037.260 | 3132.665 | 3221.156 | 3108.149 | 3205.281 | 3120.836 | 3202.481 |
| Low Weight | 0.100 | 0.185 | 0.134 | 0.113 | 0.128 | 0.125 | 0.134 | 0.119 |
| Gestational Age | 39.070 | 38.329 | 38.722 | 39.052 | 38.673 | 38.961 | 38.751 | 38.920 |
| Preterm Birth | 0.133 | 0.186 | 0.157 | 0.135 | 0.150 | 0.148 | 0.151 | 0.148 |
| Infant Mortality | 0.025 | 0.037 | 0.025 | 0.035 | 0.027 | 0.030 | 0.026 | 0.031 |
| Neonatal Mortality | 0.0127 | 0.019 | 0.011 | 0.021 | 0.012 | 0.016 | 0.012 | 0.017 |
| Sample Size | 2,122 | 1,329 | 2,296 | 1,155 | 1,546 | 1,905 | 1,715 | 1,736 |

**Table 6: Average Birth Outcomes by Detailed Program Choice**

| Program Bundle | Sample Size | Birth Weight | Low Weight | Gestational Age | Preterm Birth | Infant Mortality | Neonatal Mortality |
|---|---|---|---|---|---|---|---|
| None | 446 | 3140.0 | 0.147 | 38.61 | 0.180 | 0.003 | 0.019 |
| W | 313 | 3395.8 | 0.079 | 39.43 | 0.122 | 0.037 | 0.025 |
| F | 18 | 2582.6 | 0.589 | 37.15 | 0.466 | 0.221 | 0.022 |
| M | 246 | 2997.9 | 0.194 | 38.31 | 0.199 | 0.042 | 0.021 |
| A | 46 | 3115.1 | 0.201 | 38.58 | 0.219 | 0.059 | 0.007 |
| WF | 51 | 2992.2 | 0.140 | 38.52 | 0.147 | 0.038 | 0.020 |
| WM | 478 | 3230.6 | 0.100 | 39.18 | 0.128 | 0.023 | 0.010 |
| WA | 48 | 3368.6 | 0.110 | 39.63 | 0.102 | 0.027 | 0.011 |
| FM | 37 | 3139.2 | 0.119 | 38.10 | 0.103 | 0.021 | 0.005 |
| FA | 92 | 3114.9 | 0.110 | 38.49 | 0.071 | 0.028 | 0.016 |
| MA | 116 | 2825.9 | 0.306 | 37.56 | 0.253 | 0.053 | 0.029 |
| WFM | 147 | 3106.6 | 0.097 | 38.59 | 0.129 | 0.024 | 0.009 |
| WFA | 141 | 3120.8 | 0.079 | 39.59 | 0.072 | 0.034 | 0.025 |
| FMA | 328 | 2882.8 | 0.246 | 37.97 | 0.213 | 0.032 | 0.018 |
| WMA | 212 | 3181.2 | 0.114 | 39.08 | 0.119 | 0.012 | 0.006 |
| WFMA | 732 | 3179.9 | 0.111 | 38.73 | 0.165 | 0.022 | 0.008 |

Notes: W = WIC, F = Food Stamps, M = Medicaid, A = AFDC.

**Table 7: Means of Selected Covariates for Selected Program Choices**

| | None | W | F | WFMA |
|---|---|---|---|---|
| Age < 20 | 0.370 | 0.443 | 0.046 | 0.233 |
| Black | 0.348 | 0.346 | 0.730 | 0.557 |
| Education < HS | 0.292 | 0.473 | 0.367 | 0.524 |
| Education = HS | 0.415 | 0.410 | 0.488 | 0.374 |
| First Birth | 0.499 | 0.566 | 0.042 | 0.163 |
| Birth Order | 2.100 | 1.745 | 3.302 | 3.004 |
| Mom’s Height (inches) | 64.829 | 64.189 | 64.887 | 64.063 |
| Dad’s Weight (pounds) | 170.152 | 166.196 | 163.190 | 172.328 |
| Sample Size | 446 | 313 | 18 | 732 |

**Table 8: OLS/Probit Results**

| | Entire Sample | | Whites | | Blacks | |
|---|---|---|---|---|---|---|
| Variable | Birth Weight | Low Weight | Birth Weight | Low Weight | Birth Weight | Low Weight |
| Constant | 1.410 | 0.343 | 1.096 | -0.989 | 1.448 | 1.797 |
| | (3.57) | (0.42) | (1.51) | (-0.68) | (4.73) | (2.73) |
| WIC | 0.230 | -0.427 | 0.306 | -0.590 | 0.154 | -0.315 |
| | (6.33) | (-6.29) | (4.68) | (-4.55) | (5.14) | (-5.03) |
| FSP | -0.065 | -0.078 | -0.122 | -0.165 | -0.002 | -0.005 |
| | (-1.58) | (-0.94) | (-1.55) | (-0.96) | (-0.06) | (-0.06) |
| Medicaid | -0.088 | 0.135 | -0.126 | 0.239 | -0.051 | 0.034 |
| | (-2.45) | (1.89) | (-2.13) | (1.84) | (-1.65) | (0.50) |
| AFDC | -0.014 | 0.046 | -0.030 | 0.222 | 0.008 | -0.073 |
| | (-0.32) | (0.54) | (-0.39) | (-1.31) | (0.24) | (-0.97) |
| Age < 20 | -0.011 | -0.145 | -0.015 | -0.225 | -0.007 | -0.086 |
| | (-0.29) | (-1.80) | (-0.22) | (-1.45) | (-0.21) | (-1.15) |
| Black | -0.251 | 0.331 | --- | --- | --- | --- |
| | (-7.69) | (4.97) | | | | |
| Educ. < HS | -0.108 | 0.331 | -0.127 | 0.421 | -0.082 | 0.054 |
| | (-2.01) | (4.97) | (-1.49) | (2.11) | (-1.68) | (0.54) |
| Educ. = HS | -0.125 | 0.238 | -0.161 | 0.118 | -0.069 | -0.032 |
| | (-2.57) | (2.22) | (-2.03) | (0.61) | (-1.52) | (-0.34) |
| First Birth | -0.055 | 0.002 | -0.128 | 0.101 | 0.041 | -0.086 |
| | (-1.43) | (0.03) | (-2.04) | (0.71) | (1.23) | (-1.15) |
| Boy | 0.110 | -0.081 | 0.101 | -0.089 | 0.124 | -0.059 |
| | (3.45) | (-1.30) | (1.84) | (-0.76) | (4.74) | (-1.01) |
| Mom's Hgt. | 0.253 | -0.240 | 0.308 | -0.082 | 0.203 | -0.371 |
| | (4.20) | (-1.91) | (2.79) | (-0.38) | (4.53) | (-3.80) |
| Dad's Wgt. | 0.143 | 0.019 | 0.157 | 0.131 | 0.110 | -0.061 |
| | (2.64) | (0.17) | (1.68) | (0.61) | (2.34) | (-0.59) |
| $R^2$ | 0.094 | 0.042 | 0.103 | 0.059 | 0.034 | 0.021 |
| Sample Size | 3,451 | | 748 | | 2,703 | |

Notes: The numbers in parentheses are t-statistics.

**Table 9: OLS/Probit Results – Detailed Welfare Variables**

| | Entire Sample | | Whites | | Blacks | |
|---|---|---|---|---|---|---|
| Variable | Birth Weight | Low Weight | Birth Weight | Low Weight | Birth Weight | Low Weight |
| Constant | 1.404 | 0.372 | 1.063 | -0.836 | 1.453 | 1.758 |
| | (3.56) | (0.45) | (1.48) | (-0.56) | (4.63) | (2.64) |
| W | 0.310 | -0.400 | 0.432 | -0.585 | 0.113 | -0.256 |
| | (4.75) | (-2.99) | (4.53) | (-2.60) | (1.87) | (-1.97) |
| F | -0.452 | 1.118 | -1.101 | -0.444 | -0.191 | 0.615 |
| | (-2.07) | (2.24) | (-3.11) | (-0.54) | (-0.91) | (1.31) |
| M | -0.090 | 0.123 | -0.068 | 0.036 | -0.102 | 0.139 |
| | (-1.12) | (0.77) | (-0.58) | (0.14) | (-1.15) | (0.93) |
| A | 0.002 | 0.124 | -0.153 | 0.088 | 0.072 | -0.343 |
| | (0.02) | (0.40) | (-0.61) | (0.12) | (0.79) | (-1.27) |
| WF | 0.110 | -0.917 | 0.200 | 1.205 | 0.194 | -0.767 |
| | (0.44) | (-1.58) | (0.41) | (1.06) | (0.84) | (-1.45) |
| WM | -0.091 | -0.021 | -0.184 | 0.042 | 0.051 | -0.041 |
| | (-0.90) | (-0.10) | (-1.23) | (0.12) | (0.50) | (-0.21) |
| WA | 0.019 | -0.035 | 0.213 | -0.735 | 0.049 | 0.502 |
| | (0.13) | (-0.09) | (0.72) | (-0.88) | (0.35) | (1.39) |
| FM | 0.579 | -1.496 | 1.152 | 0.333 | 0.351 | -1.245 |
| | (2.23) | (-2.48) | (2.68) | (0.33) | (1.41) | (-2.30) |
| FA | 0.476 | -1.54 | 1.284 | --- | 0.157 | -0.262 |
| | (1.90) | (-2.52) | (2.88) | | (0.65) | (-0.46) |
| MA | -0.091 | 0.127 | -0.694 | 1.899 | 0.061 | -0.006 |
| | (-0.59) | (0.33) | (-2.18) | (2.21) | (0.43) | (-0.02) |
| WFM | -0.304 | 1.283 | -0.456 | -0.964 | -0.234 | 1.272 |
| | (-1.01) | (1.86) | (-0.79) | (-0.73) | (-0.85) | (2.07) |
| WFA | -0.445 | 1.179 | -0.865 | -0.308 | -0.317 | 0.273 |
| | (-1.51) | (1.64) | (-1.48) | (-0.34) | (-1.11) | (0.41) |
| FMA | -0.575 | 1.724 | -0.576 | -1.712 | -0.488 | 1.260 |
| | (-1.86) | (2.38) | (-1.00) | (-2.32) | (-1.69) | (1.93) |
| WMA | 0.048 | -0.146 | 0.598 | -0.982 | -0.165 | -0.284 |
| | (0.25) | (-0.31) | (1.59) | (-1.01) | (-0.90) | (-0.65) |
| WFMA | 0.615 | -1.441 | 0.344 | 1.827 | 0.550 | -1.223 |
| | (1.68) | (-1.69) | (0.48) | (1.48) | (1.62) | (-1.58) |
| Age < 20 | -0.011 | -0.148 | -0.008 | -0.284 | -0.008 | -0.081 |
| | (-0.28) | (-1.82) | (-0.12) | (-1.77) | (-0.23) | (-1.08) |
| Black | -0.250 | 0.315 | --- | --- | --- | --- |
| | (-7.57) | (4.72) | | | | |
| Educ. < HS | -0.110 | 0.229 | -0.144 | 0.456 | -0.078 | 0.043 |
| | (-2.07) | (2.13) | (-1.65) | (2.17) | (-1.59) | (0.43) |
| Educ. = HS | -0.127 | 0.049 | -0.170 | 0.152 | -0.073 | -0.032 |
| | (-2.60) | (0.50) | (-2.08) | (0.76) | (1.60) | (-0.34) |
| First Birth | -0.055 | 0.014 | -0.124 | 0.157 | 0.036 | -0.093 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (-1.42) | (0.18) | (-1.95) | (1.07) | (1.07) | (-1.25) |
| Boy | 0.113 | -0.082 | 0.107 | -0.110 | 0.127 | -0.058 |
| | (3.58) | (-1.31) | (1.97) | (-0.91) | (4.85) | (-1.00) |
| Mom's Hgt. | 0.252 | -0.247 | 0.310 | -0.094 | 0.205 | -0.372 |
| | (4.26) | (-1.96) | (2.90) | (-0.42) | (4.49) | (-3.78) |
| Dad's Wgt. | 0.142 | 0.026 | 0.153 | 0.079 | 0.112 | -0.061 |
| | (2.67) | (0.23) | (1.61) | (0.35) | (2.39) | (-0.59) |
| $R^2$ | 0.103 | 0.047 | 0.141 | 0.092 | 0.040 | 0.027 |
| Sample Size | 3,451 | | 748 | 744 | 2,703 | |
| Notes: The numbers in parentheses are t-statistics. | | | | | | |

**Table 10: Marginal Effect of Individual Programs and Program Bundles**

| | | Marginal Program | | | |
|---|---|---|---|---|---|
| Program Bundle | "Bundle Effect" | WIC | Food Stamps | Medicaid | AFDC |
| No Program | --- | 0.310 | -0.452 | -0.090 | 0.002 |
| | | (4.75) | (-2.07) | (-1.12) | (0.02) |
| WIC | 0.310 | --- | -0.342 | -0.180 | 0.022 |
| | (4.75) | | (0.004) | (0.005) | (0.83) |
| Food Stamps | -0.452 | 0.484 | --- | 0.490 | 0.478 |
| | (-2.07) | (0.08) | | (0.005) | (0.04) |
| Medicaid | -0.090 | 0.220 | 0.128 | --- | -0.089 |
| | (-1.12) | (0.006) | (0.37) | | (0.43) |
| AFDC | 0.002 | 0.330 | 0.024 | -0.181 | --- |
| | (0.02) | (0.01) | (0.85) | (0.17) | |
| WF | -0.032 | --- | --- | 0.095 | 0.052 |
| | (-0.28) | | | (0.50) | (0.67) |
| WM | 0.130 | --- | 0.067 | --- | -0.023 |
| | (2.17) | | (0.50) | | (0.75) |
| WA | 0.332 | --- | -0.312 | -0.225 | --- |
| | (3.55) | | (0.002) | (0.03) | |
| FM | 0.038 | 0.025 | --- | --- | 0.189 |
| | (0.29) | (0.87) | | | (0.19) |
| FA | 0.026 | -0.006 | --- | -0.117 | --- |
| | (0.29) | (0.95) | | (0.09) | |
| MA | -0.179 | 0.286 | 0.028 | --- | --- |
| | (-1.79) | (0.006) | (0.80) | | |
| WFM | 0.063 | --- | --- | --- | 0.048 |
| | (0.63) | | | | (0.62) |
| WFA | 0.020 | --- | --- | 0.091 | --- |
| | (0.28) | | | (0.18) | |
| FMA | -0.151 | 0.262 | --- | --- | --- |
| | (-1.70) | (0.0008) | | | |
| WMA | 0.107 | --- | .004 | --- | --- |
| | (1.51) | | (0.96) | | |
| WFMA | 0.111 | --- | --- | --- | --- |
| | (1.96) | | | | |

Notes: The cell entries in the "Bundle Effect" column measure the effect of that program bundle on birth weight with t-statistics in parenthesis. In the other columns, the cell entries measure the marginal effect of participating in the welfare program denoted at the top of each column given that the person is participating in the bundle of programs indicated by the row label. For example, the 0.484 indicates that a woman who is currently participating in food stamps could expect an increase of 484 grams is she also participated in WIC. The numbers in parenthesis are the significance values of a test that the effect is zero.

**Table 11: Joint Model Birth Outcomes Results**

| | Entire Sample | | Whites | | Blacks | |
|---|---|---|---|---|---|---|
| Variable | Birth Weight | Low Weight | Birth Weight | Low Weight | Birth Weight | Low Weight |
| Constant | 1.403 | -0.095 | 0.976 | -1.255 | 1.505 | 2.103 |
| | (7.30) | (-0.187) | (1.79) | (-0.86) | (4.48) | (2.85) |
| WIC | 0.194 | -0.230 | 0.450 | 0.089 | 0.163 | -0.830 |
| | (1.44) | (-0.56) | (1.02) | (0.09) | (0.65) | (-1.77) |
| FSP | 0.011 | -0.165 | -0.065 | -0.174 | 0.114 | 0.263 |
| | (0.11) | (-0.52) | (-0.13) | (-0.14) | (0.80) | (0.83) |
| Medicaid | -0.066 | 0.789 | -0.123 | 0.565 | -0.118 | -0.216 |
| | (-0.56) | (2.70) | (-0.34) | (0.70) | (-0.53) | (-0.46) |
| AFDC | -0.018 | 0.103 | 0.038 | -0.074 | -0.121 | -0.056 |
| | (-0.24) | (0.46) | (0.19) | (-0.12) | (-1.23) | (-0.24) |
| Age < 20 | -0.006 | -0.068 | -0.009 | -0.093 | -0.009 | -0.056 |
| | (-0.23) | (-0.90) | (-0.11) | (-0.34) | (-0.22) | (-0.64) |
| Black | -0.261 | 0.254 | --- | --- | --- | --- |
| | (-10.21) | (3.48) | | | | |
| Educ. < HS | -0.122 | 0.104 | -0.178 | 0.282 | -0.071 | 0.043 |
| | (-3.45) | (1.03) | (-1.13) | (0.61) | (-1.43) | (0.37) |
| Educ. = HS | -0.131 | -0.033 | -0.196 | 0.024 | -0.065 | -0.009 |
| | (-4.33) | (-0.37) | (-1.62) | (0.07) | (-1.59) | (-0.09) |
| First Birth | -0.035 | 0.043 | -0.104 | -0.024 | 0.022 | -0.029 |
| | (-1.10) | (0.46) | (-0.77) | (-0.06) | (0.53) | (-0.29) |
| Boy | 0.110 | -0.072 | 0.101 | -0.073 | 0.124 | -0.059 |
| | (6.54) | (-1.45) | (2.36) | (-0.49) | (4.72) | (-1.00) |
| Mom's Hgt. | 0.252 | -0.232 | 0.307 | -0.088 | 0.203 | -0.356 |
| | (9.76) | (-3.42) | (4.92) | (-0.43) | (4.88) | (-3.47) |
| Dad's Wgt. | 0.143 | 0.024 | 0.157 | 0.108 | 0.109 | -0.066 |
| | (4.90) | (-3.42) | (2.04) | (0.43) | (2.52) | (-0.68) |
| Cov(A,F) | 0.823** | 0.822** | 0.875** | 0.875** | 0.763** | 0.766** |
| Cov(A,W) | 0.248** | 0.247** | 0.362** | 0.362** | 0.174** | 0.178** |
| Cov(F,W) | 0.215** | 0.215** | 0.288** | 0.288** | 0.194** | 0.193** |
| Cov(A,M) | 0.432** | 0.433** | 0.355** | 0.355** | 0.517** | 0.520** |
| Cov(F,M) | 0.344** | 0.343** | 0.284** | 0.284** | 0.407** | 0.410** |
| Cov(W,M) | 0.352** | 0.354** | 0.371** | 0.371** | 0.323** | 0.323** |
| Cov(B,A) | -0.040 | -0.195* | -0.095 | -0.067 | 0.033 | -0.015 |
| Cov(B,F) | -0.048 | -0.134 | -0.084 | -0.061 | -0.020 | -0.056 |
| Cov(B,W) | 0.007 | -0.242 | -0.099 | -0.464 | 0.003 | 0.336 |
| Cov(B,M) | -0.025 | -0.432** | -0.040 | -0.313 | 0.028 | 0.156 |
| Cov(B,B) | 0.399** | --- | 0.364** | --- | 0.440** | --- |
| Sample Size | 3,451 | | 748 | | 2,703 | |

Notes: The numbers in parentheses are t-statistics. A "*" indicates that the covariance term is significant at 0.10, and a "**" indicates that the covariance term is significant at 0.05.