IV. THE EFFECT OF PRENATAL WIC PARTICIPATION ON MEDICAID COSTS

This chapter describes the approach used to estimate the savings in Medicaid costs due to prenatal WIC participation, and presents the detailed analytic results. Section A describes the basic econometric model and the dependent and independent variables for the analysis. Section B presents the main study results from regression-based estimates of the relationship between Medicaid costs and prenatal WIC participation. Section C discusses three important analytic issues underlying the estimates of the Medicaid cost model and presents additional empirical estimates. The three analytic issues are (1) the prorating of Medicaid costs, (2) the timing of enrollment in the WIC program, and (3) selection bias.

A. THE MODEL OF MEDICAID COSTS

The preferred design for estimating the savings in Medicaid costs from prenatal WIC participation is to compare the Medicaid costs of WIC participants with the Medicaid costs of a group of women who resemble WIC participants in every way except one: they do not participate in the WIC program. Such a comparison group is critical for providing information on what the Medicaid costs of WIC participants might be if the WIC program did not exist. Unfortunately, as discussed in the review of previous literature in Chapter II, ideal comparison groups of WIC nonparticipants are not generally available.

The comparison group used in this study consists of a group of WIC nonparticipants and their newborns with Medicaid reimbursements for labor and delivery or newborn care. This type of comparison group was also used by Wayne Schramm at the Missouri Center for Health Statistics to estimate the effects of prenatal participation in the WIC program on Medicaid costs in Missouri (Schramm, 1985, 1986, and 1989). Briefly, Schramm estimated benefit-cost ratios for WIC prenatal participation in the state of Missouri at three points in time--1980, 1982, and 1985-86, where the benefits of WIC participation were the estimated savings in the Medicaid costs of newborns, and the costs were the dollar value of redeemed WIC food instruments plus allowances for administrative and nutrition education expenses.

This study applies the basic methodology of the Schramm studies to five additional states, with some differences in the specification of the model and the definition of the Medicaid cost variables. The remainder of this section discusses the specification of the basic Medicaid cost model.

Medicaid Cost Model

The basic model of Medicaid costs in this study compares the Medicaid costs for a group of newborns and their mothers who participated in the WIC program during pregnancy with comparable Medicaid costs for a group whose mothers did not participate in the WIC program during pregnancy (nonparticipants). The problem with this approach, and with the comparison-group approach in general, is that both the observed and the unobserved characteristics of WIC participants may differ from those of comparison women who do not participate in the WIC program, thus statistically complicating comparisons of their Medicaid costs. Thus, the key analytic issue to be addressed in modeling Medicaid costs is how the effects of prenatal WIC participation can be isolated from the effects of other characteristics on Medicaid costs.

The methodological approach of the study entailed using multiple regression analysis to estimate the effects of prenatal WIC participation on the savings in Medicaid costs. Regression analysis controls for the observed differences between WIC participants and nonparticipants in estimates of the effects of prenatal WIC participation on Medicaid costs. For example, the following equation, in which Medicaid costs are related to a set of exogenous explanatory variables and to WIC participation, depicts a model that controls for differences in observed characteristics between WIC participants and nonparticipants:

$$(1) \quad Y_i = X_i\beta + \delta P_i + \varepsilon_i,$$

where the subscript i denotes a Medicaid-covered birth, Y represents Medicaid costs from birth to 60 days after birth, X is a set of observed variables thought to affect Medicaid costs, P is a dummy variable denoting participation in the WIC program, and ε is an error term. The coefficient, δ, in this equation represents the effect of WIC program participation on Medicaid costs, after differences in the observed characteristics (the X's) of WIC participants and nonparticipants are controlled for. A priori, we would expect that the sign of δ would be negative, indicating savings in Medicaid costs from prenatal WIC participation.

As discussed in Chapter III, the data used to estimate the effects of prenatal WIC participation on Medicaid costs come from five state databases. These databases were constructed from the linked Medicaid, Vital Records, and WIC state data files. The linked analysis files include data for Medicaid-covered births on Medicaid costs, WIC participation status, birthweight and other pregnancy outcomes, and the demographic and prenatal care characteristics of mothers. The remainder of this section describes the dependent and independent variables from the states' analysis files.

Dependent Variables

The dependent variables examined in this study pertain to Medicaid reimbursements from birth to 60 days after birth. Medicaid reimbursements reflect the total costs incurred by the Medicaid program, rather than the "true" cost of care to providers. All types of services reimbursed by Medicaid were included in the Medicaid cost variables, since distinguishing between services that were or were not pregnancy or birth-related would have been too time-consuming and expensive, as well as arbitrary and subjective.

Ideally, as discussed in the previous chapter, separate variables would have been constructed in each state for the Medicaid costs of newborns and the Medicaid costs of newborns and mothers combined. However, North Carolina and Texas were the only two study states in which newborns automatically received their own Medicaid identifier and in which claims for all newborns appeared under their own number. In the remaining study states, claims for normal healthy newborns generally appeared under the claims for the mothers, and it was not possible to separate Medicaid costs for newborns and for mothers. Thus, in North Carolina and Texas, Medicaid cost variables were constructed for both newborns only and newborns and mothers combined, while the Medicaid cost variables in the other states were for newborns and mothers combined. In addition, in South Carolina, it was not possible to separate physician claims for the prenatal period from claims for the 60-day postpartum period. Thus, only hospital costs from birth through 60 days were included in the Medicaid cost variable for South Carolina.

The use of global billing procedures by physicians complicated constructing the Medicaid cost variables from birth to 60 days after birth. Under global billing, physicians submit to Medicaid a single claim covering prenatal care, labor and delivery services, and routine postpartum care. A Medicaid claim with a global billing procedure covers services that occur both in the prenatal and 60-day postpartum periods, without accurately delineating the allocation of the total reimbursement to each period. Thus, for this study, all physician claims for prenatal care and delivery were allocated to the prenatal period and were not included in the Medicaid cost variables from birth to 60 days after birth. However, all hospital claims for labor and delivery and for other services received by mothers after birth, all physician claims for mothers that started after the date of delivery, and all newborn claims were included in the Medicaid cost variables for the 60-day postpartum period.

Indicator of WIC Participation

The Medicaid cost equation contains a binary indicator of WIC participation, "P." This indicator was constructed whereby it equals "1" if the mother was a prenatal WIC participant and "0" if she was a nonparticipant. A woman was considered to be a prenatal WIC participant if she redeemed or was issued any WIC food instruments during the nine months prior to birth or, for states that did not provide food instrument data, if she had a WIC certification date sometime during the nine months prior to birth. Alternative definitions of prenatal WIC participation that account for the timing of WIC enrollment were also constructed and analyzed and are discussed in Section C of this chapter.

Independent Variables

The independent variables denoted by the vector X in equation (1) are believed to affect Medicaid costs from birth to 60 days after birth. Examples of important independent variables include the sex of the newborn, multiple birth, the use of prenatal care, previous pregnancy terminations, and the demographic characteristics of the mother. These variables were used to control for observed differences between WIC participants and nonparticipants. In addition, the inclusion of control variables in the statistical analysis reduced the variance of the estimates of differences in the Medicaid costs of WIC participants and nonparticipants.

The independent variables included in the Medicaid cost equations were derived from data from the Vital Records birth file. Although the Vital Records data are relatively more standardized across states than either the Medicaid or WIC data systems, not all variables were available for all five states in the study. Table IV.1 summarizes the independent variables available from the Vital Records of each state. Of the five study states, Minnesota had the most complete set of data from the birth file; Florida and South Carolina had no data on previous pregnancy terminations; and Texas did not provide data on educational attainment or urban residence. The major difference across states, however, was that the race/ethnicity subgroups varied, as shown in the footnote to Table IV.1.

It is important to note that Vital Records data that were available in 1987 provided only a very limited set of independent variables, which constrained the ability of the econometric model of Medicaid costs to explain variations in Medicaid costs. For example, prenatal behavior such as smoking has been linked with low birthweight and can thus be expected to affect Medicaid costs. Because data on smoking were not included on

TABLE IV.1

INDEPENDENT VARIABLES BY STATE

Variable	Florida	Minnesota	North Carolina	South Carolina	Texas
Prenatal WIC Participation	X	X	X	X	X
Newborn Characteristics					
Sex	X	X	X	X	X
Multiple Birth	X	X	X	X	X
Mother Characteristics					
Age	X	X	X	X	X
Race/Ethnicity[a]	X	X	X	X	X
Marital Status	X	X	X	X	X
Adequacy of Prenatal Care[b]	X	X	X	X	X
Number of Previous Live Births	X	X	X		X
Number of Pregnancy Terminations ≤ 20 weeks		X			
Number of Pregnancy Terminations > 20 weeks		X	X		X
Education	X	X	X	X	
Urban	X	X	X	X	

SOURCE: WIC/Medicaid database for Florida, Minnesota, North Carolina, South Carolina, and Texas.

[a]Race/ethnicity varied across states. In North Carolina and South Carolina, the two subgroups were white and nonwhite. In Florida, the subgroups were white, black, Hispanic, and other, where other includes Native Americans and Asians. In Minnesota, the subgroups were white, black, Native American, and Asian. In Texas, the subgroups were white/non-Spanish, black/non-Spanish, Mexican, and other Hispanic.

[b]Prenatal care adequacy was measured by the Kessner Index, which combines information on the timing of entry into prenatal care with the number of visits and the duration of pregnancy. For a full-term pregnancy, adequate prenatal care is defined as nine or more prenatal care visits, with the first visit occurring during the first trimester of pregnancy; inadequate care is defined as four or fewer visits. Intermediate care for a full-term pregnancy encompasses all levels of prenatal care between the two extremes. Adequate prenatal care for preterm births (births before 37 weeks) requires a decreasing number of visits as the length of gestation decreases.

the birth certificates from the five states included in this study, this important independent variable was omitted from the analysis.[1]

B. ANALYSIS OF MEDICAID COSTS FROM BIRTH TO 60 DAYS AFTER BIRTH

Tables IV.2 and IV.3 show the ordinary least squares (OLS) estimates of the Medicaid cost regression equations for each of the five study states. The estimated coefficients of prenatal WIC participation in both tables are large and, with the exception of Minnesota, highly significant, indicating substantial Medicaid cost savings during the first 60 days after birth from prenatal WIC participation. The estimated reductions in Medicaid costs from birth to 60 days after birth for newborns and mothers (Table IV.2) range from $277 in Minnesota to $598 in North Carolina, with intermediate values of $347, $493, and $565 for Florida, Texas, and South Carolina (hospital costs only), respectively. For newborns only (Table IV.3), the estimated Medicaid cost savings are even greater than for newborns and mothers combined--$744 in North Carolina and $573 in Texas.

Table IV.4 presents benefit-cost ratios that compare the estimated savings in Medicaid costs with the costs of providing prenatal WIC benefits. These benefit-cost ratios show the estimated savings in Medicaid costs per dollar of WIC program costs--the cost of the WIC food benefits plus an adjustment for administrative expenses and the costs of the nutrition education component of the program. All the estimated benefit-cost ratios exceed one, suggesting that the benefits of prenatal WIC participation (that is, savings in Medicaid costs from birth to 60 days after birth) are greater than the costs of providing benefits. For newborns and mothers, these benefit-cost estimates range from 1.77 for Florida to 3.13 for North Carolina, with values of 1.83 for Minnesota and 2.44 for both South Carolina and Texas. For newborns only, the benefit-cost estimates are 3.90 in North Carolina and 2.84 in Texas. Thus, in the five states included in this study, every dollar spent on the prenatal WIC program is associated with reductions in Medicaid costs during the first 60 days after birth that range from $1.77 to $3.13 for newborns and mothers and from $2.84 to $3.90 for newborns only.

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[1]Indeed, the Missouri birth certificate includes a question on smoking and the prepregnancy weight of the mother, and both variables were found to be important predictors of Medicaid costs (Schramm). The current U.S. standard birth certificate includes a question on smoking during pregnancy.

TABLE IV.2

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON MEDICAID COSTS, BIRTH TO 60 DAYS AFTER BIRTH: NEWBORNS AND MOTHERS

(Standard Errors in Parentheses)

	Coefficients ($)				
Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	2,101 ** (134)	2,710 ** (383)	2,699 ** (176)	2,828 ** (277)	3,572 ** (151)
Prenatal WIC Participation	-347 ** (48)	-277 (154)	-598 ** (73)	-565 ** (110)	-493 ** (74)
Newborn Characteristics					
Male[a]	113 * (46)	210 (138)	99 (64)	139 (94)	223 ** (72)
Multiple Birth	7,626 ** (197)	11,007 ** (603)	8,001 ** (1,167)	6,729 ** (415)	9,428 ** (305)
Mother Characteristics					
Age 18-19	123 (89)	-499 (315)	9 (120)	-296 (179)	-238 (135)
Age 20-34	146 (84)	-249 (301)	112 (117)	-279 (162)	0 (123)
Age 35 and over	797 ** (162)	-155 (490)	699 ** (251)	530 (344)	844 ** (238)
Black[b]	399 ** (54)	1,090 ** (250)	378 ** (77)	-53 (120)	-176 (100)
Hispanic[b]	226 ** (86)	--	--	--	-319 ** (91)
Native American	--	-18 (274)	--	--	--
Asian	--	-787 ** (334)	--	--	--
Other Race/Ethnicity[b]	-351 (278)	--	--	--	-213 (213)
Not Married	20 (53)	80 (156)	-148 (81)	-86 (114)	-100 (78)
Kessner Index Intermediate	-105 * (51)	390 * (161)	289 ** (69)	0 (108)	-123 (85)
Kessner Index Inadequate	210 ** (73)	1,184 ** (254)	542 ** (128)	623 ** (144)	292 ** (106)
Kessner Index Unknown	511 ** (134)	1,663 ** (225)	1,252 ** (184)	685 (362)	654 ** (144)
Previous Live Births (Number)	-41 (20)	-155 * (60)	-162 ** (33)	--	-128 ** (29)
Pregnancy Terminations ≤ 20 Weeks	--	316 ** (95)	--	--	--

TABLE IV.2 (continued)

Explanatory Variables	Coefficients ($)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Mother Characteristics (continued)					
Pregnancy Terminations > 20 Weeks	--	484 (433)	224 ** (58)	--	678 ** (153)
Education < 9 Years	8 (113)	691 (425)	428 * (169)	229 (242)	--
Education 9-11 Years	50 (83)	496 * (236)	40 (116)	102 (172)	--
Education 12 Years	47 (78)	72 (208)	-12 (107)	-62 (164)	--
Education Missing	--	376 (312)	-183 (846)	1,726 ** (654)	--
Urban	117 (69)	952 ** (154)	220 ** (65)	81 (96)	--
R^2	.052	.049	.015	.031	.045
Sample Size	30,968	10,441	17,135	10,879	23,787

SOURCE: WIC/Medicaid birth-event analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the birth event. Observations with Medicaid costs from birth to 60 days after birth ≤ $200 are excluded.

[a]For multiple births, the binary variable "Male" is coded one if at least one of the newborns was a male.

[b]Racial/ethnic groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, non-Spanish," "Hispanic" means "Mexican," and "other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

*(**): Significant at the .05 (.01) level, two-tail test.

TABLE IV.3

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON MEDICAID COSTS, BIRTH TO 60 DAYS AFTER BIRTH: NEWBORNS

(Standard Errors in Parentheses)

	Coefficients ($)	
Explanatory Variables	North Carolina	Texas
Intercept	2,204 ** (171)	2,168 ** (154)
Prenatal WIC Participation	**-744 **** (71)	**-573 **** (75)
Newborn Characteristics		
Male[a]	79 (63)	153 * (74)
Multiple Birth	8,578 ** (1,107)	8,538 ** (297)
Mother Characteristics		
Age 18-19	-114 (118)	-194 (138)
Age 20-34	-97 (115)	-92 (125)
Age 35 and Over	306 (245)	711 ** (243)
Black[b]	227 ** (76)	-226 * (101)
Mexican[b]	--	-45 (92)
Other Hispanic	--	6 (226)
Not Married	-178 * (79)	-299 ** (79)
Kessner Index Intermediate	342 ** (68)	-19 (87)
Kessner Index Inadequate	743 ** (127)	599 ** (108)

TABLE IV.3 (continued)

Explanatory Variables	Coefficients ($) North Carolina	Coefficients ($) Texas
Mother Characteristics (continued)		
Kessner Index Unknown	1,230 ** (180)	672 ** (146)
Previous Live Births (Number)	-121 ** (32)	-115 ** (30)
Pregnancy Terminations > 20 Weeks	205 ** (57)	495 ** (153)
Education < 9 Years	288 (166)	--
Education 9-11 Years	27 (113)	--
Education 12 Years	-12 (104)	--
Education Missing	-46 (855)	--
Urban	145 * (63)	--
R^2	.020	.046
Sample Size	16,078	21,081

SOURCE: WIC/Medicaid birth-event analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the birth event. Observations with Medicaid costs from birth to 60 days after birth ≤ $200 are excluded.

[a]For multiple births, the binary variable "Male" is coded one if at least one of the newborns was a male.

[b]Racial/ethnicity groups varied across states. In North Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, non-Spanish."

*(**): Significant at the .05 (.01) level, two-tail test.

TABLE IV.4

ESTIMATED BENEFIT-COST RATIOS

	Estimated Savings in Medicaid Costs[a,b]	Estimated Prenatal WIC Costs per Participant	Estimated Benefit-Cost Ratios[b]
Florida			
Newborns and Mothers	$347	$196	1.77
Minnesota			
Newborns and Mothers	$277	$151	1.83
North Carolina			
Newborns	$744	$191	3.90
Newborns and Mothers	$598	$191	3.13
South Carolina[c]			
Newborns and Mothers	$565	$232	2.44
Texas			
Newborns	$573	$202	2.84
Newborns and Mothers	$493	$202	2.44

SOURCE: WIC/Medicaid database for Florida, Minnesota, North Carolina, South Carolina, and Texas.

[a]Medicaid costs are from birth to 60 days after birth.

[b]All estimates are statistically significant at the .01 level (two-tail test), except in Minnesota, where the estimate is statistically significant at the .07 level (two-tail test) and at the .03 level (one-tail test).

[c]Medicaid costs refer to hospital costs only.

These estimated benefit-cost ratios are larger than those obtained by Schramm for the state of Missouri. In addition to variations in Medicaid costs across states, several important differences between this study and the Schramm studies account for these large benefit-cost ratios. One important difference is the definition of Medicaid costs from birth to 60 days after birth. The definition in this study includes reimbursements for all Medicaid claims whose start date of service was at or before 60 days after birth, and claims that extend beyond the 60-day postpartum period are prorated according to the proportion of the claim period that falls within the 60-day postpartum period. The definition used in the Schramm studies includes reimbursements for all Medicaid claims whose end date of service was at or before the cutoff date (30 days in 1980, and 45 days in 1982 and 1985-86). Thus, the definition of Medicaid costs in this study is more inclusive and includes more claims for higher-cost births, particularly those whose claims extended beyond the postpartum period. Yet a third definition of Medicaid costs from birth through 60 days, and one that is discussed in the following section, includes all reimbursements (that is, no prorations) for claims whose start date of service was within 60 days of birth. Thus, the definition used for the analytical results presented in Tables IV.2 to IV.4 falls in the middle between the more inclusive and less inclusive of the possible definitions of Medicaid costs from birth through 60 days.

Other important differences between this study and the studies by Schramm may be responsible for some of the differences in the magnitude of the study findings: Missouri birth certificates include information on smoking and prepregnancy weight, which were used as additional control variables in the Schramm studies; per-diem hospital rates were used as control variables in the Schramm studies; and Missouri Medicaid had no spend-down program. Because WIC participants in Missouri were disproportionately from rural areas whose per-diem hospital reimbursement rates are lower, the ability to control for per-diem hospital reimbursement rates in the Missouri studies may have generated lower estimated benefit-cost ratios in Missouri relative to Florida and North Carolina, which also used per-diem rates to reimburse hospitals for delivery and newborn care.[2] However, Minnesota, South Carolina, and Texas used diagnosis-related group (DRG) reimbursement systems which provided a fixed reimbursement for delivery and newborn care, with some allowances for high-cost births. Thus, the estimated benefit-cost ratios in

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[2]This is true only to the extent that prenatal WIC participants in Florida and North Carolina also used hospitals whose per-diem reimbursement rates were lower.

these three states are less likely to be influenced by hospital-specific differences in Medicaid reimbursement rates.

The absence of a spend-down program in Missouri could also have the effect of lowering the estimated benefit-cost ratios in Missouri relative to the five study states.[3] Under spend-down, it is possible that some high-cost newborns, whose mothers are not income-eligible for Medicaid during pregnancy, become eligible for Medicaid after birth due to the high costs they incur for labor and delivery and neonatal care. If these "spend-down" women with high-cost newborns also would not be income-eligible for the WIC program during pregnancy, then, by definition, they are WIC nonparticipants. In Missouri, the absence of a spend-down program could have the effect of omitting some high-cost newborns born to women who were not Medicaid-eligible and who were not WIC participants. Unfortunately, it was not possible to identify spend-down recipients from the Medicaid files to determine (1) whether they were the very high-cost births, or (2) whether the WIC participation rate among spend-down cases differed from that of other Medicaid-eligible women.[4]

As shown in Tables IV.2 and IV.3, several other variables are important predictors of Medicaid costs from birth to 60 days after birth. Although the results vary somewhat by state, the principal findings are as follows:

- In all five states, receiving inadequate levels of prenatal care is associated with increased Medicaid expenditures during the first 60 days after birth. As with the findings on the effects of prenatal WIC participation, the estimated cost savings associated with receiving adequate versus inadequate levels of prenatal care for newborns alone exceeded the cost savings for newborns and mothers combined.

- The relationship between the adequacy of prenatal care and Medicaid costs is strongest in Minnesota. Relative to the estimated Medicaid costs for women who received adequate levels of prenatal care (the omitted category in the regression equation), the estimated Medicaid costs from birth to 60 days after birth for newborns and mothers in

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[3]All five states included in this study had a medically needy program with spend-down during at least part of the study period, although South Carolina terminated its medically needy program in April 1987.

[4]However, it is not necessarily clear that anything different would have been attempted with spend-down cases in an analytic sense even had it been possible to identify spend-down cases.

Minnesota are $390 greater for women who received intermediate levels of prenatal care, and $1,184 greater for women who received inadequate levels of prenatal care.

- As expected, Medicaid costs from birth to 60 days after birth are considerably higher for multiple births than for single births.

- In Florida, North Carolina, and Texas, estimated Medicaid costs from birth to 60 days after birth for newborns and mothers are higher for women older than age 35 than for younger women. Interestingly, estimated Medicaid costs for the very youngest mothers and their newborns did not differ significantly from the costs for mothers 18 to 19 years of age or 20 to 34 years of age.

- The estimated effects of race and ethnicity on Medicaid costs vary considerably across the study states. In Florida, Minnesota, and North Carolina, estimated Medicaid costs from birth to 60 days after birth for newborns and mothers are higher for black women than for white women (the omitted category). In Florida, being Hispanic is associated with increased Medicaid costs from birth to 60 days after birth for mothers and newborns, while the opposite is true in Texas. Finally, estimated Medicaid costs during the first 60 days after birth for Asian women in Minnesota are significantly less than for any other racial and ethnic subgroup in Minnesota.

- The number of previous live births is generally associated with lower Medicaid costs during the first 60 days after birth (except for Florida), while the number of pregnancy terminations is associated with increased Medicaid costs during the 60-day postpartum period.

C. KEY ANALYTIC ISSUES

Several important analytic issues must be considered as one interprets the main study findings presented in Section B. This section discusses three key issues that complicate the estimation of savings in Medicaid costs due to prenatal WIC participation, and presents additional results from the analysis of the relationship between Medicaid costs and prenatal WIC participation. The three issues are (1) the prorating of Medicaid costs, (2) the timing of enrollment in the WIC program, and (3) selection bias.

Prorating Medicaid Costs

As mandated, the Medicaid costs examined in this study include reimbursements from birth to 60 days after birth. An important analytic issue addressed was how to handle Medicaid reimbursements for services whose start date of service was within the first 60 days of birth but whose end date of service was after the 60-day postpartum period. As noted earlier, the results presented in the preceding section are based on prorating the Medicaid reimbursements according to the proportion of the service period that occurred within the first 60 days after birth. For example, if the 60th day after birth was June 15 and a newborn had a Medicaid claim for a hospital stay whose dates of service were from June 10 to June 21, then one-half of the reimbursed amount was included in the Medicaid cost variable.

Prorating Medicaid reimbursements is problematic if it does not adequately reflect the proportion of costs incurred during the 60-day postpartum period--for example, if the services received were not evenly distributed over the service period. In particular, for the hospital claims of newborns that spanned the 60-day postpartum period, it is possible that more intensive services (and, thus, higher costs) were received during the postpartum period than afterward, and prorating the Medicaid reimbursement evenly did not attribute the actual costs incurred during the first 60 days after birth to the 60-day postpartum period. Thus, a second set of Medicaid cost variables was constructed for the analysis that included the full reimbursements for any Medicaid claim whose start date of service was within 60 days after birth, regardless of the end date of service. This definition of Medicaid costs does not depend on any assumptions about the distribution of services provided over periods of time. In addition, to the extent that the benefits of prenatal WIC participation extend beyond the 60-day period after birth, this alternative definition is more inclusive of Medicaid costs for services provided after birth.[5]

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[5]As discussed previously, one other definition of Medicaid costs, which was adopted by Schramm in the Missouri studies, is to define the Medicaid cost variables whereby they include only those Medicaid claims whose start and end dates are within the postpartum period. The problem with this approach is that the Medicaid cost variable would not include many high-cost newborn claims that span the 60-day postpartum period. (In the most recent analysis of the Missouri data (unpublished), Schramm used various definitions of Medicaid costs, including the alternative discussed in the text--that is, full reimbursement for services whose start date of service was within the postpartum period, regardless of the end date of service.)

Relative to the prorated Medicaid cost variable, this alternative definition of Medicaid costs generates higher average values of Medicaid costs from birth to 60 days after birth and larger estimated reductions in Medicaid costs from birth to 60 days after birth from prenatal WIC participation (see Table IV.5). The difference in the definition of Medicaid costs has the most dramatic influence on the findings for Minnesota, in which the savings in Medicaid costs associated with prenatal WIC participation increases from an estimate of $277, which is not statistically significant at conventional two-tail significance levels, to an estimate of $636, which is statistically significant at the .05 level. The alternative definitions of Medicaid costs have the smallest impact on the findings for Florida and Texas. This is expected, given that both Florida and Texas imposed limits on the number of inpatient days that could be reimbursed by Medicaid, and, thus, service periods that spanned the 60-day postpartum period were less likely to be reimbursed in full by Medicaid. However, even in these states, the estimated savings in Medicaid costs associated with prenatal WIC participation increase with the definition that includes the full reimbursements for services starting within the first 60 days of birth.

Timing of Enrollment in the WIC Program

The WIC participation variable included in the main set of regression equations is a simple binary variable that equals one if the woman participated in the WIC program during her pregnancy, and zero otherwise.[6] Two closely related issues are associated with this definition of prenatal WIC participation:

1. This specification does not provide information on whether prenatal WIC participation has a dose-response effect.

2. Women who enroll in the WIC program at different points during pregnancy may have different risk factors for adverse pregnancy outcomes.

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[6]As discussed previously, for states that provided data on food instrument redemption data, at least one food instrument had to be redeemed during the nine months preceding the date of birth for a woman to be counted as a prenatal WIC participant. For South Carolina, the definition of prenatal WIC participation required that at least one food instrument be issued during the nine months before the date of birth, and in Texas the certification date had to be sometime during the nine months preceding birth.

TABLE IV.5

RESULTS FOR ALTERNATIVE DEFINITIONS OF MEDICAID COSTS FROM BIRTH TO 60 DAYS AFTER BIRTH

	Prorating Reimbursements for Medicaid Claims Spanning 60-Day Postpartum Period		Full Reimbursements for Medicaid Claims Spanning 60-Day Postpartum Period	
	Mean Value	Estimated Savings from Prenatal WIC Participation[a]	Mean Value	Estimated Savings from Prenatal WIC Participation[a]
Florida				
Newborns and Mothers	$2,483	$347 ** (48)	$2,530	$376 ** (51)
Minnesota				
Newborns and Mothers	$3,815	$277 (154)	$4,092	$636 * (258)
North Carolina				
Newborns	$1,942	$744 ** (71)	$2,051	$907 ** (86)
Newborns and Mothers	$2,812	$598 ** (73)	$2,919	$753 ** (86)
South Carolina[b]				
Newborns and Mothers	$2,433	$565 ** (110)	$2,586	$736 ** (139)
Texas				
Newborns	$1,866	$573 ** (75)	$1,921	$601 ** (79)
Newborns and Mothers	$3,247	$493 ** (74)	$3,299	$519 ** (77)

SOURCE: WIC/Medicaid birth-event analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the birth event. Observations with Medicaid costs from birth to 60 days after birth $\leq$ $200 are excluded:

[a]Standard errors in parentheses.

[b]Medicaid costs include hospital costs only.

*(**): Significant at the .05 (.01) level, two-tail test.

This section discusses these two issues and presents some analytic findings on the effects of the timing of enrollment in the WIC program.

The question underlying the dose-response effect is straightforward. If the food supplements and nutrition education received by pregnant women through the WIC program improve pregnancy outcomes and reduce Medicaid costs, does earlier enrollment during pregnancy and do longer durations of prenatal WIC participation generate greater Medicaid cost savings than later enrollment and shorter durations? However, given the data used in this study, estimating a dose-response effect of prenatal WIC participation is extremely difficult. If the Medicaid cost regressions include a variable for the duration or the intensity of prenatal WIC participation, the effect of the duration of prenatal WIC participation on Medicaid costs is inevitably confounded with the effect of gestational age. Women whose durations of prenatal WIC participation are longer also have newborns with higher gestational ages, which, on average, are lower-cost newborns than low gestational-age newborns. Thus, the estimated coefficient of a variable for the duration of prenatal WIC participation in a regression equation for Medicaid costs is negative (that is, positive savings) and highly significant, yet it is impossible to distinguish between the true effects of the duration of participation and the effects of increased gestational age. Put differently, women who have longer durations of prenatal WIC participation are likely to have lower Medicaid costs simply because their pregnancies are longer, and it would be incorrect to attribute the effect of the duration of pregnancy on Medicaid costs to the duration of WIC participation.[7]

One approach to estimating a dose-response effect is to examine the effect of early versus late enrollment in the WIC program. With this approach, the Medicaid costs for women who enroll in the WIC program early during pregnancy (that is, during the first trimester of pregnancy) are compared with the Medicaid costs for women who enroll later during pregnancy <u>and</u> with the Medicaid costs for nonparticipants. If WIC participation has a dose-response effect, the Medicaid costs during the first 60 days after birth for early enrollees in the WIC program would be lower than those for later enrollees.

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[7]However, to the extent that prenatal WIC participation increases gestational age and reduces the incidence of premature deliveries, part of the effect of increased length of pregnancy should be attributed to prenatal WIC participation. As discussed below, it is indeed because gestational age and prenatal WIC participation are related that the relatively simple solution of including gestational age as an independent variable in the Medicaid cost regressions does not solve the problem.

However, this approach to the dose-response issue has the same problem of confounding gestational age and late enrollment in the WIC program. That is, the group of WIC participants who enroll after the first trimester include some women who enroll late in their pregnancy. The pregnancy outcomes are likely to be more favorable and Medicaid costs less for this group of late enrollees relative to early enrollees in the WIC program for reasons that are related mostly to longer pregnancy durations rather than to WIC participation. In addition, for the very late enrollees (e.g., after 36 weeks gestation), there is the potential for an overstatement of the effects of prenatal WIC participation since Medicaid costs for these late WIC enrollees with longer gestational ages are compared with the Medicaid costs for nonparticipants, some of whom have high-cost, low-gestational age births and do not have the opportunity to enroll later as prenatal WIC participants.[8]

To examine these issues, Table IV.6 presents selected results from three different specifications of the newborn and maternal Medicaid cost regression equation: (1) the basic model, as shown in detail in Tables IV.2 and IV.3; (2) a model with the same set of independent variables from the basic model and two additional independent variables--first trimester WIC enrollment and gestational age; and (3) the basic model with a revised definition of prenatal WIC participation.

The first row of Table IV.6 shows the regression estimates discussed previously of the effects of prenatal WIC participation on newborn and maternal Medicaid costs. The second set of results presents estimated coefficients for prenatal WIC participation, first trimester WIC enrollment, and gestational age. These results should be considered illustrative, however, and interpreted with caution for two important reasons:

1. Gestational age is an outcome variable itself, and both gestational age and prenatal WIC participation are simultaneously related. The data for this study do not allow for the specification and estimation of a model of gestational age and prenatal WIC participation.

[8]At the opposite end of the spectrum, given that the WIC program actively targets early prenatal enrollment by high-risk women, early WIC enrollees (e.g., enrollment in the first trimester) may include some higher-risk pregnancies that lead to higher-cost birth outcomes.

TABLE IV.6

ESTIMATED COEFFICIENTS OF PRENATAL WIC PARTICIPATION, FIRST TRIMESTER WIC ENROLLMENT, AND GESTATIONAL AGE: MEDICAID COST MODELS

(Standard Errors in Parentheses)

	Coefficients ($)				
Model Specification	Florida	Minnesota	North Carolina	South Carolina	Texas
Prenatal WIC Participation	-347 ** (48)	-277 * (154)	-598 ** (73)	-565 ** (110)	-493 ** (74)
Prenatal WIC Participation	-154 ** (47)	122 (156)	-237 ** (71)	-247 ** (117)	-207 ** (73)
First Trimester WIC Enrollment	-147 (81)	10 (151)	-104 (87)	-38 (107)	-255 (135)
Gestational Age (Weeks)	-402 ** (7)	-1,340 ** (26)	-445 ** (9)	-447 ** (14)	-537 ** (11)
Revised Prenatal WIC Participation[a]	-333 ** (48)	-208 (152)	-573 ** (72)	-549 ** (110)	-339 ** (74)

SOURCE: WIC/Medicaid birth-event analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the birth event. Observations with Medicaid costs from birth to 60 days after birth ≤ $200 are excluded.

*(**): Significant at the .05 (.01) level, two-tail test.

[a]Revised prenatal WIC participation is defined as follows: for Florida, Minnesota, and North Carolina, WIC participants who enrolled after 36 weeks gestation and redeemed less than $55 worth of food instruments were considered nonparticipants; for South Carolina, WIC participants who enrolled after 36 weeks and were issued less than two food instruments were considered nonparticipants; and for Texas, WIC participants who enrolled after 36 weeks were considered nonparticipants.

2. Data on gestational age are of questionable quality and often are missing on birth certificates. Adding gestational age as an independent variable in the Medicaid cost regression equations leads to the exclusion of cases with missing data on gestational age, and cases with missing gestational age tend to be high-cost births (see, for example, the estimated coefficients on Kessner Index missing in Tables IV.2 and IV.3).

With these caveats in mind, it is interesting to assess (1) the estimated effects of prenatal WIC participation with and without gestational age as an independent variable and (2) the estimated effects of first trimester WIC enrollment. Except for Minnesota, adding gestational age to the Medicaid cost regression equations reduces the estimated coefficients on prenatal WIC participation to roughly 40-45 percent of the original estimates (in absolute value). Except for Minnesota, these estimates are all statistically significant and suggest that Medicaid costs from birth to 60 days after birth are significantly lower for prenatal WIC participants <u>at each level of gestational age</u>. Thus, approximately 40-45 percent of the overall estimated effect of prenatal WIC participation on Medicaid costs is attributable to reduced gestational-age specific Medicaid costs. These estimates do not imply that controlling for gestational age necessarily reduces the overall effect of prenatal WIC participation since, as noted above, prenatal WIC participation also is presumed to influence gestational age, which in turn, affects Medicaid costs.[9]

For first trimester WIC enrollees, the overall estimated effect of prenatal WIC participation, after controlling for gestational age, is the sum of the estimated coefficients of prenatal WIC participation and first trimester WIC enrollment. First trimester WIC enrollees generally have lower Medicaid costs during the first 60 days after birth than do later WIC enrollees (except for Minnesota). However, the estimated coefficients of first trimester WIC enrollment are not statistically significant at conventional two-tailed significance levels, although, for Florida and Texas, the estimated coefficients are of appreciable magnitude and are significant at conventional one-tailed significance levels.

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[9]The estimated effects of prenatal WIC participation on gestational age range from .25 weeks to .75 weeks (see Chapter V). Multiplying the estimated effects of gestational age on Medicaid costs from Table IV.6 by the estimated effects of prenatal WIC participation on gestational age provides estimates of the indirect effects of prenatal WIC participation on Medicaid costs via the effects on gestational age.

The final set of results presented in Table IV.6 is based on a revised definition of prenatal WIC participation that excludes women who enrolled so late during pregnancy and redeemed so few food instruments that it is unlikely that the WIC benefits received could have much impact on birth outcomes and Medicaid costs. Specifically, women who enrolled in the WIC program after 36 weeks gestation and redeemed less than $55 worth of food instruments were reclassified as nonparticipants. Given the lack of data on redeemed food instruments for South Carolina and Texas, this definition was modified for these two states; for South Carolina, women enrolling after 36 weeks gestation and having less than two food instruments issued were considered nonparticipants, and for Texas, women enrolling after 36 weeks gestation were considered nonparticipants.[10]

This revised definition of prenatal WIC participation reduces slightly the estimated effects of prenatal WIC participation on Medicaid costs from birth to 60 days after birth for Florida, Minnesota, North Carolina, and South Carolina, as shown by comparing the estimated coefficients in the first and last cells of Table IV.6. In Texas, the estimated savings in Medicaid costs associated with prenatal WIC participation declines substantially with the revised definition of prenatal WIC participation ($493 versus $339). Because no data on redeemed food instruments are available in Texas, the revised definition of prenatal WIC participation reclassified the greatest number of women in Texas.[11]

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[10]There is some concern that the certification dates from the WIC program files were not necessarily the initial certification date but, in some cases, may have been recertification dates or updates. Because of this concern, information on the value of redeemed food instruments or number of food instruments issued was used to reclassify very late WIC enrollees as nonparticipants.

[11]Approximately 8.6 percent of prenatal WIC participants in Texas had certification dates after 36 weeks gestation and were, thus, reclassified as nonparticipants. In contrast, between .3 and 1.5 percent of the prenatal WIC participants in the other four states were reclassified as nonparticipants based on certification and food instrument data. Even using only the certification date to reclassify late WIC enrollees in all five states leads to a larger percentage of WIC participants being considered as nonparticipants in Texas relative to the other four states.

Selection Bias

If WIC participants differ from nonparticipants <u>only</u> along exogenous, observed characteristics, a multiple regression model, such as that depicted by equation (1) and discussed above, provides unbiased estimates of the effects of WIC prenatal participation on the savings in Medicaid costs. With such a model, ordinary least squares (OLS) regression can be used to estimate the Medicaid cost equations. The estimation of WIC effects is complicated considerably, however, if the self-selection of women into the WIC program is based on unobserved or unmeasured characteristics that also affect pregnancy outcomes and, thus, newborn and maternal health care costs. For example, relative to other eligible women not receiving WIC benefits, WIC participants may participate in the program because they are more knowledgeable of and have greater access to publicly funded health-care programs. If such unobserved differences in knowledge of and access to public health programs would lead to good pregnancy outcomes and lower Medicaid costs even in the absence of the WIC program, then standard multiple regression techniques such as OLS regression produce biased estimates of the effects of the WIC program, and it is considerably more difficult to obtain unbiased estimates of program effects.

In principle, given the large sample sizes in this study, unbiased estimates of the effects of the WIC program can be obtained by controlling for observed differences directly in the Medicaid cost regression equation and by controlling for unobserved differences through the estimation of a joint model of Medicaid costs and prenatal WIC participation (Maddala, 1983). Formally, the following equations jointly depict a model of Medicaid costs that account for the WIC participation decision:

(2) $Y_i = X_i\beta + \delta P_i + \varepsilon_i$

(3) $P_i^* = Z_i\Psi + u_i$

(4) $P_i = 1 \text{ if } P_i^* \geq 0$

$= 0 \text{ if } P_i^* < 0,$

where i denotes a Medicaid-covered birth, Y depicts Medicaid costs from birth to 60 days after birth, X is the set of observed variables affecting Medicaid costs, P^* is an (unobserved) index for the "propensity" to participate in the WIC program, Z is a set of variables affecting that propensity (which may contain X, but must also contain other variables that affect participation but not Medicaid costs), P is a dummy variable denoting actual WIC participation, and ε and u are random disturbance terms.

Selection bias occurs if the two disturbance terms ε and u are correlated. A negative correlation would suggest that women who are more likely to participate in the WIC program, for whatever reason, are likely to have lower levels of Medicaid costs on average. The failure to adjust for selection bias leads to an overestimate of the effects of the WIC program on Medicaid cost savings since there would be lower Medicaid costs for participants relative to nonparticipants even without the WIC program. Conversely, a positive correlation would suggest that WIC participants have higher levels of Medicaid costs, on average, than nonparticipants (for example, states may target their WIC benefits to high-risk, low-income pregnant women). The failure to adjust for selection bias in this case would underestimate the cost savings attributable to the WIC program because any reduction in costs due to WIC participation would be, at the least, partially offset by the fact that WIC participants would likely be higher-cost pregnancies than nonparticipants even in the absence of the WIC program.

One important issue that arises in the estimation of the Medicaid cost and WIC participation equations is the extent to which the determinants of the WIC participation decision (Z variables) are not identical to the set of variables affecting Medicaid costs (X variables). If the determinants of Medicaid costs and WIC participation are nearly or almost identical then it is extremely difficult to separate the effect of a given explanatory variable on Medicaid costs from its effect on the likelihood of participating in the WIC program. In this case, the estimation procedures available to estimate selection bias models have problems converging and the resulting parameter estimates are very imprecise and unreliable.

This problem of identifying variables that affect the WIC participation decision but do not directly affect Medicaid costs is particularly severe for this study given the very limited set of independent variables from the birth file, as noted earlier. The selection bias models estimated for this study yielded very unrealistic results that were extremely sensitive to both minor changes in model specification and the estimation procedure employed. Several different estimation procedures were used in an attempt to rely on fewer distributional assumptions concerning the error structure, and virtually every possible variable was used in the analysis in order to try to identify the determinants of prenatal WIC participation and Medicaid costs.[12] The basic problem was that the predictive power of the WIC participation equation was poor, and both WIC participants and nonparticipants had roughly equal predicted probabilities of prenatal WIC participation. Thus, this analysis was not able to produce estimates of the effects of prenatal WIC participation that were corrected for selection bias.

It is important to note that selection bias is only a problem if (1) unobserved differences between WIC participants and nonparticipants are not controlled for by other variables included in the regression equation and (2) these unobserved differences also influence birth outcomes and Medicaid costs. Given the limited set of data available for this study relative to databases constructed from cross-sectional surveys, selection bias may be an important factor to consider in the interpretation of the estimated effects of prenatal WIC participation. On the other hand, given that this study includes control variables for the adequacy of prenatal care, which combine information on both the number of prenatal care visits and the timing of the first visit, it is possible that unobserved differences between WIC participants and nonparticipants related to knowledge of and access to publicly funded health-care programs are already controlled for in the statistical analysis.

D. SUMMARY AND CONCLUSIONS

The primary results of this study and their interpretation are based on a straightforward analytic model in which Medicaid costs depend on prenatal WIC participation, newborn characteristics, and maternal characteristics. For the five study states included in this study, regression-adjusted estimates of the differences in Medicaid costs between WIC participants and nonparticipants indicate substantial savings in Medicaid costs from birth to 60 days after birth from prenatal WIC participation. For every dollar spent on the prenatal component of the WIC program, the associated savings in Medicaid costs during the first 60 days after birth range from \$1.77 to \$3.13 for newborns and mothers and from \$2.84 to \$3.90 for newborns only.

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[12]The estimation techniques used include the traditional two-stage Heckman procedure (Heckman, 1979), nonlinear two-stage least squares using a predicted participation probability as an instrument for the WIC participation equation, and instrumental variables estimation (Heckman and Robb, 1985).

The primary study findings presented in Volume 1 of this report and discussed above are based on a model specification that was judged to be the most appropriate after several methodological problems and issues were assessed and examined. The most important of these issues are (1) whether to prorate Medicaid claims that span the 60-day postpartum period, (2) the confounding of the timing of enrollment in the WIC program and gestational age, and (3) selection bias. The primary analysis findings are based on a prorated Medicaid cost variable, do not reflect differences in the timing of enrollment in the WIC program, and are not corrected for selection bias. However, this chapter also presents additional analytic results from the investigation of these methodological issues. The principal findings from the analysis of these issues are:

- Including the full reimbursements for Medicaid claims that span the 60-day postpartum period increases the estimated Medicaid cost savings from prenatal WIC participation and the associated benefit-cost ratios relative to prorating Medicaid reimbursements for claims that span the 60-day postpartum period.

- Including a control variable for gestational age in the Medicaid cost regressions reduces the estimated savings in Medicaid costs due to prenatal WIC participation, although the results also indicate that Medicaid costs from birth to 60 days after birth are significantly lower for prenatal WIC participants than nonparticipants at each level of gestational age. (The exception to this is Minnesota, where adding gestational age to the Medicaid cost regression leads to very different analysis results.)

- First trimester WIC enrollees generally have lower newborn and maternal Medicaid costs during the first sixty days after birth than do later WIC enrollees. However, the estimated coefficients of first trimester WIC enrollment are not statistically significant at conventional two-tailed significance levels. For Florida and Texas, the estimated coefficients of first trimester WIC enrollment are of considerable magnitude and are significant at conventional one-tailed significance levels.

V. THE EFFECT OF PRENATAL WIC PARTICIPATION ON BIRTH OUTCOMES

A secondary objective of the WIC/Medicaid study is to examine the effects of prenatal WIC participation on the birth outcomes of Medicaid beneficiaries. This analysis serves two purposes. First, an analysis of intervening birth outcomes facilitates the interpretation of the estimated savings in Medicaid costs from prenatal WIC participation. Second, prenatal WIC participation may have effects on birth outcomes that may not fully be reflected by the estimated savings in Medicaid costs.

This chapter presents detailed analytic results from an analysis of the effects of prenatal WIC participation on birthweight, the likelihood of having a low birthweight newborn, gestational age, and the likelihood of preterm birth. The first section discusses the methodology used for the birth outcome analysis; the second section presents the full set of estimation results for the findings presented in Volume 1 of this report; and the final section presents results from the analysis of the analytic issues discussed previously in Chapter IV.

A. MODEL OF NEWBORN BIRTHWEIGHT AND GESTATIONAL AGE

The methodological approach used to estimate the effects of the WIC program on intervening birth outcomes is similar to the model to estimate the savings in Medicaid costs. Specifically, the analysis compares the birth outcomes of WIC participants with the birth outcomes of nonparticipants, controlling for observed differences between participant and nonparticipant Medicaid beneficiaries. The key difference between the analyses of Medicaid costs and birth outcomes is that birth outcomes, rather than Medicaid costs, are the dependent variables.

Four specific birth outcomes are examined--newborn birthweight, gestational age, the incidence of low birthweight, and the incidence of preterm birth. These birth outcomes are all based on data from birth certificates. Birthweight, which tends to be recorded by hospital staff, is generally believed to be more reliably reported than gestational age, which relies on the mother's recall of the date of her last menstrual period. Birthweight was recorded in grams on birth certificates in all states except Texas where it was coded in pounds and ounces in interval format. These interval data were converted to the gram value of the midpoint of each range and treated as a continuous variable. Gestational age in weeks was taken directly from the birth certificate entry if one existed. If gestational age was not present, it was computed as the number of weeks between the date of last menses and the date of birth.[1] Multiple regression analysis was used to estimate the effects of prenatal WIC participation on birthweight and gestational age.

The incidence of low birthweight and the incidence of preterm birth are binary variables defined as follows:

- The variable denoting low birthweight is equal to one if newborn birthweight is less than 2,500 grams (5.5 pounds), and equal to zero otherwise.

- The variable denoting preterm birth is equal to one if gestational age is less than 37 weeks, and equal to zero otherwise.

Probit analysis is used to estimate the effects of prenatal WIC participation on the incidence of low birthweight and the incidence of preterm birth. Probit is a maximum likelihood estimation procedure for binary dependent variables.

B. EMPIRICAL RESULTS

Prenatal WIC participation by Medicaid beneficiaries is associated with increased birthweight, as shown in Table V.1. The average increase in birthweight ranges from 51 grams in Minnesota to 73 and 77 grams in Florida and Texas, to 113 and 117 grams in South Carolina and North Carolina, respectively. However, the most dramatic increase in birthweight for prenatal WIC participants relative to nonparticipants occurs for the newborns of the subsample of women who had preterm births--births of infants with a gestational age of less than 37 weeks (see Table V.2). The average increase in birthweight for this subgroup of Medicaid beneficiaries participating in the WIC program ranges from 150 grams in Florida to 259 grams--approximately half a pound--in South Carolina, with intermediate increases of 138, 165, and 238 grams in Minnesota, Texas, and North Carolina, respectively. Increases in birthweight for full-term births are relatively small--under 50 grams--in all five states (Table V.3).

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[1]In addition, checks on gestational age and birthweight indicated some inconsistencies. In particular, gestational ages greater than 44 weeks were changed to 44 weeks, and gestational ages less than 32 weeks that were inconsistent with reported newborn birthweight were set to missing.

TABLE V.1

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON BIRTHWEIGHT: TOTAL SAMPLE

(Standard Errors in Parentheses)

Explanatory Variables	Coefficients (grams)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	3,308 ** (19)	3,370 ** (30)	3,272 ** (24)	3,215 ** (32)	3,126 ** (16)
Prenatal WIC Participation	**73 **** (7)	**51 **** (12)	**117 **** (10)	**113 **** (13)	**77 **** (8)
Newborn Characteristics					
Male	128 ** (7)	122 ** (11)	112 ** (9)	101 ** (11)	116 ** (8)
Multiple Birth	-983 ** (23)	-921 ** (34)	-994 ** (27)	-958 ** (36)	-961 ** (24)
Mother Characteristics					
Age 18-19	12 (13)	-1 (24)	9 (16)	28 (21)	52 ** (14)
Age 20-34	-12 (12)	-22 (23)	-12 (16)	45 * (19)	51 ** (13)
Age 35 and over	-73 ** (24)	-42 (38)	-39 (34)	17 (40)	95 ** (25)
Black[a]	-189 ** (8)	-218 ** (20)	-174 ** (10)	-162 ** (14)	-127 ** (11)
Hispanic[a]	7 (13)	--	--	--	17 (9)
Native American	--	129 ** (22)	--	--	--
Asian	--	-146 ** (27)	--	--	--
Other race/ethnicity[a]	-117 ** (40)	--	--	--	23 (22)
Not married	-57 ** (8)	39 ** (12)	-6 (11)	-67 ** (13)	-34 ** (8)
Kessner Index intermediate	-11 (7)	-55 ** (13)	-117 ** (9)	-11 (13)	-8 (9)
Kessner Index inadequate	-195 ** (11)	-238 ** (20)	-243 ** (17)	-144 ** (17)	-129 ** (11)
Kessner Index unknown	-129 ** (20)	-146 ** (18)	-218 ** (25)	-201 ** (42)	-94 ** (15)
Previous live births (number)	14 ** (3)	40 ** (5)	40 ** (4)	--	23 ** (3)
Pregnancy terminations ≤ 20 weeks	--	-31 ** (8)	--	--	--

TABLE V.1 (continued)

Explanatory Variables	Coefficients (grams)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	-88 * (35)	-50 ** (8)	--	-76 ** (16)
Education < 9 years	-53 ** (17)	-143 ** (34)	-138 ** (23)	-101 ** (28)	--
Education 9-11 years	-64 ** (12)	-155 ** (19)	-94 ** (16)	-84 ** (20)	--
Education 12 years	-19 (11)	-84 ** (16)	-39 ** (15)	-31 (19)	--
Education missing	--	-129 ** (24)	-41 (116)	-317 ** (77)	--
Urban	-14 (10)	-3 (12)	-20 * (9)	-3 (11)	--
Prenatal care from public health clinic	24 * (10)	--	--	--	--
R^2	.113	.118	.109	.105	.091
Sample Size	31,732	11,547	20,688	11,773	25,710

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

TABLE V.2

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON BIRTHWEIGHT: GESTATIONAL AGE < 37 WEEKS

(Standard Errors in Parentheses)

	Coefficients (grams)				
Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	2,569 ** (73)	2,183 ** (123)	2,197 ** (81)	2,377 ** (114)	2,261 ** (50)
Prenatal WIC Participation	**150 **** (26)	**138 **** (49)	**238 **** (29)	**259 **** (40)	**165 **** (24)
Newborn Characteristics					
Male	65 ** (25)	-8 (48)	90 ** (28)	111 ** (38)	110 ** (23)
Multiple Birth	-791 ** (48)	-255 ** (73)	-776 ** (53)	-803 ** (74)	-893 ** (48)
Mother Characteristics					
Age 18-19	14 (46)	108 (97)	34 (50)	-23 (67)	118 ** (41)
Age 20-34	-48 (44)	54 (90)	3 (48)	56 (60)	88 * (37)
Age 35 and over	-178 * (82)	330 * (147)	-39 (102)	-92 (136)	79 (68)
Black[a]	-54 (31)	-123 (72)	-61 (35)	-67 (53)	42 (32)
Hispanic[a]	98 (54)	--	--	--	114 (30)
Native American	--	129 (116)	--	--	--
Asian	--	210 (115)	--	--	--
Other race/ethnicity[a]	197 (136)	--	--	--	99 (75)
Not married	10 (31)	30 (54)	51 (37)	50 (50)	26 (25)
Kessner Index intermediate	53 (29)	31 (60)	107 ** (36)	71 (46)	140 ** (34)
Kessner Index inadequate	-92 ** (35)	61 (72)	27 (52)	39 (53)	-133 ** (35)
Kessner Index unknown	-237 * (111)	-128 (73)	503 ** (45)	-95 (205)	-476 ** (34)
Previous live births (number)	29 ** (10)	52 ** (20)	58 ** (13)	--	39 ** (9)
Pregnancy terminations $\leq$ 20 weeks	--	-135 ** (31)	--	--	--

TABLE V.2 (continued)

Explanatory Variables	Coefficients (grams)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	-115 (120)	-143 ** (25)	--	-182 ** (49)
Education < 9 years	0 (63)	-37 (134)	117 (72)	-49 (98)	--
Education 9-11 years	-33 (46)	-126 (83)	119 * (54)	-98 (73)	--
Education 12 years	-19 (43)	-14 (75)	108 * (50)	-54 (70)	--
Education missing	--	-223 * (106)	-339 (342)	-380 (218)	--
Urban	-75 (38)	50 (55)	-68 * (28)	-44 (39)	--
Prenatal care from public health clinic	86 * (39)	--	--	--	--
R^2	.081	.079	.123	.087	.137
Sample Size	4,093	973	3,625	1,820	4,788

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

TABLE V.3

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON BIRTHWEIGHT: GESTATIONAL AGE ≥ 37 WEEKS

(Standard Errors in Parentheses)

	Coefficients (grams)				
Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	3,412 ** (18)	3,492 ** (26)	3,398 ** (21)	3,366 ** (29)	3,272 ** (15)
Prenatal WIC Participation	**29 **** (6)	**16** (11)	**42 **** (89)	**30 **** (12)	**25 **** (7)
Newborn Characteristics					
Male	142 ** (6)	132 ** (10)	125 ** (8)	104 ** (10)	124 ** (7)
Multiple Birth	-745 ** (25)	-761 ** (38)	-788 ** (31)	-725 ** (40)	-713 ** (27)
Mother Characteristics					
Age 18-19	-12 (12)	-41 (22)	-20 (15)	-6 (19)	10 (13)
Age 20-34	-37 ** (11)	-65 ** (21)	-36 * (15)	8 (17)	12 (12)
Age 35 and over	-63 ** (22)	-94 ** (34)	-27 (31)	23 (36)	95 ** (23)
Black[a]	-151 ** (7)	-187 ** (18)	-146 ** (9)	-146 ** (12)	-130 ** (10)
Hispanic[a]	1 (11)	--	--	--	5 (9)
Native American	--	93 ** (19)	--	--	--
Asian	--	-189 ** (24)	--	--	--
Other race/ethnicity[a]	-107 ** (37)	--	--	--	10 (20)
Not married	-55 ** (7)	40 ** (11)	-16 (10)	-60 ** (12)	-34 ** (7)
Kessner Index intermediate	-19 ** (7)	-52 ** (11)	-47 ** (8)	-20 (11)	-25 ** (8)
Kessner Index inadequate	-148 ** (10)	-165 ** (18)	-169 ** (16)	-125 ** (15)	-101 ** (10)
Kessner Index unknown	-80 * (31)	-90 ** (18)	-116 (80)	-308 ** (44)	-42 * (19)
Previous live births (number)	17 ** (3)	35 ** (4)	31 ** (4)	--	23 ** (3)
Pregnancy terminations ≤ 20 weeks	--	-8 (7)	--	--	--

TABLE V.3 (continued)

Explanatory Variables	Coefficients (grams)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	-60 (31)	-21 ** (7)	--	-45 ** (15)
Education < 9 years	-60 ** (15)	-121 ** (30)	-152 ** (21)	-87 ** (25)	--
Education 9-11 years	-70 ** (11)	-149 ** (16)	-113 ** (14)	-62 ** (18)	--
Education 12 years	-22 * (10)	-84 ** (14)	-46 ** (13)	-8 (17)	--
Education missing	--	-134 ** (23)	57 (106)	-262 ** (74)	--
Urban	-8 (9)	-5 (11)	-13 (8)	-11 (10)	--
Prenatal care from public health clinic	2 (9)	--	--	--	--
R^2	.090	.103	.081	.083	.072
Sample Size	26,795	10,022	17,063	9,872	20,922

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

In general, the patterns of the estimated effects of prenatal WIC participation on Medicaid costs and birthweight are consistent with the explanation that relatively heavier babies have relatively lower-cost births. The smallest effects on birthweight and Medicaid costs are observed in Minnesota, while the largest effects for birthweight and Medicaid costs are observed in North Carolina and South Carolina.

As shown in Table V.1, several other variables are important predictors of newborn birthweight:

- Male newborns have significantly higher average birthweights than female newborns, and multiple births have significantly lower average birthweights than singleton births.
- In all five study states, newborns of black mothers receiving Medicaid have lower average birthweights than newborns of white mothers receiving Medicaid. In Minnesota, average birthweight is significantly lower for newborns of Asian mothers receiving Medicaid and significantly higher for newborns of Native American mothers receiving Medicaid than for newborns of white Medicaid mothers.
- In all five states, receiving inadequate levels of prenatal care is associated with lower average birthweights of Medicaid newborns. Medicaid mothers with missing data on the Kessner Index have newborns with lower average birthweights than Medicaid mothers with adequate or intermediate levels of prenatal care.
- The number of previous live births is positively associated with newborn birthweight for Medicaid beneficiaries, and the number of pregnancy terminations is negatively related to newborn birthweight of Medicaid beneficiaries.
- For Medicaid beneficiaries, newborn birthweight is positively related to mother's education. Medicaid mothers who did not complete 12 years of schooling or less have newborns with significantly lower birthweights than Medicaid mothers who complete more than 12 years of education.

Prenatal WIC participation by Medicaid beneficiaries is also associated with longer gestational age, as shown in Table V.4. The increase in gestational age ranged from roughly one-quarter of a week in Minnesota to almost three-quarters of a week in North Carolina. These estimated gestational age effects should be interpreted with some caution, however,

TABLE V.4

ESTIMATED REGRESSION COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON GESTATIONAL AGE

(Standard Errors in Parentheses)

Explanatory Variables	Coefficients (weeks)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	39.587 ** (.104)	39.441 ** (.121)	39.691 ** (.130)	39.378 ** (.177)	39.385 ** (.084)
Prenatal WIC Participation	.392 ** (.037)	.247 ** (.049)	.746 ** (.053)	.622 ** (.070)	.417 ** (.041)
Newborn Characteristics					
Male	.0004 (.036)	-.028 (.045)	-.110 * (.048)	-.155 ** (.061)	-.135 ** (.040)
Multiple Birth	-3.145 ** (.121)	-3.030 ** (.141)	-3.113 ** (.149)	-3.132 ** (.198)	-3.092 ** (.130)
Mother Characteristics					
Age 18-19	.365 ** (.070)	.166 (.101)	.366 ** (.090)	.249 * (.115)	.384 ** (.076)
Age 20-34	.459 ** (.066)	.226 * (.096)	.361 ** (.087)	.314 ** (.104)	.355 ** (.069)
Age 35 and over	.082 (.127)	.227 (.159)	-.178 (.187)	-.108 (.220)	-.147 (.133)
Black[a]	-1.020 ** (.042)	-.626 ** (.081)	-.809 ** (.057)	-.762 ** (.076)	-.690 ** (.056)
Hispanic[a]	-.296 ** (.067)	--	--	--	-.369 ** (.050)
Native American	--	.058 (.091)	--	--	--
Asian	--	.041 (.111)	--	--	--
Other race/ethnicity[a]	-.646 ** (.217)	--	--	--	-.251 (.118)
Not married	-.067 (.042)	-.033 (.051)	-.068 (.059)	-.310 ** (.073)	-.104 * (.043)
Kessner Index intermediate	.063 (.039)	-.141 ** (.051)	-.774 ** (.051)	.164 * (.069)	.102 * (.046)
Kessner Index inadequate	-.639 ** (.057)	-.866 ** (.083)	-1.145 ** (.092)	-.233 * (.092)	-.424 ** (.058)
Kessner Index unknown	-.216 (.180)	-.858 ** (.082)	-.828 (.465)	2.038 ** (.275)	-.324 ** (.110)
Previous live births (number)	-.055 ** (.015)	.032 (.020)	.042 (.024)	--	-.028 (.016)
Pregnancy terminations ≤ 20 weeks	--	-.163 ** (.031)	--	--	--

TABLE V.4 (continued)

Explanatory Variables	Coefficients (weeks)				
	Florida	Minnesota	North Carolina	South Carolina	Texas
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	-.122 (.142)	-.137 ** (.042)	--	-.150 (.085)
Education < 9 years	-.004 (.089)	-.315 * (.139)	-.251 * (.125)	-.286 (.155)	--
Education 9-11 years	.006 (.064)	-.187 * (.076)	-.102 (.086)	-.173 (.110)	--
Education 12 years	.001 (.061)	-.124 (.066)	-.100 (.080)	-.069 (.105)	--
Education missing	--	-.204 (.108)	-.824 (.642)	-1.139 ** (.432)	--
Urban	-.059 (.054)	-.034 (.050)	.076 (.048)	.098 (.062)	--
Prenatal care from public health clinic	.267 ** (.054)	--	--	--	--
R^2	.063	.074	.067	.050	.042
Sample Size	30,902	11,012	20,051	11,692	24,253

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

since, as noted in Chapter IV, it is likely that gestational age and prenatal WIC participation are simultaneously related. That is, women with longer gestational ages also have more time to become prenatal WIC participants than women with shorter gestational ages.

Tables V.5 and V.6 present estimated probit coefficients for models of the effects of prenatal WIC participation on the incidence of low birthweight (newborn birthweight less than 2,500 grams) and the incidence of preterm birth (birth before 37 weeks gestation). As noted earlier, the dependent variables for these analyses are binary, equal to one if the newborn is low birthweight (Table V.5) or if there is a preterm birth (Table V.6) and equal to zero otherwise. The estimated probit coefficients presented in the tables do not have an intuitive interpretation except to show the direction of the effects of the variables on the likelihood or probability of the event (i.e., low birthweight or preterm birth) occurring. However, the estimated coefficients can be used to calculate the predicted probability of low birthweight and a preterm birth with and without prenatal WIC participation. These predicted probabilities are shown in Table V.7 and indicate that prenatal WIC participation by Medicaid recipients is associated with both a lower probability of low birthweight and a lower probability of preterm birth. The estimated reduction in the percentage of women who gave birth to low-birthweight Medicaid newborns ranges from 2.2 percentage points for Minnesota to 5.1 percentage points for North Carolina and South Carolina, with values of 3.3 and 3.4 percentage points for Florida and Texas, respectively. Similarly, the estimated reduction in the percentage of Medicaid mothers with preterm births ranges from 2.3 percentage points for Minnesota to 6.3 percentage points for South Carolina.

C. ANALYTIC ISSUES

Two of the three key analytic issues discussed in the interpretation of the findings from the analysis of Medicaid costs are also relevant to the analysis of birth outcomes. These issues are (1) selection bias and (2) the timing of enrollment in the WIC program. As noted in Chapter IV, selection bias is a problem if unobserved differences between WIC participants and nonparticipants would lead to differences in birth outcomes even in the absence of the WIC program. While econometric estimation procedures are available to correct impact estimates for potential selection bias and were attempted in this analysis, the design of this study was such that the selection bias models estimated in this study for both Medicaid costs and birth outcomes resulted in very unstable and unrealistic estimates of the effects of prenatal WIC participation.

TABLE V.5

ESTIMATED PROBIT COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON THE INCIDENCE OF LOW BIRTHWEIGHT

(Standard Errors in Parentheses)

Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	-1.422 ** (.058)	-1.632 ** (.096)	-1.384 ** (.064)	-1.209 ** (.090)	-1.149 ** (.045)
Prenatal WIC Participation	-.191 ** (.020)	-.152 ** (.038)	-.258 ** (.025)	-.264 ** (.033)	-.202 ** (.023)
Newborn Characteristics					
Male	-.120 ** (.020)	-.121 ** (.035)	-.084 ** (.023)	-.092 ** (.031)	-.090 ** (.022)
Multiple Birth	1.711 ** (.050)	1.689 ** (.078)	1.679 ** (.057)	1.657 ** (.080)	1.638 ** (.053)
Mother Characteristics					
Age 18-19	-.048 (.038)	-.087 (.076)	-.017 (.044)	-.080 (.057)	-.141 ** (.040)
Age 20-34	.026 (.036)	.014 (.071)	.050 (.042)	-.078 (.051)	-.094 ** (.036)
Age 35 and over	.266 ** (.066)	.015 (.124)	.180 * (.087)	.136 (.104)	.012 (.070)
Black[a]	.272 ** (.023)	.373 ** (.056)	.222 ** (.028)	.172 ** (.040)	.120 ** (.029)
Hispanic[a]	-.085 ** (.041)	--	--	--	-.096 ** (.028)
Native American	--	-.239 ** (.079)	--	--	--
Asian	--	-.071 (.088)	--	--	--
Other race/ethnicity[a]	-.104 (.134)	--	--	--	-.192 ** (.072)
Not married	.037 (.024)	.038 (.041)	-.067 * (.029)	-.064 (.038)	.025 (.024)
Kessner Index intermediate	.004 (.023)	.117 ** (.044)	.282 ** (.026)	.035 (.037)	.004 (.027)
Kessner Index inadequate	.369 ** (.029)	.505 ** (.059)	.412 ** (.042)	.315 ** (.044)	.251 ** (.031)
Kessner Index unknown	.274 ** (.053)	.371 (.055)	.520 ** (.058)	.430 ** (.101)	.230 ** (.041)
Previous live births (number)	-.014 (.008)	-.063 ** (.016)	.061 ** (.012)	--	-.034 * (.009)
Pregnancy terminations $\leq$ 20 weeks	--	.094 ** (.022)	--	--	--

TABLE V.5 (continued)

Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	-1.422 ** (.058)	-1.632 ** (.096)	-1.384 ** (.064)	-1.209 ** (.090)	-1.149 ** (.045)
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	.183 (.097)	.108 ** (.019)	--	.172 ** (.041)
Education < 9 years	.033 (.050)	.321 ** (.109)	.160 ** (.060)	.053 (.079)	--
Education 9-11 years	.078 * (.036)	.272 ** (.065)	.118 ** (.042)	.070 (.056)	--
Education 12 years	.002 (.034)	.195 ** (.058)	.032 (.039)	.032 (.054)	--
Education missing	--	.252 ** (.080)	.076 (.298)	.441 * (.181)	--
Urban	.030 (.031)	-.011 (.041)	.054 * (.023)	-.033 (.031)	--
Prenatal care from public health clinic	-.091 ** (.031)	--	--	--	--
Sample Size	31,734	11,547	20,696	11,773	25,710

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The dependent variable is equal to one if newborn birthweight is less than 2,500 grams (5.5 pounds), and equal to zero otherwise. The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

TABLE V.6

ESTIMATED PROBIT COEFFICIENTS FOR A MODEL OF THE EFFECT OF PRENATAL WIC PARTICIPATION ON THE INCIDENCE OF PRETERM BIRTH

(Standard Errors in Parentheses)

Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	-1.150 ** (.054)	-1.399 ** (.093)	-1.465 ** (.063)	-1.114 ** (.085)	-1.152 ** (.043)
Prenatal WIC Participation	-.170 ** (.191)	-.125 ** (.038)	-.242 ** (.025)	-.261 ** (.032)	-.205 ** (.021)
Newborn Characteristics					
Male	.010 (.018)	-.001 (.035)	.025 (.023)	.027 (.029)	.042 * (.021)
Multiple Birth	.973 ** (.049)	1.244 ** (.079)	1.026 ** (.057)	.959 ** (.078)	.935 ** (.054)
Mother Characteristics					
Age 18-19	-.161 ** (.035)	-.114 (.074)	-.143 ** (.042)	-.192 ** (.052)	-.155 ** (.038)
Age 20-34	-.199 ** (.033)	-.147 * (.071)	-.120 ** (.040)	-.181 ** (.047)	-.183 ** (.034)
Age 35 and over	-.047 (.063)	.002 (.118)	.050 (.085)	-.096 (.102)	-.053 (.065)
Black[a]	.303 ** (.021)	.163 ** (.057)	.285 ** (.028)	.196 ** (.038)	.237 ** (.029)
Hispanic[a]	-.047 (.035)	--	--	--	.069 ** (.265)
Native American	--	-.303 ** (.079)	--	--	--
Asian	--	-.205 * (.087)	--	--	--
Other race/ethnicity[a]	-.257 ** (.044)	--	--	--	.101 (.061)
Not married	.084 ** (.022)	.017 (.040)	.018 (.029)	.158 ** (.036)	.073 ** (.022)
Kessner Index intermediate	.006 (.021)	.073 (.042)	.603 ** (.025)	.028 (.034)	.032 (.024)
Kessner Index inadequate	.286 ** (.028)	.560 ** (.058)	.649 ** (.040)	.279 ** (.042)	.242 ** (.029)
Kessner Index unknown	.181 * (.087)	.534 ** (.057)	.673 ** (.191)	-.239 (.142)	.204 ** (.054)
Previous live births (number)	.031 ** (.008)	-.033 * (.016)	-.026 * (.011)	--	.021 ** (.008)
Pregnancy terminations $\leq$ 20 weeks	--	.053 * (.023)	--	--	--

TABLE V.6 (continued)

Explanatory Variables	Florida	Minnesota	North Carolina	South Carolina	Texas
Intercept	-1.150 ** (.054)	-1.399 ** (.093)	-1.465 ** (.063)	-1.114 ** (.085)	-1.152 ** (.043)
Mother Characteristics (continued)					
Pregnancy terminations > 20 weeks	--	.091 (.101)	.050 ** (.020)	--	.056 (.042)
Education < 9 years	-.025 (.046)	.225 * (.104)	.184 ** (.060)	.167 * (.074)	--
Education 9-11 years	-.012 (.034)	.057 (.061)	.109 ** (.042)	.104 * (.054)	--
Education 12 years	-.030 (.032)	.029 (.054)	.099 * (.039)	.102 * (.051)	--
Education missing	--	.107 (.082)	-.042 (.309)	.368 * (.184)	--
Urban	-.026 (.028)	.011 (.040)	-.027 (.023)	-.081 ** (.029)	--
Prenatal care from public health clinic	.001 (.002)	--	--	--	--
Sample Size	30,907	11,012	20,059	11,692	24,253

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The dependent variable is equal to one if gestational age is less than 37 weeks, and equal to zero otherwise. The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tailed test.

[a]Racial/ethnicity groups varied across states. In North Carolina and South Carolina, a small number of women classified neither as white nor black are included with black women. In Texas, "black" means "black, nonspanish," "Hispanic" means "Mexican," and "Other race/ethnicity" means "other Hispanic." In Florida, "other race/ethnicity" means "Native American or Asian."

TABLE V.7

ESTIMATED EFFECTS OF PRENATAL WIC PARTICIPATION ON THE PROBABILITY OF LOW BIRTHWEIGHT AND THE PROBABILITY OF PRETERM BIRTH

	Probability of Predicted Low Birthweight (%)	Probability of Predicted Preterm Birth (%)
Florida		
With WIC Program	9.5	11.8
Without WIC Program	12.8	15.3
Estimated Effect of WIC Participation	-3.3	-3.5
Minnesota		
With WIC Program	7.8	10.4
Without WIC Program	10.0	12.7
Estimated Effect of WIC Participation	-2.2	-2.3
North Carolina		
With WIC Program	11.1	13.2
Without WIC Program	16.2	18.6
Estimated Effect of WIC Participation	-5.1	-5.4
South Carolina		
With WIC Program	11.7	13.9
Without WIC Program	16.8	20.2
Estimated Effect of WIC Participation	-5.1	-6.3
Texas		
With WIC Program	8.8	11.5
Without WIC Program	12.2	15.7
Estimated Effect of WIC Participation	-3.4	-4.2

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn. All estimated effects of prenatal WIC participation are statistically significant at the .01 level.

The issue of the timing of enrollment in the WIC program reflects the difficulty in estimating a dose-response effect of prenatal WIC participation due to the confounding of the timing of WIC enrollment and gestational age. To examine this issue, Table V.8 presents selected results from three specifications of the birthweight regression equation: (1) the basic birthweight model, as shown in Table V.1; (2) a model with the same set of independent variables from the basic model and two additional independent variables--first trimester WIC enrollment and gestational age; and (3) the basic model with a revised definition of prenatal WIC participation.

The first row shows the regression estimates presented in Table V.1 of the effects of prenatal WIC participation on newborn birthweight. Estimated coefficients for prenatal WIC participation, first trimester WIC enrollment, and gestational age are presented in the second cell of Table V.8. As noted earlier, these results should be interpreted with caution given the potential endogeneity of gestational age. With this caveat in mind, the most striking finding is that average newborn birthweight is higher for first trimester WIC enrollees than for later enrollees. In all five states, the estimated coefficients of first trimester WIC enrollment are highly significant and of appreciable magnitude, ranging from 29 grams in South Carolina to 73 grams in Florida. The sum of the coefficients of prenatal WIC participation and first trimester WIC enrollment gives the overall estimated effect of prenatal WIC participation for first trimester WIC enrollees, after controlling for gestational age. Thus, enrollment in the first trimester of pregnancy is associated with increases in newborn birthweight that ranged from 30 grams in Minnesota to 76 grams in South Carolina to 95 grams, 97 grams, and 98 grams in North Carolina, Texas, and Florida, respectively.

These findings are generally consistent with the findings from the analysis of Medicaid costs discussed in Chapter IV. That is, higher average newborn birthweight for first trimester WIC enrollees is generally reflected by lower levels of newborn and maternal Medicaid costs. However, the estimated coefficients of first trimester WIC enrollment in the Medicaid cost regression equations are not statistically significant at conventional two-tailed levels, in contrast to the highly significant coefficients in the birthweight regression equations. These findings suggest that prenatal WIC participation may have beneficial effects on

TABLE V.8

ESTIMATED COEFFICIENTS OF PRENATAL WIC PARTICIPATION, FIRST TRIMESTER WIC ENROLLMENT, AND GESTATIONAL AGE: BIRTHWEIGHT MODELS

(Standard Errors in Parentheses)

	Coefficients (grams)				
Model Specification	Florida	Minnesota	North Carolina	South Carolina	Texas
Prenatal WIC Participation	73 ** (7)	51 ** (12)	117 ** (10)	113 ** (13)	77 ** (8)
Prenatal WIC Participation	25 ** (6)	-5 (11)	32 ** (9)	47 ** (13)	26 ** (7)
First Trimester WIC Enrollment	73 ** (11)	35 ** (11)	63 ** (11)	29 * (12)	71 ** (14)
Gestational Age (Weeks)	87 ** (1)	150 ** (2)	87 ** (1)	84 ** (2)	88 ** (1)
Revised Prenatal WIC Participation[a]	71 ** (7)	46 ** (12)	112 ** (10)	111 ** (13)	58 ** (8)

SOURCE: WIC/Medicaid newborn analysis file for Florida, Minnesota, North Carolina, South Carolina, and Texas.

NOTE: The unit of observation is the newborn.

*(**): Significant at the .05 (.01) level, two-tail test.

[a]Revised prenatal WIC participation is defined as follows: for Florida, Minnesota, and North Carolina, WIC participants who enrolled after 36 weeks gestation and redeemed less than $55 worth of food instruments were considered nonparticipants; for South Carolina, WIC participants who enrolled after 36 weeks and were issued less than two food instruments were considered nonparticipants; and for Texas, WIC participants who enrolled after 36 weeks were considered nonparticipants.

birth outcomes that are not fully reflected by reductions in Medicaid costs.[2]

The final set of results presented in Table V.8 show the estimated effects of prenatal WIC participation when very late enrollees in the WIC program are reclassified as nonparticipants. To review briefly, women who enrolled after 36 weeks gestation and redeemed or were issued fewer than two months worth of food instruments were considered nonparticipants. Given the lack of data on food instruments for Texas, this definition was modified such that women enrolling after 36 weeks gestation were considered nonparticipants. In Texas, a greater proportion of WIC participants were reclassified as nonparticipants than in the other states.

With the exception of Texas, the revised definition of prenatal WIC participation reduces only slightly the estimated effects of prenatal WIC participation on birthweight (from 2 to 5 grams). In Texas, the estimated increase in birthweight attributed to prenatal WIC participation fell 19 grams from 77 grams to 58 grams.

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[2]For example, first trimester WIC enrollees may be heavier than average users of publicly funded health care, which translates into higher than expected use of health care services after birth (e.g., postpartum check-ups, infant check-ups).

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