The Dynamics of Prenatal WIC Participation and the Role of Past Participation

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Abstract:

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides food vouchers, nutritional counseling, and health care referrals to low-income pregnant and breastfeeding women and their young children. This paper uses non-parametric and parametric duration models to study the factors that influence the timing of prenatal WIC participation among eligible women. The estimates show that black and Hispanic women, women with low levels of education, women who participate in other welfare programs and who have no insurance, and women who are overweight participate in WIC earlier than others. Thus, there appears to be negative selection on observables across a number of dimensions. The model is extended to allow past WIC participation to influence current WIC participation, and past participation is found to be the most important determinant of current participation. This result suggests that policies reach out to women who have not received WIC before may be especially beneficial. Finally, policy simulations show that recent policy changes requiring income documentation while also making recipients of other programs automatically eligible for WIC have off-setting effects with a small net increase in participation.

Keywords: Duration Analysis, WIC Program.

1. Introduction

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides food vouchers, nutritional counseling, and health care referrals to low-income pregnant and breastfeeding women and their young children. In 2002 it served 7.5 million people each month at an annual cost of $4.4 trillion. While many studies have examined the effect of WIC participation on infant health (Kennedy et al. 1982, Kotelchuck et al. 1984, Rush 1988, Gordon and Nelson 1995, Brien and Swann 2001), Medicaid Costs (Devaney, et al. 1992), and numerous other health outcomes (Rush 1988, Gordon and Nelson 1995), remarkably little of this research has addressed the decision to participate in WIC or the timing and duration of participation. Of the outcome studies listed above, only Gordon and Nelson (1995) and Brien and Swann (2001) consider participation decisions. Gordon and Nelson (1995) provide descriptive information about the month at which participation began and the number of months of participation, but they do not model this behavior. More recently, Brien and Swann (2001) and Bitler, Currie, and Scholz (2003) estimate simple models of the decision to participation in WIC at any point in a pregnancy, but they do not model the timing or duration of participation.

Understanding the factors that affect the decision to participate in WIC and the timing and duration of participation is important for a number of reasons. First, from a policy perspective, knowing the factors that are associated with late enrollment (or non-participation) will help target resources toward vulnerable women. Reaching these women early may increase the benefit they receive from the program. This idea is supported by the prenatal care literature where adequate care is defined as care that begins early in a pregnancy and is received regularly thereafter (Kessner et al. 1973, Kotelchuck 1994). Similarly, early enrollment in WIC may be more beneficial than late enrollment, if, for example, receiving nutritious food for longer periods

of time during pregnancy has a larger effect on birth outcomes than receiving such food over a shorter period of time.

Second, understanding which factors are associated with timely participation will help shape the on-going discussion of the importance of selection bias in the estimates of WIC's effect on birth outcomes. For example, knowing that WIC recipients are negatively selected on most or all observed characteristics presumably increases the likelihood that they are negatively selected on unobserved characteristics as well.

This is the first paper to study the timing of participation using survival analysis to understand the characteristics that affect the probability of participation during each month of pregnancy.[1] Parametric and non-parametric survival analysis techniques are used to examine the relationship among recipient characteristics, state characteristics, WIC program rules, and the timing of participation. The results show that WIC recipients are negatively selected on a number of observed characteristics such as age, education, resources (e.g., income, insurance), and health status. It is also the first paper to highlight the role of past WIC participation. This analysis shows that past WIC participation is the largest single determinant of current participation. Consequently, the model is estimated separately for women who have received WIC in the past and those who have not. These results show that state characteristics and resources are particularly important for women who have not received WIC in the past. Finally, policy simulations show that recent policy changes requiring income documentation while also making recipients of other programs automatically eligible for WIC have off-setting effects with a small net increase in participation.

[1] Survival analysis has been used to examine participation in other welfare programs including AFDC (Blank 1989) and Medicaid (Black and Berger 1998). Lancaster (1990) provides an overview of these methods.

2. Brief Description of the WIC Program

The WIC program was enacted in 1974 to provide food vouchers, nutritional education, and health screening and referrals to low income (typically income less than 185 percent of poverty) women, infants, and children who are "nutritionally needy." WIC recipients receive three types of benefits. Perhaps the most well known benefit is food vouchers that may only be used to purchase a limited number of healthy foods. Additionally, the program 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 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.

Each of these benefits may have a larger effect on maternal and child health if received early in the pregnancy, and the food vouchers and behavioral counseling may be more beneficial if received for longer periods of time. For example, nutritious food received throughout the pregnancy may have a larger effect on birth outcomes than food received only during the last month. Increased exposure to WIC may also increase the effectiveness of behavioral counseling if, for example, advice about quitting smoking or receiving prenatal care is more likely to change behavior if it is heard repeatedly. Finally, referrals for health care may be more effective if they are received early in the pregnancy so that adverse health conditions can be quickly addressed. Thus, the efficacy of each type of benefit may be greater if it is received early in the pregnancy.[2]

[2] Gordon and Nelson (1995) and Devaney, et al. (1992), among others, explore the role of early versus late participation in WIC on birth outcomes, but they do not model the timing of participation.

3. Data

3.1 National Maternal and Infant Health Survey

The primary data for this analysis come from the National Maternal and Infant Health Survey (NMIHS). Although collected in 1988, these data are well-suited for this study for two reasons. First, the purpose of the original data collection was to study adverse pregnancy outcomes. Consequently, the NMIHS is a large sample of *pregnant* women. Second, a number of questions focused specifically on WIC participation. Most relevant for this study, women were asked whether they received WIC food in each month of their pregnancy. From these data it is possible to construct a month-by-month history of WIC participation for the 1988 pregnancy. The questionnaire data also include detailed demographic information such as age, education, and race; information on the mother's behavior during the pregnancy (e.g., participation in other welfare programs); household income; and state of residence.

In constructing the estimation data, I confronted two issues. First, the data include information on month of WIC participation while gestational age at birth is in weeks. For some of the analysis it will be helpful to have these variables in the same units. In these cases, I assume that each month is four and one-third weeks long (and round the resulting fractions to whole months) and that women start participating on the first week of each month.

The second issue is how to determine eligibility for WIC. I consider two sources of eligibility. The first is adjunctive eligibility. In 1988, some states automatically deemed AFDC, Medicaid, or Food Stamp recipients eligible for WIC. From another data source (discussed below) I have information on which states allowed this, and I assume that anyone living in one of these states who participated in the appropriate program is eligible for WIC.

The second source of eligibility is the standard income test. The NMIHS reports a number of income variables including household income in dollars for a number of sources and

bracketed overall household income (i.e., indicators equal to one if household income is between $0 and $5,000; $5,001 to $10,000, etc). To determine which families are income eligible, the following procedure is used: if household wage income is available, compare this amount to 185% of the poverty line; if income is less than the cutoff, the family is eligible. If wage income is missing and if bracketed household income is available, use the lower bound of the relevant income bracket as the measure of income and make the same comparison. The lower bound is used because the measure of household income is likely to contain non-wage income.[3] Finally, if no income measure is available, then the observation is dropped.[4]

Table 1 presents means of variables used in the analysis for the entire sample, participants, eligible non-participants, and ineligible women. The table shows that *eligible* women are younger, have less education, are more likely to be black, and are more likely to participate in other welfare programs when compared to ineligible women.

Compared to eligible non-recipients, *WIC recipients* are negatively selected on a number of characteristics. They are younger, less educated, more likely to be a member of a minority group, more likely to have low income, more likely to participate in other welfare programs, less likely to be married, and more likely to have poor health. There are particularly large difference in the percentage of the women who are black or Hispanic and in those who receive other government benefits.

Although not used to construct the eligible sample, women must also have some type of documented nutritional risk. The section "Health Variables" compares the groups across a number of health measures that are also risk factors for WIC eligibility. The means of the health variables contain both good and bad news. The good news is that WIC participants are more likely to be overweight or obese than eligible non-recipients. They are also more likely to have

[3] The results are not sensitive to the choice of the lower bound.
[4] The conclusions of the paper are not significantly altered if the women with missing income are included

experienced a previous adverse pregnancy outcome (miscarriage or stillbirth). This is good news because it means that the program is reaching women who are in poor health. The bad news is that over 16 percent of eligible non-recipients are either overweight or obese, and these women are not being served by the WIC program.

3.2 State Characteristics

The likelihood of WIC participation and timing of this decision may depend on the ease with which one can apply for WIC and on the general atmosphere toward social programs faced by each recipient. To account for these influences, a number of state-level characteristics (and region dummies) are included in the analysis. Some of these variables are related to the WIC program and some are not. Variables in the latter group include the maximum AFDC benefit for a family of two; spending per 1,000 people on Title IV-B of the Social Security Act; indicator variables equal to one if the governor is a Republican, if the state house is controlled by Republicans, or if the state senate is controlled by Republicans; and indicator variables for the northeast, north central, and west regions.[5] The first two variables measure the generosity of two programs that affect child wellbeing; the next three measure the political climate in the state; finally, the region dummies capture unmeasured differences at the region level.[6]

Much of the analysis also includes measures of WIC program rules that may affect the ease of participation. These variables come from the 1988 Survey of WIC Program Characteristics. From this survey I create three variables to describe the program. The first is an indicator equal to one if a recipient may self-declare income and equal to zero if the recipient must produce income documentation. The last two are indicators equal to one if the states make

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in the analysis along with a variable that indicates if income is missing.

[5] Title IV-B is a program that funds child welfare programs. Spending on this program thus proxies for a state's commitment to its most vulnerable children.

[6] Ideally the analysis would included state effects rather than region effects. The fact that the data are a

AFDC or Medicaid recipients adjunctively eligible for WIC. A fourth variable used to characterize the availability of WIC is the number of WIC clinics per 1,000 pregnant women. Descriptive statistics for these variables are included in the "WIC Program Variables" section of Table 1.

3.3 Descriptive Analysis of WIC Spells

The central focus of this paper is the timing of entry into WIC, and Table 2 presents the unweighted distribution of month of initial entry into WIC for the sample. It is clear from this table that there is substantial heterogeneity in timing of entry into WIC. It is not the case that women begin participating in the first month or two or that most women begin participating in the last month.

While recidivism is a frequent concern with other means-tested programs, it has not been a topic of consideration in the previous WIC literature. Table 3 documents the fact that relatively few women experience multiple spells of participation during a single pregnancy – at least not at the monthly level. The role of repeat participation across pregnancies will be explored in detail in Section 5 below, but Table 1 shows that current WIC participants are over three times more likely to have previously participated than are eligible women who have not previously participated.

4. Survival Analysis

Survival analysis techniques are used to examine how the probability of entering the WIC program evolves over the course of the pregnancy and how this probability is affected by observed characteristics such as age, education, participation in other welfare programs, and WIC program rules.

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cross-section preclude that.

All of the survival analysis focuses on women who are eligible for WIC. When a woman who is eligible for WIC becomes pregnant, she becomes "at-risk" for prenatal WIC participation. The *hazard rate* for beginning a WIC spell at time (month) *t* is defined as the probability that a woman enters the WIC program at time *t* given that she has not done so before this time. Thus, the hazard rate for entering WIC during the second month of the pregnancy is the probability that a woman who did not participate in WIC during the first month of her pregnancy begins to participate in the second month. The *survivor function* gives the probability that a woman has not yet entered the WIC program at some time period *t* – it is the probability that she "survives" in the non-participation choice.

4.1 Kaplan-Meier

Two different approaches to survival analysis are used. The first, the *Kaplan-Meier Estimator*, makes no assumptions about the mathematical form of the hazard function and allows the data alone to determine the shape of the hazard function. To calculate the Kaplan-Meier hazard function, define n_t as the number of women at risk of entering the WIC program at time t and p_t as the number of women who begin to participate at time t. The Kaplan-Meier estimate of the hazard function at time t, $\lambda(t)$, is the fraction of eligible, uncensored women who begin to participate in WIC during month t:

$$\hat{\lambda}(t) = \frac{p_t}{n_t},$$

and the corresponding Kaplan-Meier survivor curve can be written as

$$\hat{S}(t) = \prod_{i=1}^{t} (1 - \hat{\lambda}(i)).$$

Kaplan-Meier Survivor curves for different samples are presented in Figures 1 through 5. Figure 1 examines the role of race. The most significant differences are between blacks and whites. By the ninth month, black women are about twenty percentage points more likely than

white women to have begun participating in WIC. Because the distance between the curves widens as time passes, the hazard rate for blacks is higher than for whites over the entire pregnancy rather than being higher only in the first or last months of pregnancy.

Figure 2 extends this analysis to the roles of marriage and race for white and black women. Interestingly, the group that is clearly different from the others is white women who are married. This means that race has very little effect for single women. For whites, marriage has a significant effect on the likelihood of WIC participation while for blacks it has a much smaller effect.

Figure 3 explores the role of education. Women with higher levels of education are less likely to participate in WIC at any point in the pregnancy. In fact, by the ninth month, women with less than a high school education are twice as likely to be participating in WIC when compared to women who have more than a high school education.

The next two graphs focus on the effect of WIC program rules on the timing of participation. Figure 4 considers on the ability of recipients to self-declare income. Being able to self-declare income increases the likelihood of participation by almost 10 percentage points. In Figure 5, the effect of linking eligibility for WIC to Medicaid is also shown to have a positive effect on participation. These results provide some evidence that program rules to play a role in the timing of participation.

In summary, the Kaplan-Meier survivor curves show that black women, single women, women living in states that make participation relatively easy, and women with low education participate earlier in their pregnancies than other women. However, with the exception of the interaction between marriage and race, each of these factors was considered in isolation. It is possible to incorporate multiple characteristics by, for example, extending the analysis in Figure 2 to women who did and did not receive AFDC. However, given the sample size, it is not

possible to do this for very many variables. In order to incorporate a full set of observed characteristics, I turn to parametric hazard rate methods.

4.2 Parametric Hazard Model

The second method of survival analysis allows for the inclusion of covariates. In this case, the hazard function is specified as

$$\lambda_i(t) = \exp\{X_{it}\beta\}\lambda_0(t)$$

where X_{it} is a vector of observed characteristics for woman i at time t, β is a vector of parameters that describe the effect of these characteristics on the hazard rate, and $\lambda_0(t)$ is the "baseline" hazard.

The baseline hazard describes how the hazard rate changes over the course of a spell. For some problems one might expect the hazard rate to either increase or decrease as spell length increases. For example, the probability of leaving the unemployment insurance program may rise as spell lengths increase and recipients near the exhaustion of benefits. Unlike that case, there is no compelling reason to believe the hazard rate into WIC would monotonically rise or fall over the course of the pregnancy.

A number of commonly used baseline specifications (e.g., the Weibull, Gompertz, lognormal, and log-logistic) are available, but each of these specifications imposes potentially important restrictions on the shape of the baseline hazard. For example, the baseline hazard in the Weibull model can only be monotonically increasing or decreasing. To allow for more flexibility, I specify the baseline hazard as a step function that can change in arbitrary ways (Meyer 1990). Because there are only nine potential entry points, I specify a discrete time hazard function and assume the hazard rate remains constant during each month. The hazard function for this model may be specified as

$$\lambda_i(s) = \exp\{X_{is}\beta + g_1 s_1 + \cdots + g_9 s_9\}$$

where the g's are parameters to be estimated and $s_j = 1$ if s is the j^{th} month and zero otherwise.

The log likelihood function for the discrete time model can be written in terms of the hazard function as

$$L(\theta) = \sum_{i=1}^{N} \log\left((1-c_i)\left[\exp\left\{ -\sum_{s=1}^{t_i-1} \lambda_i(s) \right\} \left[1 - \exp\{-\lambda_i(t_i)\right] \right] + c_i \exp\left\{ -\sum_{s=1}^{t_i} \lambda_i(s) \right\} \right)$$

where θ is a vector of all of the unknown parameters in the model (the β's, and the g's), i indexes individuals, $c_i = 1$ if person i's spell is censored and = 0 otherwise, and t_i is the time the spell is censored or the mother enters WIC as appropriate.

The results for a number of different specifications of the hazard function are reported in Table 4. The columns differ only in the variables included in the estimation. The first column includes only demographic and state characteristics, the second adds household resource variables, the third includes health measures, and the last column adds variables that describe the WIC program. The coefficients reported are hazard ratios. For example, in specification 1, the coefficient on "Black" of 1.496 means that the hazard rate for someone who is black is 1.496 times as large as it is for someone who is otherwise identical except that she is white (the base category for race). The hazard rate is decreasing in age and education, and it is lower for white women and women experiencing their first pregnancy.

Among the state characteristics, higher levels of spending on Title IV-B are associated with a higher probability of participating in WIC while higher levels of AFDC benefits and having Republicans in control of any aspect of the state government reduce the rate at which women participate in WIC. The first result may mean that states with relatively high levels of spending on Title IV-B do other things that encourage WIC participation. The negative relationship between WIC and AFDC benefits points to a possible substitution effect where

women who receive relatively high AFDC benefits do not seek out additional benefits from WIC.

Adding the resource variables has a large effect on the coefficients of the demographic variables because these characteristics proxy for a lack of resources. The effect of being young, having low education, and being non-white are all smaller when the resource measures are included in the analysis. The hazard ratios for the resource variables show that women who receive Food Stamps and Medicaid have higher hazards for entry into WIC and women for whom insurance pays for their prenatal care have significantly lower hazards. In contrast, however, receiving AFDC does not significantly increase the likelihood of participation.

The next specification adds four health measures to the previous specification. These include indicators for being underweight, overweight, and obese prior to pregnancy and an indicator equal to one if the woman has experienced a miscarriage or stillbirth during a prior pregnancy. Each of these variables increases the hazard into WIC, and all but being underweight are statistically significant. For example, being overweight increases the likelihood of participation by 26 percent while being obese increases it by 36 percent.

The last column adds the WIC variables to the analysis. They all have the "correct" sign. For example, the hazard rate for women living in states where the can self-declare income is about 1.231 times as large as the hazard in states where recipients must provide documentation. While adding the variables that describe the WIC program has only a small effect on the demographic and resource factors, it has a larger effect on the state characteristics. For example, the importance of Title IV-B funding, being in the Northeast region, and being in the North Central region all become smaller once the WIC variables are included. Given this instability, the WIC characteristics should be seen primarily as additional controls for state characteristics rather

than being viewed as purely causal. A strictly causal interpretation would require panel data on recipients along with changes in the WIC program rules within states over time.

To this point, the discussion of the results has omitted mention of the shape of the baseline hazard. The shape of the hazard over the course of a pregnancy is easiest to see using an average hazard function. To construct this function, the hazard rate is computed using the estimates from the last column of Table 4 and the (weighted) sample average characteristics. The graph of this function is presented in Figure 6. The hazard function a step function with nine different levels corresponding to each month of possible entry. The hazard has a minimum of about 0.009 and a maximum of about 0.036. It is not monotonic and is in fact increasing over the first few months and then decreasing.[7]

One of the advantages of the parametric specification of the hazard is that it is possible to simultaneously control for many variables. Thus, we can reexamine Figure 1 to see how much of the difference in survival probabilities is due to race itself and how much of the difference is due to other factors that are related to race. Figure 7 presents survivor curves derived from the last column of Table 4. Both curves hold all variables except the race variables at their sample averages. The curve for blacks assumes that the average person is black, and the curve for whites assumes that the average person is white. This figure shows that a substantial amount of the difference depicted in Figure 1 is due to factors such as income, education, and participation with other welfare programs that differ between blacks and whites rather than to race itself.

5. The Role of Past WIC Participation

Although Table 3 showed that relatively few women experience multiple spells of participation during a single pregnancy, the Past WIC Participation row of the Resources section

[7] One possible explanation for the declining hazard is unobserved heterogeneity (Heckman and Singer 1984). Because it can be difficult to distinguish the effect of unobserved heterogeneity from a flexible baseline

of Table 1 shows that recipients in 1988 are much more likely to have received WIC in the past. Figure 8 shows that this difference extends to the timing of participation. Of those who participate in WIC, those who have participated in WIC in the past participate earlier than those who have not participated in the past. This difference is reinforced by Figure 9 which shows Kaplan-Meier survivor curves separately for the samples of women who have and have not previously participated in WIC. For a woman who has participated in WIC in the past, the probability of participating in WIC during the 1988 pregnancy is over 80 percent – 30 percentage points – higher than the probability for a woman who has not previously participated in WIC.

There are a number of possible explanations for these differences. It may be the case that women who are repeat recipients are significantly worse off in observed or unobserved ways and are simply more likely to participate in welfare programs. It is not possible to control for previous eligibility because very little information is available about the previous pregnancies (including, for example, income) in the NMIHS. However, repeating Figure 8 and 9 (not reported) for the sample of women who have fewer than 12 years of education, a group that is likely to have been eligible during the previous pregnancies, shows similar patterns. It also may be the case that, however they come to the program the first time, past receipt alters their information and either increases the value or decreases the cost of participation.

To better understand the role of past participation, the last specification from Table 4 is re-estimated with an additional variable indicating whether the woman received WIC in the past or not. The results of this estimation, found in the first column of Table 5, confirm the findings of Figure 9 and show that previous WIC participation has a large and statistically significant effect on participation even after controlling for demographic characteristics, resources, state characteristics and health.[8] A woman who has participated in WIC in the past is three times

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hazard when one only has a single spell of data (as in this case), I do not pursue this issue.

[8] When the model is estimated on the subsample of women with less than a high school education, the

more likely to participate in WIC than a woman who has not. Including past participation reduces by a small amount the magnitude of the effect of many of the other characteristics such as age, education, and race.

Including an indicator variable to capture past participation is restrictive because the explanatory variables may play different roles for past recipients compared to women who have not received WIC in the past. Consequently, the model is estimated separately for previous recipients and for first time recipients. These results, found in the second and third columns of Table 5, show a number of interesting differences in the roles played by state characteristics, resources, and health variables.

For example, state characteristics play a larger role for women who have not gotten WIC in the past. This suggests that state differences (from whatever source) are important determinants of a woman's decision to first participate in WIC. The resource variables also play a large role for these women. In particular, for women who have not received WIC in the past, receiving Medicaid almost doubles the likelihood that they receive WIC while receiving Medicaid has no effect on the likelihood that past recipients receive WIC. Being in poor health also increases the likelihood that someone who has not previously participated will participate. This is especially true for underweight women, overweight (but not obese) women, and women who have experienced a previous miscarriage. Thus, it appears that for people who have not received WIC in the past, poor health, participation in Medicaid, and low income are key determinants of participation.

A particularly important group of women who have not received WIC in the past is women who are pregnant for the first time. In fact the second column of Table 5 shows that the most important reason why a woman who had not received WIC in the past would receive WIC is that it is her first pregnancy. The model is estimated separately for this group, and the

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coefficient on past WIC participation rises to 3.30.

estimates are found in the last column of Table 5. The results are similar to the main model with the difference that low income, participation in Medicaid, and poor health are more important determinants of participation for women during their first pregnancies than they are for all women. In fact the health variables have the largest effect for this group than in any other specification.

To understand how the likelihood of participation changes over the course of pregnancy for each of these groups, Figure 10 presents the average hazard rates for four models: specification 4 from Table 4 and the last three models of Table 5. With the exception of the eighth month, the hazard rate is highest for the group that has previously received WIC and lowest for the group that has not previously received WIC. These effects can be further seen in Figure 11 which depicts the associated survivor curves. This picture shows that the probability that a previous recipient participates in WIC during her previous pregnancy is over eighty percent whereas a woman who has not previously participated in WIC has a participation probability by the ninth month of about fifty percent. The results for all pregnancies and for first pregnancies are remarkably similar to each other. The hazard rate for women experiencing their first pregnancies is slightly lower in the first two months but is slightly higher during the second and third trimesters. These differences show up in Figure 11 as a survivor curve for first pregnancies that is slightly higher for the first seven months or so and then is slightly lower. Women experiencing their first pregnancies are slightly more likely to participate in WIC than all women, but this is not true for most of the pregnancy. These women are participating in WIC later in their pregnancies than are other women and should be a focus of outreach. The difference would of course be more pronounced if the comparison were made between women experiencing their first pregnancy and those who were not experiencing their first pregnancy (rather than all women).

These survivor curves do not distinguish between differences in the characteristics of women who have received WIC in the past and those who have not. If it is the case that women who have received WIC in the past are significantly worse off than women who have not, much of the difference in the survivor curves may be due to those differences – similar to the way that the large differences between blacks and whites in Figure 1 turned out to be due to differences in characteristics. To examine this issue, two additional survivor curves are calculated. One of these curves uses the coefficients from the "No Past WIC" column of Table 5 and the average characteristics of the "Only Past WIC" sample. When this curve is compared to the "No Past WIC" survivor curve in Figure 11, the difference is due to differences in average characteristics. The second survivor curve uses the coefficients from the "Only Past WIC" column of Table 5 and the average characteristics from the "No Past WIC" sample. The difference between this curve and the "Only Past WIC" curve in Figure 11 is due to differences in characteristics. These four survivor curves, the two new ones and the two that are relevant from Figure 10, are presented in Figure 12. They show that very little of the large difference in the survivor curves is due to differences in the sample characteristics. Almost all of the difference is due to differences in the coefficients. This means that the processes determining participation are different for women who have and have not participated in WIC in the past.

6. Policy Simulations

In the same way that the model can be used to isolate the role of race, it can be used to examine how different WIC policies affect entry into the program. This is interesting because the implementation of the WIC program changed between 1988 and the present. In 1988, states had more discretion in how they administered the WIC program than is presently the case. In 1988 some states allowed recipients to self-declare income and some required documentation while

1998 legislation requires income documentation for all recipients. Additionally, in 1988 some states deemed participants in other transfer programs presumptively eligible for WIC and others did not while current law makes recipients in TANF, Medicaid, and Food Stamps adjunctively eligible for WIC. Given the parameter estimates, these policies have offsetting effects: restricting the ability of recipients to self-declare income lowers the hazard rate and mandating presumptive eligibility increases it. Thus, the overall effect is ambiguous.

To understand how these changes may affect the probability of participating in WIC over the course of a pregnancy, simulated survivor curves are constructed for the rules as they existed in 1988 and as they exist presently.[9] The simulations are conducted in the following manner: the hazard rate and associated survivor curve is simulated for each woman in the sample and these values are averaged across all women (using sample weights). This comparison incorporates the fact that significant fractions of the population already faced restrictions on income declaration and/or presumptive eligibility. The simulated survivor curves are presented in Figure 13. The fact that the curves are very similar in both cases results both from the fact that the effects are offsetting and only a sub sample of the total eligible population was subject to reform. The end result of the policy change is estimated to be about a one percentage point increase in the probability of participation over the course of a forty week pregnancy.

7. Discussion and Conclusion

The goal of this paper has been to better understand the roles of maternal and state characteristics in the timing of prenatal WIC participation. Understanding this relationship is important because early participation in WIC may improve the efficacy of the WIC program,

[9] It is important to remember that the effect of the policy variables on participation decisions is partially causal and partially captures state to state differences in attitudes or other programs. The simulation is meant to be illustrative.

understanding the factors related to late (or non-) participation may help target resources to those most in need, and it sheds light on the type of selection into the WIC program.

The results show consistent negative selection on observables where women who are Hispanic and black, younger, less educated, less likely to be married or have insurance, and more likely to be in poor health are more likely to participate and to participate earlier. This finding has important implications for outcomes studies that have been concerned about selection (for example, Gordon and Nelson 1995, Brien and Swann 2001, Devaney, et al. 1992). This literature has been concerned with whether selection on unobservables exists and whether it is negative or positive. The answers to these questions are important because they determine whether OLS is appropriate and if it is not whether OLS estimates under or over estimate the effect of WIC on birth outcomes. If, as seems likely, women who are negatively selected on many observed characteristics are also negatively selected on unobserved characteristics, this paper suggests that OLS estimates underestimate the effect of WIC on birth outcomes. It does not, however, shed light on whether there is selection on unobservables.

The results also have implications for efforts to increase WIC participation. They suggest that the decision to participate for the first time is different from subsequent participation decisions. Women who have participated in WIC in the past are over three times more likely to participate in WIC, even after controlling for many individual and state characteristics.. For women who have not participated before, the Medicaid program plays an important role in participation decisions. Women who are receiving Medicaid are almost twice as likely to participate in WIC than women who are not. This is important given the evidence that WIC participation can actually reduce Medicaid expenditures (Devaney, et al. 1992). Similar results are found for women experiencing their first pregnancy. In fact the effect of poor health is largest for this group.

The state characteristics and WIC program rules are also particularly important for women who have not participated in WIC before – and the subgroup of those women who are experiencing their first pregnancy. These results reflect both state-to-state differences in attitudes toward maternal and child health and the effects of different program rules in different states. The fact that the link is not necessarily causal does not diminish the value in knowing that special efforts may be required in areas that have traditionally implemented policies that have not encouraged participation.

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Table 1: Sample Means

	Full Sample	Eligible Participants	Eligible Non-Participants	Ineligible
Demographic Characteristics				
Age	26.367	23.389	25.362	28.001
Years of Education	12.767	11.221	12.086	13.667
Black	0.153	0.311	0.197	0.070
Hispanic	0.111	0.193	0.134	0.065
Other	0.044	0.039	0.039	0.047
Non-WIC State Characteristics				
Northeast	0.179	0.147	0.147	0.217
North Central	0.256	0.252	0.251	0.257
West	0.205	0.168	0.232	0.208
Title IV-B	0.911	0.945	0.913	0.895
AFDC Ben. Family of 2	296.686	274.538	295.576	308.022
Governor Republican	0.528	0.482	0.555	0.541
House Republican	0.128	0.098	0.140	0.138
Senate Republican	0.304	0.291	0.286	0.316
Resources				
Income < $5000	0.099	0.273	0.147	0.003
Income $5000 to $10000	0.114	0.292	0.202	0.002
Income $10000 to $20000	0.212	0.356	0.438	0.071
WIC	0.285	1.000	0.000	0.063
Past WIC Participation	0.103	0.293	0.085	0.024
AFDC	0.134	0.389	0.192	0.012
Food Stamps	0.145	0.419	0.190	0.010
Medicaid	0.205	0.581	0.252	0.031
Insurance	0.589	0.177	0.430	0.823
Work During Pregnancy	0.638	0.427	0.574	0.754
Married at Birth	0.760	0.464	0.692	0.909
Live with Parents	0.127	0.264	0.182	0.050
Health Variables				
Mother Underweight	0.260	0.261	0.261	0.262
Mother Overweight	0.086	0.102	0.073	0.084
Mother Obese	0.086	0.121	0.088	0.068
Previous Adverse Event	0.083	0.099	0.080	0.077
WIC Program Variables				
Self-Declare Income	0.295	0.346	0.270	0.280
Link to AFDC	0.434	0.439	0.417	0.450
Link to Medicaid	0.592	0.622	0.539	0.601
Clinics	7.948	7.774	7.917	8.075
Sample Size	12,333	4,070	3,105	5,158

Excludes observations with missing income.

Table 2: First Month of WIC Participation

First Month	Number of Recipients	Fraction of Recipients
1	708	0.17
2	742	0.18
3	890	0.22
4	637	0.16
5	428	0.11
6	287	0.07
7	176	0.04
8	81	0.02
9	121	0.03

Table 3: Number of Spells

Spells	Number of People
0	3,105
1	4,049
2	19
3	1
4	1

Table 4: Flexible Baseline Hazard Model: Non-Baseline Parameters

	Specification			
	1	**2**	**3**	**4**
Demographic Characteristics				
Age	0.953**	0.966**	0.967**	0.957**
Age^2/100	1.026	1.018	1.008	1.028**
Years of Education	1.496**	1.373**	1.344**	1.312**
Years of Education^2/100	0.107**	0.174**	0.191**	0.209**
Black	1.496**	1.141**	1.141**	1.125**
Hispanic	1.608**	1.431**	1.416**	1.465**
Other	1.729**	1.507**	1.554**	1.479**
First Pregnancy	0.899**	1.008	1.040	1.045**
State Characteristics				
Title IV-B	2.048**	1.785**	1.786**	1.389**
Northeast	1.650**	1.480**	1.516**	1.265**
North Central	1.339**	1.335**	1.350**	1.250**
West	1.081**	1.043	1.083	1.323**
AFDC Ben. Family of 3	0.912**	0.931**	0.921**	0.883**
Governor Republican	0.803**	0.792**	0.799**	0.905**
House Republican	0.803**	0.954**	0.946**	0.785**
Senate Republican	0.914**	0.858**	0.852**	0.928**
Resources				
Income < $5000	---	1.556**	1.541**	1.554**
Income $5000 to $10000	---	1.599**	1.583**	1.599**
Income $10000 to $20000	---	1.575**	1.558**	1.581**
AFDC	---	1.009	1.017	1.020
Food Stamps	---	1.237**	1.215**	1.232**
Medicaid	---	1.616**	1.577**	1.582**
Insurance	---	0.733**	0.717**	0.714**
Work During Pregnancy	---	0.910**	0.919**	0.920**
Married at Birth	---	0.906**	0.896**	0.918**
Live with Parents	---	0.883**	0.880**	0.890**
Health Variables		---		
Mother Underweight	---	---	0.996	1.000
Mother Overweight	---	---	1.261**	1.240**
Mother Obese	---	---	1.363**	1.368**
Previous Miscarriage	---	---	1.170**	1.190**
WIC Program Variables				
Self-Determine Income	---	---	---	1.231**
Link to AFDC	---	---	---	1.112**
Link to Medicaid	---	---	---	1.170**
Clinics	---	---	---	1.026**
Likelihood	-18,496.04	-18,159.85	-18,131.76	-18,101.90

Notes: ** indicates a coefficient is statistically significant at 0.05 and * indicates a coefficient is statistically significant at 0.10. The sample size is 7,151.

Table 5: Flexible Baseline Hazard Model: Role of Past WIC

	Specification			
	Role of Past WIC	**No Past WIC**	**Only Past WIC**	**First Pregnancy**
Demographic Characteristics				
Past WIC Participation	3.047**	---	---	---
Age	0.945**	0.980**	0.896**	1.014
Age^2/100	1.062	0.999	1.149**	0.933
Years of Education	1.266**	1.391**	0.819**	1.356**
Years of Education^2/100	0.248**	0.169**	2.134**	0.176**
Black	1.078**	1.043	0.996	1.015
Hispanic	1.473**	1.417**	1.501**	1.404**
Other	1.389**	1.644**	0.918	1.678**
First Pregnancy	1.960**	2.020**	---	---
State Characteristics				
Title IV-B	1.302**	1.427**	0.985	1.730**
Northeast	1.295**	1.472**	1.068	1.576**
North Central	1.310**	1.372**	1.401**	1.602**
West	1.316**	1.459**	1.048	1.162**
AFDC Ben. Family of 3	0.894**	0.879**	0.910**	0.891**
Governor Republican	0.891**	0.833**	1.030	0.865**
House Republican	0.863**	0.792**	1.374**	0.675**
Senate Republican	0.882**	0.807**	0.998	0.808**
Resources				
Income < $5000	1.602**	1.640**	1.501**	1.616**
Income $5000 to $10000	1.654**	1.834**	1.483**	1.994**
Income $10000 to $20000	1.602**	1.694**	1.483**	1.746**
AFDC	0.923**	0.999	0.887**	1.055
Food Stamps	1.194**	1.188**	1.142**	1.158**
Medicaid	1.548**	1.811**	1.029	1.706**
Insurance	0.717**	0.745**	0.785**	0.710**
Work During Pregnancy	0.953**	0.929**	1.020	0.888**
Married at Birth	0.905**	0.809**	1.059	0.783**
Live with Parents	0.890**	0.945**	0.792**	0.962**
Health Variables				
Mother Underweight	1.011	1.052*	0.888**	1.125**
Mother Overweight	1.231**	1.423**	1.025	1.495**
Mother Obese	1.383**	1.396**	1.354**	1.424**
Previous Miscarriage	1.306**	1.323**	1.185**	---
WIC Program Variables				
Self-Determine Income	1.224**	1.222**	1.262**	1.289**
Link to AFDC	1.092**	1.034	1.118**	1.028
Link to Medicaid	1.145**	1.172**	1.053	1.258**
Clinics	1.021**	1.015**	1.025**	1.018**
Sample Size	7,175	5,318	1,857	3,921
Likelihood	-17,871.74	-12,323.42	-5,699.08	-9,681.62

Notes: ** indicates a coefficient is statistically significant at 0.05 and * indicates a coefficient is statistically significant at 0.10.

Figure 1: Kaplan-Meier Survivor Curves by Race

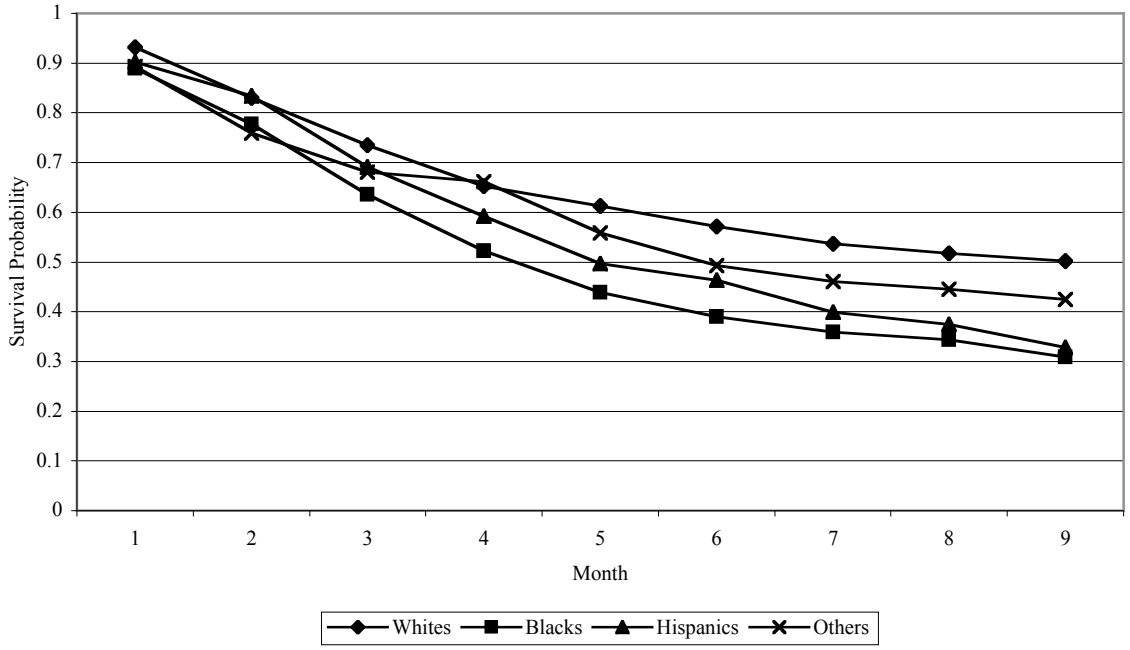

Figure 2: Kaplan-Meier Survivor Curves by Race and Marital Status

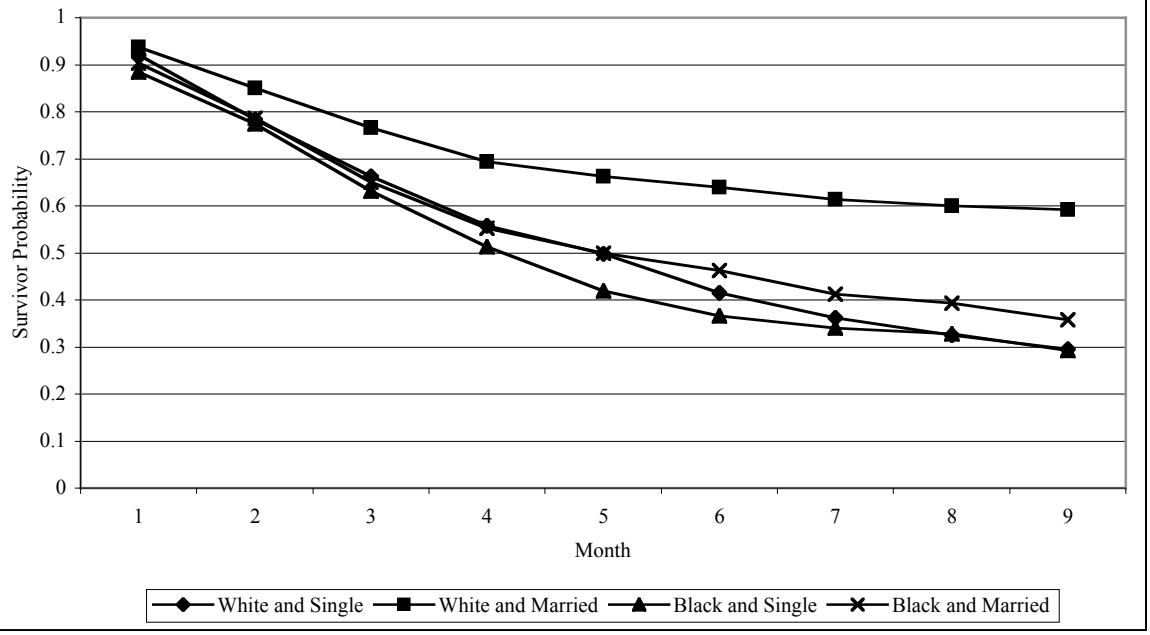

Figure 3: Kaplan-Meier Survivor Curves by Education

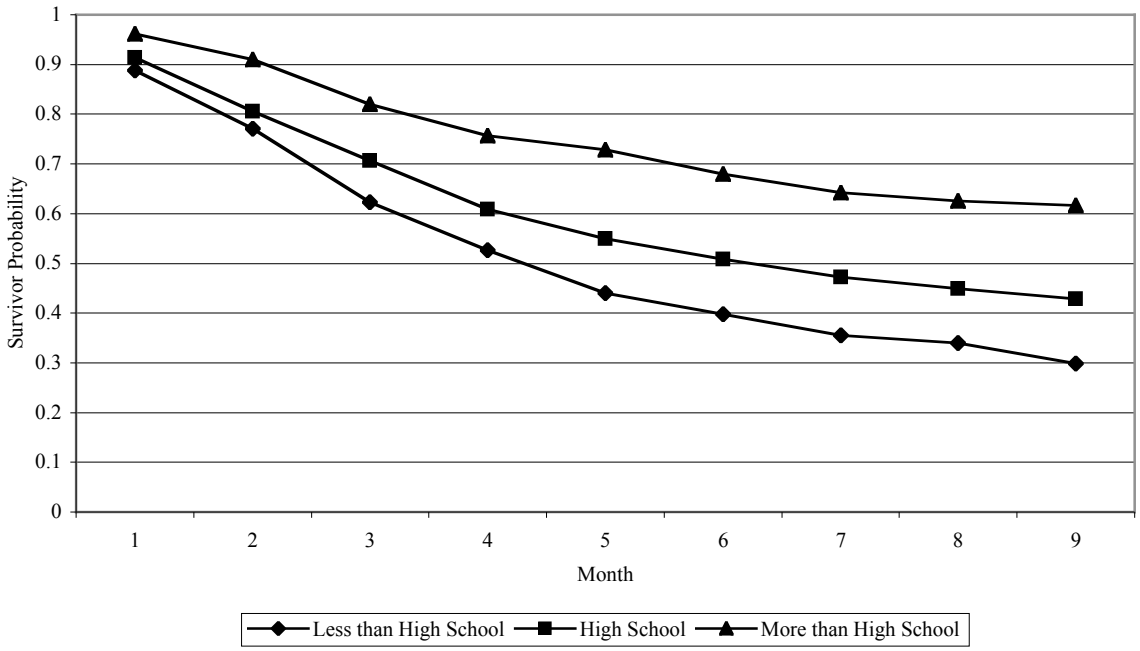

Figure 4: Kaplan-Meier Survivor Curves by Ability to Self-Declare Income

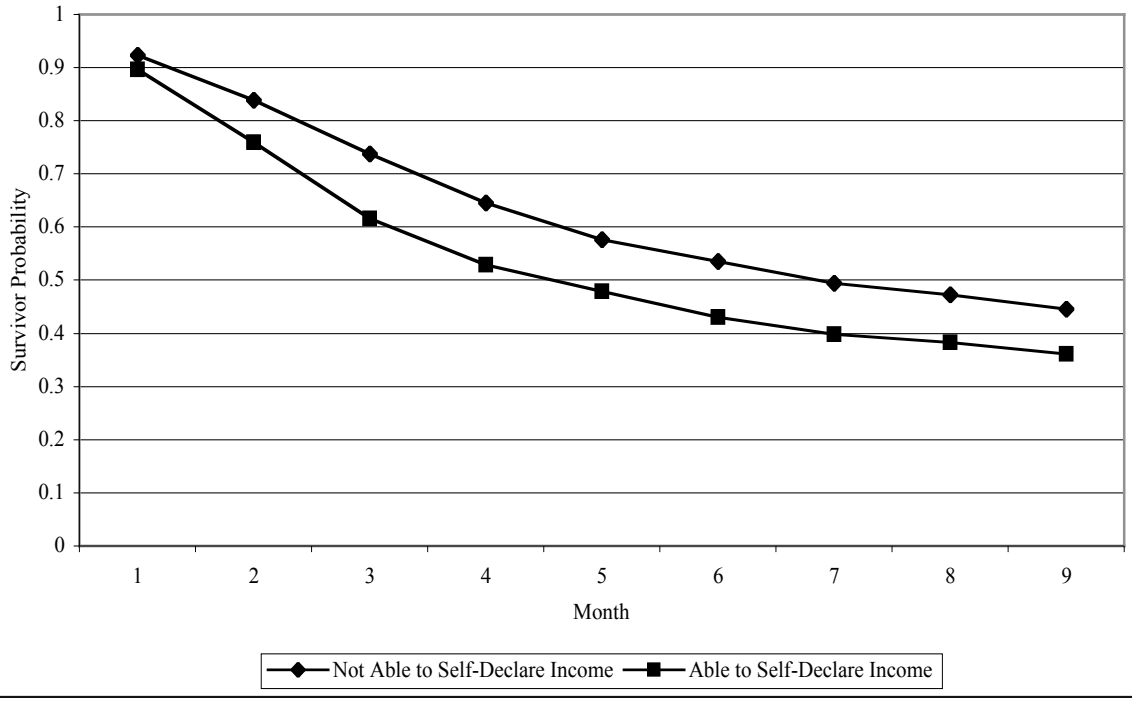

Figure 5: Kaplan-Meier Survivor Curves by Adjunctive Eligibility for Medicaid Recipients

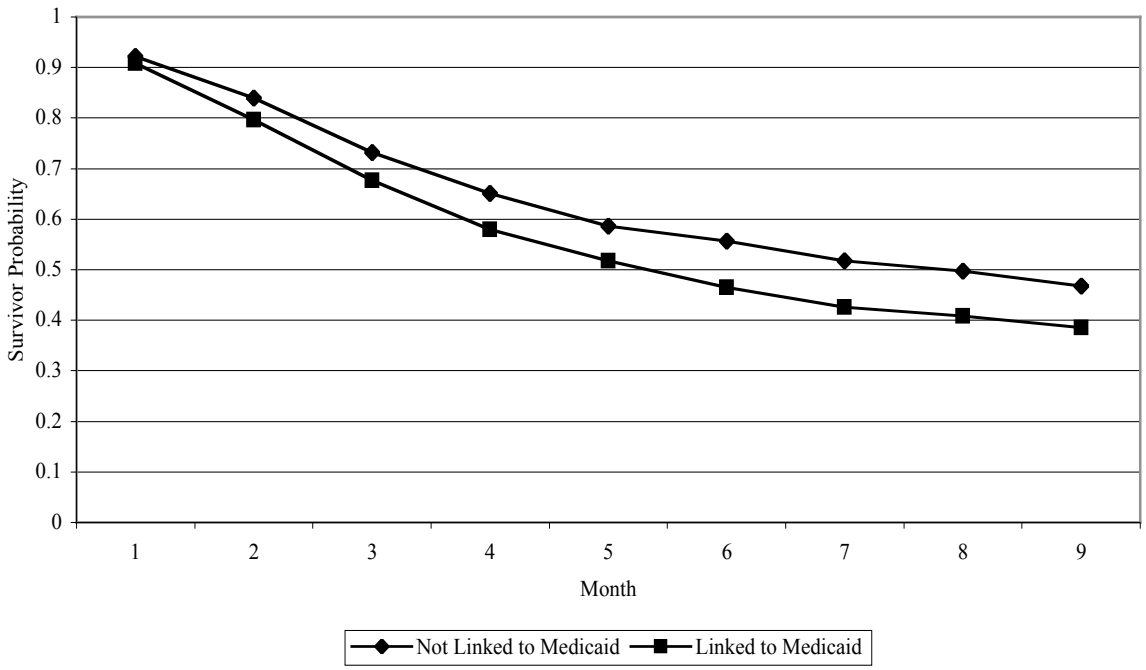

Figure 6: Baseline Hazard for Average Person

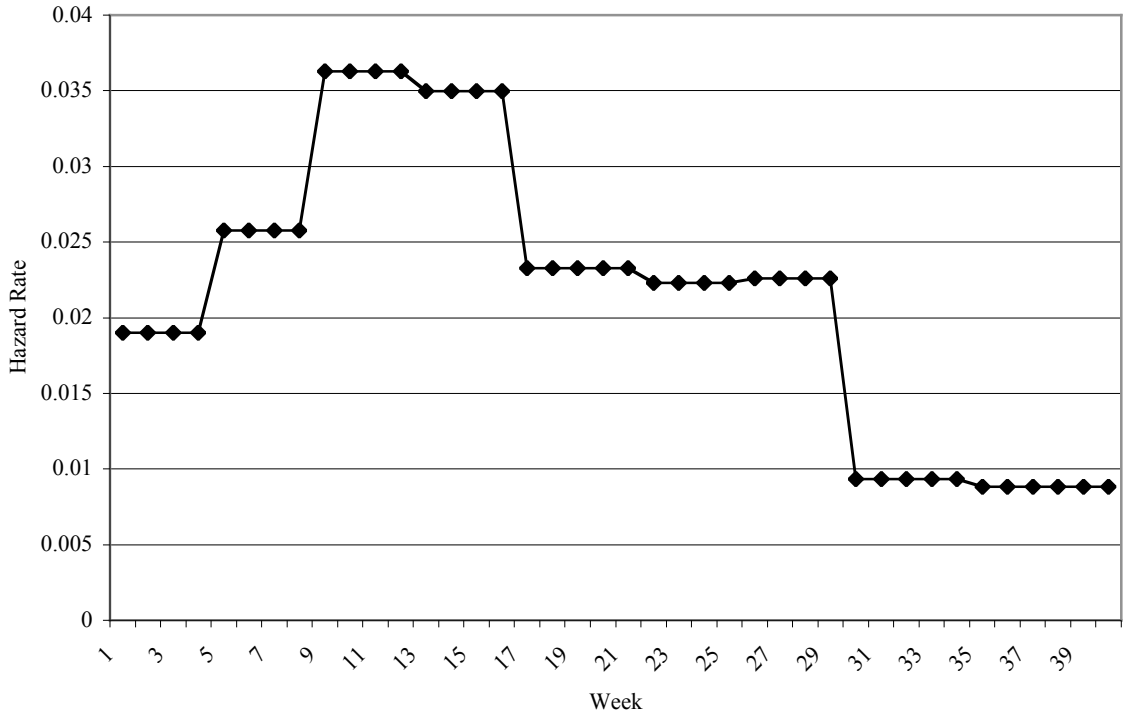

Figure 7: Survivor Curves by Race

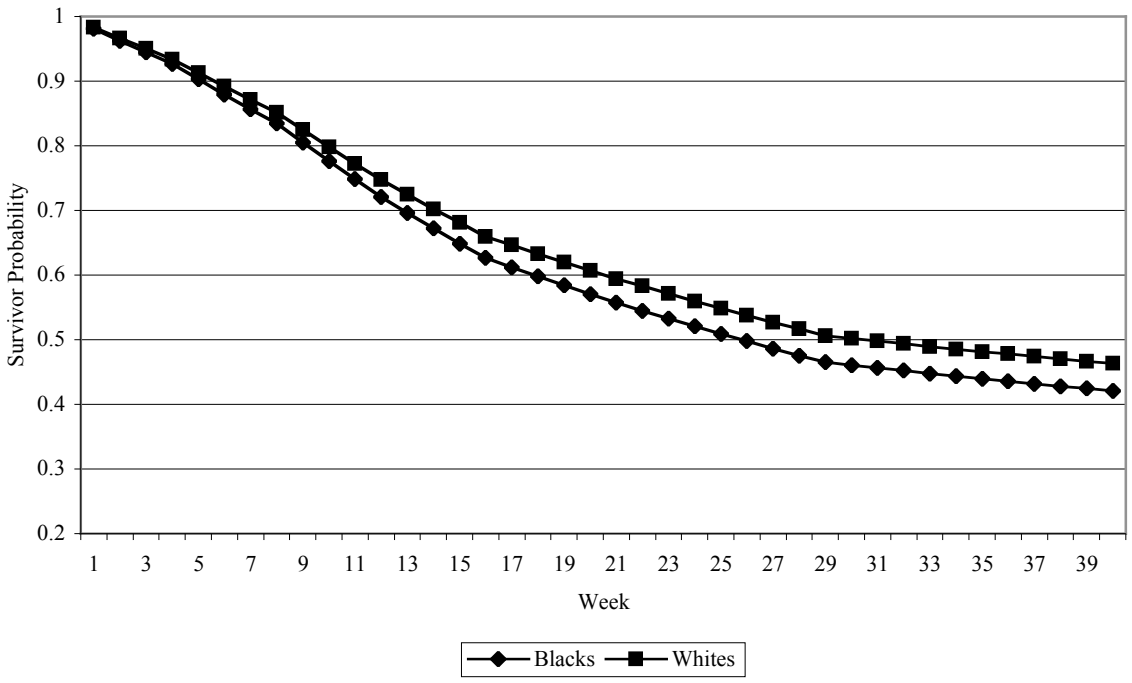

Figure 8: Distribution of Beginning Month by Past WIC Participation

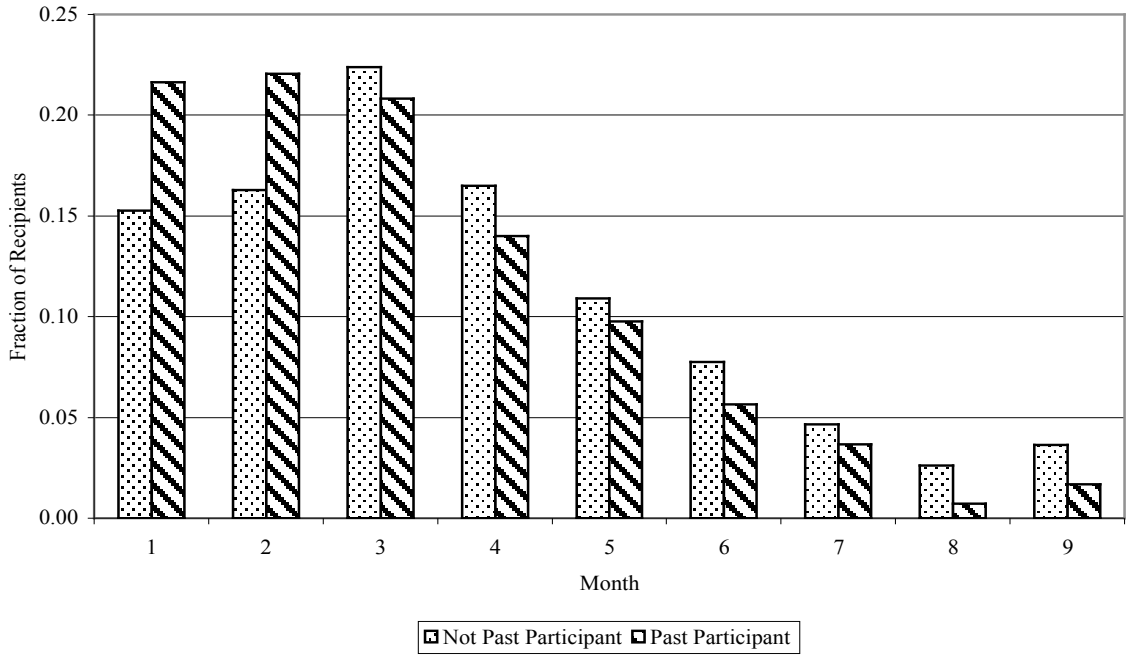

Figure 9: Kaplan-Meier Survivor Curves by Past WIC Participation

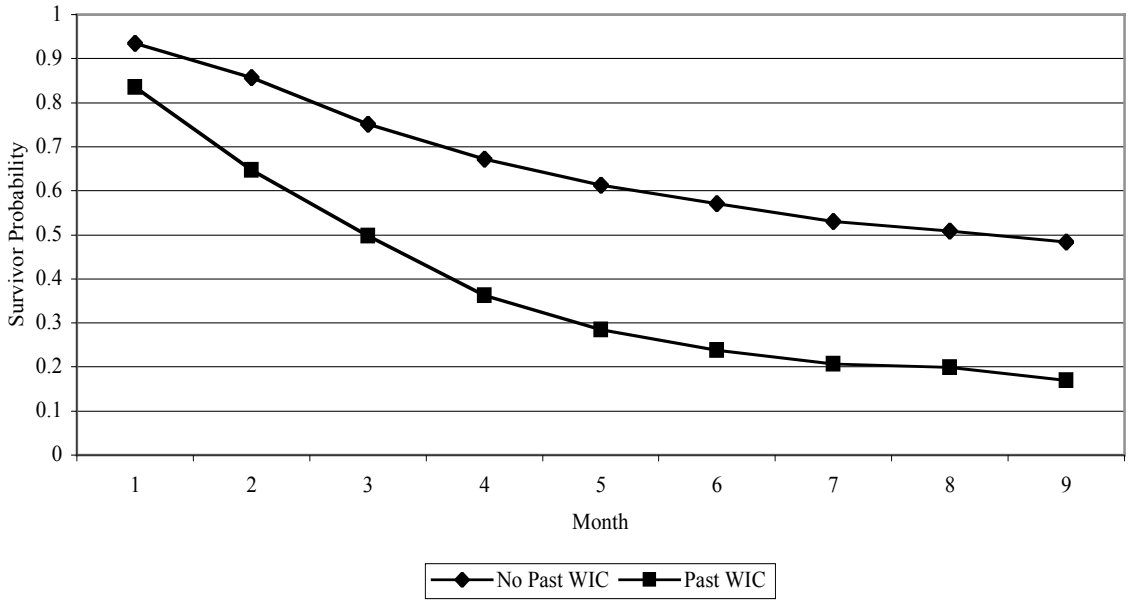

Figure 10: Hazard Rates and Past WIC

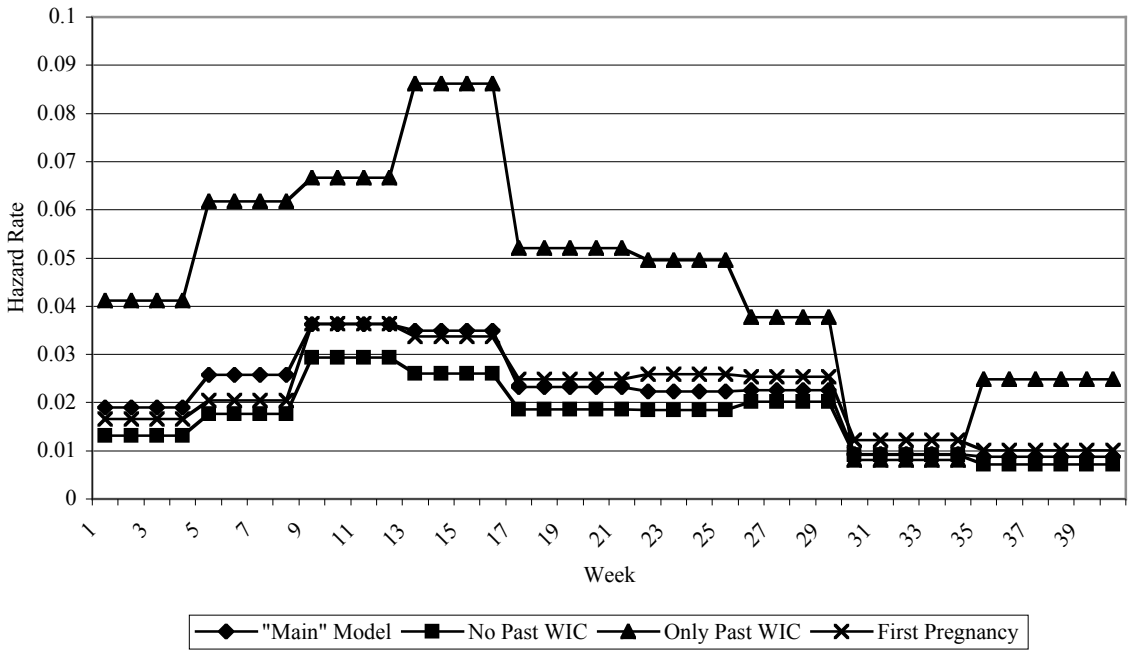

Figure 11: Survivor Curves by Past WIC

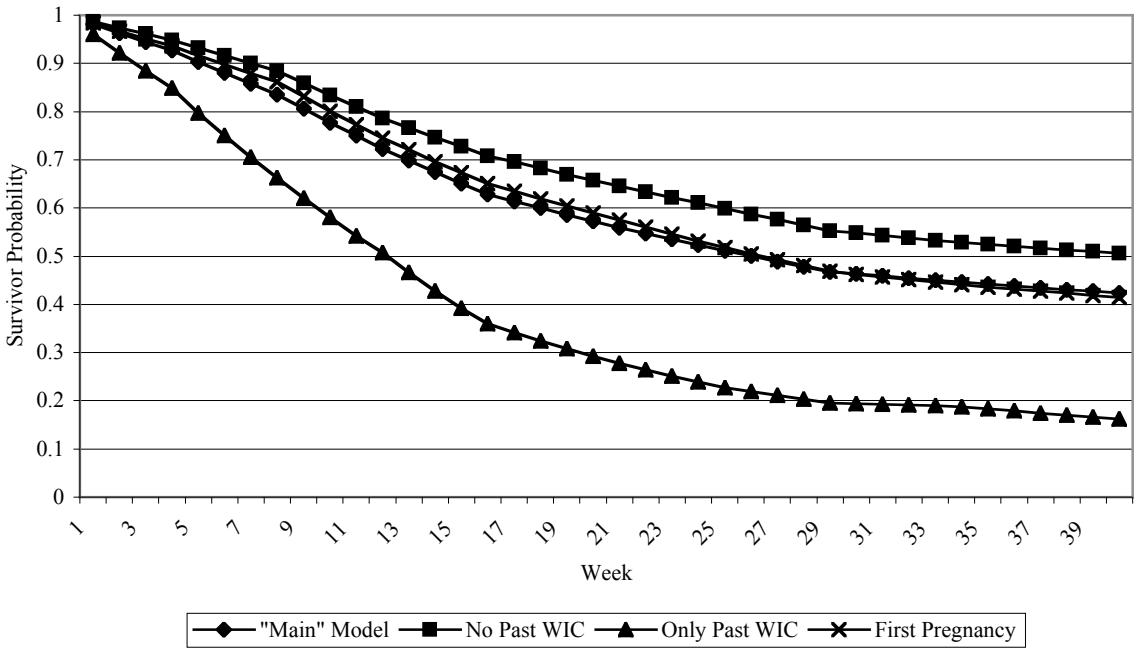

Figure 12: Differences in Coefficients and Differences in Characteristics

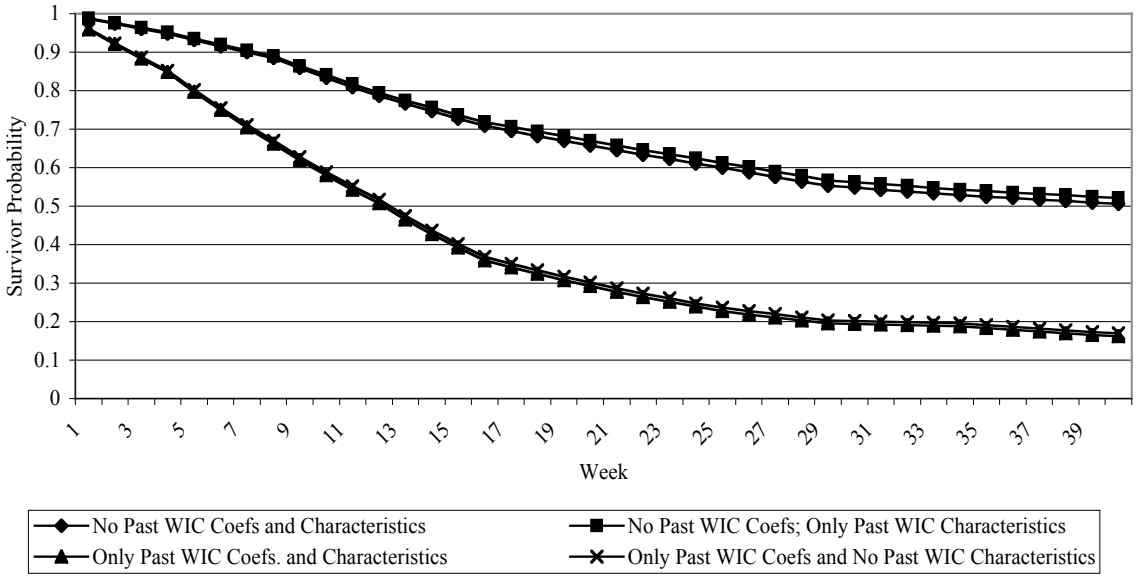

Figure 13: Survivor Curves for 1988 Policy and Current Policy