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The Dynamics of Prenatal WIC 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. Understanding the factors, including program rules, that affect the timing and duration of participation may help target resources toward women who are most likely to enroll in WIC late in their pregnancies or not enroll at all. In this paper I apply survival analysis techniques to data from the National Maternal and Infant Health Survey and the 1988 Survey of WIC Program Characteristics.

The hazard rate analysis shows that socioeconomic characteristics such as low education, Hispanic ethnicity, low income, and participation in other welfare programs are correlated with a higher likelihood of participation in WIC. Additionally, characteristics of the WIC program, including the ability to self-declare income and adjunctive eligibility for AFDC and Medicaid recipients, significantly increase the probability of participation. The results show that the hazard rate for participating in WIC is generally increasing during the first 4 months of pregnancy and decreasing thereafter. Finally, although the analysis is only suggestive because of data limitations, women who have participated in WIC during a previous pregnancy are about three times more likely to participate in WIC than women who have not participated in the past.

Recent policy changes have mandated income documentation and have expanded presumptive eligibility. The model estimates are used to simulate survivor curves under the 1988 rules and under the present rules, and these simulated outcomes are compared to assess the impact of the policy change. The simulated effect of the new policy is estimated to be about a 1 percentage point increase in the probability of participation over the course of a 40-week pregnancy.

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. While many studies have examined the effect of WIC participation on various health outcomes, little research has focused on the decision to participate in WIC and even less has examined participation over the course of pregnancy. Understanding the factors, including program rules, that affect the timing and duration of participation may help target resources toward women who are most likely to either enroll in WIC late in their pregnancies or not enroll at all.

The hypothesis that early (and continuous) enrollment in WIC may be especially beneficial is supported by the prenatal care literature where it is generally accepted that "adequate" care begins early in a pregnancy and is received regularly thereafter (Kessner et al. 1973, Kotelchuck 1994). 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.

The paper utilizes survival analysis to understand the characteristics that affect the probability of participation during each month of pregnancy.[1] The data come from the 1988 National Maternal and Infant Health Survey, a nationally representative sample of women who experienced a live birth or infant death in 1988. These data are merged with information on state WIC policies from the 1988 Survey of WIC Program Characteristics. Parametric and non-parametric survival analysis techniques are used to examine the relationship among recipient characteristics, WIC program rules, and the timing of participation. The parameter estimates are

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

used to conduct policy simulations including an examination of the effect of recent policy changes on the probability of participation in WIC.

The paper is organized as follows: Section 2 describes the WIC program, Section 3 discusses the previous literature, Section 4 introduces the data, Section 5 presents the results of both the non-parametric (Kaplan-Meier survivor curves) and parametric duration analysis, Section 6 extends the basic model to examine the role of previous participation in the WIC program; Section 7 presents simulation results that show how different WIC policies affect participation; and Section 8 concludes.

2. 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 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 that they should avoid. Finally, although the WIC program does not provide health care services, recipients may be referred to a health care provider or for other social services.

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.

It is important to note that 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.

3. Previous Research

Previous research on WIC has sought to describe the effect of prenatal WIC participation on birth outcomes (Kennedy et al. 1982, Kotelchuck et al. 1984, Rush 1988, Gordon and Nelson 1995, Brien and Swann 1999a), Medicaid Costs (Devaney, et al. 1992), child health (Brien and Swann 1999b), 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. Gordon and Nelson (1995) provide descriptive information about the month at which participation began and the number of months of participation. Additionally Gordon and Nelson (1995) and Devaney, et al. (1992), among others, explore the role of early versus late participation in WIC on birth outcomes. They do not, however, model early participation. Finally, as part of the estimation of two stage least squares models, Brien and

Swann (1999a, 1999b) estimate participation models for receiving WIC at any point in a pregnancy and find that a number of observed characteristics and program rules affect the likelihood of participation, but they do not model the timing or duration of participation.

4. Data

4.1 National Maternal and Infant Health Survey

The primary data for this analysis come from the National Maternal and Infant Health Survey (NMIHS). Compiled by the National Center for Health Statistics, these data were collected to examine the determinants of adverse pregnancy outcomes and are based on a sample of birth and death certificates in 48 states and the District of Columbia. The data set has three components: 9,953 women who experienced a live birth in 1988, 3,309 women who experienced a fetal death in 1988, and 5,332 women whose child born in 1988 died prior to his or her first birthday.

Women who were selected for the sample were sent a detailed questionnaire regarding their behavior during and after the 1988 pregnancy outcome. 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., prenatal care utilization and participation in other welfare programs); household income; information about the child's father; and state of residence.

A number of restrictions were imposed in order to reach the analysis sample. First, the study uses only the live birth and infant death samples.[2] Second, observations with missing data for key variables are deleted. An observation is dropped if it is missing data on any of the variables used in the analysis (e.g., the months of WIC participation). Finally, observations with inconsistent information about WIC participation (e.g., a woman participates in WIC in the 9th month but the gestational age at birth is 30 weeks) are dropped from the analysis. Table 1 lists the number of observations dropped for each variable. The resulting sample contains information on 12,354 women.

In constructing relevant variables, a number of issues were confronted. First, the data includes information on month of WIC participation while gestational age at birth is in weeks. It is helpful to have these variables in the same units. Consequently, I assume that each month is four and one third weeks long (and then round the resulting fractions to whole months) and that women start participating on the first week of each month. Table 2 gives the assumed starting week based on the month of participation. For example, if a woman participated in WIC during her third and fourth months, this spell is assumed to as start at week 9.

The second issue is how to determine income eligibility for WIC. 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 eligible, the following procedure is used: 1) 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; 2) if wage income is missing and if bracketed household income is available, use the midpoint of the relevant income bracket

[2] Although not reported in the paper, the parametric survivor analysis has be conducted using only the live birth sample with very similar results.

as the measure of income and make the same comparison; and 3) if no income measure is available, the observation is dropped from the sample.[3]

Table 3 presents means of variables used in the analysis for the entire sample, participants, eligible non-participants, and ineligible non-participants. The table shows that eligible (low income) women are much more likely to be young, have less than a high school education, be black, and participate in other welfare programs. Among eligible women, women who participate in WIC are also more likely to be young, less educated, black, and recipients of other welfare.

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. WIC participants are no more likely to be underweight than non-participants, but they are more likely to be overweight and significantly more likely to be obese – particularly when compared to the ineligible non-recipients. Additionally, recipients are somewhat more likely to have experienced a previous adverse pregnancy outcome (miscarriage or stillbirth).

4.2 Survey of WIC Program Characteristics

The timing of WIC participation decisions may also depend on the ease with which one can apply for WIC. Although it is a federal program, states have leeway in a number of administrative details. In 1988, the USDA conducted the first Survey of WIC Program Characteristics to understand how federal WIC rules are implemented by states. 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

[3] Although not reported in the paper, the parametric survival analysis has been conducted using a cutoff of 100% of poverty rather than 185% in an attempt to be certain that only those truly eligible are included in the analysis. The results showed some differences in the influence of some observed characteristics (such has being young or having low education), but the overall results are similar to those reported below.

documentation. The last two are indicators equal to one if the states make 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.

A priori we would expect each of the indicators to be associated with an increased likelihood of participation in WIC. Comparing the second and third columns of Table 3 shows some evidence that these variables are associated with WIC participation. Of the women who are eligible for WIC, women who participate in WIC are more likely to live in states where they may self-declare income and where WIC is linked to AFDC and Medicaid.

The role of program characteristics in determining the timing of participation can be examined more directly by comparing the average month that WIC participation begins for women who live in states where WIC is more accessible with the average month that participation begins for women who do not live in such states. These comparisons are presented in Table 4. For this analysis, the sample is restricted to women who ever participate in WIC. On average women who live in states where WIC is more easily accessible participate in WIC earlier in their pregnancies. The effects for the ability to self-declare income and for presumptive eligibility for AFDC recipients are significant at 0.05. Although this comparison does not imply there is a causal relationship, it suggests that the state-level program rules may be associated with earlier entry into WIC.[4]

The central focus of this paper is the month at which recipients begin to participate, and Table 5 presents the (unweighted) distribution of month of initial entry into WIC. 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

[4] None of the analysis in this paper includes state effects so some of the differences in WIC program rules may be capturing state-to-state differences in attitudes toward welfare or in other programs and services.

the last month.[5] Table 6 documents the fact that relatively few women experience multiple spells of participation during a single pregnancy – at least not at the monthly level.

5. 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, and WIC program rules.

All of the survival analysis focuses on women who are eligible for WIC. When a woman who is income 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.

5.1 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 thus allows the data 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, h_t as the number of women who begin to participate at time t, and c_t as the number of women

[5] Gordon and Nelson (1995) note that there is a discrepancy between the NMIHS data and 1988 WIC Participants and Program Characteristics data in the timing of participation. Specifically, the NMIHS shows more early participation.

who are censored at time t. The Kaplan-Meier estimate of the hazard function at time t, $l(t)$, is the fraction of eligible, uncensored women who begin to participate in WIC during month t:

$$\hat{l}(t) = h_t/(n_t - c_t),$$

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

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

Kaplan-Meier Survivor curves for different samples are presented in Figures 1 through 6. The first figure shows that the survivor curve for the full sample falls to about 0.42 by the ninth month. Figure 2 examines the role of race. The most significant of the racial 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. Hispanics and women of other races fall somewhere in between.

The next two graphs focus on the effect of WIC program rules on the timing of participation. The first graph focuses on the ability of recipients to self-declare income, and the second examines the role presumptive eligibility for Medicaid recipients. Being able to self-declare income increases the likelihood of participation by about 10 percentage points. In Figure 4, the effect of linking eligibility for WIC to Medicaid also has a positive effect on participation. These results suggest that program rules to play a role in the timing of participation.

Finally, given that eligibility for WIC contains a nutritional risk component, it is interesting to see whether women who are at risk participate earlier. Figure 5 explores differences in the timing of participation by prepregnancy weight. The survivor curves are quite similar for the first three months. After that, the biggest differences are between women in the normal weight range and women who are overweight or obese.

Figure 6 shows relatively small differences in timing and probability of participation

depending on whether a woman has experienced a miscarriage or stillbirth during a previous pregnancy. Women who have experienced these adverse events are more likely to participate, but the difference is small. Thus, it does appear that the who are at risk are more likely to participate.

In summary, the Kaplan-Meier survivor curves show that black women, women with low education, women living in states that make participation relatively easy, and women at risk for a poor outcome participate earlier in their pregnancies than other women. However, each of these factors was considered in isolation. In order to incorporate a full set of observed characteristics, parametric hazard rate methods are used.

5.2 Parametric Hazard Model

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

$$l(t) = \exp\{X_{it} b\} l_0(t)$$

where X_{it} is a vector of observed characteristics for woman i at time t, b is a vector of parameters that describe the effect of these characteristics on the hazard rate, and $l_0(t)$ 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. In fact it might first rise as women learn they are pregnant and seek benefits and later fall as most women who are going to participate have done so. A number of specifications of the baseline hazard are frequently used. These include the Weibull,

Gompertz, lognormal, and log-logistic. Unfortunately, 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

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

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

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

$$L(q) = \sum_{i=1}^{N} \left[\exp\left\{ -\sum_{s=1}^{t_i - 1} h_i(s) \right\} \left[1 - \exp\{-h_i(t_i)\} \right] \right]^{1-c_i} \left[\exp\left\{ -\sum_{s=1}^{t_i} h_i(s) \right\} \right]^{c_i}$$

where q is a vector of all of the unknown parameters in the model (the b's, and the g's), i indexes individuals, $c_{it} = 1$ 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 7. The columns differ only in the variables included in the estimation. The first column includes demographic characteristics only; the second column adds the WIC program variables; the third adds household resource variables; and the last column includes the health measures. The coefficients reported are hazard ratios. For example, in specification 1, the coefficient on "Age < 20" of 1.651 means that the hazard rate for someone who is less than twenty years old is 1.651 times as large as it is for someone who is otherwise identical except that she is thirty years old or older (the base category for age).

With the exception of living in the West, each of the variables included in specification 1 increases the hazard rate into WIC participation. For example, younger women, women with low education, and non-white women are have significantly higher hazard rates than other women – and the effect is particularly large for women with less than a high school education.

Adding the variables describing the WIC program has only a small effect on the demographic factors affecting the hazard. The WIC variables all have the "correct" sign. For example, the hazard rate for women living in states where the can self-declare income is about 1.35 times as large as the hazard in states where recipients must provide documentation. In contrast to the WIC variables, however, an increase in the generosity of AFDC reduces the hazard rate slightly. This suggests that women in states with less generous AFDC programs may be more likely to seek out benefits from other programs.

Adding the resource variables has a larger effect on the coefficients of the demographic variables because these characteristics were proxying for a lack of resources. Thus, the effect of being young, having low education, and being black are all smaller when the resource measures are included in the analysis. Most of the resource variables have the hypothesized signs: women who receive Food Stamps and Medicaid have higher hazards for entry into WIC, and women form whom insurance pays for their prenatal care have significantly lower hazards.

The last column 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. The inclusion of the health variables has a minor impact on the other estimated coefficients.

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 using a simulated hazard function. To construct this function the hazard rate is computed for each woman in the sample using her observed characteristics. This result is then averaged over the sample (using the sample weights) to find the average hazard function. The graph of this function is presented in Figure 7. The simulated hazard function a step function with nine different levels corresponding to each month of possible entry. The hazard has a minimum of about 0.008 and a maximum of about 0.0425. Even disregarding the effect of prenatal care, it is not monotone and is in fact increasing over the first few months and then decreasing.[6]

6. The Role of Past WIC Participation

Table 6 showed that relatively few women experience multiple spells of participation during a single pregnancy. It may still be the case, however, that women have repeated prenatal WIC spells across a number of pregnancies. The NMIHS collects retrospective information on whether WIC was received for each respondent's previous pregnancy or pregnancies. Of the 7,023 women who are eligible for WIC in 1988, about 21 percent participated in WIC during a previous pregnancy. Additionally, the first row of the "Other Variables" section of Table 3 shows that recipients in 1988 are much more likely to have received WIC in the past. Although not reported, a test similar to those presented in Table 4 shows that among the group of current recipients, women who have received WIC in the past participate earlier than other women. This finding is confirmed by Figure 8 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

[6] This negative duration dependence may be the result of uncontrolled unobserved differences across women.

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 important to note that very little information is available about the previous pregnancies (including for example income). 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.

In an attempt to understand these effects as well as to understand the role of observed characteristics and policy variables in these decisions, the model from Table 7 is re-estimated with different specifications and for different subgroups to better understand the role of past receipt.

The first column of Table 8 simply adds an indicator variable equal to one if the woman participated in WIC during a previous pregnancy and zero otherwise to the full model presented in Table 7. These results show that previous WIC participation has a large and statistically significant effect on participation. 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.

To further explore differences in the role of past participation, the model is estimated separately for previous recipients and for first time recipients. These results show that education and resource variables play very different roles for these two groups. For example, having a low education has a much larger effect on first time recipients than on previous recipients. The policy variables have interesting effects whereby the ability to self-declare income and the link to Medicaid have larger effects on first-time recipients while the link to AFDC and the number of clinics have a larger effect on previous recipients.

Finally, one difference between the two groups is that by construction, each woman who has received WIC during a previous pregnancy has had at least one previous pregnancy while the group that has not received WIC is a mixture of women who have and who have not had previous pregnancies. The last column presents the results for the subsample of women who have had at least one previous pregnancy but who have not previously received WIC. While this restriction further reduces the sample size, it creates a more appropriate comparison group. For this group, being less than 20 years old, having a high school degree or some college, and receiving Medicaid have the largest positive effects on the likelihood of receiving WIC.

To understand how the likelihood of participation changes over the course of pregnancy changes for each of these groups/models, Figure 9 presents the simulated hazard rates for each of the four models. 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 received WIC but has had at least one previous pregnancy.

7. Policy Simulations

The parameters of the model can be used to examine how different WIC policies affect entry into the program. Because of the uncertainty about eligibility during previous pregnancies, these simulations use the parameters from the fourth column of Table 7.

The simulations are conducted in the same manner as the simulations of the baseline hazard functions above: the hazard rate and associated survivor curve is simulated for each woman in the sample, and these values are averaged across all women. As an example of how these simulations can be used, Figures 10 and 11 compare two WIC policy regimes, a more restrictive regime and a less restrictive regime. Under the more restrictive regime, there is no presumptive eligibility for AFDC or Medicaid recipients, and recipients may not self-declare

income. Under the less restrictive regime, WIC eligibility is linked to the other two programs, and recipients may self-declare income.

The hazard rate under the less restrictive policy is uniformly higher than hazard under the more restrictive regime with the largest differences occurring in the third and fourth months. The cumulative difference in hazard rates results in a difference in survivor probabilities of almost twenty percentage points by the fortieth week.

While this exercise is illustrative of the effects of policy, the policies considered have not been implemented nor are they likely to be. In fact, recent policy changes have mandated documentation for income and have expanded presumptive eligibility coverage. Given the parameter estimates, these policies have off-setting 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. Consequently, a more instructive exercise is to compare the previous policy to the current policy. This comparison incorporates the fact that significant fractions of the population already faced restrictions on income declaration and/or presumptive eligibility. The simulated hazard functions and survivor curves are presented in Figures 12 and 13, respectively. 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.

8. Summary and Conclusion

The goal of this paper has been to better understand the role of maternal characteristics and state WIC policy in the decision to participate in WIC and the timing of participation.

Understanding this relationship is important because early participation in WIC may improve the efficacy of the WIC program.

The results show a consistent negative selection on observables with younger and less educated women being more likely to participate. Furthermore, WIC program rules play a significant role in the likelihood of participation. The model estimates show that the hazard rate is increasing for the first four months of pregnancy and decreasing thereafter. Policy simulations show that recent changes that expanded adjunctive eligibility and required income documentation on net increased the likelihood of participation by about one percentage point.

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Table 1: Missing Values

Variable	Missing	Remaining
NMIHS Sample		18,594
Fetal Death Sample	3,309	15,285
WIC Months	183	15,102
Family Size	14	15,088
Gestational Age	54	15,034
Mother's Age	48	14,986
Mother's Education	27	14,959
Worked During Pregnancy	130	14,829
Insurance Paid for Prenatal Care	118	14,711
Delivery Date	389	14,322
Lived with Parents	34	14,288
Gestation < 20 Weeks	99	14,189
Income	1,346	12,843
Past WIC Participation Imputed	365	12,478
Inconsistent WIC Data	118	12,360
Marital Status	2	12,358
Inconsistent First Birth and Past WIC	4	12,354

Table 2: Converting Months to Weeks

Month	Starting Week
1	1
2	4
3	9
4	13
5	17
6	22
7	26
8	30
9	35

Table 3: Sample Means

	Full Sample	Eligible Participants	Eligible Non-Participants	Ineligible
Demographic Characteristics				
Age < 20	0.112	0.247	0.146	0.042
Age 20 to 29	0.602	0.624	0.633	0.582
Less Than High School	0.191	0.440	0.270	0.057
High School	0.396	0.427	0.441	0.367
Some College	0.232	0.117	0.203	0.291
Black	0.153	0.310	0.197	0.070
Hispanic	0.111	0.194	0.140	0.065
Other	0.044	0.040	0.040	0.047
Resources				
Income < $5000	0.099	0.278	0.151	0.003
Income $5000 to $10000	0.114	0.297	0.208	0.002
Income $10000 to $20000	0.212	0.358	0.446	0.071
WIC	0.285	1.000	0.000	0.063
AFDC	0.134	0.392	0.178	0.012
Food Stamps	0.145	0.425	0.181	0.010
Medicaid	0.205	0.576	0.241	0.031
Insurance	0.589	0.176	0.430	0.823
Work During Pregnancy	0.638	0.419	0.568	0.754
Married at Birth	0.760	0.467	0.701	0.909
Live with Parents	0.127	0.263	0.183	0.050
Health Variables				
Mother Underweight	0.260	0.260	0.257	0.262
Mother Overweight	0.086	0.101	0.074	0.084
Mother Obese	0.086	0.122	0.089	0.068
Previous Adverse Event	0.083	0.100	0.079	0.077
WIC Program Variables				
Self-Declare Income	0.295	0.348	0.268	0.280
Link to AFDC	0.434	0.427	0.399	0.450
Link to Medicaid	0.592	0.618	0.530	0.601
Clinics	7.948	7.696	7.899	8.075
Other Variables				
Past WIC Participation	0.103	0.296	0.085	0.024
AFDC Ben. Family of 2	296.686	273.187	294.371	308.022
Northeast	0.179	0.138	0.124	0.217
North Central	0.256	0.252	0.254	0.257
West	0.205	0.171	0.236	0.208
Sample Size	12,354	3,987	3,036	5,331

Table 4: Effect of WIC Rules on Beginning Month of WIC

Variable	No	Yes	t-statistic (No=Yes)
Self Declare Income	3.924	3.431	3.95
Link to AFDC	3.877	3.584	2.35
Link to Medicaid	3.841	3.698	1.08

Table 5: Month of Initiation of WIC

Beginning Month	Number of Women
1	695
2	729
3	878
4	621
5	410
6	284
7	171
8	79
9	120

Note: The sample is restricted to the 3,987 WIC participants.

Table 6: Count of People by Number of Spells

Spells	Number of Women
0	3,041
1	3,974
2	20
3	1
4	1

Table 7: Flexible Baseline Hazard Model: Non-Baseline Parameters

	Specification			
	1	**2**	**3**	**4**
Demographic Characteristics				
Age < 20	1.651**	1.631**	1.481**	1.572**
Age 20 to 29	1.395**	1.391**	1.285**	1.343**
Less Than High School	4.562**	4.635**	2.965**	2.936**
High School	3.511**	3.515**	2.719**	2.683**
Some College	2.529**	2.555**	2.225**	2.200**
Black	1.480**	1.418**	1.053	1.058*
Hispanic	1.428**	1.553**	1.390**	1.392**
Other	1.581**	1.626**	1.385**	1.426**
First Pregnancy	0.914**	0.911**	1.021	1.060**
Northeast	1.095**	1.129**	0.979	0.986
North Central	1.042*	1.150**	1.102**	1.109**
West	0.710**	0.988	1.037	1.106
WIC and AFDC Program Variables				
Self-Declare Income	---	1.349**	1.329**	1.322**
Link to AFDC	---	1.109**	1.117**	1.103**
Link to Medicaid	---	1.187**	1.190**	1.194**
Clinics	---	1.005*	1.018**	1.019**
AFDC Ben. Family of 3	---	0.907**	0.918**	0.911**
Resources				
Income < $5000	---	---	1.569**	1.557**
Income $5000 to $10000	---	---	1.613**	1.601**
Income $10000 to $20000	---	---	1.593**	1.581**
AFDC	---	---	1.025	1.036
Food Stamps	---	---	1.282**	1.259**
Medicaid	---	---	1.629**	1.594**
Insurance	---	---	0.728**	0.711**
Work During Pregnancy	---	---	0.893**	0.897
Married at Birth	---	---	0.890**	0.884**
Live with Parents	---	---	0.886**	0.885**
Health Variables		---		
Mother Underweight	---	---	---	1.014
Mother Overweight	---	---	---	1.211**
Mother Obese	---	---	---	1.349**
Previous Miscarriage	---	---	---	1.193**
Likelihood	-18,248.57	-18,182.98	-17,809.08	-17,784.31

Notes: ** indicates a coefficient is statistically significant at 0.05 and * indicates a coefficient is statistically significant at 0.10. The sample size is 7,023.

Table 8: Flexible Baseline Hazard Model: The Role of Past WIC

	Specification			
	Full Sample	**No Past WIC**	**Past WIC**	**No Past WIC Num. Preg. > 1**
Demographic Characteristics				
Age < 20	1.460**	1.327**	1.933**	2.207**
Age 20 to 29	1.234**	1.244**	1.260**	1.033
Less Than High School	2.909**	3.165**	0.982	1.740*
High School	2.768**	2.863**	1.090	2.190**
Some College	2.296**	2.553**	0.826	1.929**
Black	1.017	1.000	0.929	1.130
Hispanic	1.425**	1.330**	1.504**	1.443**
Other	1.351**	1.547**	0.893	1.340**
First Pregnancy	2.002**	2.074**	---	---
Northeast	0.989	1.041	1.040	0.800
North Central	1.128**	1.110**	1.289**	0.505**
West	1.089**	1.105**	1.170**	0.927
WIC and AFDC Program Variables				
Past WIC Participation	3.098**	---	---	---
Self-Declare Income	1.297**	1.336**	1.189**	1.013
Link to AFDC	1.094**	1.037	1.120**	1.166**
Link to Medicaid	1.176**	1.193**	1.069*	0.917
Clinics	1.019**	1.013**	1.041**	1.029**
AFDC Ben. Family of 3	0.920**	0.918**	0.886**	0.893**
Resources				
Income < $5000	1.600**	1.627**	1.310**	1.755**
Income $5000 to $10000	1.658**	1.826**	1.322**	1.406**
Income $10000 to $20000	1.602**	1.696**	1.356**	1.355**
AFDC	0.942**	1.009	0.894**	0.687**
Food Stamps	1.224**	1.224**	1.165**	1.479**
Medicaid	1.547**	1.827**	1.019	2.764**
Insurance	0.711**	0.736**	0.730	1.026
Work During Pregnancy	0.922**	0.908**	0.979	0.944
Married at Birth	0.872**	0.789**	1.011	1.060
Live with Parents	0.892**	0.949*	0.800**	0.863
Household Size	1.004	1.000	1.004	0.970*
Health Variables				
Mother Underweight	1.022	1.089**	0.899**	0.721**
Mother Overweight	1.194**	1.381**	0.998	1.029
Mother Obese	1.364**	1.408**	1.369**	1.313**
Previous Miscarriage	1.334**	1.337**	1.214**	1.252**
Sample Size	7,023	5,191	1,832	1,354
Likelihood	-17,550.34	-12,065.33	-5,633.02	-2,448.78

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 Curve: Full Sample

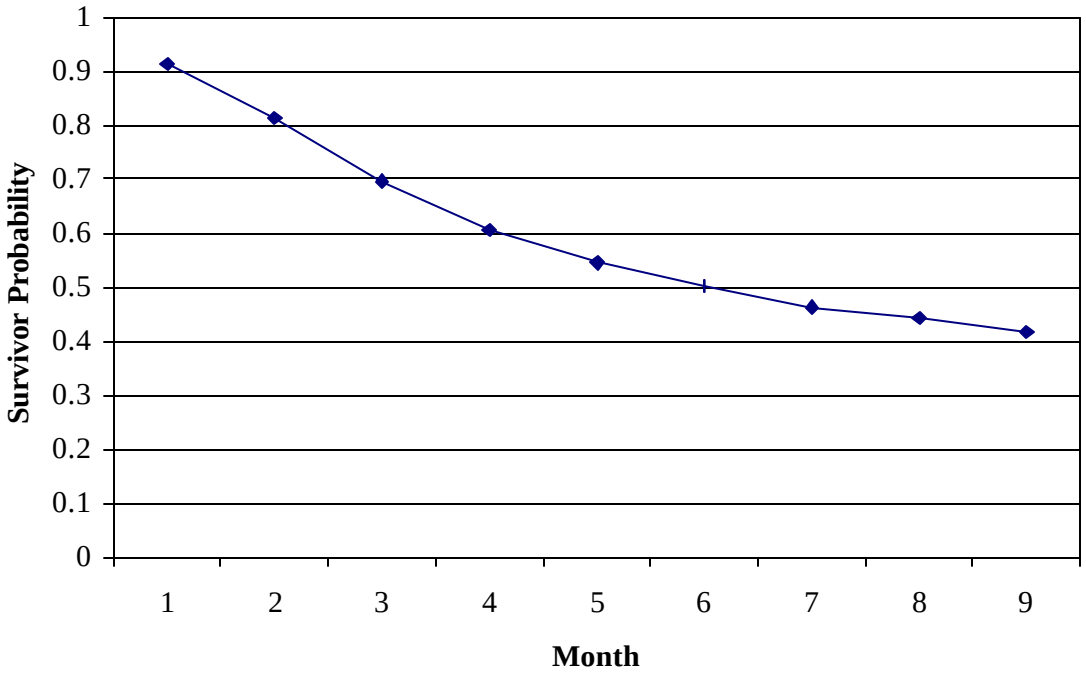

Figure 2: Kaplan-Meier Survivor Curves by Race

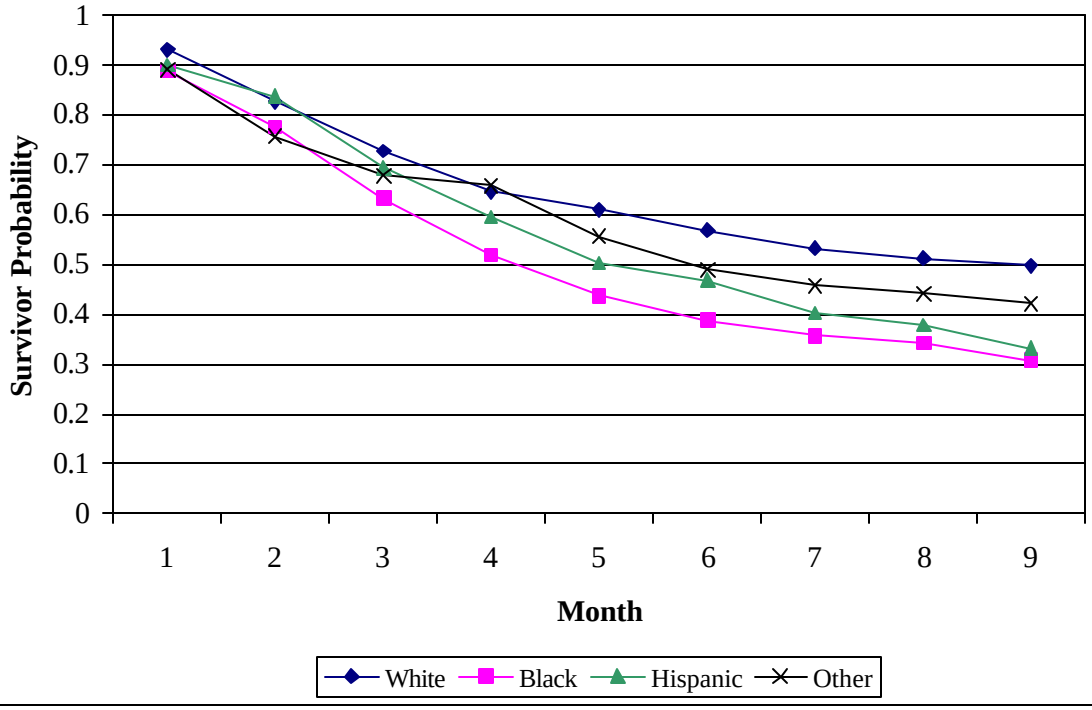

Figure 3: Kaplan-Meier Survivor Curves by Ability to Self-Declare Income

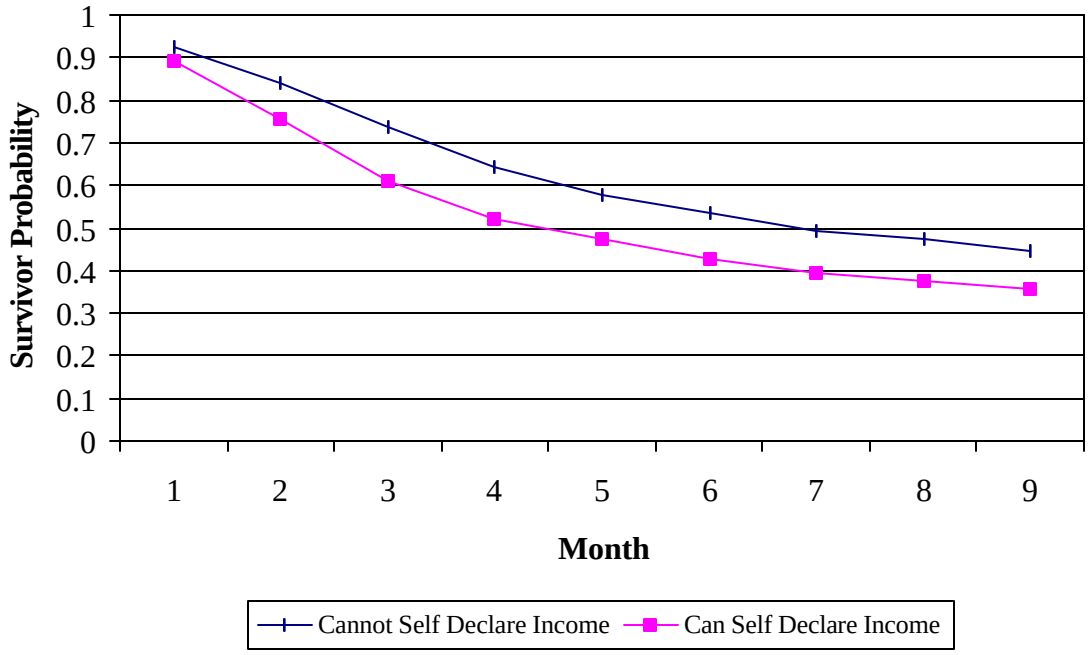

Figure 4: Kaplan-Meier Survivor Curves by Link to Medicaid

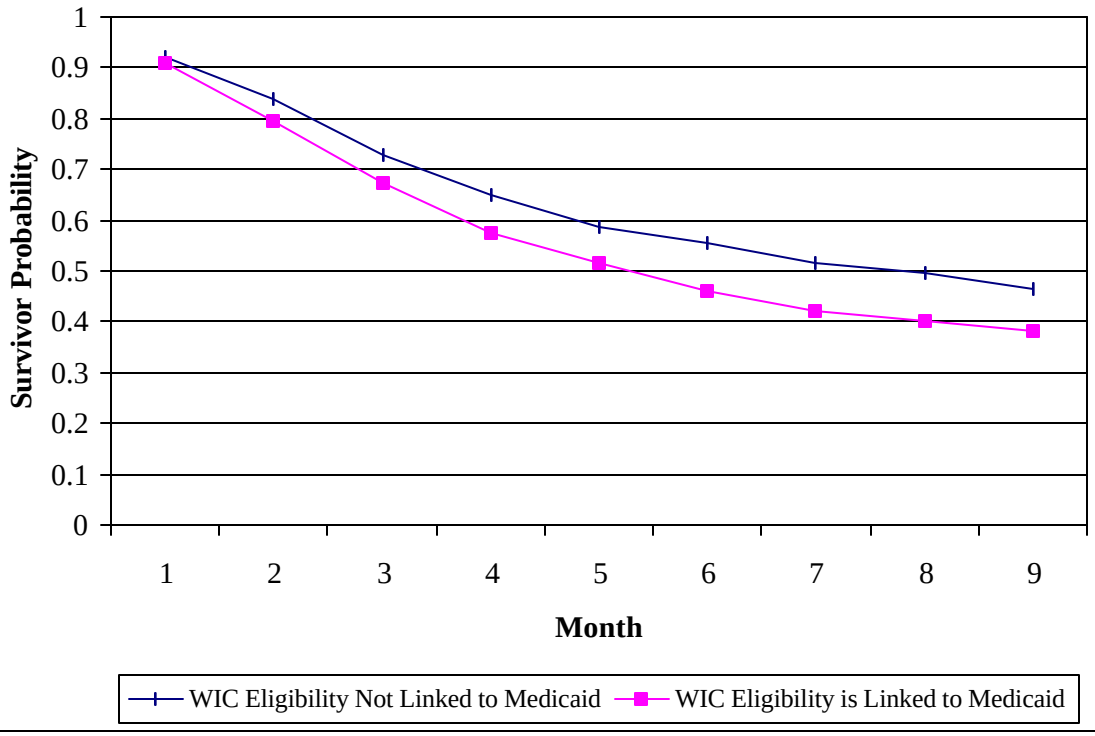

Figure 5: Kaplan-Meier Survivor Curves by Weight

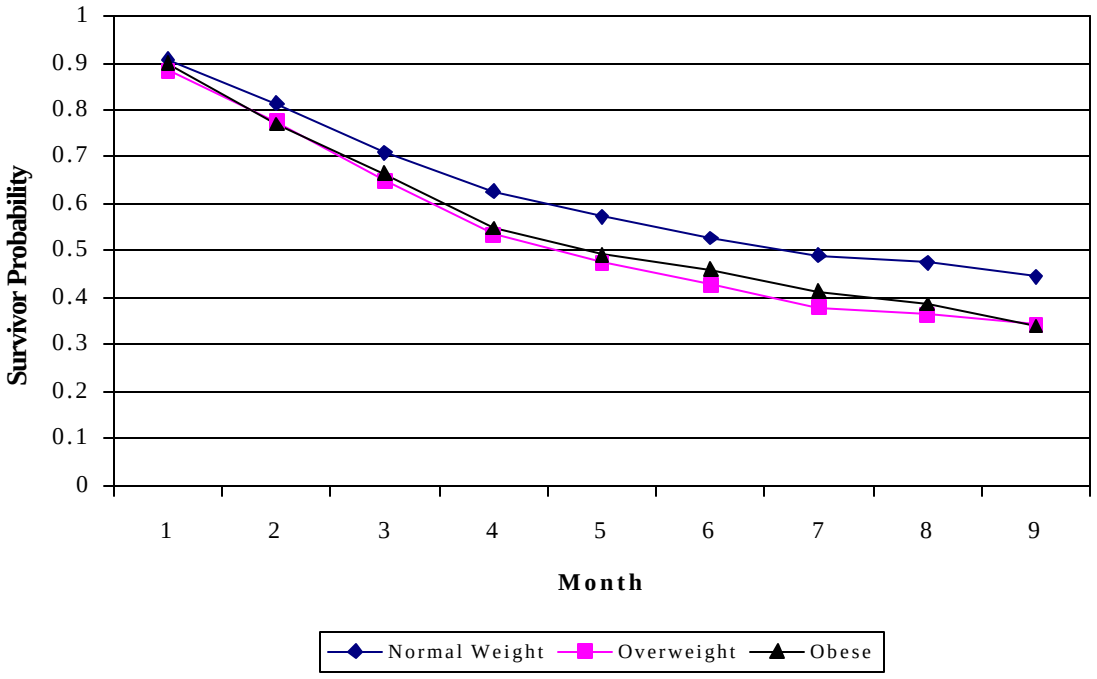

Figure 6: Kaplan-Meier Survivor Curves by Previous Adverse Pregnancy Outcome

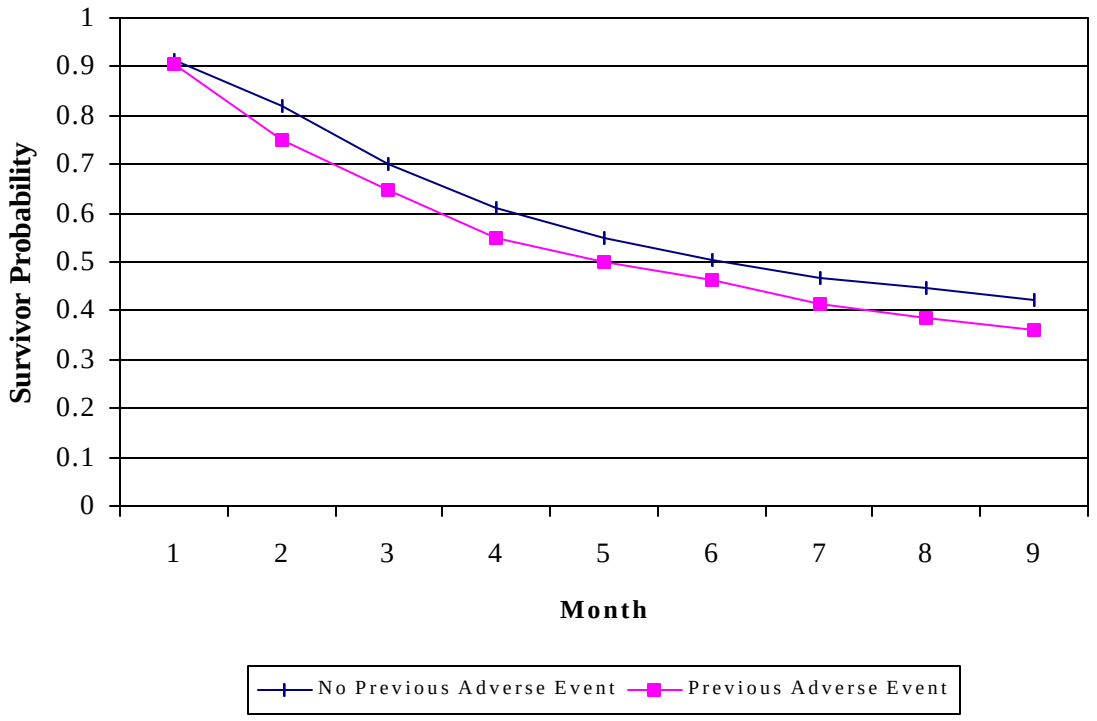

Figure 7: Simulated Hazard Function

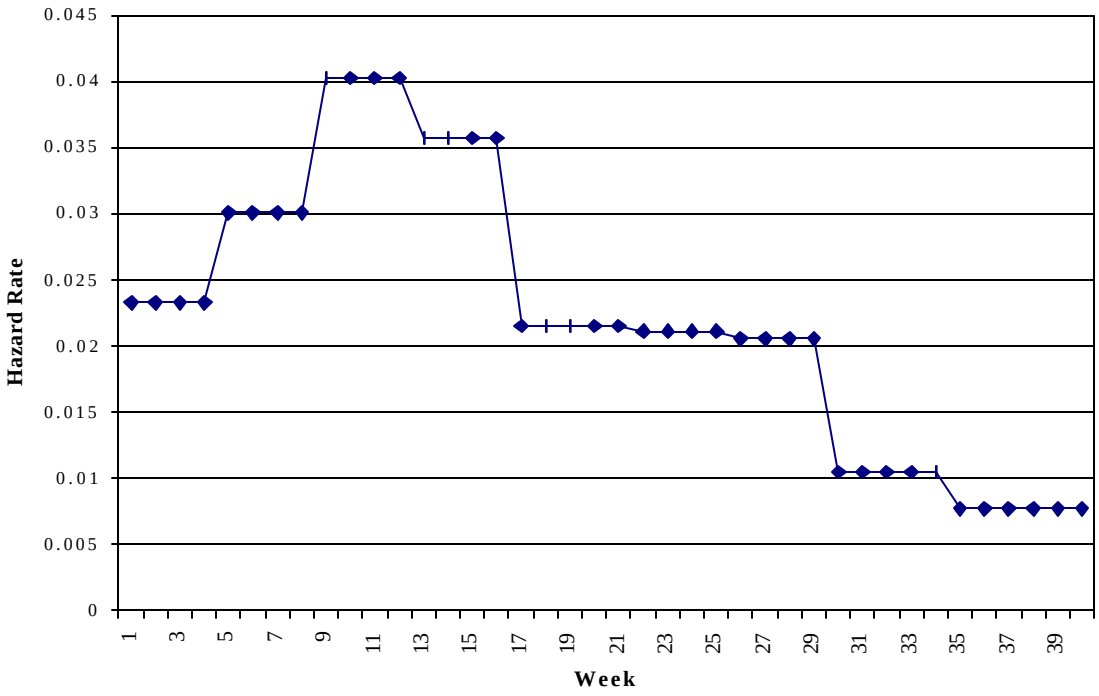

Figure 8: Kaplan-Meier Survivor Curves by Previous WIC Receipt

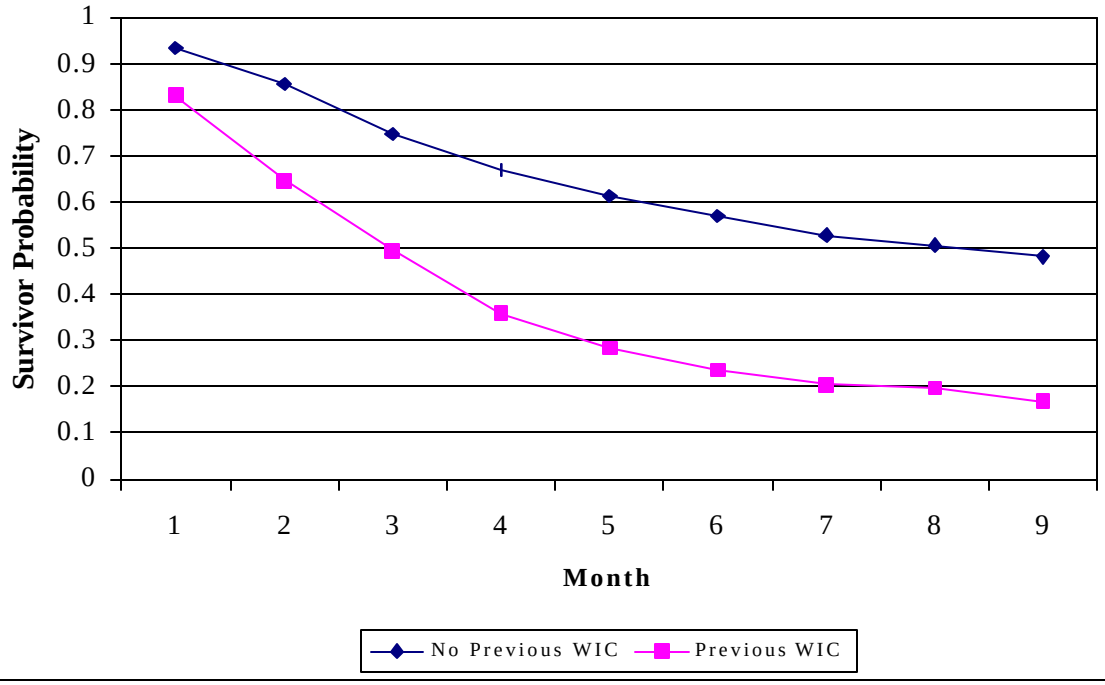

Figure 9: Simulated Baseline by Previous WIC Recipient

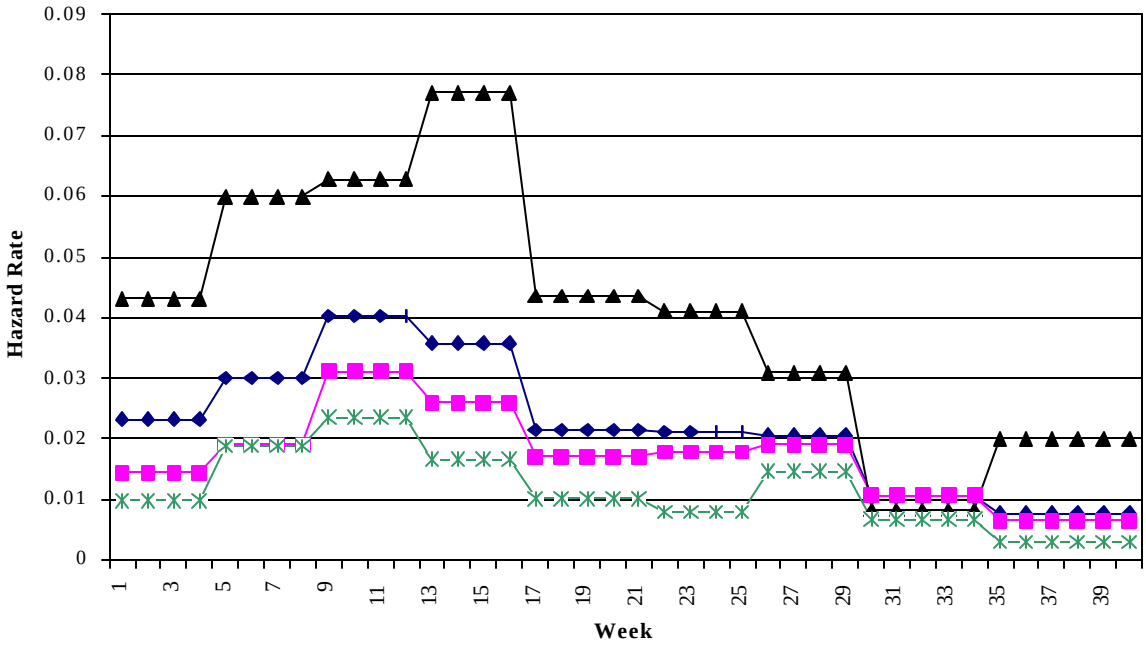

Figure 10: Simulated Baseline Hazard Functions for More and Less Restrictive Policies

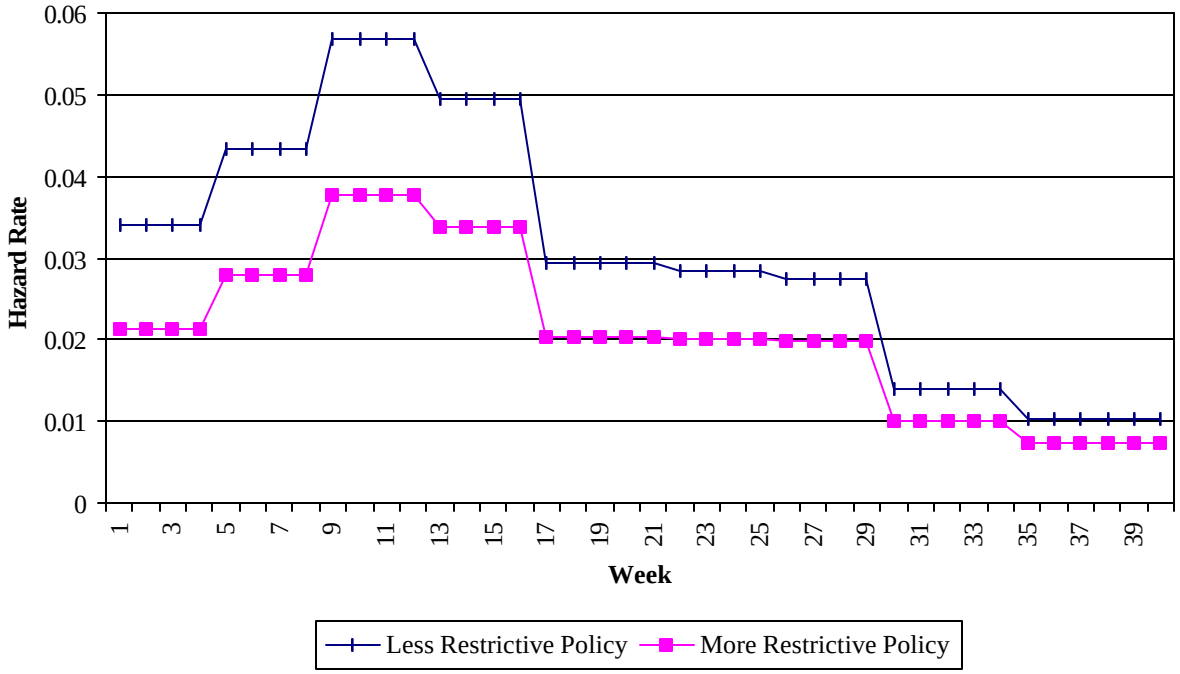

Figure 11: Simulated Survivor Curves for More and Less Restrictive Policies

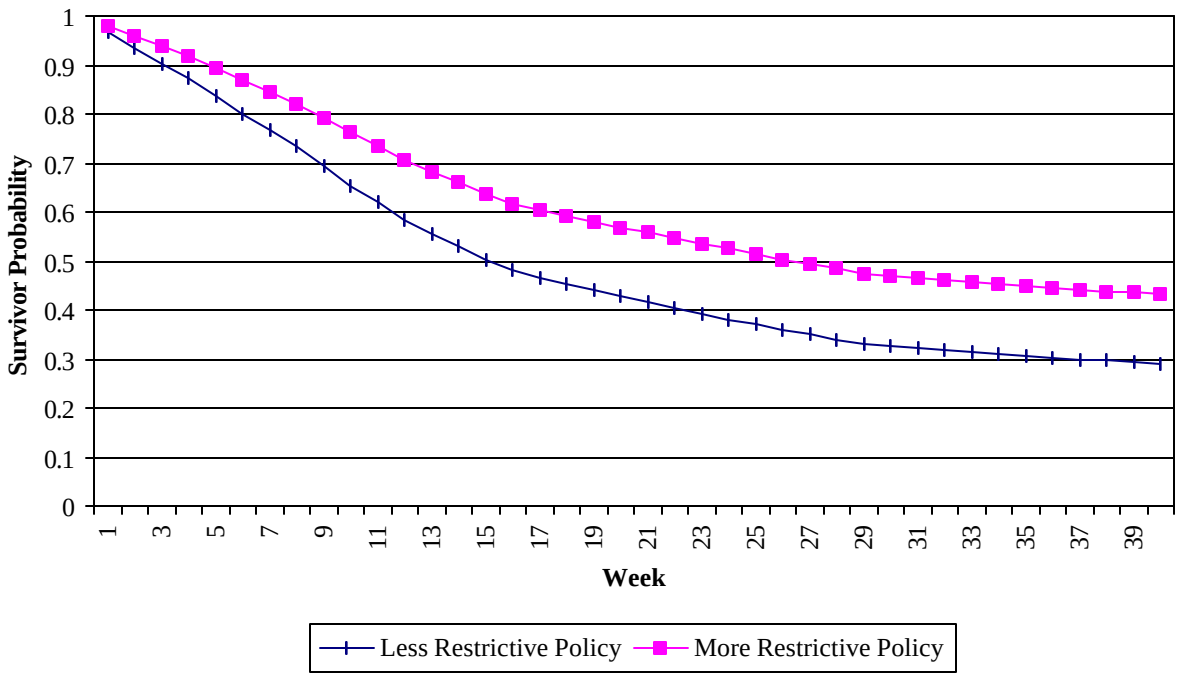

Figure 12: Simulated Hazard Functions for 1988 Policy and Current Policy

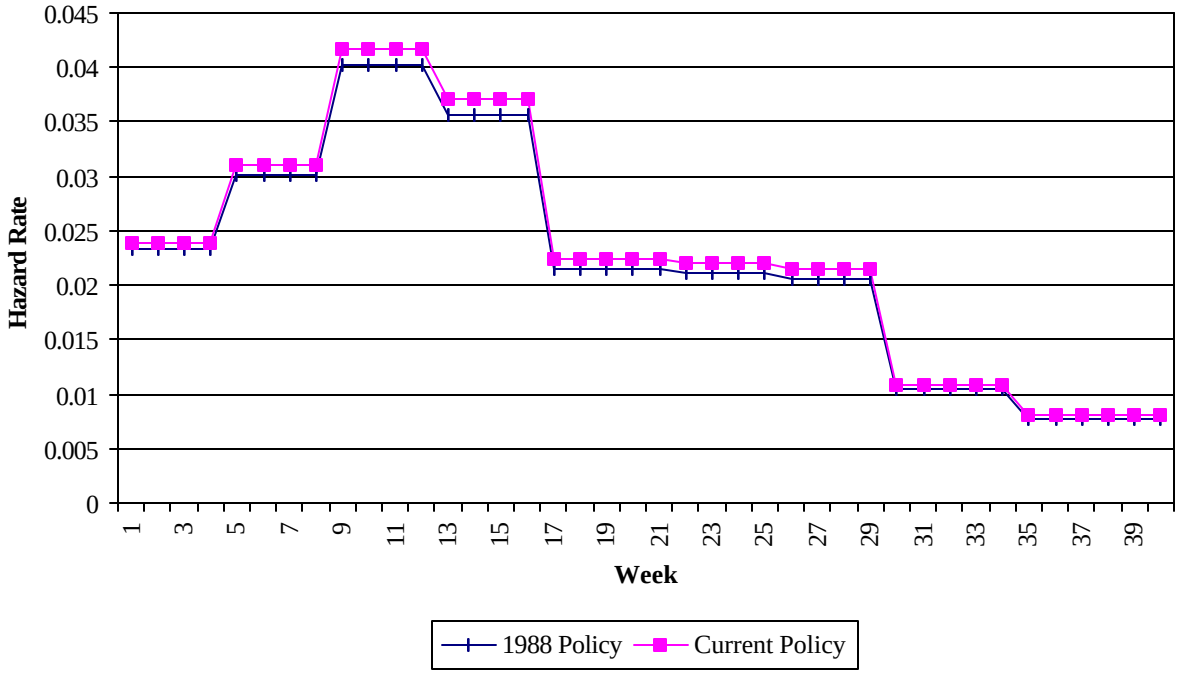

Figure 13: Simulated Survivor Curves for 1988 Policy and Current Policy