The Dynamics of Food Stamp Program Participation: A Lagged Dependent Variable Approach

Sibel Atasoy
Department of Agricultural and Applied Economics
Virginia Polytechnic Institute and State University
Blacksburg, VA, 24060
E-mail: sibela@vt.edu

Bradford F. Mills
Department of Agricultural and Applied Economics
Virginia Polytechnic Institute and State University
Blacksburg, VA, 24060
E-mail: bfmills@vt.edu

Christopher F. Parmeter
Department of Agricultural and Applied Economics
Virginia Polytechnic Institute and State University
Blacksburg, VA, 24060
E-mail: parms@vt.edu

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Introduction

Most welfare programs in the U.S. were designed to alleviate poverty by providing a safety net for families during economic downturns. However, the efficiency of these programs continues to be the focus of debate due to concerns with long-term welfare dependency among recipients. Specifically, prolonged periods of reliance on public assistance may arise from the adverse effects of the welfare system on recipients' choices and behavior, with respect to work and family structure (Moffitt, 1992). Addressing such adverse incentives in social assistance program design requires understanding the mechanisms that both drive individuals to seek public assistance and cause some individuals to remain on public assistance for long periods of time.

Two explanations are often put forward for the observed serial persistence in welfare receipt (Heckman, 1981). On the one hand, persistence may be the result of "true" state dependence in which current participation directly influence an individual's propensity to participate in the future by altering the cost or stigma related to welfare participation and shifting the structure of the individual's preferences. True state dependence is often associated with the concept of a "welfare trap" in the literature. On the other hand, persistence may result from unobserved individual heterogeneity, in that individuals have different underlying propensities to participate in all periods. In this case, current participation does not structurally affect the future propensity to participate, but rather observed propensities to participate differ over time due to correlations with unobserved factors. For instance, individuals with unobserved high stigma levels leave the program more rapidly, leaving predominantly low stigma individuals in the population of long-term participants.

Distinguishing state dependence from other sources of welfare persistence is important from a policy perspective. If the relationship between past and current participation in a welfare program is mostly due to true state dependence, changing welfare program parameters to reduce entrance welfare can have long-term benefits in terms of reducing welfare dependency. Policies that discourage participation in welfare may also indirectly encourage work and improve economic well-being among recipients. If most participation is due to persistent individual unobserved heterogeneity, then changing the welfare policy will be less effective in the long-run and can have only temporary effects, and the unobserved causes of persistent welfare participation need to be addressed.

Existing research on welfare dynamics is heavily dominated by duration or hazard models that analyze the probability that a spell will end at some point in time, given that it has not previously ended at the start of the period. Early work on the dynamics of welfare participation using hazard models examined the exit rate from welfare (Ellwood, 1986; O'Neill et al., 1987; Blank, 1989; Fitzgerald, 1991). Given high reentry rates among welfare recipients, especially after the enactment of the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) in 1996, later empirical work analyzed welfare reentry patterns and multiple participation spells (Blank and Ruggles, 1994; Cao, 1996; and Bruce et al., 2004). Studies that use hazard models typically analyze welfare dependence by looking at the degree of duration dependence by allowing for the estimation of factors that contribute to ending a particular spell, including the effect of the duration of the spell itself. In these models, evidence in favor of negative duration dependence (the longer an individual stays on welfare the less likely it is for the individual to leave welfare) is typically taken as an indicator of true state dependence. Hazard models that incorporate unobserved heterogeneity do exist in the literature, however these models cannot

distinguish between the possible sources of persistence, and therefore are unable to explicitly model the serial persistence that exists in welfare dynamics (Cappellari and Jenkins, 2002).

Recently, dynamic binary response panel data models, also known as lagged dependent variable models, have been adopted to distinguish between true and spurious state dependence in social assistance dynamics (Andren, 2007; Hansen and Lofstrom, 2009; Hansen, Lofstrom and Zhang, 2006; Cappellari and Jenkins, 2008). These models have only recently been applied to study U.S. welfare dynamics (Chat and Hyslop, 1998; Chay, Hoynes and Hyslop, 2004). The dynamics of participation in the Food Stamp Program (FSP), the largest transfer program in the U.S., have not been studied using this approach.[1] This article fills that gap in the literature and employs lagged dependent variable models to study FSP participation dynamics over the period 1990-2005 using Panel Study of Income Dynamics data. As part of this effort the article also addresses the question of whether persistence in FSP participation decreased after the 1996 PRWORA Legislation, which focused on moving families off cash assistance but also indirectly increased exits from the FSP.

Empirical Model

State dependence is modeled by introducing a lagged FSP participation indicator into the probability of FSP participation in the current period. In general form, a dynamic reduced form model for FSP participation can be expressed as:

$$(1) \qquad S_{it} = \gamma P_{F,it-1} + X_{it}\beta + a_i + \varepsilon_{it}, \quad P_{F,it} = 1[S_{it} \geq 0]$$

[1] There exist a number of studies that use simple regression techniques to analyze household experience with public assistance programs as a determinant of FSP entry or exits (Hisnanick and Walker, 2000; Zedlewski and Rader, 2004). These studies use past participation as a proxy for low information costs or lower stigma, and therefore only address the first source of state dependence as they fail to account for unobserved household characteristics that may cause persistent participation in the FSP.

where S_{it} is the underlying latent variable for observed FSP participation $P_{F,it}$ at time t, and X_{it} is a vector of individual characteristics, a_i is the individual specific effects or unobserved heterogeneity and ε_{it} is the error term which is normally distributed with mean zero and variance σ_ε^2. Dynamics are assumed to be first-order, meaning that the degree of state dependence from the past is collapsed into a single parameter, measured by γ.[2] $\gamma > 0$ would imply that the likelihood of receiving food stamps in the current period is larger for those with previous period experience with the program compared to others without such experience.

The central econometric issues that arise in estimating equation (1) are unobserved heterogeneity and the endogeneity of initial conditions. In this article, we estimate two dynamic random effects models that have been developed in the literature to deal with these issues. The first specification is a correlated random effects model developed by Mundlak (1978) and Chamberlain (1984) that addresses only the issue of unobserved heterogeneity while treating the initial conditions exogenous. The second specification is a dynamic random effects probit model that follows Wooldridge (2005) to deal with both unobserved heterogeneity and endogeneity of initial conditions.[3]

The correlated random effects model allows for correlations between a_i and X_{it} by adding the means of the time-varying variables for each household to the model. In order to write the model

[2] Higher order dynamics can be allowed (e.g. Heckman (1981)) however this requires simultaneous estimation of multiple equations since there will be multiple initial conditions depending on the order of dynamics. This makes the model computationally very intensive. The model can be estimated using simulated maximum likelihood techniques, but the difficulty of finding valid exclusion restrictions for multiple equations makes the approach difficult to implement in empirical work (Cappellari et al., 2009).

[3] An alternative to Wooldridge's model was developed by Heckman (1981). The Wooldridge method is preferred over the Heckman method. First, the Wooldridge model is computationally less intensive. Second, the Heckman model requires appropriate instruments for the initial conditions. In the absence of appropriate instruments, identification of the model must rely on non-linearities in functional form. On the other hand, the Wooldridge approach does not require instruments for identification. Further, there is evidence that these estimators lead to very similar results (Arulampalam and Stewart, 2007). For the current application, the models were also estimated using the Heckman approach, but since the results are quite similar only the results based on Wooldridge are presented.

formally, let X_{it} and Y_i represent the time-varying and time-invariant characteristics, respectively. The FSP participation equation can then be written as:

$$(2) \qquad S_{it} = \gamma P_{F,it-1} + X_{it}\beta_X + Y_i\beta_Y + \bar{X}_\iota\beta_{\bar{X}} + c_i + \varepsilon_{it}, \quad P_{F,it} = 1[S_{it} \geq 0]$$

where $a_i = \bar{X}_\iota\beta_{\bar{X}} + c_i$ encompasses the relationships with unobserved and observed characteristics. The composite error term $v_{it} = c_i + \varepsilon_{it}$ is independent of X_{it}, and $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$. Given that $P_{F,it}$ is a binary variable, a normalization is necessary and it is commonly assumed that $\sigma_\varepsilon^2 = 1$. The correlation between v_{it} for different periods is constant and given by: $\tau = corr(v_{it}, v_{is}) = \sigma_c^2/(\sigma_c^2 + 1)$ for $t, s = 2, \dots, T; t \neq s$.

Estimation of the correlated random effects model requires the specification of the relationship between the initial observations $P_{F,i1}$ and c_i. If the initial observations are exogenous, which is likely to be the case only if the start of the FSP participation coincides with the start of the observation period for each household, a standard random effects probit model can be estimated. If not, the initial conditions are likely to be correlated with unobserved heterogeneity and the random effects probit model will overstate the degree of state dependence (Chay and Hyslop, 1998).

Wooldridge (2005) deals with the problem of initial conditions by specifying the distribution of the unobserved heterogeneity, conditional on the initial value and any exogenous variables. The model for c_i is specified in its simplest form as $c_i = \eta_0 + \eta_1 P_{F,i1} + u_i$, where u_i is a normally distributed error term. Under this specification, the dynamic equation becomes:

$$(3) \qquad S_{it} = \gamma P_{F,it-1} + X_{it}\beta_X + Y_i\beta_Y + \bar{X}_\iota\beta_{\bar{X}} + \eta_0 + \eta_1 P_{F,i1} + u_i + \varepsilon_{it}, \quad P_{F,it} = 1[S_{it} \geq 0]$$

The distribution of $(P_{F,i2}, \dots, P_{F,iT})$ given the exogenous individual characteristics and $P_{F,i1}$ for each individual is then:

$$(4) \qquad f\left((P_{F,2}, \dots, P_{F,T})\middle|P_{F,1}, X, Y, u\right) = \prod_{t=2}^{T} f\left(P_{F,t}\middle|P_{F,t-1}, P_{F,1}, X, Y, \bar{X}, u\right)$$

The parameters of interest are estimated by maximum likelihood. Under the assumption that u_i is distributed normally, the expression of the likelihood function is identical to the structure of the standard random effects probit model with the only difference being that the explanatory variables at time t now also include the initial value of the dependent variable $P_{F,i1}$. Essentially then, the Wooldridge (2005) specification adds $P_{F,i1}$ as an additional explanatory variable in each time period and estimates the parameters using a correlated random effects probit estimator.

In the empirical specification, the dynamic reduced form model for FSP participation includes covariates that influence the decision to receive FSP benefits through their impact on the utility from participation in the FSP. Higher level of benefits available to the household will increase the disposable income of the household, increasing their utility. However, costs of participation in the program reduce household utility either directly through stigma or by reducing the disposable income through monetary costs. The key determinants of expected FSP benefits are income and household composition. Also, it is well established in the literature that costs of participation are a function of household characteristics, economic conditions and policy variables. A key determinant of FSP participation is prior FSP receipt, which reduces the stigma associated with program participation and makes it more likely for households with prior experience with the FSP to participate in the program relative to others without such experience. Also, some individuals such as single mothers, minorities or those with low education levels may have lower stigma, and are therefore more likely to participate in the FSP. On the other hand,

geographic isolation and availability of public/private transportation to the welfare office affects the monetary cost of participating in the FSP (Blank and Ruggles, 1996). Therefore it may not be worthwhile for households with high transportation costs to apply for FSP benefits. The FSP policy environment also influences FSP participation through its impact on the cost of participation. For instance, an important policy change in the second half of the 1990s was the switch from paper coupons to electronic cards in delivering food stamps, which was completed in all states in 2004. A major reason for this transition was to induce eligible families to participate in the FSP by reducing the social stigma associated with using food stamps.

Combining the determinants of expected FSP benefits and FSP participation costs, we arrive at four groups of covariates to include in the empirical model for FSP participation. Family demographic and household head characteristics include the number of adults, number of children, home ownership, number of weeks spent unemployed by the household head, as well as the age, gender, marital status and race of household head.[4] Family educational assets are measured by discrete indicators for the education level of the household head (no high-school degree, high-school degree, some post-secondary education but no college degree, and a college degree). Location attributes are measured by distance to the nearest welfare office[5], county unemployment rates, and an indicator of residence in the rural South. Variables describing the FSP policy environment are state-level average recertification periods, state-level shares of FSP participants that received an erroneous overpayment and underpayment of FSP benefits, the

[4] Family income is not included due to possible endogeneity issues since workforce participation decisions are likely to be made jointly with welfare participation decisions (Keane and Moffitt, 1998). Instead a number of covariates that determine labor force participation and therefore income (such as family composition, gender, educational attainment, etc.) are included in the analysis.

[5] This is measured as the distance from the zip code of the household to the zip code of the closest FSP office. If the household resides in a zip code where there is a FSP office, distance is zero miles, otherwise, it is measured as the distance to the nearest FSP office within the same state.

percentage of the population receiving food stamps in the county of residence, and state Electronic Benefits Transfer (EBT) penetration rates measured as the percentage of food stamps issued via EBT cards in a given year.

Data

The primary source of data for the analysis comes from the Panel Study of Income Dynamics (PSID) waves of 1990-2005. The PSID is a long-term panel that started in 1968 with a sample of roughly 5,000 households (3,000 nationally representative households and an over sampling of 2,000 low-income households). The original families and the families of their offspring were followed, and by 2001 over 7,000 families are included in the sample. We conduct the analysis on a sample of low-income households with annual income less than two times the official poverty line in at least one survey period to focus on the population that is the most likely to be eligible to participate in the FSP.[6]

Figure 1 presents FSP participation rates and trends in annual transition rates into and out of FSP receipt for the study period. Exit rates appear to influence participation rates more than entry rates. For instance, a major increase in the FSP exit rate following the passage of the 1996 PRWORA Legislation resulted in a significant drop in participation rates after 1996. After 1999, with declining exit rates and increasing entry rates, participation rates start to trend back upward. It is also important to note that low exit rates from the FSP imply high raw FSP participation persistence rates (measured as one minus the exit rate from the FSP, expressed as a percentage).

[6] The gross income test for FSP eligibility requires that a household's pre-tax income the previous month be at or below 130% of the poverty line. However, monthly incomes are not reported in the PSID, making it difficult to assess eligibility. Following a number of previous studies, a low-income sample based on annual incomes below two times the poverty line is constructed to focus on the households that are the most likely to be eligible to participate in the FSP, as about 90 percent of FSP participants are also low-income households.

In fact, in any given year at least sixty percent of those who have received food stamps in the previous period continue to receive FSP benefits in the current period.

Descriptive statistics for model covariates are reported in table 1 for the low-income sample of households participating in the FSP in all periods, participating in at least one period, and never participating in the FSP. Household characteristics display expected differences when comparing FSP participants and non-participants. For instance, the food stamp receiving households have on average a smaller number of adults and more children than non-participating households. Taking the more educated spouse to be the head of the household for married families and the reported head for families for families with other marital status, food stamp receiving households have younger household heads. Also, a larger percentage of food stamp receiving households do not own their homes, are headed by an African-American or by a single mother when compared to non-participants. Food stamp receiving households also have heads with lower levels of educational attainment than heads of non-participating households. With respect to economic and policy variables, differences between FSP participants and non-participants appear to be smaller.

There are also some notable differences with respect to some covariates among households participating in the FSP in all periods. For instance, households with an African-American head constitute 90 percent of households that receive food stamps in all periods, about thirty percentage points larger than the percentage of households participating in at least one period that are headed by an African-American person. Similarly, single mother headed households make up a significantly larger share of households participating in the FSP in all periods compared to those participating in the FSP in at least one period. Significant differences also exist with respect to educational attainment. In particular, households that receive food stamps in all periods have lower education levels (72 percent with no high school degree and 16 percent

with a high school degree) than those participating in at least one period (48 percent with no high degree and 34 percent with a high school degree). It is also worth noting that households that participate in the FSP in all periods live in states with higher penetration rates than households that participate in the FSP in at least one period. These differences imply that household, economic and policy variables do not only impact participation probabilities, but also have an influence on FSP participation persistence over time.

Results

The coefficient estimates for the models employed in this study are reported in table 2. The discussion focuses on the Wooldridge model, while results from the correlated random effects probit specification are also presented to compare estimates.[7] Also, as the coefficients from the nonlinear models do not have a straightforward interpretation, these results are supplemented by average partial effect (APE) estimates for key covariates that are statistically significant (table 3).[8] The APEs are computed by calculating individual marginal effects using individual characteristics and averaging these calculations over the sample. For a continuous variable, the APEs are estimated by taking the derivative of the predicted probability with respect to the individual variable in question. For indicator variables, the APEs are calculated by predicting the probability when the indicator is set to one and when indicator is zero. The difference between these two probabilities is then, again, averaged over the sample.

The existence of endogenous initial conditions implies that state dependence will be overestimated in the correlated random effects model. This is confirmed by the coefficient

[7] As mentioned above, the Heckman specification was also estimated as a robustness check; however since the results are quite similar to the Wooldridge model, they are not presented in this study.

[8] APEs are arguably more appropriate than taking the marginal effects at the mean of the independent variables as sample mean characteristics might not realistically represent the actual households (Bartus, 2005).

estimate on lagged FSP participation: it is 1.45 in the Wooldridge model compared to 1.70 in the correlated random effects model that assumes exogenous initial conditions. Turning to the magnitude of the effect of lagged FSP participation, APEs in table 3 suggest that past receipt of food stamps increases the probability of receiving food stamps in a given period by 31 percent using the Wooldridge estimates. This represents a substantially smaller estimate than the persistence rate (42 percent) obtained from the correlated random effects probit that only controls for unobserved heterogeneity.

Turning to other parameter estimates, variables that reflect economic disadvantage and are often associated with difficulty of workforce entry are found to play a role in the FSP participation decision. In particular, minority status, single motherhood, and low educational attainment increase the probability of participating in the FSP among low-income households. Other variables such as number of children and time spent unemployed by the household head increase the probability of FSP receipt while the age of head and home ownership have negative effects on the probability of receiving food stamps.

For the location attributes, only county unemployment rates and distance to the closest office are statistically significant. Residents of counties with higher unemployment rates are more likely to participate in the FSP, while longer distances to the nearest FSP office lower the probability of participation. For policy variables, only state EBT penetration rates are found to have an impact on the probability of FSP receipt. Contrary to expectations, higher EBT penetration rates decrease the propensity to participate in the FSP among low-income households, which may partially reflect the time trends observed in FSP participation.

Based on results in table 3, various tests regarding the assumptions in the models, namely state dependence, unobserved heterogeneity and endogeneity of initial conditions can be performed. First, the coefficient of lagged FSP participation status is positive and strongly significant in both models, which indicates that there is positive state dependence in FSP participation. Second, in Wooldridge's estimator, the estimate on the initial value of FSP participation status is statistically significant, which implies that the assumption of endogenous initial conditions is not rejected. Third, the importance of allowing for unobserved heterogeneity through individual random effects is shown by the rejection of the hypothesis that $\rho = 0$ in both models.

Testing for Structural Change in Persistence Rates

An important policy question is whether persistence rates declined over time in response to the welfare reform under the 1996 PRWORA. Welfare measures implemented under PRWORA focused on moving families off cash welfare and into the workforce; however existing literature suggests that the Temporary Assistance to Needy Families (TANF) program and FSP participation are strongly linked (Mills et al., 2001; Ziliak et al., 2000; Quint and Widom, 2000; Currie and Grogger, 2001).

As noted in figure 1, raw persistence rates declined significantly after 1996. This post-PRWORA period effect remains after conditioning for household, economic, and policy variables in the Wooldridge and correlated random effects probit specifications that also include interaction terms between lagged FSP participation and year dummies (figure 2).[9] Estimating the Wooldridge model for the pre-welfare reform and post-welfare reform separately also reveals a sudden drop in estimated persistence rates (table A1). For the pre-PRWORA period, the

[9] Parameter estimates for these models are available from the authors upon request.

parameter estimate for state dependence is 1.4 in the pre-welfare reform, while the estimate is 0.97 in the post-welfare reform period. In order to test whether there was indeed a structural change in persistence rates after 1996, a fully interacted model that includes an indicator variable for post-welfare reform and interactions between this indicator and all the covariates in the model was also estimated using the Wooldridge specification. Parameter estimates (not reported here) for the post-welfare reform indicators are jointly statistically significant at the $p=0.01$, implying that there is indeed a structural break in FSP participation dynamics following the implementation of welfare reform measures.

Estimated Degree of State Dependence among Subpopulations

The results indicate that a number of household and location attributes impact the decision to participate in the FSP. This raises the question of whether persistence rates also vary by household characteristics. For instance, in the literature it is often noted that socio-economically disadvantaged households are more likely to be trapped in welfare. Regional differences may also exist with respect to state dependence in FSP utilization patterns due to regional differences in welfare policies and economic conditions (Figlio et al., 1999). For instance, the Southern region of the U.S. experience higher levels of persistent poverty and food insecurity than other regions and may therefore experience higher persistence rates for FSP participation. In order to test for such differences, the Wooldridge specification was extended to include interaction terms between lagged FSP participation and key variables that determine economic well-being (i.e. single motherhood, racial status, educational attainment, and residence in the rural South) and

region dummies (Northeast, North Central, South Central, South Atlantic, Pacific and Mountain, with South Atlantic taken as the reference category)[10].

Table 4 reports the estimated degree of state dependence for all these subgroups and regions. The associated parameter estimates (presented in table A2 and A3) indicate that structural differences exist with respect to minority status and among regions. With respect to persistence in FSP participation by minority status, non-White household heads are five percent more likely to remain on the FSP if they have received food stamps in the previous period than White household heads. Given that minority households also have higher FSP utilization propensities, this suggests that they are more likely to participate in the FSP, and once they participate they tend to be more likely to remain in the program. Thus welfare traps appear to be more prominent among low-income households headed by minorities.

The estimated degree of state dependence in FSP participation is notably larger in the Northeast region than other regions. According to Andren (2007), regional differences in welfare persistence rates may be caused by a number of factors including regional welfare generosity. For instance, in regions with relatively high participation rates the negative signal attached to receiving welfare may be smaller than in regions with relatively lower participation rates. In this case, the degree of structural state dependence will be higher in regions with high participation rates. Indeed, the highest participation rates are observed in the Northeast and South Central regions (with 35 and 34 percent, respectively) that also show the highest estimate of structural

[10] The states that constitute each region are as follows: Northeast (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York and Pennsylvania), North Central (Indiana, Illinois, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota), South Central (Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas), South Atlantic (Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia), Pacific (Alaska, California, Hawaii, Oregon, and Washington) and Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming).

persistence. This implies that policies that lower participation rates may be efficient in reducing long-term participation in the program; however the goal of increasing participation in the program among eligible families without encouraging long-term FSP dependency remains a major policy concern.

Discussion and Conclusions

This study employs dynamic random effects probit models to analyze the dynamics of FSP participation using PSID data for the years 1990 to 2005. The principal focus is to measure structural persistence in FSP participation after controlling for both unobserved household-specific effects and the endogeneity of initial conditions that arise in dynamic models. Results show that FSP participation in the previous period increases the propensity to participate in the FSP in the current period by thirty percent. Structural FSP persistence rates are also found to have declined significantly following the passage of the 1996 PRWORA Legislation. PRWORA focused directly on moving families off cash welfare but also had a major indirect impact on FSP participation patterns. The current estimates strongly suggest that welfare reform measures have been successful in the unintended goal of decreasing long-term welfare dependency among welfare recipients in the FSP.

A major policy implication of the results is that FSP policies aimed at reducing the initial entrance into the FSP through changes in benefit levels or certification requirements can have long-term benefits in terms of reducing dependence among low-income households. However, in a program that commonly struggles to enroll half of all eligible participants, the long-term benefits of initial exclusion need to be carefully weighed against the cost of deterring the enrollment of eligible households. Alternative pathways to reducing structural dependence may

be two-fold. Alternative short-term food assistance programs can be implemented for families facing temporary food insecurity while households with long-term needs are provided with job training and child care to address workforce related constraints and mitigate the adverse influence of growing program dependence.

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Figure 1: Annual Trends in FSP Receipt and Raw Persistence Rates, 1990-2005

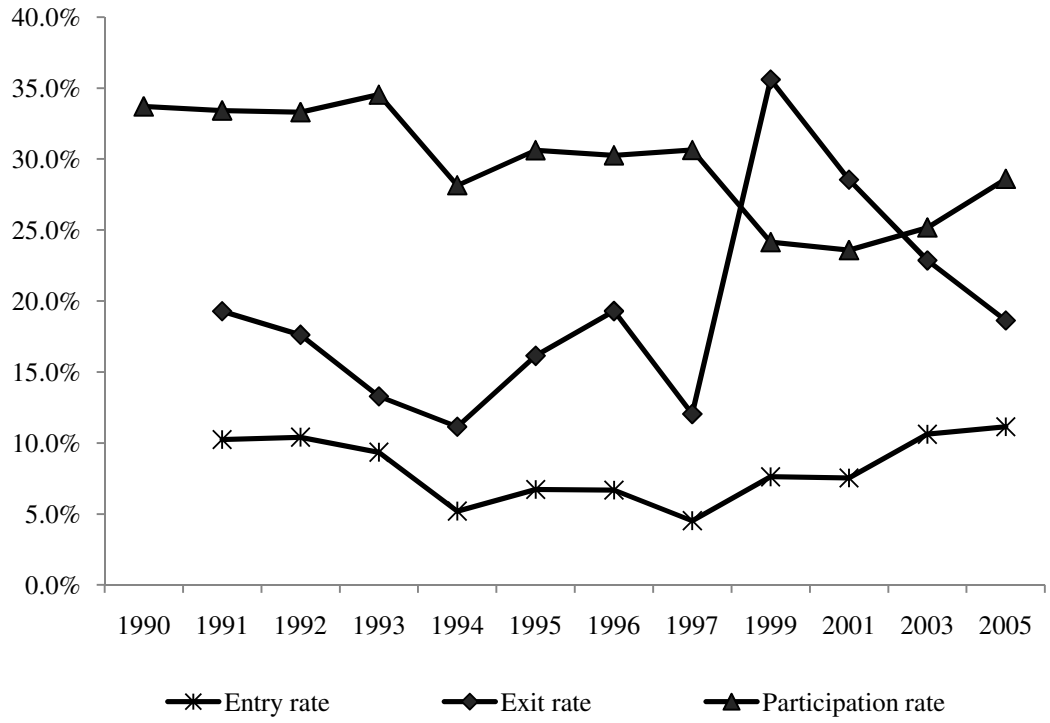

Figure 2: Annual Trends in Estimated Welfare Persistence

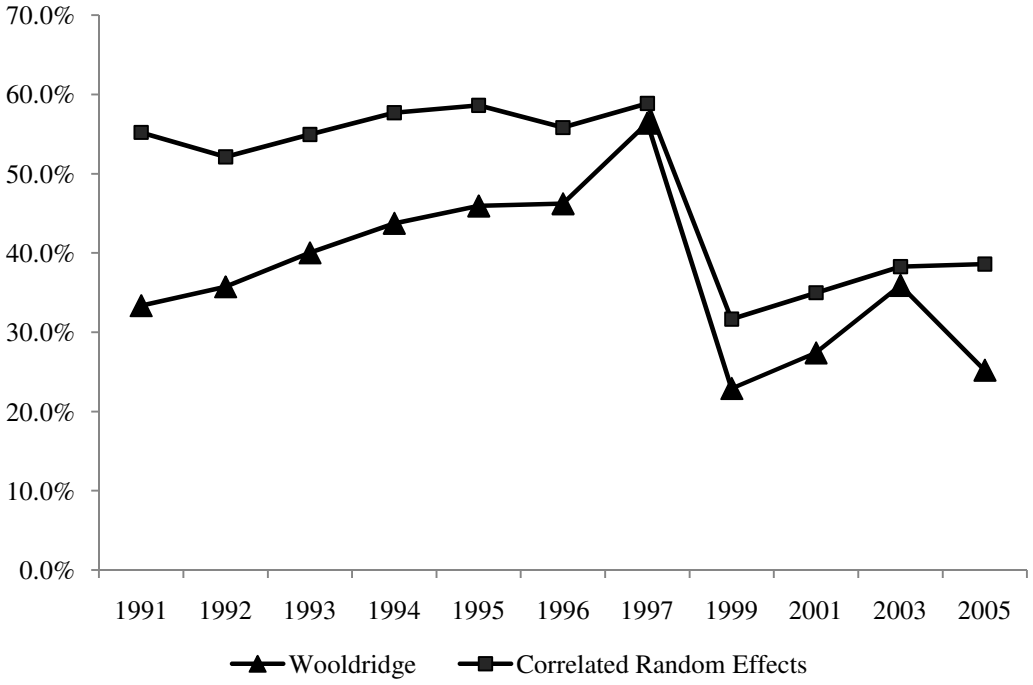

Table 1: Descriptive Statistics

Variable	Participating in all Periods		Participating in at least one Period		Never Participating	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Rural South	0.18	0.39	0.14	0.34	0.13	0.34
Number of Adults	1.42	0.67	1.64	0.81	1.67	0.82
Number of Children	2.15	2.03	1.52	1.54	0.77	1.20
Age of Head (10)	4.53	1.42	4.26	1.58	5.10	2.02
Head is White	0.06	0.23	0.30	0.46	0.56	0.50
Head is African American	0.91	0.29	0.63	0.48	0.36	0.48
Head is Other Race	0.03	0.18	0.07	0.26	0.07	0.26
Home Owner	0.17	0.38	0.26	0.44	0.47	0.50
Head has no High School Degree	0.72	0.45	0.48	0.50	0.38	0.49
Head is High School Graduate	0.16	0.37	0.34	0.47	0.35	0.48
Head has College no Degree	0.12	0.32	0.15	0.36	0.18	0.39
Head has College Degree	0.00	0.00	0.03	0.16	0.09	0.28
Head is Single Mother	0.62	0.49	0.39	0.49	0.10	0.31
Head Unemployed Weeks	4.22	10.85	3.61	10.88	2.07	8.37
County Unemployment Rate (%)	6.28	1.62	6.65	2.70	6.21	2.55
State Average Certification Period (months)	10.70	1.89	10.14	2.17	10.02	2.15
State EBT Penetration Rate (%)	20.59	39.23	14.61	33.41	13.31	31.88
County FSP Participation Rate (%)	0.14	0.05	0.12	0.07	0.10	0.06
Distance to Closest FSP office (miles)	4.84	5.56	4.48	5.00	5.13	5.26
State Overpayment Rate (%)	0.12	0.05	0.12	0.04	0.12	0.04
State Underpayment Rate (%)	0.08	0.03	0.08	0.03	0.08	0.03
Number of Observations	212		13,492		12,488	

[a] Head is defined to be the more educated spouse.

Table 2: Dynamic Random Effects Probit Results

Variable	Wooldridge			Correlated Random Effects		
	Parameter		SE	Parameter		SE
FSP Participation at *t-1*	1.451	***	0.044	1.695	***	0.027
FSP Participation at *t=1990*	0.824	***	0.060			
Rural South	-0.020		0.059	-0.013		0.039
Number of Adults	-0.030		0.038	0.005		0.028
Number of Children	0.170	***	0.030	0.167	***	0.021
Age of Head	-0.151		0.095	-0.156	**	0.065
Head is African American	0.078	*	0.045	0.094	***	0.029
Head is Other Race	0.218	***	0.076	0.097	**	0.047
Home Owner	-0.321	***	0.042	-0.348	***	0.029
Head is High School Graduate	-0.197	***	0.045	-0.173	***	0.029
Head has College No Degree	-0.270	***	0.060	-0.250	***	0.037
Head has College Degree	-0.353	***	0.096	-0.420	***	0.064
Head is Single Mother	0.333	***	0.050	0.377	***	0.032
Head Unemployed Weeks	0.005	***	0.002	0.006	***	0.001
County Unemployment Rate	0.049	***	0.014	0.035	***	0.010
State Average Recertification Period	0.006		0.019	0.009		0.013
State EBT Penetration Rate	-0.002	**	0.001	-0.002	***	0.0005
County FSP Participation Rate	0.625		0.768	1.206	**	0.577
Distance to Closest FSP Office	-0.026	***	0.009	-0.013	**	0.006
State Overpayment Rate	0.286		0.892	0.235		0.661
State Underpayment Rate	-1.542		1.355	-2.451	***	0.969
Mean Number of Adults	-0.010		0.047	-0.041		0.034
Mean Number of Children	-0.050		0.034	-0.038	*	0.024
Mean Age of Head	0.135		0.096	0.143	**	0.065
Mean Head Unemployed Weeks	0.016	***	0.004	0.011	***	0.003
Mean County Unemployment Rate	-0.031	*	0.019	-0.032	***	0.012
Mean State Average Recertification Period	-0.033		0.021	-0.010		0.014
Mean State EBT Penetration Rate	0.0002		0.001	-0.000004		0.001
Mean County FSP Participation Rate	1.568	*	0.893	1.430	**	0.642
Mean Distance to Closest FSP Office	0.018	*	0.010	0.012	*	0.007
Mean State Overpayment Rate	1.161		1.219	0.998		0.861
Mean State Underpayment Rate	1.056		1.809	0.860		1.265
Intercept	-1.697	***	0.178	-1.572	***	0.111
ρ	0.270	***	0.024	0.136	***	0.017
N	16,512			25,980		
Log-Likelihood	-5,266.30			-9,206.93		

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table 3: APEs for Selected Statistically Significant Variables

Variable	Wooldridge		Correlated Random Effects	
FSP Participation at *t-1*	0.313	***	0.421	***
FSP Participation at *t=1990*	0.158	***		
Number of Children	0.027	***	0.032	***
Age of Head			-0.030	**
Head is African American	0.013	*	0.018	***
Head is Other Race	0.036	***	0.019	**
Home Owner	-0.048	***	-0.063	***
Head is High School Graduate	-0.031	***	-0.033	***
Head has College No Degree	-0.043	***	-0.048	***
Head has College Degree	-0.055	***	-0.078	***
Head is Single Mother	0.057	***	0.078	***
Head Unemployed Weeks	0.001	***	0.001	***
County Unemployment Rate	0.008	***	0.007	***
State EBT Penetration Rate	-0.0003	**	-0.0003	***
County FSP Participation Rate			0.233	**
Distance to Closest FSP Office	-0.004	***	-0.003	**
State Underpayment Rate			-0.473	***

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table 4: Estimated Degree of State Dependence based on the Wooldridge Model

Subgroup/Region	Degree of State Dependence
Full Sample	0.31
Non-White	0.42
White	0.37
Single Mother	0.38
Not Single Mother	0.39
Low Education (No College)	0.39
High Education (At Least College)	0.40
Rural South	0.42
Non-Rural South	0.39
Northeast	0.47
North Central	0.37
South Central	0.40
Mountain	0.30
Pacific	0.34
South Atlantic	0.35

Appendix

Table A1: Wooldridge Model Results, Pre- and Post-Welfare Reform

Variable	Pre-Welfare Reform			Post-Welfare Reform		
	Parameter		SE	Parameter		SE
FSP Participation at *t-1*	1.388	***	0.054	0.965	***	0.087
FSP Participation in the Initial Period	0.967	***	0.079	0.760	***	0.108
Rural South	-0.062		0.070	0.002		0.096
Number of Adults	-0.013		0.046	-0.066		0.060
Number of Children	0.186	***	0.036	0.192	***	0.048
Age of Head	-0.156		0.119	0.089		0.188
Head is African American	0.088	*	0.052	0.162	**	0.080
Head is Other Race	0.198	**	0.086	0.104		0.122
Home Owner	-0.368	***	0.050	-0.309	***	0.071
Head is High School Graduate	-0.224	***	0.052	-0.196	***	0.072
Head has College No Degree	-0.318	***	0.071	-0.368	***	0.095
Head has College Degree	-0.362	***	0.114	-0.463	***	0.155
Head is Single Mother	0.428	***	0.058	0.191	**	0.083
Head Unemployed Weeks	0.005	**	0.002	0.015	***	0.003
County Unemployment Rate	0.049	***	0.016	0.032		0.024
State Average Recertification Period	-0.008		0.024	0.010		0.027
State EBT Penetration Rate	-0.001		0.002	0.0007		0.001
County FSP Participation Rate	0.241		0.886	3.632	**	1.677
Distance to Closest FSP Office	-0.031	***	0.011	-0.015		0.013
State Overpayment Rate	0.626		1.004	-4.543	*	2.495
State Underpayment Rate	-0.788		1.723	4.317		3.140
Mean Number of Adults	0.006		0.057	-0.013		0.080
Mean Number of Children	-0.066		0.041	-0.062		0.057
Mean Age of Head	0.139		0.120	-0.113		0.190
Mean Head Unemployed Weeks	0.021	***	0.005	0.006		0.007
Mean County Unemployment Rate	-0.030		0.021	-0.031		0.028
Mean State Average Recertification Period	-0.032		0.029	-0.007		0.031
Mean State EBT Penetration Rate	-0.006	*	0.004	-0.001		0.002
Mean County FSP Participation Rate	2.170	**	1.031	-1.499		1.876
Mean Distance to Closest FSP Office	0.025	**	0.012	0.008		0.014
Mean State Overpayment Rate	1.107		1.417	4.618		3.119
Mean State Underpayment Rate	0.773		2.198	-6.652		4.228
Intercept	-1.774	***	0.227	-1.487	***	0.276
ρ	0.332	***	0.030	0.282	***	0.051
N	12,935			4,993		
Log-Likelihood	-4,166.57			-1,779.48		

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A2: Dynamic Random Effects Probit Results with Interaction Effects between Lagged FSP Participation and Household Characteristics

Variable	Wooldridge			Correlated Random Effects		
	Parameter		SE	Parameter		SE
FSP Participation at *t-1*	1.448	***	0.096	1.698	***	0.062
FSP Participation at *t=1990*	0.818	***	0.060			
FSP Participation at *t-1**Rural South	-0.040		0.076	-0.192	***	0.051
FSP Participation at *t-1**White	0.152	**	0.072	0.195	***	0.051
FSP Participation at *t-1**Low Education	-0.044		0.092	0.031		0.060
FSP Participation at *t-1**Single Mother	0.092		0.098	-0.077		0.068
Rural South	-0.056		0.070	0.015		0.046
Number of Adults	-0.033		0.038	0.001		0.028
Number of Children	0.167	***	0.029	0.165	***	0.021
Age of Head	-0.152		0.095	-0.158	**	0.065
Head is White	-0.157	***	0.049	-0.170	***	0.033
Home Owner	-0.330	***	0.042	-0.355	***	0.029
Head has Low Education Level	0.208	***	0.057	0.186	***	0.036
Head is Single Mother	0.352	***	0.061	0.462	***	0.038
Head Unemployed Weeks	0.005	***	0.002	0.005	***	0.001
County Unemployment Rate	0.049	***	0.014	0.034	***	0.010
State Average Recertification Period	0.006		0.019	0.008		0.013
State EBT Penetration Rate	-0.002	**	0.001	-0.002	***	0.000
County FSP Participation Rate	0.601		0.768	1.213	**	0.575
Distance to Closest FSP Office	-0.026	***	0.009	-0.013	**	0.006
State Overpayment Rate	0.227		0.890	0.236		0.659
State Underpayment Rate	-1.329		1.352	-2.389	***	0.966
Mean Number of Adults	-0.003		0.047	-0.038		0.034
Mean Number of Children	-0.043		0.034	-0.036		0.023
Mean Age of Head	0.153		0.096	0.157		0.065
Mean Head Unemployed Weeks	0.017	***	0.004	0.011	***	0.003
Mean County Unemployment Rate	-0.026		0.018	-0.029	**	0.012
Mean State Average Recertification Period	-0.036	*	0.021	-0.009		0.014
Mean State EBT Penetration Rate	0.000		0.001	0.000		0.001
Mean County FSP Participation Rate	1.510	*	0.892	1.348	**	0.639
Mean Distance to Closest FSP Office	0.017	*	0.010	0.012	*	0.007
Mean State Overpayment Rate	1.092		1.214	1.039		0.854
Mean State Underpayment Rate	1.246		1.804	0.913		1.258
Intercept	-1.956	***	0.178	-1.801	***	0.112
ρ	0.269	***	0.024	0.128	***	0.017
N	16,512			25,980		
Log-Likelihood	-5,275.99			-9,209.72		

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table A3: Dynamic Random Effects Probit Results with Interaction Effects between Lagged FSP Participation and Region Dummies

Variable	Wooldridge			Correlated Random Effects		
	Parameter		SE	Parameter		SE
FSP Participation at *t-1*	1.377	***	0.067	1.532	***	0.047
FSP Participation at *t=1990*	0.805	***	0.060			
FSP Participation at *t-1**Northeast	0.351	***	0.122	0.463	***	0.086
FSP Participation at *t-1**North Central	0.043		0.094	0.147	**	0.067
FSP Participation at *t-1**South Central	0.155	*	0.089	0.213	***	0.064
FSP Participation at *t-1**Mountain	-0.171		0.194	-0.043		0.134
FSP Participation at *t-1**Pacific	-0.054		0.123	0.173	**	0.085
Northeast	0.089		0.090	-0.013		0.059
North Central	0.136	**	0.069	-0.049		0.046
South Central	0.071		0.071	-0.071		0.046
Mountain	0.127		0.121	0.031		0.080
Pacific	0.149		0.095	-0.040		0.062
Number of Adults	-0.032		0.038	0.009		0.028
Number of Children	0.170	***	0.029	0.169	***	0.021
Age of Head	-0.137		0.095	-0.136		0.064
Head is African-American	0.135	***	0.047	0.118	***	0.031
Head is Other Race	0.216	***	0.077	0.108	**	0.048
Home Owner	-0.304	***	0.042	-0.341	***	0.029
Head is High School Graduate	-0.198	***	0.045	-0.173	***	0.029
Head has College No Degree	-0.279	***	0.060	-0.250	***	0.037
Head has College Degree	-0.352	***	0.096	-0.418	***	0.064
Head is Single Mother	0.327	***	0.049	0.375	***	0.032
Head Unemployed Weeks	0.005	***	0.002	0.006	***	0.001
County Unemployment Rate	0.049	***	0.014	0.034	***	0.010
State Average Recertification Period	0.010		0.019	0.011		0.013
State EBT Penetration Rate	-0.002	**	0.001	-0.002	***	0.000
County FSP Participation Rate	0.599		0.769	1.189	**	0.577
Distance to Closest FSP Office	-0.026	***	0.009	-0.014	**	0.006
State Overpayment Rate	0.289		0.892	0.244		0.661
State Underpayment Rate	-1.454		1.354	-2.368	***	0.966
Mean Number of Adults	-0.009		0.047	-0.047		0.034
Mean Number of Children	-0.051		0.034	-0.039	*	0.024
Mean Age of Head	0.118		0.096	0.123	*	0.065
Mean Head Unemployed Weeks	0.016	***	0.004	0.011	***	0.003
Mean County Unemployment Rate	-0.032		0.019	-0.030	**	0.013
Mean State Average Recertification Period	-0.040	*	0.022	-0.013		0.015
Mean State EBT Penetration Rate	0.001		0.001	0.001		0.001
Mean County FSP Participation Rate	1.336		0.909	1.310	**	0.651

Table A3 – continued

Mean Distance to Closest FSP Office	0.020	**	0.010	0.013	**	0.007
Mean State Overpayment Rate	1.531		1.334	1.706	*	0.922
Mean State Underpayment Rate	1.222		2.016	0.268		1.386
Intercept	-1.811	***	0.201	-1.588	***	0.123
ρ	0.268	***	0.024	0.139	***	0.017
N	16,534			26,070		
Log-Likelihood	-5,262.91			-9,237.93		

Note: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.