Institute for Research on Poverty
Discussion Paper no. 1081-96

Welfare Recipiency and Welfare Recidivism: An Analysis of the NLSY Data

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March 1996

This research was funded under a grant from the Office of Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. I thank Glen Cain, John Engberg, Peter Gottschalk, Reuben Snipper, Yu Xie, and especially Scott Cardell and Ernst Stromsdorfer for their helpful comments, as well as seminar participants at the University of Wisconsin–Madison and the May 1995 Poverty Research Seminar Series in Washington, D.C. Yang Yao provided excellent research assistance. David Zimmerman and Philip Levine kindly gave me their data on state maximum AFDC benefits. The views expressed are the author's own and do not necessarily reflect those of the Institute or of the Department. All errors are mine.

Abstract

This paper analyzes welfare recipiency and recidivism of first-time AFDC recipients over the 168-month (14-year) period from January 1978 to December 1991 using the National Longitudinal Survey of Youth (NLSY) database. Duration of a single AFDC spell is short, but repeated welfare dependency is common. On average, 57 percent of former AFDC recipients return to the rolls after an exit and most of them come back within two years. Having a newborn is the most important direct cause for going on the AFDC rolls and for recidivism.

The results from bivariate duration models suggest a negative correlation due to unobserved heterogeneity between the previous welfare recipiency and recidivism. An inverted U-shaped hazard function is found for both the first and second spells on AFDC and the intervening off-AFDC spell. Age, years of education or AFQT score, martial status, ethnic origin, and region are the significant correlates with a recipient's initial welfare dependency and recidivism. However, few variables have significant effects on the duration of the second AFDC spell and off-AFDC spell at the conventional statistical level.

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I. INTRODUCTION

Policymakers are increasingly concerned with welfare recidivism. Studies find that between 20 to 40 percent of former AFDC recipients return to the rolls after having left for a time (Ellwood 1986; Blank and Ruggles 1994). Ignoring reentry to the welfare rolls, or welfare recidivism, leaves an incomplete picture of welfare dynamics and likely understates long-term dependency.

This study, which investigates welfare recipiency and recidivism among young mothers in the United States using data from the National Longitudinal Survey of Youth (NLSY) for 1979–1992, differs from previous analyses in several respects. First, I construct AFDC spells from the NLSY database over the period from January 1978 to December 1991—longer than any representative monthly AFDC duration data reported in the literature. Second, the data allow one to observe a respondent's *first* AFDC experience and any subsequent welfare recidivism. Third, by jointly estimating the determinants of the AFDC spell and the following off-AFDC spell, the econometric approach taken here takes into account the possible correlation between welfare recipiency and recidivism.

The study seeks to answer the following questions: (1) Who returns to welfare after an exit? (2) Why do some individuals return to welfare while others do not? (3) What is the timing and pattern of this recidivism and its relationship to an individual's past welfare experience? Finally, (4) what determines this welfare dependency and recidivism?

Section II reviews the existing studies on welfare recidivism. Section III describes the NLSY and the construction of the AFDC and off-AFDC spells. Section IV provides a descriptive analysis of welfare recipiency and recidivism. Section V estimates the determinants of the AFDC spell and off-AFDC spell using a log-logistic bivariate duration model with heterogeneity. Section VI summarizes the findings.

II. A REVIEW OF LITERATURE ON WELFARE RECIDIVISM

Research on recidivism is scant, although there is relatively large literature that employs longitudinal data (of varying quality) on the use and effects of welfare (Moffitt 1992). This shortage can be attributed to the lack of adequate data on multiple spells of welfare recipiency as well as on the econometric difficulty of taking into account dependency across spells for the same individuals. Ellwood, in his analysis (1986) using Panel Study of Income Dynamics (PSID) data, is the first to focus on welfare recidivism and the total time on welfare. He finds that over 40 percent of welfare recipients have multiple spells of AFDC receipt, and 11 percent of the recipients who exit from AFDC during any given year return to the rolls within 12 months. He also finds that education, marital status, number of children, work experience, and disability are among the most closely correlated covariates with the return to welfare. However, Ellwood does not find a clear pattern between the length of first spells and the likelihood of recidivism.

Recently, Blank and Ruggles (1994) studied short-term recidivism to AFDC and to Food Stamps using monthly data from two panels of the Survey of Income and Program Participation (SIPP). They determined that 20 percent of the persons who left AFDC returned to the program before the end of the 28-month sample period. Virtually all of these returns occurred within the first 9 months. But at the end of the survey, 50 percent of the former recipients remained off AFDC. The remaining 30 percent lost AFDC eligibility by marrying or because their children had reached age 18. Blank and Ruggles found that the usual personal characteristics, such as age and education, provide little evidence for identifying potential recidivists. Nevertheless, their estimation indicates that ethnic origin, number of children, other nonearned income, and the level of maximum AFDC benefit have significant effects on the probability of recidivism. Moreover, when former recipients return, they do so quickly. Research by Weeks (1991) using a 36-month AFDC duration file from the Washington State Family Income Study data, and by Brandon (1995) using four SIPP panels, also bears out Blank and Ruggles' finding of substantial multiple occurrence of welfare recipiency.

But these studies have several limitations—most important, the data. Ellwood uses a 15–year (1968–1982) panel from the PSID, and constructs the annual AFDC spells using a $250 total annual benefit as the cutoff in defining AFDC recipiency for a given year. Thus, he could have overstated the periods of continuous receipt and underestimated the extent of recidivism. Although Blank and Ruggles analyze monthly data from the 1986 and 1987 panels of the SIPP, the maximum length of an observed spell is only 28 months, which is far too short in the analysis of recidivism.[1] As a result, their study also suffers from an underestimation of the extent of welfare recidivism and likely introduces selection bias in measuring recidivism. Also, since welfare recipients whose AFDC spell start is observed during the sample period may already have been exposed to the welfare system prior to the NLSY study, the explanatory variables such as schooling and work experience are likely to have been affected by their welfare experience and thus are endogenous. Fortunately, these problems do not exist or can be easily eliminated in the NLSY sample. The current version of the NLSY data used in this study provides a respondent's AFDC receipt history over a 168-month (that is, 14-year) period. The respondents are between 13 and 20 years of age in 1978. If a respondent did not give birth to a child prior to 1978, then her first observed AFDC spell during the sample period is the first true welfare spell. Potential endogeneity bias can be eliminated by using explanatory variables whose values are fixed at the start of her first AFDC spell.

I also take a different econometric approach to determining the causes of welfare recipiency and recidivism. Ellwood, using a method similar to that developed in his earlier research with Bane (Bane and Ellwood 1983), relies on sample tabulations to calculate AFDC exit and recidivism rates and multinominal logit models to analyze determinants. A key assumption made is that initial AFDC spells, subsequent AFDC spells, and welfare recidivism are independent of each other. Blank and Ruggles employ a competing risks proportional hazard model to examine the determinants of recidivism using only off-AFDC spells of former

[1]By design, each SIPP panel contains four rotating groups; each group is followed up with interviews every four months over a period of twenty-four or twenty-eight months.

recipients.[2] Again, their approach does not consider the possible correlation between the initial AFDC spells and the subsequent off-AFDC spells.

As noted by Ellwood (1986), ignoring the dependence between sequential spells will produce inefficient estimates. The inferences drawn will also be biased in an unknown direction since there is no prior relationship between the duration of an initial spell and that of a subsequent spell of a different type.[3] Also, neither Ellwood nor Blank and Ruggles correct for unobservable heterogeneity. In the multiple spell process, any persistent individual differences would produce interdependence between spells.

I specify a reduced-form bivariate duration model that simultaneously estimates the determinants of the AFDC spell and the off-AFDC spell. The model controls for unobserved heterogeneity in a variance component structure based upon the multivariate logistic distribution work of Cardell (1994). The correlation between the two spells is induced by the unmeasured common heterogeneity factor.

III. THE DATA

The data used are from the NLSY Female and Children sample (1979–1992) and the NLSY Work History (1979–1992). Additional data on state maximum AFDC benefit levels for a family of three are added to examine the generosity of the AFDC program on welfare recipiency.

The initial NLSY female sample had 6,283 respondents in 1979 and is made up of three subsamples: (1) a randomly chosen cross-section sample of 3,108 young females who were between the ages 14 and 21 as of January 1979, (2) a supplemental random sample of 2,719 African Americans, Hispanics, and

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[2]They distinguish three types of off-welfare spells based on the different endings of each: through recidivism, through demographic change, or through right-censoring. They then estimate separate exit probabilities associated with each corresponding exit route.

[3]The recidivism rate could either rise or fall with an increase in the duration of a previous AFDC spell. This is because, on the one hand, persons with long spells of AFDC receipt are likely to be particularly disadvantaged and thus to have a higher than average probability of returning. On the other hand, those who have been on a welfare for a long period of time are less likely to have young children and might have a lower than average probability of returning (Ellwood 1986).

economically disadvantaged whites, and (3) a sample of 456 young females aged 17–21 as of January 1979 who were enlisted in the military. The survey has been conducted annually since 1979.[4] I exclude the armed forces members but retain the overrepresented, economically disadvantaged white women in the analysis. As of 1992, there were 4,146 mothers and 9,357 children born to these women.

AFDC Spells

The unit of analysis in this study is a spell, which is defined as a time period of continuous occupancy in a certain state by an individual, and for the NLSY data, a spell is measured in months. A respondent is said to be on AFDC for a given month if she receives an AFDC benefit check for that month. Receiving AFDC benefits continuously for one or more months makes up an AFDC spell. At the end of the sample period any ongoing spell is right-censored. To avoid spurious right-censored spells, AFDC recipients who miss one or more interviews are excluded. The data cover a respondent's monthly AFDC recipiency history from January 1978 through December 1991, thus allowing me to construct spells over a 168-month period—longer than any representative AFDC duration data reported in the literature to date.

I exclude AFDC spells that are ongoing in January 1978. To focus on respondents' *first* welfare experience and recidivism, I also exclude those women who gave birth to a live child before January 1978. This is because these teen mothers would have been exposed to welfare before the survey. As a result, I analyze 820 first-time AFDC recipients who generated 1,770 spells as of December 1991. The number of multiple spells and right-censoring information by sequence of recipiency is displayed in Table 1.

[4]After the 1984 surveys, only 15 female members of the military subsample were retained for continued interviewing, and, beginning with the 1991 interview, white females from the supplemental poor subsample were no longer interviewed.

TABLE 1
Number and Mean Duration of Multiple AFDC Spells

	AFDC Spells						
	Complete		Right-Censored		Total		
Sequence	Number	Mean Duration (Std.Error)	Number	Mean Duration (Std. Error)	Number	Mean Duration (Std. Error)	% Right Censored
1	820	20.4 (23.3)	106	67.9 (48.3)	926	25.9 (31.2)	11.4
2	387	16.2 (19.3)	91	39.5 (30.5)	478	20.6 (23.7)	19.0
3	163	15.3 (17.0)	56	34.8 (26.8)	219	20.3 (21.7)	25.6
4	68	11.1 (12.6)	24	19.5 (11.2)	92	7.6 (7.3)	26.1
5	25	6.6 (7.2)	9	10.3 (7.3)	34	11.7 (12.1)	26.5
6	9	10.0 (10.1)	3	16.7 (18.5)	12	10.2 (11.7)	25.0
7	6	7.8 (6.3)	0	n.a.	6	7.8 (4.5)	0.0
8	0	n.a.	3	7.3 (4.5)	3	7.3 (4.5)	100.0
Total Number of Spells or Average Total Months on AFDC	1,478	32.4 (29.69)	292	45.8 (40.1)	1,770	43.1 (37.8)	16.5

Source: Data are from the NLSY (1979–1992).
Note: Only spells of the first-time AFDC recipients observed after January 1978 are analyzed. One-month gap between two successive AFDC spells is closed.

<u>Off-AFDC Spells</u>

I construct off-AFDC spells to study welfare recidivism based on the multiple AFDC spells generated by first-time recipients. An off-AFDC spell is defined by the observed duration of a former recipient's non-AFDC recipiency status until she returns to the rolls or her nonreceipt status is censored because of the termination of the sample period. In addition, to eliminate artificially short recidivism due to possible administrative "churning," I do not count any non-censored off-AFDC spells that last only one month, and close this one-month gap between two successive AFDC spells. As a result, there is a total of 1,478 off-AFDC spells and 478 recidivists. Information on the number of multiple off-AFDC spells and censoring by order of welfare recidivism is in Table 2.

Explanatory variables used are described in Appendix A. Table 3 reports sample characteristics for the first-time AFDC recipients.

The average age for first-time AFDC recipients is about 22. Seventy percent of the sample never married, and 37 percent of them became a mother as a teenager. They have a very low AFQT score. The average years of education completed is 11. Ten percent of the sample report are disabled. In the sample, the majority of recipients (36 percent) live in the South.

IV. DYNAMICS OF WELFARE RECIPIENCY AND WELFARE RECIDIVISM

<u>Multiple Occurrence of Welfare Recipiency and Recidivism</u>

Tables 1 and 2 report the number and mean length of the AFDC and off-AFDC spells by sequence and by right-censoring.

As Table 1 shows, multiple occurrence of welfare recipiency is typical: 820 first-time recipients generate a total of 1,770 spells during the 168-month survey period, with a maximum of 8 multiple spells.About 47 percent of these recipients have 2 spells, and 20 percent have 3 spells. There are three individuals who have as many as 8 multiple AFDC spells during the survey period.

TABLE 2
Number and Mean Duration of Multiple Off-AFDC Spells

	Off AFDC Spells						
	Complete		Right-Censored		Total		
Sequence	Number	Mean (Std.Error)	Number	Mean (Std. Error)	Number	Mean (Std. Error)	% Right Censored
1	478	20.1 (22.8)	342	67.7 (41.3)	820	39.9 (39.6)	58.3
2	219	14.4 (14.70)	168	50.6 (33.3)	387	30.1 (30.4)	56.6
3	92	14.4 (17.47)	71	37.6 (29.8)	163	24.5 (26.2)	56.4
4	34	15.4 (17.8)	34	26.9 (22.9)	68	21.1 (21.1)	50.0
5	12	10.83 (7.7)	13	18.1 (11.0)	25	14.6 (10.1)	48.0
6	6	7.8 (7.4)	3	19.3 (18.1)	9	11.7 (19.1)	66.7
7	3	7.3 (4.9)	3	9.7 (4.0)	6	8.5 (4.2)	50.0
Total Number of Spells or Average Total Months on AFDC	844	31.0 (27.0)	634	56.1 (39.4)	1,478	61.4 (38.7)	57.1

Source: Data are from the NLSY (1979–1992).
Note: Only spells of the first-time AFDC recipients observed after January 1978 are analyzed. One-month gap between two successive AFDC spells is closed.

TABLE 3

Sample Characteristics at the Start of the First AFDC Spell (N = 926)

Variable Description	*Mean*	*Standard Error*
Age at first receiving AFDC	21.97	3.62
Never married	0.70	0.46
Teen birth ≤18 (1=yes)	0.37	0.48
Total work experience (in months)	78.80	108.34
Years of education completed	11.02	1.70
AFQT score (in percentile)	22.46	19.45
Other nonearned income (1978 dollars)	6,141.50	7928.22
Total children in household	1.28	0.63
Number of children age ≤1 year	0.65	0.48
Number of children age (1, 3)	0.34	0.52
Number of children age (3, 6)	0.19	0.45
Number of children age ≥6	0.10	0.38
Total adults in household	2.60	1.27
Ethnic origin (1 = yes):		
Black	0.43	0.50
White	0.36	0.48
Hispanic	0.14	0.35
Other ethnic origin	0.07	0.24
Disability (1 = yes)	0.10	0.30
Urban (1 = yes)	0.79	0.41
Location (1 = yes):		
West	0.21	0.41
South	0.36	0.48
Northeast	0.13	0.34
North-central	0.30	0.46
Local unemployment rate	3.30	1.21
State maximum AFDC benefit (1978 dollars)	479.38	220.06
Mother's years of education completed	9.88	2.90

Source: Data are from the NLSY (1979–1992).

Notes: Only spells of first-time recipients observed after January 1978 are used. Effective sample size for individual variables can vary. Means are computed at the beginning of the first AFDC spell or using the values from previous yearly survey.

A majority of AFDC recipients have at least 2 AFDC spells. Table 3 shows that nearly 58 percent of those who complete their first AFDC spell return to the rolls. About the same percentage of those who have two AFDC spells (57 percent) return after their second AFDC spell ends. Among former recipients, an average of 57 percent return to the AFDC rolls. The extent of recidivism found here is substantially higher than that reported by Ellwood or Blank and Ruggles.

Mean Duration and Total Observed Time on Welfare

Tables 1 and 2 also provide the mean duration of complete AFDC spells and off-AFDC spells. Those who complete their first welfare spell have an average duration of 20 months. The average duration for the second observed complete AFDC spell is approximately 16 months.[5] The average total observed time on welfare across completed spells is about 32 months. But the average time off AFDC among recidivists is 20 months for those who will go on to experience their first return, and 14 months for those who experience a second return.

Time Pattern of Welfare Recipiency and Recidivism

Lifetime tables are used to display time patterns of dependence and recidivism without adjusting for personal characteristics and other factors that may affect welfare recipiency and recidivism. To test the homogeneity of the survival functions across the spells, I conduct the generalized Wilcoxon test (Kalbfleisch and Prentice 1980, chapter 6). For the AFDC spells, the test suggests an overall significantly different pattern in terms of survival curves across spells (p-value = 0.0027). But the hypothesis of homogeneity in the survival function between the first and second spells is not rejected (p-value = 0.34). The overall heterogeneity seems to come from different survival patterns among later spells, that is, spells after the second one (p-value = 0.0040).

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[5]Note that individuals who have multiple spells are likely to have shorter complete spells.

The test results for the off-AFDC spells are different. The test does not reject the null hypothesis for off-AFDC spells as a whole (*p*-value = 0.1399). However, the results from separate tests reveal that the first and second off-AFDC spells are different from each other at a 5 percent significance level (*p*-value = 0.050) and that there is no statistically different survival pattern (*p*-value = 0.63) among later spells. Furthermore, the survival rates of the first observed off-AFDC spell is quite different from those of later spells (*p*-value = 0.015).

Based on these test results, I focus the discussion on the first two spells. Another reason for not analyzing later spells is to minimize possible sample selection bias. Even for the NLSY sample, the sample period is still not sufficiently long enough to analyze welfare recidivism of later spells. Later spells are observed only if the preceding spells are relatively short.

Table 4 presents monthly hazard (exit) rates and cumulative percentages at selected months for the first and second AFDC spells. Similarly, Table 5 presents monthly hazard (recidivism) rates and cumulative percentages for the first and second off-AFDC spells. The monthly hazard rate is the probability of leaving a given state during the month, conditional on that a spell has survived to the beginning of that month. The cumulative percentage for AFDC spells for a given month provides an estimate of the proportion of welfare recipients who exit welfare as of the end of that month, and for off-AFDC spells, an estimate of the proportion of former recipients who return to welfare as of the end of that month.

Table 4 shows that about 30 percent of first-time AFDC recipients have left the rolls by the end of the sixth month; nearly 53 percent complete their AFDC spells by month 12. Within the first two years, over 63 percent of the sample leave welfare. The exit rate increases during early months and then drops and fluctuates during the remaining course of an AFDC spell.[6] Overall, the time pattern of the second AFDC spell is quite similar to that of the first AFDC spell.

[6]The results should be interpreted with caution since a large number of spells end in December of a given year. This anomaly is known as a seam problem in panel data. For example, Blank and Ruggles (1993) find the seam bias problem with SIPP data.

TABLE 4

Exit Rates and Cumulative Percentages for Those Who Leave AFDC

	First AFDC Spell (N=926)		*Second AFDC Spell* (N=478)	
Month	Cumulative % Who Exit	Exit Rate	Cumulative % Who Exit	Exit Rate
1	0.0444	0.0444	0.0632	0.0632
2	0.0985	0.0593	0.1318	0.0761
3	0.1627	0.0738	0.1845	0.0625
4	0.2060	0.0581	0.2427	0.0741
5	0.2529	0.0559	0.2756	0.0444
6	0.2987	0.0632	0.3050	0.0415
7	0.3274	0.0419	0.3253	0.0296
8	0.3517	0.0368	0.3401	0.0222
9	0.3688	0.0267	0.3717	0.0491
10	0.3850	0.0261	0.4071	0.0580
11	0.3995	0.0238	0.4220	0.0255
12	0.5312	0.2071	0.5273	0.1765
18	0.5777	0.0314	0.5790	0.0290
24	0.6348	0.0103	0.6331	0.0110
30	0.7050	0.0231	0.7287	0.0163
36	0.7436	0.0307	0.7596	0.0000
42	0.7878	0.0337	0.7758	0.0220
48	0.8059	0.0157	0.7933	0.0382
60	0.8390	0.0408	0.8518	0.0000
72	0.8705	0.0174	0.8817	0.0000
84	0.9021	0.1389	0.8967	0.0000
96	0.9250	0.0183	0.9149	0.0000
120	0.9408	0.0784	0.9471	0.0000
143	—	—	0.9471	2.0000
144	0.9482	0.0000	—	—
166	0.9741	0.0000	—	—

Source: Data are from the NLSY (1979–1992).

Note: Only spells of the first-time recipients observed after January 1978 are analyzed.

TABLE 5

Recidivism Rates and Cumulative Percentages for Those Who Return to Welfare

	First Off-AFDC Spell (N=820)		*Second Off-AFDC Spell* (N=387)	
Month	Cumulative % Who Return	Recidivism Rate	Cumulative % Who Return	Recidivism Rate
2	0.0391	0.0391	0.0313	0.0313
3	0.0793	0.0427	0.0830	0.0548
4	0.1065	0.0300	0.1215	0.0429
5	0.1349	0.0323	0.1465	0.0289
6	0.1542	0.0226	0.1855	0.0467
7	0.1705	0.0195	0.1970	0.0142
8	0.1878	0.0211	0.2269	0.0380
9	0.2031	0.0190	0.2547	0.0365
10	0.2164	0.0168	0.2616	0.0094
11	0.2256	0.0118	0.2755	0.0190
12	0.3328	0.1393	0.3829	0.1559
18	0.3667	0.0105	0.4276	0.0133
24	0.4131	0.0076	0.4706	0.0145
30	0.4601	0.0022	0.5208	0.0000
36	0.4816	0.0047	0.5322	0.0061
42	0.5090	0.0080	0.5533	0.0000
48	0.5246	0.0000	0.5665	0.0155
60	0.5489	0.0065	0.6054	0.0000
72	0.5720	0.0000	0.6100	0.0301
84	0.5913	0.0047	0.6371	0.0000
96	0.6108	0.0060	0.6473	0.0000
120	0.6379	0.0000	0.6473	0.0000
133	—	—	0.6473	0.0000
144	0.6599	0.0000	—	—
162	0.6599	0.0000	—	—

Source: Data are from the NLSY (1979–1992).

Note: Only spells of the first-time recipients observed after January 1978 are analyzed. Since a one-month gap between two successive AFDC spells is closed, there is no recidivism during month 1.

Table 5 reports the lifetime table estimates for the off-AFDC spells. The percentages of those returning to the rolls are high for both the first and second off-AFDC spells. By the end of month 12, 32 percent of those who have had a first complete AFDC spell return and 38 percent of those who have had two complete AFDC spells return. Within two years, 41 percent and 47 percent respectively of those who have ended their first and second welfare spells returns to the rolls. Recidivism rates for both first off-AFDC and second off-AFDC spells exhibit an inverted U-shape, similar to that found for the AFDC spells.

Entry/Exit Due to Changes in AFDC Eligibility

Before turning to the results from the econometric model that jointly estimates the AFDC spell and subsequent off-AFDC spell, I look at changes in the conditions of AFDC eligibility that can be linked to an opening or closing of an AFDC spell. Since AFDC eligibility depends upon being the parent of a minor child and on the household's monthly income and asset level, I focus on whether the opening or closing of a spell is due to three factors: (1) changes in marital status, (2) the youngest child reaching age 18 (for leaving AFDC) or the women has a birth (for entering AFDC), and (3) changes in the recipient's income from work.[7] Table 6 lists the observed changes associated with the observed beginning and ending of an AFDC spell.

Not surprisingly, the most common cause for *first* entering welfare is having a baby within the last six months (74 percent). Giving birth also appears to be a major cause for reentering AFDC: among recidivists having a first, second, and third return to welfare, the rates are 54 percent, 45 percent, and 40 percent, respectively. As Table 6 shows, much less movement is due to change in marital status or earnings

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[7]I can construct monthly variables only on respondent's earnings. Changes in nonearned income are provided in yearly survey. The procedure is similar to those employed by Bane and Ellwood (1983) and Blank (1989), with some modifications. I first look for changes in marital status, then changes in number of children, and lastly, changes in earnings. For changes in marital status, I compare a mother's status during the last month of recipiency or nonrecipiency to her status during the next six months. When a change in number of children is the cause for leaving AFDC, I check if the close of a spell is due to losing a minor child; for entering AFDC, I check if she gave a birth during the six-month period prior to receiving welfare. For changes in earnings, comparison is made between monthly income from work within a six-month interval across the transition month. A $50 (denominated in 1978 dollars) threshold is used, but using other thresholds such as $40 or $45 produces very similar results.

TABLE 6

Observed Changes in AFDC Eligibility Conditions Associated with a Closing or Opening of an AFDC Spell

	First Spells		*Second Spells*		*Later Spells*	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Leaving AFDC:						
Getting married	40	4.9	16	4.1	6	2.2
Youngest kid > 18	0	0	0	0	0	0
Increase in earnings >$50 (1978 $)	112	13.7	61	15.8	54	19.9
Other	845	84.6	378	84.0	259	83.5
Total	820	100.0	387	100.0	271	100.0
First Entering AFDC:						
Becoming unmarried	17	1.8	n.a.	n.a.	n.a.	n.a.
Having a birth	686	74.1	n.a.	n.a.	n.a.	n.a.
Decrease in earnings >$50 (1978 $)	32	3.5	n.a.	n.a.	n.a.	n.a.
Other	191	20.6	n.a.	n.a.	n.a.	n.a.
Total	926	100.0	n.a.	n.a.	n.a.	n.a.
Reentering AFDC: (Recidivism)						
Becoming unmarried	17	3.6	2	0.9	7	4.8
Having a birth	256	53.6	99	45.2	58	39.5
Decrease in earnings >$50 (1978 $)	37	7.7	21	9.6	16	10.9
Other	168	35.1	97	44.3	66	44.9
Total	478	100.0	219	44.3	147	44.9

Source: Data are from the NLSY(1979–1992).
Notes: Only spells of the first-time AFDC recipients observed after January 1978 are analyzed. Statistics for later spells after the second spell are combined.

than that found by Bane and Ellwood and Blank, as noted in the previous section. For spell endings, 14 percent of the recipients leave welfare because of an increase in earnings. The number increases slightly to about 16 percent for later spell endings. A fall in earnings accounts for only about 4 percent of the cases first entering AFDC, and between 8 and 10 percent of the cases of welfare recidivism. The difference between the numbers shown here and the work by the above-mentioned authors is due in large part to different sample composition. For example, none of the exits from AFDC in the NLSY sample is a consequence of a recipient's child being older than 18 years of age. The low percentage entering/leaving AFDC due to a marriage breakup may also reflect the relative youth of welfare recipients in the NLSY sample, many of whom became mothers in their teen years and never got married.[8]

Relationship between Length of Previous AFDC Spell and Recidivism

Table 7 examines the relationship between the duration of the previous AFDC spell and subsequent welfare recidivism.

As can be seen in Table 7, recidivism seems to be more likely among former recipients with short spells, although the percentage is also high among those with spells of long duration. That is, there is no strong evidence of "state dependence" in the sense that the longer the previous AFDC spell, the shorter the following off-AFDC spell. In the next section, I consider a bivariate duration model in which the correlation between spells is induced by unobserved common heterogeneity.

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[8]There are some AFDC recipients who are reportedly married. There is difficulty in eliminating these cases so as to include only single-parent female-headed AFDC families because a married mother is still potentially eligible for the AFDC-Basic benefit if her husband is not the natural father of her children (see Moffitt, Reville, and Winkler 1995).

TABLE 7

Relationship between Duration of Previous AFDC Spell and Subsequent Welfare Recidivism

Duration of Previous Complete AFDC Spell	*Percentage Who Return to AFDC After a First Exit (N=820)*	*Percentage Who Return to AFDC After a Second Exit (N=387)*
1	61.2	51.4
2	58.1	47.4
3	45.8	62.1
4	69.8	62.5
5	52.1	22.2
6	45.1	68.8
7	62.5	63.6
8	63.0	62.5
9	63.2	76.5
10	50.0	63.2
11	50.0	62.5
12	56.9	52.7
18	70.0	—
24	52.6	55.9
30	50.0	33.3
36	50.0	66.7
42	50.0	—
48	28.6	50.0
60	53.8	33.3
72	50.0	100.0
84	63.6	—
96	—	66.7

Source: Data are from the NLSY (1979–1992).
Note: Only spells of the first-time AFDC recipients observed after January 1978 are analyzed.

V. JOINT ESTIMATION OF DETERMINANTS OF WELFARE DEPENDENCY AND WELFARE RECIDIVISM

I specify a reduced-form bivariate duration model to estimate the determinants of the AFDC spell and the off-AFDC spell:

$$\begin{aligned} \alpha_1 \log T_1 &= X\beta_1 + \zeta_1 \\ \alpha_2 \log T_2 &= X\beta_2 + \zeta_2 \end{aligned} \qquad \textbf{(1)}$$

Model (1) is referred to as the accelerated failure time model, which assumes that covariates X act linearly on the logarithm of duration $logT$ or multiplicatively on T (see Kiffer 1988 for the discussion of this class of duration models). The constants α_i (i=1,2) are the scale parameters that power T_i. ζ_1 and ζ_2 are the bivariate error terms. For the single duration model, various univariate probability distributions have been suggested for the error term. Sensitivity analysis conducted by Swaim and Podgusky (1992) and Bergstrom and Edin (1992) on unemployment spells, and Blank (1989) on AFDC spells find that parameter estimates are quite robust to distributional assumptions but the estimates of duration dependence are critically dependent on distributional assumption.[9] However, for the multiple spell models, these is a scarcity of realistic, tractable multivariate distributions for ζ_1 and ζ_2. Moreover, the need to account for unmeasured heterogeneity in economic duration models complicates the estimation of multiple-spell models.

Heckman and Singer (1984), Honore (1993), and Heckman and Taber (1994) discuss a multiple-spell proportional hazard model. Heterogeneity is estimated as a distribution-free parameter but the baseline hazard function is specified as a Weibull distribution. Trussell and Richards (1985) show that the Heckman-Singer approach causes the parameter estimates to be inconsistent when the distribution for the baseline hazard is incorrectly specified. A different type of multiple duration model is proposed by Olsen and Wolpin (1983) in

[9]Simple distributions such as the exponential and the Weibull impose that the hazard rate be constant or monotonic. Other distributions such as the logistic allow a more flexible hazard function.

which the heterogeneity is captured by fixed effects. However, the computation of the nonlinear fixed effects model is difficult.

I use the variance component structure to introduce the unobserved heterogeneity in (1). Variance component structure is a parsimonious way to account for individual differences. For example, Han and Hausman (1990) and Meyer (1990) parameterize the heterogeneity as a gamma random variable in the single-spell proportional-hazard model, which results in a mixed-variance component structure representation. Cardell (1994) provides another class of distributions that form the basis for a useful variance component structure for the logistic distribution. It is known that the logistic distribution, when compared to the normal distribution, gives robust parameter estimates in the sense that the estimates have a bound influence function.[10]

Specifically, I assume that ζ_1 and ζ_2 in Model (1) have a bivariate distribution with logistic marginal distribution and a free correlation parameter, r ($-1 \leq r \leq 1$). Cardell proves the existence of a class of distributions, denoted by $CL(\lambda)$ ($0 \leq \lambda \leq 1$), which is conjugate to the logistic distribution. That is, if $\upsilon \sim CL(\lambda)$, and $\varepsilon_i \sim$ logistic distribution, then $\zeta_i = \upsilon + \lambda\varepsilon_i$ has the same (logistic) distribution as ε_1. Note that $-\zeta_i = -\upsilon + \lambda(-\varepsilon_i)$ is also logistic because the logistic distribution is symmetric. Thus, the logistic distribution-based bivariate variance component structure has the form:

$$\begin{aligned} \zeta_1 &= \upsilon + \lambda\varepsilon_1 \\ \zeta_2 &= \text{sign}(r)\upsilon + \lambda\varepsilon_2 \end{aligned} \qquad \textbf{(2)}$$

where the stochastic term υ represents heterogeneity and affects both spells while ε_i affects only the i^{th} spell. The indicator function sign *(r)* takes on the value 1 or -1 to allow υ to affect spells in the same or opposite direction. This specification of the heterogeneity in the multiple-spell model introduces the correlation as a

[10]Note that values that are very large or small even after the log transformation will have a strong influence in fitting the normal distribution.

consequence of unmeasured attributes in common. The stochastic correlation coefficient is given by $(1 - \lambda^2)$ or $-(1 - \lambda^2)$ for the positively or negatively correlated spells, respectively.

Thus, the log-logistic bivariate duration model with heterogeneity can be formulated:

$$\begin{aligned} \alpha_1 \log T_1 &= X\beta_1 + \upsilon + \lambda\varepsilon_1 \\ \alpha_2 \log T_2 &= X\beta_2 + \text{sign}\,(r)\upsilon + \lambda\varepsilon_2 \end{aligned} \qquad \textbf{(3)}$$

Model (3) is estimated by the maximum likelihood method. The log-likelihood function is provided in Appendix B.

Model (3) is used to jointly estimate the determinants of the first AFDC and off-AFDC spell. I also fit the model for the second AFDC spell and off-AFDC spell. Explanatory variables used are standard in the literature. In an attempt to account for the seam problem, I include a dummy variable to indicate that a spell ends in December of a given year. Since an individual's initial welfare experience likely influences her schooling and employment, the variables years of education completed and total work experience are fixed at the start of the first AFDC spell in predicting the second AFDC spell and first and second off-AFDC spells. Other explanatory variables are fixed at the start of a given AFDC or off-AFDC spell or are the values reported in the previous yearly survey.

Results using the full set of explanatory variables are shown in Tables 8 and 9. Table 8 shows the estimates for the determinants of the first AFDC and off-AFDC spell. I estimate the model to test the alternative specifications with regard to years of education vs. the AFQT score. Table 9 presents the estimates for the second AFDC and off-AFDC spell estimated from similar specifications.

I find a significant and negative correlation between the first AFDC spell and the following off-AFDC spell (r = -0.16, t = 2.09). Since the variance component structure in Model (3) assumes that stochastic correlation between spells is due to unmeasured individual differences across spells, this result indicates that heterogeneity which leads to an initial AFDC recipiency spell also results in welfare recidivism.

TABLE 8

Estimates of the Bivariate Log-Logistic Duration Model of the First AFDC and Off-AFDC Spells

	(1) AFDC Spell		(2) Off-AFDC Spell		(3) AFDC Spell		(4) Off-AFDC Spell	
Variable Description	β_1	σ_1	β_2	σ_2	β_1	σ_1	β_2	σ_2
Intercept	5.4157	1.0706	2.4344	1.2992	4.8693	1.0349	2.7496	1.2996
Age (years)	-0.0731	0.0436	-0.0385	0.0512	-0.0858	0.0428	-0.0117	0.0514
Years of education	-0.1112	0.0554	0.1336	0.0612	—	—	—	—
AFQT score	—	—	—	—	-0.0094	0.0041	0.0176	0.0046
Total work experience (years)	-0.0083	0.0126	0.0143	0.0155	-0.0097	0.0126	0.0113	0.0156
Never married	0.5345	0.1721	-0.1854	0.1764	0.5098	0.1729	-0.1982	0.1773
Teenage birth (≤18)	-0.2737	0.2016	0.4033	0.2205	-0.1931	0.1997	0.3761	0.2192
Black	0.6424	0.1867	-0.1664	0.2048	0.4315	0.1863	0.0927	0.2026
Hispanic	0.6783	0.2449	-0.2551	0.27	0.5458	0.2523	-0.0352	0.2773
Other ethnic origin	-0.2056	0.2946	0.8818	0.3613	-0.2601	0.2953	0.8848	0.3621
Total adults in household	0.0372	0.0605	0.0144	0.0637	0.0286	0.0614	0.0196	0.0644
No. of children age ≤1 year	0.0888	0.2029	-0.3026	0.2068	0.1048	0.2036	-0.2314	0.2153
No. of children age (1, 3)	0.0055	0.1817	-0.1867	0.1623	-0.0289	0.1818	-0.1330	0.165
No. of children age (3, 6)	0.1224	0.1835	0.0711	0.1635	0.1303	0.1843	0.0679	0.1634
No. of children age ≥6	-0.0757	0.2364	-0.0837	0.2153	-0.0253	0.2346	-0.1346	0.2121
Disability	-0.2051	0.2731	-0.2192	0.3257	-0.2181	0.2778	-0.1944	0.3312
Other income (×1,000)	-0.0135	0.0104	-0.0021	0.0149	-0.0111	0.0105	-0.0079	0.015
R's mom's education	0.0219	0.0287	0.0054	0.0307	0.0251	0.029	-0.0024	0.0309
Northeast	0.2994	0.2737	-0.2857	0.3174	0.3765	0.2781	-0.3911	0.3176
North-central	0.3401	0.2084	-0.4189	0.2291	0.3781	0.2095	-0.5127	0.23
West	-0.0449	0.2848	-0.3932	0.3242	-0.0567	0.2863	-0.3974	0.3242
Local unemployment rate	0.0619	0.0608	0.0529	0.0699	0.0544	0.061	0.0660	0.071

(table continues)

TABLE 8, continued

Variable Description	(1) AFDC Spell β_1	(1) AFDC Spell σ_1	(2) Off-AFDC Spell β_2	(2) Off-AFDC Spell σ_2	(3) AFDC Spell β_1	(3) AFDC Spell σ_1	(4) Off-AFDC Spell β_2	(4) Off-AFDC Spell σ_2
Maximum AFDC benefit (×100)	0.0705	0.0517	0.0047	0.0530	0.0597	0.0519	0.0119	0.0528
Seam Dummy (1 = December)	0.2600	0.1451	2.4409	0.1747	0.2220	0.146	2.4976	0.1771
α (Scale parameter)	1.6732	0.0547	1.212	0.0532	1.6779	0.055	1.2199	0.0538
λ (Heterogeneity)	0.9155 (0.0404)				0.9120 (0.0406)			
Correlation coefficient ($1-\lambda^2$)	-0.1619				-0.1683			
Log-likelihood value	-4,285.27				-4,247.59			
Sample size	648				642			

Source: Data is from the NLSY Females file 1979–1992.
Note: The dependent variable in each equation is $\log_e T$, where T is the measured spell duration in months.

TABLE 9

Estimates of the Bivariate Log-Logistic Duration Model of the Second AFDC and Off-AFDC Spells

	(1) AFDC Spell		(2) Off-AFDC Spell		(3) AFDC Spell		(4) Off-AFDC Spell	
Variable Description	β_1	σ_1	β_2	σ_2	β_1	σ_1	β_2	σ_2
Intercept	4.0906	1.7490	4.9278	2.1926	3.3416	1.5811	4.2491	1.9293
Age (years)	-0.0038	0.0593	-0.0855	0.0734	0.0069	0.0590	-0.0651	0.0702
Years of education	-0.0873	0.0944	0.0212	0.1121	—	—	—	—
AFQT score	—	—	—	—	-0.0013	0.0060	0.0190	0.0076
Total work experience (years)	-0.0287	0.0212	-0.0197	0.0229	-0.0309	0.0208	-0.0344	0.0227
Never married	0.3198	0.2423	-0.5543	0.2715	0.3378	0.2376	-0.5630	0.2649
Teenage birth (≤18)	0.1598	0.3003	-0.5238	0.3556	0.3531	0.2804	-0.6112	0.3230
Black	0.0867	0.2805	-0.3829	0.3153	-0.0552	0.2658	-0.1567	0.2963
Hispanic	0.2634	0.3622	0.0506	0.4148	0.2875	0.3634	0.1196	0.4137
Other ethnic origin	0.0575	0.6206	-0.3436	0.6672	0.1282	0.6661	-0.1750	0.6909
Total adults in household	0.0834	0.0949	0.0783	0.1069	0.0700	0.0932	0.0974	0.1057
No. of children age ≤1 year	-0.1458	0.2924	-0.3874	0.3172	-0.0431	0.2884	-0.2190	0.3098
No. of children age (1, 3)	0.0510	0.2078	-0.1771	0.2217	0.0476	0.2119	-0.2317	0.2170
No. of children age (3, 6)	0.0310	0.1917	0.0127	0.2051	0.0051	0.1912	0.0482	0.2005
No. of children age ≥6	-0.2409	0.2675	-0.0948	0.2523	-0.2485	0.2662	0.0640	0.2508
Disability	0.6587	0.5246	-0.1077	0.4329	0.4685	0.5211	-0.3481	0.4425
Other income (×1,000)	-0.0233	0.0200	0.0404	0.0264	-0.0230	0.0198	0.0214	0.0249
R’s mom’s education	0.0191	0.0456	0.1003	0.0524	-0.0133	0.0454	0.0759	0.0508
Northeast	1.3317	0.4545	-0.4282	0.5652	1.2973	0.4361	-0.6323	0.5470
North-central	1.0562	0.3141	-0.5946	0.3682	1.1057	0.3066	-0.5765	0.3603
West	0.4107	0.4287	-0.2385	0.5376	0.3088	0.4185	-0.3253	0.5256
Local unemployment rate	0.0446	0.0998	0.0355	0.1140	0.0118	0.0989	0.0518	0.1123

(table continues)

TABLE 9, continued

Variable Description	(1) AFDC Spell β_1	(1) AFDC Spell σ_1	(2) Off-AFDC Spell β_2	(2) Off-AFDC Spell σ_2	(3) AFDC Spell β_1	(3) AFDC Spell σ_1	(4) Off-AFDC Spell β_2	(4) Off-AFDC Spell σ_2
Maximum AFDC benefit (×100)	-0.0442	0.0702	0.0252	0.0880	-0.0491	0.0690	0.0510	0.0864
Seam Dummy (1 = December)	0.6593	0.2191	3.1734	0.2971	0.6856	0.2131	2.9477	0.2814
α (Scale parameter)	1.7892	0.0846	1.5123	0.0998	1.7788	0.0845	1.4786	0.0943
λ (Heterogeneity)		0.9625 (0.0454)				0.9532 (0.0478)		
Correlation coefficient ($1-\lambda^2$)		-0.0736				-0.0914		
Log-likelihood value		-1,804.87				-1,893.11		
Sample size		298				308		

Source: Data is from the NLSY Females file 1979–1992.
Note: The dependent variable in each equation is $\log_e T$, where T is the measured spell duration in months.

Compared to univariate log-logistic duration models that assume the AFDC spell and the off-AFDC spell are independent (that is, there is zero correlation between spells), the bivariate specification improves the efficiency of the coefficient estimates.[11]

Inference about the time pattern in departing from or returning to welfare can be made by using the estimated value of the scale parameters α_1 or α_2 in Model (3). The results imply an initially increasing and then declining hazard function for both the AFDC spell and the off-AFDC spell, which reinforces the earlier findings using the life table techniques.

Looking at the effects of the explanatory variables on spell duration in the first and second columns of Table 8, at the 10 percent significance level, age, years of education, martial status, and ethnic origin have significant effects on the first welfare recipiency, while years of education, ethnic origin, and geographical region have significant impact in determining the length of the first off-AFDC spell. The variable on early childbearing has incorrect sign in predicting the duration of the first AFDC spell and the off-AFDC spell. Dividing β_{ij} by α_i provides an estimated percentage increase or decrease in duration as a result of a one-unit change in the x_{ij}. For example, completing one more year of schooling reduces the duration of one's first AFDC spell by 6.7 percent, and increases a former AFDC recipient's time off welfare by 11 percent. Being a black or Hispanic woman, as compared to being a white woman, increases time on welfare by, respectively, 38 and 41 percent, while being of "other ethnic origin" increases a former recipient's time off AFDC by 73 percent. After controlling for the state maximum AFDC benefit level, region does not show strong effects on duration of either an AFDC spell or an off-AFDC spell, with the exception that north-central is negative and significant in predicting an off-AFDC spell.[12] Other variables such as work experience, presence of small

[11]Univariate log-logistic model results are available upon request.

[12]When the state maximum AFDC benefit is not controlled, the coefficients associated with geographic regions are significant in both AFDC and off-AFDC duration equations. The sign of these variables suggests that people living in the south have shorter AFDC spells and longer off-AFDC spells, presumably due to relatively low benefit levels in the southern states.

children, and nonwage, nontransfer income have the correct sign, but they are not precisely estimated in the full model.

Columns 3 and 4 of Table 8 report the results from the alternative specification that controls for the AFQT score instead of years of education. If the AFQT score can be interpreted as a measure of ability, then using AFQT does not have the problem of causing endogeneity bias, as does the use of schooling. A high AFQT score should reduce welfare dependency and lengthen the duration of time off welfare. As implied by the estimates, a 10 percentage-point increase in AFQT score would cut the AFDC spell by 5.6 percent and increase time off AFDC by 14.4 percent. Results on other variables are very similar between the two specifications.

Table 9 shows the estimates for the determinants of the second AFDC spell and the following off-AFDC spell. In the specification that controls for education, the estimated correlation coefficient is -0.074. However, the t-test fails to reject the null hypothesis that H_0: $r = 0$ ($t = 0.8259$), which suggests that no correlation due to unobserved heterogeneity is found between later AFDC and off-AFDC spells. A similar finding is obtained when AFQT replaces schooling. Similar to results from the first spell, the estimates of scale parameters indicate an inverse U-shaped hazard function for both the second AFDC spell and off-AFDC spell.

At the 10 percent level, few variables are found to be significantly correlated with the duration of the second AFDC spell and off-AFDC spell. The sign of these variables is in the expected direction. In comparing the results from two specifications, AFQT shows a significant effect only in determining the duration of the second off-AFDC spell.

VI. SUMMARY

This study investigates multiple welfare recipiency and welfare recidivism using a rich data set from the NLSY. It has enabled me to observe a sample of young mothers' *first* welfare experience and subsequent welfare recidivism over the relatively long period of 168 months. Compared to existing studies, I find an average of 57 percent of initial AFDC recipients return to the rolls—higher than what has been previously reported in the literature. About 22 percent of those who make a first exit from AFDC and 26 percent of those who make a second exit from welfare come back to the program by the end of a year and by the end of a second year, 41 percent and 47 percent, respectively, of those who have different welfare experience backgrounds return to welfare.

Having a newborn is the most important reason for first entering welfare and also for recidivism, other things being equal. This finding is different from that of Ellwood (1986) and Blank (1989), who report that changes in marital status and family composition or a decrease in earnings and other income account for the majority of the openings of AFDC spells.

I have used a bivariate duration model to jointly estimate the initial AFDC spell and following off-AFDC spell that takes into account the possible correlation between spells. The results for the first AFDC spell and off-AFDC spell show a strong negative correlation due to unobserved heterogeneity. However, the evidence of interdependence of welfare recipiency and recidivism for the second spell is statistically weak. For both the first and later spell, the estimates for the scale parameters indicate an increasing and then declining time pattern in leaving AFDC and returning to the AFDC program.

The determinants of the first AFDC spell and off-AFDC spell resemble the existing studies but individual characteristics seem to have little significant effect in explaining the variation in the length of the second AFDC spell and the following off-AFDC spell. Among the variables that are significant in determining the first spell are years of education, ethnic origin, and marital status. Use of AFQT has an effect similar to years of education in determining the duration of an AFDC spell but the AFQT score also helps to identify welfare recidivism.

Appendix A

Description of the Variables

Some variables used in this study are readily available from the NLSY data. Other variables are re-coded from other variables or constructed from other data sources for the purpose of this study. Variables that need some explanation follow.

Hourly Wage Rate	For a given year, this variable is derived by dividing total annual wage income by total annual hours of work for pay. This before-tax average hourly wage rate is denominated in 1978 dollars using the CPI.
Total Monthly Hours of Work	This variable is obtained by adding weekly hours of work at all jobs for each month. Weekly hours of work is available from the NLSY Work History.
Monthly Earnings	This variable is obtained by multiplying a respondent's hourly wage rate by total hours of work for each job held in a given month.
Other Income	This is total yearly family income minus the respondent's own total yearly wage income minus the total yearly benefits from any social welfare programs. Total yearly benefits is the sum of income from AFDC, Food Stamp, and other public assistance programs. It is denominated in 1978 dollars.
Total Adults in Household	Total number of adults (age 18 years or over) in household of respondent. Note that in the sample some AFDC families live with the recipient's parents, other family members, or a cohabiting male. Unless the cohabitor is the natural father of the recipient's child, the presence of such a male, including a stepfather, does *not* preclude eligibility for the AFDC-Basic program (see Moffitt, Reville, and Winkler 1995 for a description of the state AFDC rules).
Total Children in Household	Total number of respondent's *own* children in the household.
Total Work Experience	Cumulative work experience since 16 years of age, measured in months. This variable is computed from the NLSY Work History File. One full month of work equals 173 hours of work or 4.333 weeks of work.

AFQT Score	The Armed Forces Qualification Test score in percentiles (1989 version). The Armed Services Vocational Aptitude Battery (ASVAB) was administered to the respondents in 1980. The ASVAB is a set of ten tests of which four—paragraph comprehension, arithmetic reasoning, word knowledge, and mathematical knowledge—are used to construct the AFQT score.
State Maximum AFDC Benefit	This is the benefit maximum for a family of three, defined as one adult and two children. It is denominated in 1978 dollars.

Appendix B

The Log-Likelihood Function for the Log-Logistic Bivariate Duration Model with Heterogeneity

This appendix discusses the likelihood function for the log-logistic bivariate duration model with unobserved heterogeneity as presented in Section V. The properties of the generalized logistic distribution $CL(\lambda)$ on which the model is based are found in Cardell (1994).

1. LOG-LIKELIHOOD FUNCTION

Suppose that for a given individual we observe an AFDC spell and a subsequent off-AFDC spell, the length of each of which is denoted by the random variables T_1 and T_2, respectively. In terms of right-censoring, two types of events are observed: (i) both AFDC and off-AFDC spells are complete, and (ii) the first (on-AFDC) spell is complete and the second (off-AFDC) spell is right-censored. Assume that there are n_1 observations of two complete spells and n_2 observations of one complete spell and one right-censored spell in the sample ($n_1 + n_2 = n$). Also, let $d_i=1$ if both spells are complete; $d_i=0$ if the first spell is complete and the second one is censored. Thus, the log-likelihood function for Model (3) is:

$$LL(\beta_1, \beta_2, \alpha_1, \alpha_2, \lambda | X) = \sum_{i=1}^{n} d_i \; Prob(T_i = t_{i1} \cap T_{i2} = t_{i2}) + \sum_{i=1}^{n} (1 - d_i) \; Prob(T_i = t_{i1} \cap T_{i2} > t_{i2}) \qquad \text{(B-1)}$$

2. CALCULATING PROBABILITIES FOR CORRELATED EVENTS

To form the sample likelihood function (B-1), one needs to calculate the probabilities of the two events: $Prob(T_1 = t_1 \cap T_2 = t_2)$ and $Prob(T_1 = t_1 \cap T_2 > t_2)$. Positively correlated spells and negatively correlated spells are considered separately.

Case 1: Positive Correlation

The joint probability that two spells are complete at $T_1 = t_1$ and $T_2 = t_2$ is:

$$\begin{aligned} &Prob(T_1 = t_1 \cap T_2 = t_2) \\ &\approx Prob(T_1 > t_1 \cap T_2 > t_2) - Prob(T_1 > t_1 + 1 \cap T_2 > t_2) \\ &- Prob(T_1 > t_1 \cap T_2 > t_2 + 1) + Prob(T_1 > t_1 + 1 \cap T_2 > t_2 + 1) \end{aligned} \tag{B-2}$$

The above probability is evaluated approximately in order to avoid using the PDF directly.[13] The approximation assumes that: $Prob(T_i = t_i) = Prob(T_i > t_i) - Prob(T_i > t_i + \Delta)$ for a very small increment. Obviously, the precision depends on how small the increment is. For most economic data the observations are recorded in calendar periods such as weeks or months. In this study the increment is one month.

Using the bivariate logistic CDF for ζ_1 and ζ_2 ($\zeta_1 \neq \zeta_2$), which are positively correlated, the joint probability is:

$$\begin{aligned} &Prob(T_1 > t_1 \cap T_2 > t_2) \\ &= Prob(\zeta_1 < A_1(t) \cap \zeta_2 < A_2(t)) \equiv F_{\zeta_1,\zeta_2}(A_1, A_2) \\ &= \left(\frac{e^{-A_2(t)/\lambda}}{1 + e^{-A_2(t)}} - \frac{e^{-A_1(t)/\lambda}}{1 + e^{-A_1(t)}}\right)\left(\frac{1}{e^{-A_2(t)/\lambda} - e^{-A_1(t)/\lambda}}\right) \end{aligned} \tag{B-3}$$

where $A_i(t) = (\alpha_i \log t_i - X\beta_i)$ (i = 1, 2). Each item in (B-2) can be substituted by (B-3) or similar expressions with appropriate changes.

The probability for the event of observing a complete AFDC spell of length t_1 and a right-censored non-AFDC spell of length t_2 is:

[13] Both the CDF and PDF for the generalized logistic distribution have a closed form. However, the CDF is easier to use.

$$Prob(T_1 = t_1 \cap T_2 > t_2)$$
$$\approx Prob(T_1 > t_1 \cap T_2 > t_2) - Prob(T_1 > t_1 + 1 \cap T_2 > t_2) \qquad \text{(B-4)}$$

Similarly, (B-4) can be evaluated using (B-3).

Case 2: Negative Correlation

To obtain the joint CDF for ζ_1 and ζ_2 for the variance component structure that permits negative correlation, I utilize the symmetric property of the logistic distribution. That is, if ε_m and ζ_m are logistic, then -ε and -ζ are also logistic. Therefore, the joint CDF for $\zeta_1 \neq \zeta_2$ can be written:

$$\begin{aligned} F_{\zeta_1,\zeta_2}(A_1, A_2) &= F_{\zeta_1}(A_1) - Pr(\zeta_1 < A_1 \cap \zeta_2 > A_2) \\ &= F_{\zeta_1}(A_1) - Pr(\zeta_1 < A_1 \cap -\zeta_2 < -A_2) \end{aligned} \qquad \text{(B-5)}$$

where $F_{\zeta_1}(A_1)$ is the univariate logistics' CDF, that is, $F_{\zeta_1}(A_1) = \dfrac{1}{1+e^{-A_1}}$, and the joint probability $Prob(\zeta_1 < A_1 \cap -\zeta_2 < -A_2)$ is:

$$Prob(\zeta_1 < A_1(t) \cap -\zeta_2 < -A_2(t))$$
$$= \left(\frac{e^{A_2(t)/\lambda}}{1+e^{A_2(t)}} - \frac{e^{-A_1(t)/\lambda}}{1+e^{-A_1(t)}}\right)\left(\frac{1}{e^{A_2(t)/\lambda} - e^{-A_1(t)/\lambda}}\right) \qquad \text{(B-3}'\text{)}$$

The probability statements for the two types of events, the two complete spells, and the first spell is complete and the second is censored, are, respectively:

$$Prob(T_1 = t_1 \cap T_2 > t_2)$$
$$\approx Prob(T_1 > t_1 + 1 \cap T_2 > t_2) - Prob(T_1 > t_1 \cap T_2 > t_2) \qquad \text{(B-4}'\text{)}$$
$$\equiv F_{\zeta_1,\zeta_2}(A_1(t_1+1), A_2(t_2)) - F_{\zeta_1,\zeta_2}(A_1(t_1), A_2(t_2))$$

and

$$
\begin{aligned}
&Prob(T_1 = t_1 \cap T_2 = t_2) \\
&\approx -[Prob(T_1 > t_1 \cap T_2 > t_2) - Prob(T_1 > t_1 + 1 \cap T_2 > t_2) \\
&\quad - Prob(T_1 > t_1 \cap T_2 > t_2 + 1) + Prob(T_1 > t_1 + 1 \cap T_2 > t_2 + 1)] \\
&\equiv F_{\zeta_1,\zeta_2}(A_1(t_1 + 1), A_2(t_2)) - F_{\zeta_1,\zeta_2}(A_1(t_1), A_2(t_2)) \\
&\quad + F_{\zeta_1,\zeta_2}(A_1(t_1), A_2(t_2 + 1)) - F_{\zeta_1,\zeta_2} A_1(t_1 + 1), A_2(t_2 + 1))
\end{aligned}
\qquad \text{(B-2}'\text{)}
$$

where $F_{\zeta_1,\zeta_2} A_1(t_1), A_2(t_2))$ and others with different evaluation points are given by (B-5).

3. FIRST-ORDER DERIVATIVES

To derive the first-order derivatives, denote the components in (B-2) and (B-4), or (B-2′) and (B-4′), by the following symbols:

$$
\begin{aligned}
&Prob(T_1 > t_1 \cap T_2 > t_2) \equiv S_{..}(T_1, T_2), Prob(T_1 > t_1 + 1 \cap T_2 > t_2) \equiv S_{+.}(T_1, T_2), \\
&Prob(T_1 > t_1 \cap T_2 > t_2 + 1) \equiv S_{.+}(T_1, T_2), \text{ and } Prob(T_1 > t_1 + 1 \cap T_2 > t_2 + 1) = S_{++}(T_1, T_2)
\end{aligned}
$$

Note that these probability functions, denoted by $S_{..}$, $S_{+.}$, $S_{.+}$ and S_{++}, are in fact survival functions for joint spells with different length. Conditional on a set of explanatory variables *X* , *S(T)* is written as *S(T; X* | θ*)*, where θ is a set of parameters, θ = α_1, α_2, β_1, β_2, λ).

The derivative of (B-1) with respect to θ is:

$$
\begin{aligned}
\frac{dLL}{d\vartheta} &= \sum d_i \frac{1}{S_{..} - S_{+.} - S_{.+} + S_{++}} \left(\frac{dS_{..}}{d\theta} - \frac{dS_{+.}}{d\theta} - \frac{dS_{.+}}{d\theta} + \frac{dS_{++}}{d\theta} \right) \\
&\quad + \sum (1 - d_i) \frac{1}{(S_{..} - S_{+.})} \left(\frac{dS_{..}}{d\theta} - \frac{dS_{+.}}{d\theta} \right)
\end{aligned}
\qquad \text{(B-6)}
$$

The components in $\frac{dS_{..}}{d\vartheta}$ are shown in (B-7) to (B-9):

$$\frac{\partial S_{..}}{\partial \alpha_k} = \log t_k \{ \frac{e^{A_k(..)} e^{A_l(..)} ((1 + e^{-\lambda A_k(..)})^{-1} - (1 + e^{-\lambda A_l(..)})^{-1})}{(e^{A_k(..)} - e^{A_l(..)})^2 \lambda} - \frac{(e^{A_k(..)} e^{A_l(..)} - e^{A_l(..)} e^{A_l(..)}) ((1 + e^{-\lambda A_k(..)})^{-1} - (1 + e^{-\lambda A_k(..)})^{-2})}{(e^{A_k(..)} - e^{A_l(..)})^2} \} \tag{B-7}$$

$$\frac{\partial S_{..}}{\partial \beta_k} = -X \{ \frac{e^{A_k(..)} e^{A_l(..)} ((1 + e^{-\lambda A_k(..)})^{-1} - (1 + e^{-\lambda A_l(..)})^{-1})}{(e^{A_k(..)} - e^{A_l(..)})^2 \lambda} - \frac{(e^{A_k(..)} e^{A_l(..)} - e^{A_l(..)} e^{A_l(..)}) ((1 + e^{-\lambda A_k(..)})^{-1} - (1 + e^{-\lambda A_k(..)})^{-2})}{(e^{A_k(..)} - e^{A_l(..)})^2} \} \tag{B-8}$$

and

$$\frac{\partial S_{..}}{\partial \lambda} = \frac{e^{A_k(..)} e^{A_l(..)} ((1 + e^{A_k(..)})^{-1} + (1 + e^{A_l(..)})^{-1}) (\lambda (e^{A_k(..)} - e^{A_l(..)})}{(e^{A_k(..)} - e^{A_1(..)})^2 \lambda^2} \tag{B-9}$$

where $k \neq l$, and $k, l = 1, 2$. Similarly, one obtains the derivatives for the other $S_{+.}$, $S_{.+}$ and S_{++}.

4. JOINT CDF FOR TIED OBSERVATIONS

In the above, I consider the non-tied events in which $A_1(t) \neq A_2(t)$ (that is, $\zeta_1 \neq \zeta_2$). For tied events—that is, $A_1(t) = A_2(t) = A(t)$—the joint probability for two positively correlated spells is:

$$\begin{aligned} & Prob(T_1 > t_1 \cap T_2 > t_2) \\ & = Prob(\zeta_1 < A_1(t) \cap \zeta_2 < A_2(t)) \\ & = (1 - \lambda)\ (\frac{1}{1 + e^{-A(t)}}) + \lambda\ (\frac{1}{1 + e^{-A(t)}})^2 \end{aligned} \tag{B-10}$$

The first-order derivatives are:

$$\begin{aligned} \frac{\partial S}{\partial \alpha_k} &= \log t_k \{(1 - \lambda)\ \frac{e^{-A(t)}}{(1 + e^{-A(t)})^2} + 2\lambda\ \frac{e^{-A(t)}}{(1 + e^{-A(t)})^3}\} \\ \frac{\partial S}{\partial \beta_k} &= -X\{(1 - \lambda)\ \frac{e^{-A(t)}}{(1 + e^{-A(t)})^2} + 2\lambda\ \frac{e^{-A(t)}}{(1 + e^{-A(t)})^3}\} \\ \frac{\partial S}{\partial \lambda} &= \frac{1}{(1 + e^{-A(t)})^2} - \frac{1}{(1 + e^{-A(t)})} \end{aligned} \tag{B-11}$$

The joint probability for the negatively correlated spells is:

$$\begin{aligned} & Prob(T_1 > t_1 \cap T_2 > t_2) \\ & = Prob(\zeta_1 < A_1(t) \cap \zeta_2 < A_2(t)) \\ & = \frac{\lambda e^{A(t)}}{(1 + e^{A(t)})^2} \end{aligned} \tag{B-12}$$

and the first-order derivatives are:

$$\begin{aligned} \frac{\partial S}{\partial \alpha_k} &= (\log t_k)\ \lambda\ (\frac{e^{A(t)}}{(1 + e^{-A(t)})^2} - \frac{2(e^{A(t)})^2}{(1 + e^{A(t)})^3}) \\ \frac{\partial S}{\partial \beta_k} &= -X\lambda\ (\frac{e^{A(t)}}{(1 + e^{-A(t)})^2} - \frac{2(e^{A(t)})^2}{(1 + e^{A(t)})^3}) \\ \frac{\partial S}{\partial \lambda} &= \frac{e^{A(t)}}{(1 + e^{A(t)})^2} \end{aligned} \tag{B-13}$$

References

Bane, Mary Jo, and David Ellwood. 1983. “The Dynamics of Dependence: The Routes to Self-Sufficiency.” Report prepared for the U.S. Department of Health and Human Services.

Bergstrom, R., and P.-A. Edin. 1992. “Time Aggregation and Distributional Shape of Unemployment Duration.” *Journal of Applied Econometrics* 7: 75–130.

Blank, Rebecca. 1989. “Analyzing the Length of Welfare Spells.” *Journal of Public Economics* 39: 245–273.

Blank, Rebecca, and Patricia Ruggles. 1993. “When Do Women Use AFDC and Food Stamps? The Evidence of Eligibility vs. Participation.” NBER Working Paper no. 4429.

Blank, Rebecca, and Patricia Ruggles. 1994. “Short-Term Recidivism among Public Assistance Recipients.” *American Economic Review* 84: 49–53.

Brandon, Peter. 1995. “Vulnerability to Future Dependence among Former AFDC Mothers.” Institute for Research on Poverty Discussion Paper no. 1055-95, University of Wisconsin–Madison.

Cardell, Scott. 1994. “Variance Components Structures for the Extreme Value and Logistic Distributions with Application to Models of Heterogeneity.” Mimeo. Department of Economics, Washington State University, Pullman, Wash.

Ellwood, David. 1986 “Targeting ‘Would Be’ Long-Term Recipients of AFDC.” Report prepared for the U.S. Department of Health and Human Services.

Han, Aaron, and Jerry Hausman. 1990. “Flexible Parametric Estimation of Duration and Competing Risk Models.” *Journal of Applied Econometrics* 5: 1–28.

Heckman, James, and Burton Singer. 1984. “Econometric Duration Analysis.” *Journal of Econometrics* 24: 63–132.

Heckman, James, and Christipher Taber. 1994. “Econometric Mixture Models and More General Models for Unobservables in Duration Analysis.” NBER Technical Working Paper No. 157.

Honore, Bo. 1993. "Identification Results for Duration Models with Multiple Spells." *Review of Economic Studies* 60: 241–246.

Kalbfleisch, John, and Ross Prentice. 1980. *The Statistical Analysis of Failure Time Data*. New York: John Wiley.

Kiffer, Nicholas. 1988. "Economic Duration Data and Hazard Functions." *Journal of Economic Literature* 11: 646–679.

Meyer, Bruce. 1990. "Unemployment Insurance and the Unemployment Spells." *Econometrica* 58: 757–782.

Moffitt, Robert. 1992. "Incentive Effects of the U.S. Welfare System: A Review." *Journal of Economic Literature* 15: 1–61.

Moffitt, Robert, Robert Reville, and Anne Winkler. 1995. "State AFDC Rules Regarding the Treatment of Cohabitors: 1993." IRP Discussion Paper no. 1058-95, University of Wisconsin–Madison.

Olsen, Randall, and Kenneth Wolpin. 1983. "The Impact of Exogenous Child Mortality on Fertility: A Waiting Time Regression with Dynamic Repressors." *Econometrica* 51: 731–749.

Swaim, Paul, and Michael Podursky. 1992. "The Distributional Shape of Unemployment Duration: A Reconsideration." *Review of Economics and Statistics* 74: 712–717.

Trussell, J., and T. Richards. 1985. "Correcting for Unmeasured Heterogeneity in Hazard Models Using the Heckman-Singer Procedure." *Sociological Methodology*, ed. N. Tuma. San Francisco: Jossey-Bass.

Weeks, Gregory. 1991. "Leaving Public Assistance in Washington State." Working Paper, Washington State Institute for Public Policy, Evergreen State College, Olympia, Wash.