LABOR SUPPLY AND THE AFDC CHILD CARE SUBSIDY: AN ECONOMIC ANALYSIS

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INTRODUCTION

Since the 1960s the dominant approach for reducing poverty and welfare dependency among female headed families has been to promote employment among poor mothers. Despite various efforts, only a small number of women on welfare hold jobs. Explanations for the low labor force participation rates of single mothers include inadequate education, little work experience, health problems, welfare regulations with inappropriate incentive structures and prevalence of poverty in a welfare recipient's neighborhood. One aspect that has received relatively little consideration is the role child care plays in a welfare recipient's labor supply decision. Assuming that parents want their children cared for while at work, a lack of affordable, let alone quality, child care may deter some women with young children from participating in the labor force and, thus, contribute to increased welfare dependency.

This study analyzes the extent to which changes in the price of child care influence the labor supply of single recipients of Aid to Families with Dependent Children (AFDC). A model guided by a static, microeconomic framework is developed which addresses the complex structure of AFDC child care regulations. Multiple statistical techniques with varying abilities to capture the intricacies of the theoretical model are used to estimate the empirical labor supply model.

EVIDENCE FROM EXISTING STUDIES

Evidence from attitudinal studies indicates that a lack of adequate child care reduces mothers' labor force participation and/or the number of hours worked in the short run, and is likely to have consequences for women's professional success in the long-run. The percentage of mothers reporting to be constrained in their work efforts by child care issues ranges from under two to 50% (Dickinson, 1975; Ditmore & Prosser, 1973; Lueck, Orr, O'Connell, 1983; Oppenheim, 1987; Presser & Baldwin, 1980). Perceived child care constraints were most prevalent among single and black mothers with young children, low education and low family incomes.

A major drawback of attitudinal research is that it does not necessarily reflect people's behavior. Evidence from research based on behavioral observations is not conclusive. While cost or availability of child care seemed to influence work behavior in some studies, others did not find this to be the case (Blau & Robins, 1988; Ditmore & Prosser, 1973; Floge, 1985; Heckman, 1974; Kurz, Robins, Spiegelman, 1975; Morgan, 1981; Robins & Spiegelman, 1978; Stolzenberg & Waite, 1981; Yaeger, 1977). None of these studies focuses on the role of child care in the labor force behavior of welfare or even low-income mothers.

THE THEORETICAL MODEL

The labor supply equation for AFDC recipients is derived from the economic framework of utility maximization subject to a time and budget constraint. If the decisions to work and find child care are simultaneous ones, utility is a function of leisure, child care and the composite commodity all-other-goods.

Time and Budget Constraints for AFDC Recipients

For a family participating in the AFDC program the budget constraint is more complex than the ones typically encountered in economic models. Whenever family income falls below a certain level, it is supplemented by the state. AFDC benefits are determined by subtracting a recipient's net earnings from a 'need standard'. Net earnings are defined as earned income minus the following income disregards:

(a) \$75 (or less for part-time) for work expenses,
(b) the actual cost up to \$160 (or less for part-time) for care of each child or incapacitated adult,
(c) \$30,
(d) one third of any remainder.

"The 'thirty and one-third' disregard may be applied until used for four consecutive months and must not be repeated until twelve consecutive months have elapsed since AFDC was last received" (U.S. Dept. of Health and Human Services 1984, xiii). In the case of less than full employment, maximum child care deductions are reduced according to state regulations.

These regulations have three implications relevant for this study: an AFDC recipient's wage rate varies with hours worked, and decreases after working for more than four months while on AFDC; the price of child care changes with hours worked, the magnitude of child care expenses, the number of children in child care and the state a welfare recipient lives in. As long as child care expenses are less than or equal to the maximum AFDC child care subsidy, the price of child care to an AFDC recipient is a percentage of the price charged by the caregiver. If child care expenses exceed the maximum subsidy, the effective price of child care is the actual price charged by the supplier.

According to these regulations, income for AFDC recipients who work and are eligible for the thirty and one-third earned income disregard consists of supplementary AFDC income (BEN), nonlabor income (v) plus earned income (wM). If income is spent on the composite good (X) and child care (C), the budget constraint for AFDC

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recipients can be written as[2]

$$(1) \qquad p_c C + p_x X = wM + v + BEN$$

Supplementary AFDC income is determined as

$$(2) \qquad BEN = PSTD - f \cdot NETEARN - v$$

where:
f = percentage reduction

Net earnings[3], NETEARN, consist of

$$(3) \; NETEARN = wM - DISR\text{-}Min\left[K \cdot MAXCD, p_c C\right] - t\left[wM\text{-}DISR\text{-}Min\left[K \cdot MAXCD, p_c C\right]\right]$$

where:
DISR = \$30 (earned income disregard)
K = no. of children for whom child care is purchased
MAXCD = maximum child care deduction per child
t = 1/3 (earned income disregard)

The combined budget and time constraint (5) is derived by substituting time constraint (4) into equation (1).

$$(4) \qquad T = M + L$$

where:
L = leisure M = hours worked T = total time

This results in

$$(5) \quad PSTD' + t'wT = p_c C - f(1-t)Min\left[K \cdot MAXCD, p_c C\right] + p_x X + t'wL$$

where:
PSTD' = PSTD + f(1-t)DISR t' = 1-f(1-t)

Using child care disregard regulations from Colorado, the budget and time constraint for AFDC recipients receiving the earned income disregard is the piecewise discontinuous function:

$$(6) \quad \begin{cases} t'p_c C + p_x X + t'wL = PSTD' + t'wT & \text{if } 1 \le M < 100 \text{ and } p_c C \le 130 \\ p_c C + p_x X + t'wL = PSTD' + t'wT + f(1-t)130K & \text{if } 1 \le M < 100 \text{ and } p_c C > 130 \\ t'p_c C + p_x X + t'wL = PSTD' + t'wT & \text{if } M \ge 100 \text{ and } p_c C \le 160 \\ p_c C + p_x X + t'wL = PSTD' + t'wT + f(1-t)160K & \text{if } M \ge 100 \text{ and } p_c C > 160 \end{cases}$$

The combined budget/time constraint consists of several segments which differ in the price of child care and nonlabor income. Since each segment of the constraint is linear, the complete constraint is piecewise-linear. A graphical representation of the constraint is shown in Figure 1. Four areas and three kink lines correspond to the budget constraint in (6).

A Labor Supply Function for AFDC Recipients

In the case of budget constraints with one segment, a labor supply function is derived by maximizing utility subject to the constraints and by solving the resulting system of equations for

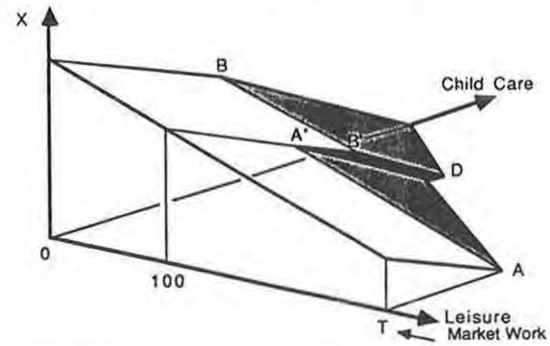

FIGURE 1 The Time and Budget Constraint for AFDC Recipients Receiving the Earned Income and Child Care Disregard

preferred hours of work. The piecewise-linear nature of the budget constraint for AFDC recipients makes it necessary to repeat the process of utility maximization for every segment of the constraint. The resulting labor supply equation consists of several parts and is a <u>conditional</u> labor supply equation: it describes the labor supply choice conditional on the segment or kink of the budget constraint chosen (Moffitt, 1986c). For AFDC recipients who live in Colorado and receive the earned income and child care disregards, the <u>conditional</u> labor supply function is,

$M = m[w_1, p_{c1}, p_{x1}, v_1]$	if $M < 100$ and $p_c C_1 < 130K$	area I
$M = m[w_2, p_{c2}, p_{x2}, v_2]$	if $M < 100$ and $p_c C_2 > 130K$	area II
$M = m[w_3, p_{c3}, p_{x3}, v_3]$	if $M > 100$ and $p_c C_3 < 160K$	area III
$M = m[w_4, p_{c4}, p_{x4}, v_4]$	if $M > 100$ and $p_c C_4 > 160K$	area IV
$M = m[w_5, p_{x5}, v_5]$	if $M < 100$ and $p_c C_1 = 130K$	kink AA'
$M = m[w_6, p_{x6}, v_6]$	if $M > 100$ and $p_c C_3 = 160K$	kink BB'
$M = 100$	if $M = 100$ and $p_c C_4 > 160K$	kink BD

where: $C_i = c[w_i, p_{ci}, p_{xi}, v_i]$ for $i = 1,2,3,4$

$p_{ci} = t'p_c$ for $i = 1,3$ $\qquad p_{ci} = p_c$ for $i = 2,4$

$p_{xi} = p_x$ for $i = 1,..,6$ $\qquad v_i = PSTD'$ for $i = 1,3,5,6$

$v_i = PSTD' + f(1-t)130K$ for $i = 2$

$v_i = PSTD' + f(1-t)160K$ for $i = 4$

$w_i = t'w$ for $i = 1,..,6$

Which segment of the constraint will be chosen depends on the level of utility associated with each location. Preferred hours of work will be in area I if the utility derived from the optimal bundle of goods in area I is greater than the

[2] A mathematical and graphical representation of the budget and time constraint for working AFDC recipients will be based on Colorado AFDC regulations since data from Colorado are used for the empirical part of this study. In Colorado, the difference between the need standard and net earnings is multiplied by 0.8237. The max. child care deduction is \$130 per child per month if an AFDC recipient works between one and 100 hours/month. The max. child care deduction increases to \$160 per child/month, if monthly labor supply is 100 hours or more.

[3] The possibility that an AFDC recipient earns between \$0 and \$30 per month is ignored in this model, assuming that working AFDC recipients earn more than \$30/month. This assumption was confirmed by the data.

utility from the optimal bundles of goods in areas II-IV and along kink-lines AA', BB' and BD (Moffitt, 1986c).

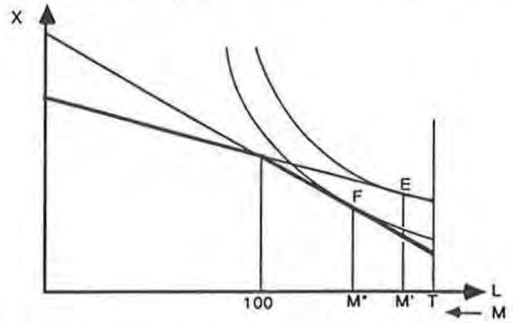

FIGURE 2 Unique Maximum - Convex Budget Set

Hausman (1979) showed that a comparison of utility levels is not necessary as long as the budget set is convex and preferences are strictly quasi-concave. In such a case, there is exactly <u>one unique</u> utility maximum in a feasible range, as illustrated by Figure 2. Although there is a utility maximizing point along segment II of the budget constraint, it is not a possible solution, since it is outside the feasible range of segment II. In addition it was shown that a kink is chosen if all utility maxima occur in the infeasible ranges of the segments adjacent to a kink (Moffitt, 1986c). A simplification of expression (7) is not possible if the budget set is nonconvex. In that case, a comparison of utility levels is necessary to establish the global maximum, since several utility maximizing solutions may be found within feasible ranges of the budget constraint, as illustrated by Fig. 3.

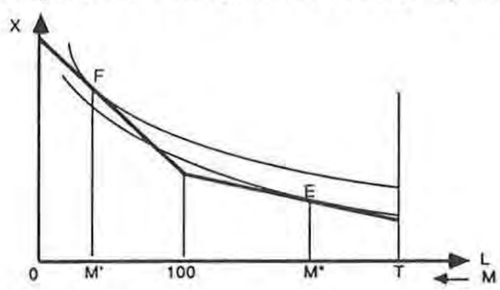

FIGURE 3 Multiple Maxima - Nonconvex Budget Set

According to Figure 1 the budget set for AFDC recipients consists of convex as well as non-convex parts. The budget set is convex with respect to areas I, III and IV and kink lines AA', BB'. Thus, if a utility maximizing point is in either of these segments or kink lines, it is guaranteed to be a unique maximum, in which case a comparison of utility levels is not necessary. Nonconvexity of the budget set is an issue with respect to area II: a utility maximizing point in the feasible range of area II does not preclude a utility maximizing solution in the feasible range of area IV or line BD (Fig.4,5). Both graphs represent a "cut through" areas II and IV of the budget constraint in Fig.1, parallel to the hours axis. The segment from zero to 100 hours of leisure corresponds to area IV, the segment from 100 to T hours of leisure to area II and point D corresponds to kink line BD.

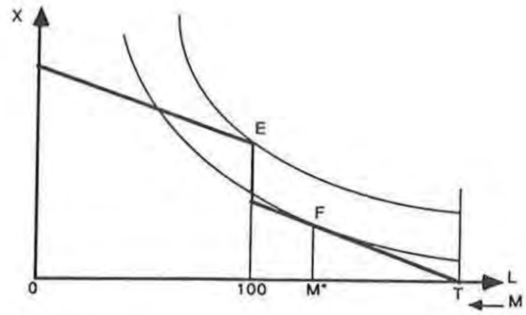

FIGURE 4 Nonconvexity Area II - Kink BD
Multiple Feasible Solutions

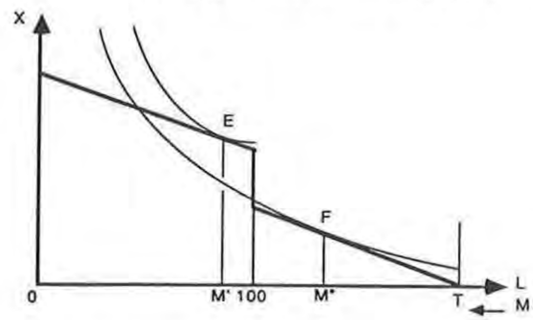

FIGURE 5 Nonconvexity Area II - Area IV
Multiple Feasible Solutions

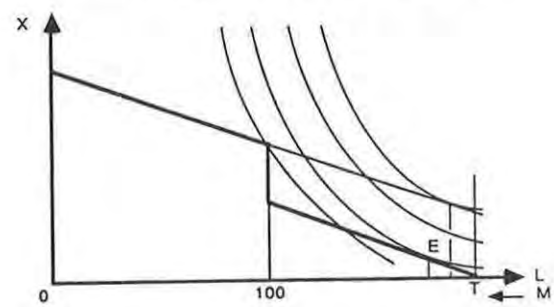

FIGURE 6 Conditions for Segment II to be Chosen

If, however, the utility from a feasible solution in area II is greater than the utility from a solution along kink BD, then the indifference curve corresponding to the solution in area II will intersect area IV in the <u>infeasible range</u>, as will all higher indifference curves (Fig.6); i.e. a comparison of utility levels for solutions in areas II and IV is not necessary. Area II will be chosen as the preferred location if the utility from a maximizing solution in area II is larger than the utility from a point along kink BD. The choice of location can, thus, be simplified as follows:

Choose area I if,

(8) $m\left[w_1, p_{c1}, p_{x1}, v_1\right] < 100$ and $p_c C_1 < 130K$

Choose area II, if,

(9) $V\left[w_2, p_{c2}, p_{x2}, v_2\right] > U\left[M_{BD}, C_{BD}, X_{BD}\right]$

Choose area III, if

$$(10)\quad 100 < m\left[w_3, p_{c3}, p_{x3}, v_3\right] \quad \text{and} \quad p_c C_3 < 160K$$

Choose area IV, if

$$(11)\quad 100 < m\left[w_4, p_{c4}, p_{x4}, v_4\right] \quad \text{and} \quad p_c C_4 > 160K$$

Choose line AA′, if

$$(12)\quad m\left[w_5, p_{x5}, v_5\right] < 100 \quad \text{and} \quad p_c C_2 < 130K < p_c C_1$$

Choose line BB′, if

$$(13)\quad 100 < m\left[w_6, p_{x6}, v_6\right] \quad \text{and} \quad p_c C_4 < 160K < p_c C_3$$

Choose line BD, if

$$(14)\quad U\left[M_{BD}, C_{BD}, X_{BD}\right] > V\left[w_2, p_{c2}, p_{x2}, v_2\right]$$

where:

$$C_{BD} = \left[PSTD' + f(1-t)160K + 100t'w - p_x X\right]/p_c$$

$$M_{BD} = 100 \qquad X_{BD} = X$$

Given these conditions for the choice of location, a more compact expression for the complete piecewise-linear labor supply equation is,

$$
\begin{aligned}
M = {} & D_1 D_8 m\left[w_1, p_{c1}, p_{x1}, v_1\right] + D_2 m\left[w_2, p_{c2}, p_{x2}, v_2\right] \\
& + D_3 D_9 m\left[w_3, p_{c3}, p_{x3}, v_3\right] + D_4 D_{10} m\left[w_4, p_{c4}, p_{x4}, v_4\right] \\
& + D_5 D_{11} D_{12} m\left[w_5, p_{x5}, v_5\right] + D_6 D_{13} D_{14} m\left[w_6, p_{x6}, v_6\right] \\
& + D_7 \cdot 100
\end{aligned}
\qquad (15)
$$

where:

$D_i = 1$ if $D'_i > 0$; $D_i = 0$ otherwise; $i = 1,..,14$

$D'_1 = 100 - m\left[w_1, p_{c1}, p_{x1}, v_1\right]$

$D'_2 = V\left[w_2, p_{c2}, p_{x2}, v_2\right] - U\left[M_{BD}, C_{BD}, X_{BD}\right]$

$D'_3 = m\left[w_3, p_{c3}, p_{x3}, v_3\right] - 100$ $\quad D'_4 = m\left[w_4, p_{c4}, p_{x4}, v_4\right] - 100$

$D'_5 = 100 - m\left[w_5, p_{x5}, v_5\right]$ $\quad D'_6 = m\left[w_6, p_{x6}, v_6\right] - 100$

$D'_7 = U\left[M_{BD}, C_{BD}, X_{BD}\right] - V\left[w_2, p_{c2}, p_{x2}, v_2\right]$ $\quad D'_8 = 130K - p_c C_1$

$D'_9 = 160K - p_c C_3$ $\quad D'_{10} = p_c C_4 - 160K$ $\quad D'_{11} = 130K - p_c C_2$

$D'_{12} = p_c C_1 - 130K$ $\quad D'_{13} = 160K - p_c C_4$ $\quad D'_{14} = p_c C_3 - 160K$

THE ECONOMETRIC MODEL

Estimating the unknown parameters of piecewise-linear labor supply equations with ordinary least squares (OLS) has several limitations. These limitations can be overcome by applying the technique of maximum likelihood estimation (MLE), instead. The maximum likelihood approach and its application to the case of piecewise-linear labor supply equations will be outlined below[4].

[4] A detailed technical appendix can be obtained from the author.

Estimation of Parameter Values With OLS

The "linearization" approach (Hall, 1973) enables the estimation of a piecewise-linear labor supply equation with ordinary least-squares by creating a one-segmented labor supply equation. The piecewise-linear nature of the labor supply equation is avoided by focusing on the segment of the budget constraint chosen by a respondent, as indicated by the number of hours worked. Only prices and nonlabor income describing the relevant segment of the budget constraint are considered in the estimation. This approach is based on the assumption that a person faced with a piecewise-linear budget constraint behaves *as if* faced with a simple linear budget constraint consisting of the chosen linearized segment.

Estimating the parameters of the reduced labor supply equation with OLS has several drawbacks. One problem is that it requires knowledge of the segments of the budget constraint chosen by the respondents. The main problem with this simplification stems from the dependence of the price of child care and unearned income on the number of hours worked. Since the error term in an empirical labor supply function affects hours worked, and consequently unearned income and the price of child care - which, in this case, are functions of hours worked - unearned income and the price of child care are necessarily correlated with the error term. This creates simultaneous equations bias, i.e. biased and inconsistent estimates if the unknown parameters are estimated with OLS. A further limitation of OLS is that kinklines are ignored as possible utility maximizing points in convex budget sets. Similarly, in nonconvex budget sets areas in which no utility maxima can occur will not be excluded from the solution space.

Maximum Likelihood Estimation

An alternative estimation technique for nonlinear models is the method of maximum likelihood. In large samples maximum likelihood estimates are asymptotically normal, asymptotically efficient and consistent (Moffitt, 1986c). The formulation of a likelihood function requires labor supply to be a random variable. This is typically accomplished by adding a normally distributed $N(0,\sigma^2)$ error term to the deterministic model.

For two reasons it is not desirable to estimate a segmented labor supply model on the basis of an additive error-term model. If, as one would expect, the variance of the error term is different from zero, then it is not guaranteed that the segment of the budget constraint on which hours of work are observed is identical with the one on which an individual's utility maximizing choice is located. A person's optimal and observed hours of work will only be on the same segment of the constraint if the variance of the error term is small enough to not move observed hours of work to a different segment. This possibility implies a systematic correlation between the magnitude of the error term and the marginal prices and income assigned as regressors which results in inconsistent estimates.

A second problem with the additive error-term model is the restriction it imposes on supply responses to changes in the budget constraint. Underlying the additive-error-term model is the assumption that differences in the observed number of hours worked is due to measurement, specification or optimization error only. This implies that everybody in the population faced with identical prices, wage rates, and nonlabor income will choose the same utility maximizing point. Given that there is just one utility maximizing point, (ignoring income effects) price changes will only impact labor supply if the price change occurs on the segment on which the utility maximizing point is located. Price changes along any other segment of the budget constraint will have no effect on labor supply and, thus, on the expected value of hours worked (Moffitt, 1986c).

The assumption of identical utility maximizing choices for respondents faced with identical prices, wage rates and nonlabor income is very restrictive. Instead, one would expect some differences in labor supply to be caused by variations in people's preferences. Accounting for differences in preferences will result in more than one utility maximizing choice among respondents with identical budget constraints, so that a change in price along any segment of the budget set will induce a change in the expected value of labor supply.

Heterogeneity of preferences can be incorporated into the labor supply model by allowing one or more parameters in the utility function to vary according to measurable or unmeasurable personal differences. Measurable differences in tastes are most often attributed to characteristics such as age or education. Since it is unlikely that all differences in preferences are accounted for with measurable variables, it is still possible that two individuals with identical personal characteristics and budget sets prefer to work substantially different hours. The effects of unmeasurable individual preferences can be captured by including random parameters in the utility function. Depending on the values these random variables take on, indifference curves rotate and, therefore, create different utility maximizing points along the budget constraint.

Random parameters in the utility function have a further advantage. In combination with the error term model they allow for the possibility that actual and desired hours of work are not the same by assessing the joint likelihood of observing (1) optimal hours of work, <u>and</u> (2) a discrepancy between optimal and actual hours of work. Since optimal labor supply may not be on the same segment of the budget constraint as actual labor supply, it is necessary to determine for each person in the sample the likelihood of observing reported hours of work if optimal labor supply were on either segment or kink of the constraint.

THE EMPIRICAL MODEL

In this study, labor supply is a function of the wage rate, the price of child care, the per capita AFDC payment standard and variables accounting for differences in individuals' preferences. The hypothesized effect of each variable is outlined below.

Wage Rate: Economic theory does not predict the net effect of a ceteris paribus change in the wage rate. Depending on whether the substitution effect or the income effect prevails, market work will either increase or decrease. A measure of the wage rate was obtained by dividing monthly earnings by hours worked per month.

Price of Child Care: An increase in the price of child care is expected to result in a decrease in the quantity of market child care demanded, due to the negative own-price effect, holding everything else constant. If market work and child care are complements, this reaction will lead to fewer hours worked. An increase in the price of market care also decreases the relative price of child care provided by the parent, ceteris paribus. As a result, home produced child care is expected to increase which, given the time constraint, will result in fewer hours of market work. A measure of the price of child care was derived by dividing monthly child care expenditures by hours of child care purchased per month.

Nonlabor Income: Previous research indicates that leisure is a normal good (Killingsworth, 1983; Killingsworth & Heckman, 1986). The only nonlabor income AFDC recipients receive are welfare payments, the amount of which depends on family size and the state a recipient lives in. Within a particular state an increase in the AFDC payment standard is, thus, due to an increase in family size. To distinguish effects of changes in nonlabor income from family size effects, the per capita AFDC payment standard was used as a measure of nonlabor income.

Family Size: In this model the effect of family size and composition is addressed by including the number of children five years and younger into the labor supply equation. Considering only the number of children under six clearly does not do justice to the varying effects of family members of different ages on mother's employment. However, since children below the age of five tend to influence a mother's work behavior more than older children, this variable is expected to account for a substantial portion of the family size and composition effects.

Education: Additional years of education, measured as completed years of school, are expected to increase a woman's market and household productivity as well as change her preferences. Since these effects influence labor supply in opposite directions, the net effect of a ceteris paribus change in education on market work is ambiguous a priori.

Length of Stay on AFDC: Length of stay on AFDC may influence a recipient's labor supply in a number of ways, ceteris paribus. In the past it has been documented that a majority of welfare recipients are on welfare for a relatively short period of time, that other recipients stay on welfare for several years, interrupted by spells of independence, while still another group of recipients receives AFDC until their children are no longer eligible (Hoffman, 1987). Based on these observations, the conclusion has been drawn that some people are prone to welfare dependency. To be eligible for AFDC less than a certain amount of money has to be earned. Therefore, the longer a person is on AFDC, the more likely it is that fewer hours will be spent in market work.

In a society in which individual effort is highly regarded, to some, welfare receipt has a stigma effect (Moffitt, 1983). Since one way of leaving welfare is through work, it is hypothesized that the longer a person is on AFDC, the more the stigma effect may serve to increase work effort, and thus enable a welfare recipient to leave the program. The reverse argument is also made: the longer a person is on welfare, the less burdensome the stigma effect becomes, which in turn may lower paid work efforts. In addition, a recipient will learn to manage with very limited resources and will learn how to use the welfare system to her advantage. As in the case of education, the theoretical model does not provide a definite hypothesis for the net effect of length of stay of AFDC on labor supply. Length of stay on AFDC was measured as number of years a respondent has received AFDC payments.

Race: Previous research has found race to be an important determinant of labor force behavior (Ehrenberg & Smith, 1987). Differences in the respondents' race are incorporated into the empirical model with two dummy variables: the variable RACE1 takes on a value of one if a respondent is black, the variable RACE2 takes on the value of one if the respondent is Caucasian. The majority of the respondents represented in the excluded category are of Hispanic origin.

In the case of nonconvex budget sets, the derivation of a maximum likelihood function designed to estimate a piecewise-linear labor supply equation requires a specific indirect utility function and the corresponding labor supply equation. Finding reasonably simple mathematical expressions for a labor supply equation and the corresponding utility functions is, in the case of three goods, not trivial. The indirect utility function used by Hausman and Ruud (1984) has the advantage of flexibility and of a labor supply equation linear in variables. The empirical model is shown in equation (16)[5].

$$(16)\quad M_{ij} = \alpha_1 + \beta_1\theta + \beta_1 PC\_PSTD_j + \left[\alpha_1\beta_1+\gamma_1\right]wage_j + \left[\alpha_2\beta_1+\delta\right]P_{ccj} + \tfrac{1}{2}\beta_1\left[\gamma_1 wage_j^2+\gamma_2 P_{ccj}^2\right] + \beta_1\delta wage_j P_{ccj} + a_1 KO\_5 + a_2 EDU + a_3 YRS\_AFDC + a_4 RACE1 + a_5 RACE2 + \epsilon_{1i}$$

where:
$i = 1, .., n$ observations in the sample
$j = 1, .., 7$ sections of the labor supply equation
a_k = unknown parameters of the labor supply equation

5 In a three-dimensional budget set two parameters need to be random to allow for different utility maximizing points for respondents with identical observed characteristics. The two random parameters in this model are α_1 and α_2.

RESULTS

The results are based on a 1983/84 panel data set of 100 working AFDC recipients in Denver, CO. Some some characteristics of the sample can be found in table 1. Three different techniques are used to estimate the labor supply model. The first set of estimates is based on OLS, ignoring AFDC regulations ("naive" approach). The second set is based on the linearization approach and OLS, while the final estimates are the result of ML estimation[6] (tables 2-4).

TABLE 1 Characteristics of Working AFDC Recipients Receiving the Earned Income Disregard

Variable	Mean	Std. Dev.	Median
AFDC Payment Standard	374.89	88.50	336.00
R's Age	30.92	6.42	30.00
R's Age at First Birth	19.00	2.74	19.00
Child Care Expenditures/Month	57.92	72.75	30.00
Earnings/Month	420.51	226.50	382.00
Hours of Work/Month	102.16	43.97	92.00
Hrs. of Child Care/Month	122.30	49.32	120.00
Number of Children 0-17	2.59	1.28	2.00
No. of Children 0-2	0.31	0.51	0.00
No. of Children 3-5	0.61	0.70	0.00
No. of Children 6-11	1.26	0.80	1.00
No. of Children 12-17	0.42	0.71	0.00
Adults in HH besides R	0.48	1.02	0.00
Price of Child Care/Hr.	0.50	0.59	0.33
Wage Rate/Hour	4.03	1.21	3.96
Years of Education	11.17	1.76	11.50
Years on AFDC	6.79	3.93	7.00

Race Black 44.4% White 21.4% Other 43.2%

Number of Observations: 196

TABLE 2 Labor Supply Estimates for AFDC Recipients Receiving Earned Income Disregard: "Naive" Approach

Variable	P.Estimate	Std.Error	t-Statistic
Intercept	79.489	35.757	2.223
P.C. AFDC Paym. Std./100	-24.128	23.092	-1.045
Wage Rate/Hr.	34.590	9.400	3.704
Wage Rate/Hr. Squared	-9.051	2.293	-3.947
Price of Child Care/Hr.	-119.515	25.228	-4.737
Price of Child Care/Hr. Squ.	-27.820	18.070	-1.540
Wage Rate•Price of Child Care	30.161	5.206	5.793
Number of Children 0-5	-3.037	4.218	-0.720
Years of Education	0.632	1.756	0.360
Years on AFDC	-0.722	0.796	-0.907
Race1	2.368	6.930	0.342
Race2	-37.476	8.406	-4.458

St. Error of Error Term: 37.900 Degrees of Freedom: 184
R-Squared: 0.299 Adjusted R-squared: 0.257

For the "naive" approach, the effect of an increase in the price of child care on the labor

6 The empirical model was estimated with the programming language GAUSS (Gauss, 1986). Two state-of-the-art maximization algorithms were used: the BHHH modified version of scoring and the BFGS positive definite secant update algorithm.

supply of AFDC recipients can be determined by differentiating the estimated labor supply equation with respect to the price of child care. An evaluation of the resulting expression at the sample mean indicates that child care and work are complementary goods: a one dollar increase in the price of child care, on the average, leads to a monthly reduction in labor supply of about 12 (-11.89) hours, ceteris paribus.

Determining the effect of a ceteris paribus increase in the price of child care on AFDC recipients' work effort for the segmented labor supply equation requires differentiating every segment of the equation with respect to the price of child care. Conditional on the choice of a segment, a change in the price of child care has the following effect on labor supply:

$$(17)\quad \frac{dM}{dp_c} = D_1D_8\left[\frac{dm}{dp_{c1}}\cdot\frac{dp_{c1}}{dp_c}\right] + D_2\left[\frac{dm}{dp_{c2}}\cdot\frac{dp_{c2}}{dp_c}\right] + D_3D_9\left[\frac{dm}{dp_{c3}}\cdot\frac{dp_{c3}}{dp_c}\right] + D_4D_{10}\left[\frac{dm}{dp_{c4}}\cdot\frac{dp_{c4}}{dp_c}\right] + D_5D_{11}D_{12}\left[\frac{dm}{dp_{c5}}\cdot\frac{dp_{c5}}{dp_c}\right] + D_6D_{13}D_{14}\left[\frac{dm}{dp_{c6}}\cdot\frac{dp_{c6}}{dp_c}\right]$$

Note that the marginal effect of a change in the price of child care differs with the choice of segment or kink. A one dollar increase in the market price of child care translates into an increase in the effective price of child care of one dollar in areas two or four, but results in an increase of only [1-f•(1-t)] or 0.451 dollars in areas one and three of the budget constraint. If a kink is chosen prior to a change in the price of child care a person may "stick" at the kink, i.e. not react to the change. Note,

TABLE 3 Labor Supply Estimates for AFDC Recipients Receiving Earned Income Disregard: Linearization Approach

Variable	P.Estimate	Std.Error	t-Statistic
Intercept	68.182	35.673	1.911
P.C. AFDC Paym. Std./100	-12.497	20.561	-0.608
Wage Rate/Hr.	64.817	21.055	3.079
Wage Rate/Hr. Squared	-33.603	11.118	-3.022
Price of Child Care/Hr.	-144.871	31.866	-4.546
Price of Child Care/Hr. Squ.	26.485	22.512	1.176
Wage Rate•Price of Child Care	60.848	13.393	4.543
Number of Children 0-5	-6.245	4.365	-1.431
Years of Education	0.854	1.754	0.487
Years on AFDC	-0.674	0.817	-0.824
Race1	6.932	6.956	0.997
Race2	-37.788	8.613	-4.387

St. Error of Error Term: 38.902 Degrees of Freedom: 184
R-Squared: 0.261 Adjusted R-Squared: 0.217

furthermore, that equation (17) does not take into account the total change in labor supply due to a change in the price of child care. The assessment of the marginal effect ignores the possibility that an individual may change the segment or kink originally chosen (Moffitt, 1986c). If the marginal effect of a change in the price of child care is calculated as the average of the marginal effects of all observations in the sample according to the linearization approach a ceteris paribus increase by one dollar is associated with 26 (-26.44) fewer hours of work per month.

Maximum likelihood estimates predict the following labor supply equation[7]:

$$(18)\quad M_j = 80.16 - 17.06\cdot(PC\_PSTD_j/100) + 101.34\cdot wage_j - 25.67\cdot wage_j^2 - 147.93p_{ccj} + 10.11\cdot p_{ccj}^2 + 56.51\cdot w_j p_{ccj} - 5.08\cdot K0\_5 - 1.52\cdot EDU - 1.96\cdot YRS\_AFDC + 2.82\cdot RACE1 - 41.24\cdot RACE2$$

Holding all other factors constant, an increase in the price of child care by one dollar results, on the average, in 51 (-51.21) fewer work hours per month, holding all other variables constant.

TABLE 4 Labor Supply Estimates for AFDC Recipients Receiving Earned Income Disregard: Maximum Likelihood Approach

Parameter	P.Estimate	Std.Error	t-Statistic
α_1	-5.765	3.010	-1.915
β_1	-17.056	7.970	-2.140
θ	-5.038	2.478	-2.033
γ_1	3.010	1.674	1.798
α_2	8.479	4.691	1.807
δ	-3.313	2.353	-1.408
γ_2	-1.186	5.576	-0.213
Number of Children 0-5	-5.080	5.637	-0.901
Years of Education	-1.524	2.046	-0.745
Years on AFDC	-1.960	0.873	-2.245
Race1	2.815	7.445	0.378
Race2	-41.237	8.999	-4.583
St. Dev. Error Term	13.819	5.362	2.577
St. Dev. α_1	1.303	0.612	2.129
St. Dev. α_2	0.731	3.064	0.238

- Log Likelihood: 1008.8287 Degrees of Freedom: 181

DISCUSSION

A comparison of the three sets of parameter estimates shows that the number of children five years and younger, years spent on AFDC and being Caucasian all serve to decrease AFDC recipients' labor supply, ceteris paribus. Years of education have the opposite effect, except for the MLE estimate. Note that only being Caucasian has a statistically significant effect.

For ease of comparison table 5 reports the nonlabor income, wage rate and price of child care effects as elasticities[8].

[7] MLE requires finding the global maximum of a function. In the case of complex likelihood functions, it is very possible that estimates represent a local rather than a global maximum. This issue can be addressed by repeating the estimation procedure with different starting values. The initial estimates in this study were either OLS estimates from the 'naive model', or OLS estimates derived from the linearization approach. There is still no guarantee that the reported estimates are associated with the global maximum of the likelihood function.

[8] Since AFDC regulations were ignored in the 'naive' approach, the elasticities were computed at the sample means. The complex nature of the labor supply equation accounting for AFDC regulations

TABLE 5 Nonlabor Income, Uncompensated Wage Rate and Child Care Price Elasticities of Labor Supply

	Nonlabor Income	Wage Rate	Price of Child Care
"Naive" Approach	-0.259	0.519	-0.058
Linearization Approach	-0.221	0.451	-0.013
Maximum Likelihood Estimation	-0.302	0.506	-0.199

All three nonlabor income elasticities are consistent with the hypothesized sign and inelastic (-0.221 to -0.302): AFDC recipients work fewer hours if the per capita AFDC payment standard is increased, ceteris paribus.

The three wage rate elasticities also have the expected sign and are inelastic. Previous research indicates a rather large range of uncompensated wage rate elasticities for female labor supply, reaching from -0.30 to over 14, with more recent uncompensated wage rate elasticities between 0 and 2 (Killingsworth & Heckman, 1986). All three of the uncompensated wage rate elasticities for AFDC recipients in this study, thus, fall within the range of existing estimates, although they are clearly on the lower end. They are consistent with Moffitt's 1983 study which found the wage rate elasticities for AFDC recipients to be 0.44.

The child care price elasticities of labor supply are also as hypothesized in sign and inelastic. While two of the estimates are close to zero, the child care price elasticity based on MLE results is -0.2. Although an average of thirteen fewer hours of work per month as a reaction to a one dollar increase in the price of child care is not a large change, a decrease of fifty-one hours of paid work indicates that the price of child care may have a substantial influence on welfare recipients' work behavior. The 51-hour estimate is based on an economic model which accounts for AFDC regulations and a corresponding statistical analysis. Thus, in theory, this result should represent the better estimate.

Since this study is based on a sample from one state and did not address the issues of autocorrelation, multicollinearity and sample selectivity, further research efforts are needed to ascertain the robustness of the results.

To understand the role of child care in welfare recipients' work behavior it is furthermore necessary to determine the types of child care preferred by low-income parents, whether certain child care arrangements are more suitable to stable employment patterns and how in-kind payments impact on labor supply decisions. To my knowledge, there is no research that addresses any of these issues.

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required a calculation of elasticities for each respondent in the sample. The reported elasticities are their averages.

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