

Technical Analysis Paper No. 2  
Office of Evaluation  
Office of the Assistant Secretary  
for Policy, Evaluation and Research  
Department of Labor  
June 1973

USING ESTIMATES OF INCOME AND  
SUBSTITUTION PARAMETERS TO PREDICT  
THE WORK INCENTIVE EFFECTS OF VARIOUS INCOME  
MAINTENANCE PROGRAMS: A BRIEF EXPOSITION AND PARTIAL  
SURVEY OF THE EMPIRICAL LITERATURE

by

Orley Ashenfelter  
and  
Ronald Ehrenberg

The views expressed in this paper are those of the authors and do not represent an official position of the U.S. Department of Labor, its agencies, or staff.

In this paper we have set down a moderately rigorous exposition of the use of conventional economic analysis for the purpose of estimating the work (dis)incentives resulting from the institution of various income maintenance schemes. Most of the analysis is couched in terms of simplified versions of the Family Assistance Plan (FAP), a variant of a negative income tax, and a wage subsidy program. Our intent is to set out the conventional theory of labor supply in an easily understood way, to show how this theory may be helpful in the examination of an issue of importance to public policy, and to survey the available empirical literature for reasonable estimates of the parameters necessary for implementation of the theory.

What we will do in the sequel is perfectly conventional. The only wrinkles are that we will try to simplify and verbalize the analysis often, and we will try to integrate various income maintenance schemes into the analysis to see what implications are provided regarding work (dis)incentives from them. There are accordingly three parts to the paper: Part I is a strictly verbal discussion of everything that follows. Part II is a more conventional discussion with some mathematics. Part III is a review of much of the empirical work currently available. Our discussion throughout draws heavily on two previous

PROPERTY OF  
MARTIN F. C. ...  
RESEARCH ...  
INSTITUTE ...  
Cleveland, Ohio

papers\*.

### I. Verbal Discussion

The theory of labor supply is based on the notion that a family is faced with a number of short run decisions regarding how to allocate the time that its members have available to it. (We will speak of families with only two members potentially able to perform work in the labor market, and we will call them the husband and the wife, but there is no reason why they need be related in this way nor why there cannot be more family members capable of work.) These decisions relate to the amount of time that each family member will take as leisure, and, since the total amount of time available to them is fixed by nature, how much time they will therefore work. It is important to recognize that the decisions we will analyze are of a short run nature. Thus, time spent in long run upgrading of skills is not a part of the analysis.

Now it is assumed that the family chooses the amount of leisure of the husband, the amount of homework (or leisure)

---

\* O. Ashenfelter, "Using Estimates of Income and Substitution Parameters to Predict the Work Incentives of the Negative Income Tax: A Brief Exposition and Partial Survey", Princeton University, mimeo, Nov. 1970.

G. Cain and H. Watts, "Toward a Summary and Synthesis of the Evidence", in G. Cain and H. Watts ed. Income Maintenance and Labor Supply: Econometric Studies (forthcoming)

of the wife, and thus the amount of goods and services that it will purchase, so as to make the household as satisfied as possible given the constraints it faces. These constraints aside from the length of a day and thus the total amount of time that the household owns, are the net after-tax wage rates of both the husband and wife and the amount of unearned income available to the household. Notice that the wage rates may be thought of as prices. In particular, they are the prices of the husband's and wife's leisure. If the family wishes to "purchase" another hour of either persons' leisure, then it must forego a dollar amount in consumption goods equal to the wage per hour. Put another way, the household receives positive satisfaction from three types of goods: the husband's leisure, the wife's leisure, and purchased goods and services. Since the household cannot have all that it wants of each, it must choose some combination of amounts of these three so as to make itself as satisfied as possible given the constraints under which it operates.

Now suppose that we confront a "typical" family with wage rates for husband and wife and some amount of unearned income. The family will choose values for the husband's and wife's amounts of work effort so as to make itself as well off as possible. Given these values, the wage rates, and the amount of unearned family income, we can then determine this family's total income. We suppose that the

family is now in equilibrium, doing the best that it can with the situation it faces. Let us proceed by changing the wage rate that the husband in this family faces and then asking what happens to the behavior of the family. Clearly the family will be out of equilibrium after the wage change, and it may take some time before it has changed its behavior to the best possible alternative under the new situation it faces. What changes in behavior will a change in the husband's wage initiate? In particular, what will happen to the amounts of labor supplied by the husband and wife to the market? Suppose that the wage change is an increase. In general, this will have two different effects of opposite sign on the husband's work effort. On the one hand, the family now finds that each extra hour of work that the husband does will buy a larger amount of purchased goods and services. Naturally, this will cause a tendency to increase work effort. This is called the substitution effect in the jargon of economics because a wage increase tends to cause a substitution of work for leisure. In effect, the price of leisure goes up when the wage rate does and this causes the family to want to substitute purchased goods and services for the husband's leisure. On the other hand, at the same amount of work effort as the husband previously expended, the family will clearly have a higher family money income. Thus, a wage increase

tends to make the family able to purchase--even at the old amount of work effort for the husband--more of all goods, including the leisure time of both the husband and the wife. Thus, the wage increase to the husband is also like a wind-fall gain to the family. Such gains are likely to cause both members of the family to want to retain more time for leisure (or non-market work) activities. Thus, a wage increase to the husband will cause the income of the family to be higher and thus a decrease in the work effort of all family members. This is known as the income effect of a wage change. Notice that income and substitution effects have opposite signs, and it is thus generally impossible to predict the net effect of a wage increase on work effort. It is worth pointing out that an increase in the unearned income of the family would have only an income effect on work effort because such an increase would not change the number of hours of work required to obtain the dollar amount necessary to purchase any particular amount of goods and services. Thus, an increase in unearned income would tend to make the family wealthier and hence would unambiguously decrease the amount of work effort expended by husband and wife.\*

---

\*We have ignored one other small, and we believe second-order, effect that an increase in the husband's wage would have on the wife's labor supply. In particular, it may be that the wife's and husband's leisure are either net substitutes or net complements. If they are net substitutes, then an in-

Given this framework for the analysis of the family's work-related behavior, we can analyze the impact of various income maintenance schemes. First what is the effect on that behavior which would result from the institution of FAP, or a similar type plan? The two key features of FAP are (for a given family size, etc.): (1) a minimum guaranteed income level for the family regardless of the amount of work done, and (2) a tax rate on earned income -- in the absence of complications from the introduction of state supplements -- 50 percent. There are three separate groups of families we must consider. First, there are those families who, at the present time of the institution of the FAP, earn more than the break-even level of income.\*\* So long as we assume these families are well above the break-even level, the institution of the FAP presumably will not affect their behavior. Second, there are those families below the break-

crease in the price of the husband's leisure (i.e., an increase in his wage) would tend to cause a substitution of the wife's leisure for the husband's, i.e. a decrease in the wife's work effort. For example, if the family has young children then the wife's and husband's leisure (non-market work) may be substitutable in caring for the children. On the other hand, to the extent that the husband's and wife's leisure are complements, an increase in the price of the husband's leisure will result in a decrease in the leisure time taken by the wife. For example, if the members of the family customarily engage in leisure activities together, the husband's and wife's leisure time might be complementary. As we note above, these effects are likely to be very small relative to those discussed in the text.

\*\* The level of income above which no payment is made to the family is the break-even level.

even level who are currently participating in a welfare scheme. The spirit of the FAP legislation is that, at their current level of work effort, these people will not be made monetarily worse off after the institution of the FAP. So long as this is true, and so long as the tax rate under the FAP is less than the (often implicit) tax rate that these families face under the current welfare system, the substitution effect will operate to increase the work effort of this group. This happens because a reduction in the tax rate is equivalent to an increase in the after-tax wage rate. Likewise, the income effect of the tax change will have a negative effect on work effort. On the other hand, if the minimum guaranteed income level does not change, then this part of the FAP will have no effect on work effort for this group. If the minimum guarantee declines, then this will have a positive effect on work effort that may offset the negative income effects of the tax decline. In practice this group would be hard to handle in any model, and a realistic approach to their likely work behavior would require the untangling of state legislated implicit tax rates as well as information on the size of behavioral parameters which simply is not known.\*

---

\*However, see our discussion below of Hausman's (1970) work, which attempts to analyze the labor supply responses of AFDC recipients.

The third group of families we must consider in some detail are the so-called "working poor." These are families who do not currently receive assistance, but who would receive assistance under FAP. Clearly, the change in the tax rate they face (from the normal income tax rate to 50 percent) will have a substitution effect tending to reduce the labor supply of both husband and wife and an income effect tending in the opposite direction. On the other hand, the minimum guarantee, of say \$1600, would have a negative income effect for both husband and wife that would tend to reduce their labor supplied. For this group, however, we can definitely predict a reduced work effort for both husband and wife. The reason is that the positive income effect of a tax increase cannot be as great as the negative income effect of the minimum guarantee if the family is below the break-even level, which is true by hypothesis for this group.

It should be clear from the preceding discussion that although we may predict that the net effect of the FAP provisions on the work effort of the working poor will be negative, the size of this effect depends crucially on the magnitude of the income and substitution effect parameters in the labor supply functions of the husband and wife. We now have an accumulating body of empirical research on precisely this subject. In our opinion a great deal of this research is poorly directed, and some of it tends to contradict the

theoretical model on which it is based. It seems likely that--for reasons this is not the place to discuss\*--this is due less to any inadequacy in the underlying theory of labor supply (as we have briefly outlined it above) than to an imprecise and poorly specified movement from theory to data, and vice versa. In any event, although it is by no means a universal finding, quite a bit of this research suggests that both the income and substitution parameters are relatively small in magnitude for male heads of households. On the other hand, this same body of research generally suggests that both income and substitution parameters are much larger in magnitude for married females (with husband present). This suggests that the institution of FAP is likely to have a relatively small effect on the labor supplied by family heads, but may have a somewhat larger effect on the labor supplied by married women.

A percentage, or absolute dollar amount, wage subsidy may be analyzed in virtually an identical manner. Typically, such programs can be thought of as increasing the after-tax wage which low-income workers face, without changing their nonlabor income. This wage increase leads to both a work increasing substitution effect and a work decreasing income

---

\*For critiques of the existing empirical literature, see Ashenfelter and Heckman (1973), Cain and Watts (1973), and Garfinkle (1973).

effect, with the net impact on labor supply being ambiguous. Clearly, however, a wage subsidy program would induce people who are not in the labor force initially to increase their work effort (since for these individuals, the income effect is zero). Furthermore, one can show (see Browning (1972)) that a wage subsidy program will always lead an individual to work longer hours than a comparable negative income tax program which would yield him an equivalent total income level. This conclusion holds regardless of whether the individual's labor supply function is forward or "backward" bending.

## II. Formal Analytic Treatment

In this section, we formally spell out the analytic framework, and indicate how it may be used to simulate the impact of several income maintenance schemes.

The problem of the family is to choose  $X_1$ , consumption goods;  $X_2$ , the leisure of the husband; and  $X_3$ , the leisure of the wife so as to maximize

$$(1) \quad U = U(X_1, X_2, X_3)$$

subject to the constraint

$$(2) \quad (T-X_2)P_2 + (T-X_3)P_3 + Y = X_1 P_1,$$

where  $T$  = total time available to a person

$P_2$  = wage of husband

$P_3$  = wage of wife

$Y$  = unearned income

$P_1$  = price of consumption goods

$W_2 = T - X_2$  = time worked by husband

$W_3 = T - X_3$  = time worked by wife

(2) says that earned income plus unearned income has to equal expenditures on consumption goods. First order conditions for a maximum require that

$$(3) U_i - \lambda P_i = 0 \quad i = 1, \dots, 3$$

and that (2) hold, where  $U_i$  is the partial derivation  $\frac{\partial U}{\partial X_i}$  and

$\lambda$  is the marginal utility of income (a lagrangean multiplier).

Confronting the household in equilibrium as described by (2)

and (3) with changes in  $P_1$ ,  $P_2$ ,  $P_3$ , and  $Y$  is equivalent to total differentiation of the former with respect to these parameters.

Assuming that  $dP_1 = 0$  (i.e., that the prices of consumption goods

do not differ as between households -- which seems reasonable for this application) one may solve the resulting system for the small displacements  $dx_1$  and  $dx_2$  as functions of  $dP_2$ ,  $dP_3$ ,  $dY$ ,  $\bar{X}_1$  and  $\bar{X}_2$

(where  $\bar{X}$  indicates the equilibrium value of  $X$ ). Since  $dx_1 = dW_1$

it is possible to rewrite the resulting equations as

$$(4) \quad dW_2 = S_{22} dP_2 + a_2 (\bar{W}_2 dP_2 + \bar{W}_3 dP_3 + dY)$$

$$(5) \quad dW_3 = S_{33} dP_3 + a_3 (\bar{W}_2 dP_2 + \bar{W}_3 dP_3 + dY)$$

The theory of labor supply tells us that  $S_{22}$  and  $S_{33}$ , the income compensated substitution effects for husband and wife respectively, must be positive. The presumptive signs of the income coefficients  $a_2$  and  $a_3$  are negative. Note that cross-substitution effects have been assumed to be zero. The term  $(\bar{W}_2 dP_2 + \bar{W}_3 dP_3 + dY)$  is essentially the change in family income that results from displacements in the wages of husband and/or wife and unearned income. The institution of a FAP-like plan results in displacements to  $P_2$ , and  $P_3$ , and  $Y$  because of the tax on earnings and the minimum guarantee level. If the after tax wages were initially  $P_2$  and  $P_3$ , and the tax rate changes by  $t$ , then  $dP_2 = -tP_2$  and  $dP_3 = tP_3$ . Likewise, if the minimum guarantee level is  $R$ , then  $dY = R$ . We may substitute these values in (4) and (5) to get the work effort effects of a FAP-like plan on a family with income less than the break-even level:

$$(4a) \quad dW_2 = S_{22} tP_2 + a_2 [-\bar{W}_2 tP_2 - \bar{W}_3 tP_3 + R]$$

$$(5a) \quad dW_3 = S_{33} tP_3 + a_3 [-\bar{W}_2 tP_2 - \bar{W}_3 tP_3 + R].$$

Since  $a_2$  and  $a_3$  are presumably negative, both  $dW_2$  and  $dW_3$  will be likewise so long as pre-FAP family income,  $FI = \bar{W}_2 P_2 + \bar{W}_3 P_3$ , is less than  $R/t$ . [this inequality follows from the fact that the term in brackets in (4a) and 5a) is just  $-tFI + R$ . For this term to be

positive, and thus  $a_{2s}$  time it to be negative, tFI must be less than R; i.e., FI less than R/t.) But this must be so because R/t is just the break-even income level and we are assuming that the family's pre-tax income level is below this point\*

For the review of the empirical work that follows it is useful to transform (4a) and (5a) slightly by multiplying the substitution terms by  $\bar{W}_2/\bar{W}_2$  and  $\bar{W}_3/\bar{W}_3$  respectively and rearranging terms to get

$$(4b) \quad dW_2 = -\left(S_{22} \frac{P_2}{W_2}\right) tW_2 + a_2 [R - t(\bar{W}_2 P_{22} + \bar{W}_3 P_{33} + Y)]$$

$$(5b) \quad dW_3 = -\left(S_{33} \frac{P_3}{W_3}\right) tW_3 + a_3 [R - t(\bar{W}_2 P_{22} + \bar{W}_3 P_{33} + Y)].$$

The terms to the immediate right of the equalities are income compensated substitution "elasticities." Once we know these elasticities, we simply multiply them by a persons' wage and the increase in his tax rate to get the substitution component of the disincentive. Once we know  $a_2$  and  $a_3$  we simply multiply them by the difference between the minimum guarantee level and the pre-FAP family income multiplied by the increase in the tax rate. Call the substitution elasticities,  $S_{22} \frac{P_2}{W_2}$  and  $S_{33} \frac{P_3}{W_3}$ ,

\*It is worth observing that we are assuming that unearned income is essentially negligible for these families. If it were not then -t times its level would have to appear within the bracketed terms in (4a) and (5a).

$n_2^c$  and  $n_3^c$ . We will shortly turn to a review of the evidence on the values of  $n_2^c$  and  $n_3^c$  as well as  $a_2$  and  $a_3$ .

These elasticities can best be used to analyze the impact of various wage subsidy schemes, if they are first transformed into slightly different form. From (4) and (5), the uncompensated substitution effects (the slope of the labor supply curves) for husband and wife respectively are given by

$$(6) \quad \partial W_2 / \partial P_2 = S_{22} + a_2 \bar{W}_2$$

$$(7) \quad \partial W_3 / \partial P_3 = S_{33} + a_3 \bar{W}_3$$

Because the income and substitution effects of a wage change operate in opposite directions, in general the slopes of the labor supply curves may be either positive or negative. However, for those individual's initially not in the labor force ( $\bar{W}_j = 0$ ), the slope must be positive. To obtain, the uncompensated substitution elasticities ( $n_2^u, n_3^u$ ) we multiply both sides of (6) by  $\bar{P}_2 / \bar{W}_2$  and both sides of (7) by  $\bar{P}_3 / \bar{W}_3$

$$(8) \quad n_2^u = n_2^c + a_2 \bar{P}_2$$

$$(9) \quad n_3^u = n_3^c + a_3 \bar{P}_3$$

Finally, it is convenient to express the last term on the right-hand sides of (8) and (9) in terms of income elasticities of labor supply ( $n_2^y, n_3^y$ ). Observe that

$$(10) \quad a_{22}^{\bar{P}} = \frac{\partial W_2}{\partial Y} \bar{P}_2 = \frac{\partial W_2}{\partial Y} \frac{Y}{\bar{W}_2} \frac{\bar{W}_2 \bar{P}_2}{Y} = n_{22}^{Yf}$$

where  $f_2$  is the proportion of total family income earned by the husband. Consequently we can rewrite (8), and in an analogous manner (9) as

$$(11) \quad n_2^u = n_2^c + n_{22}^{Yf}$$

$$(12) \quad n_3^u = n_3^c + n_{33}^{Yf}$$

If we call the last term in (11) and (12) the total income elasticity, then the uncompensated substitution elasticity is simply the sum of the compensated substitution elasticity and the total income elasticity\*.

Now consider a wage subsidy program in which an individual's after-tax wage is increased by some fraction ( $\alpha$ ) of the difference between his (her) current wage ( $p$ ) and a specified target wage ( $p^*$ ). The amount of the subsidy ( $s$ ) which an individual receives is clearly conditional upon his (her) hours of work.

\*Most investigators empirically estimate

$$a_{22}^1 = \frac{\partial W_2}{\partial y_n}, \text{ where } y_n \text{ is nonlabor income, rather than } a_{22}. \text{ In}$$

these cases, one can show that

$$(11^1) \quad n_2^u = n_2^c + n_{22}^{ynf^1}, \text{ where } n_{22}^{yn} \text{ is the elasticity of labor supply with respect to nonlabor income and } f_2^1 \text{ is the ratio of the husband's earned income to the family's nonlabor income.}$$

$$(13) \quad S = \alpha (P^* - P) W \quad \text{for } \begin{matrix} P < P^* \\ P \geq P^* \end{matrix}$$

$$= 0$$

This type of scheme has the effect of increasing the net after-tax wage which the individual faces by  $\frac{\alpha}{P}$  percent.

$$(14) \quad \frac{\Delta W}{P} = (P + \alpha(P^* - P) - P) / P$$

$$= \frac{\alpha(P^* - P)}{P}$$

Consequently, the percentage change in labor supply induced by the subsidy can be calculated as

$$(15) \quad \frac{\Delta W}{W} = n_2^u \frac{\alpha(P^* - P)}{P} - 1$$

$$(16) \quad \frac{\Delta W}{W} = n_3^u \frac{\alpha(P^* - P)}{P} - 1$$

Once again we note that to evaluate the (dis)incentive aspects of the various schemes requires us to have estimates of the compensated substitution elasticities ( $n_2^c, n_3^c$ ), the income coefficients ( $a_2$ , and  $a_3$ ) and the uncompensated substitution elasticities ( $n_2^u, n_3^u$ ). It is to a survey of the empirical estimates of these variables that we now turn.

### III. Survey of the Empirical Evidence

Our survey of the empirical evidence covers three areas. First, the sets of income and substitution parameters estimated from cross-section survey data for both married men and women. Second, an attempt to infer labor supply responses of AFDC recipients, again using survey data. Finally, a discussion

of the limited implications that can be drawn from the mid-experiment results from the New Jersey negative-income tax experiment.

Table 1 contains estimates of income and substitution parameters for males derived from 13 separate studies, while Table 2 contains similar estimates for 7 studies for females. Table 3 lists in some detail, the data source for each study, the marital-status and age group of the sample, and crucially, the income and substitution variables which are treated as parameters in the empirical analysis. Note that the variables treated as parameters vary between studies, as does the functional form of the equation estimated. Furthermore, most elasticity estimates are calculated using the mean values of the variables. Since the exact sample utilized varies across studies, even when the same underlying survey is used (i.e. primarily the S.EO), it is not surprising that the estimates vary across studies.

Most author's present numerous sets of parameter estimates, rather than a single estimate for each coefficient. Furthermore, due to the varying model specifications, in many cases a number of manipulations were required before it was possible to produce the summary estimates listed in tables 1 and 2. These estimates are based upon interpretations of what is implied by each study's results, made previously by Orley Ashenfelter (1970) and Glen Cain and Harold Watts (1973) and those made by Ronald Ehrenberg

in an attempt to fill in the "gaps" in the two previous surveys. In tables 1 and 2, the letters "A", "C", and "E" indicate which individual(s) calculations are being used. It should not be inferred that any of the original authors would agree with these interpretations. Furthermore, Ashenfelter's and Cain and Watts' interpretations have been "filtered through" Ehrenberg, so he must bear full responsibilities for these tables.

Turning first to table 1, the estimates of the income effect parameter ( $a_2$ ) for males lie primarily in the range -.2 to 0.0. Only Hill (-.40) and Kalachek and Raines (-.25) consistently come up with larger (in absolute value) estimates. However, both of these studies confine themselves to samples of low-income households and, as shown by Cain and Watts, truncation of the sample to exclude observations with current incomes above a certain level is likely to result in a negative bias in the income coefficient.\* Consequently, it seems likely that the "true" income effect parameters lies in the -.2 to 0.0 range with perhaps -.15 to -.10 being a reasonable "best" estimate.

---

\* Detailed critiques of the methodologies used in the various studies are presented in Ashenfelter and Heckman (1973), Cain and Watts (1973) and Garfinkle (1973). Rather than attempting to repeat all their comments, we shall simply discuss those points which we believe relevant to the divergence in the estimates.

The estimates of the compensated substitution elasticity for male ( $n_2^C$ ) fall into two groups. Estimates by Kalachek and Raines and Hill lie between .4 and 1.0, while all other estimates are below .4 with most in the 0.0 to 0.3 range. It is important to note (see table 3) that most studies do not estimate directly the compensated substitution term, Ashenfelter and Heckman being the sole exception, but rather infer it from (17)

$$(17) \quad n_2^C = n_2^U - a_2 \bar{P} \quad (\text{where } \bar{P} \text{ is the initial wage rate})$$

Consequently, if the income coefficient  $a_2$  is biased in a negative direction, ceteris paribus, the compensated substitution elasticity will be biased in a positive direction. This clearly explains why Hill obtained larger values than the "consensus" for " $n_2^C$ "; note that his estimates of  $n_2^U$  do not differ substantially from those of most investigators. Kalachek and Raines' income coefficient is too close to the "consensus", however, to be able to explain a compensated substitution elasticity of close to 1.0. But other things are not equal, as their estimated uncompensated substitution elasticity of .55 to .65 is substantially larger than that found by any other investigator. Furthermore, the large elasticity is traceable to the responsiveness of the annual labor force participation decision to wages - a result which seems strange given the high participation rates of prime-age males.

Kalachek and Raines estimated a "potential wage" variable to use as a measure of expected earnings for non participants. However, as they themselves note, "Potential wages assigned to those outside the labor force may overstate their realistic earnings potential since non-labor force status leads to skill obsolescence and since the personally inadequate are more likely to be found without than within the labor force."\* To the extent that nonparticipants earning potentials are overstated by their approach, it is easy to show that their estimated uncompensated substitution elasticity is biased upwards. Consequently, as equation (17) indicates, their estimate of the compensated substitution elasticity is also biased in a positive direction.

It thus seems likely that a consensus estimate of the compensated substitution elasticity should lie in the interval 0.0 to 0.3. The range of the uncompensated substitution elasticity is more difficult to pin down, probably in the order of (-.3,.2). However, most of the evidence indicates that labor supply curves for males are backward bending over the relevant range.

Turning to table 2, the substitution and income parameters for females are much less uniform in magnitude than the comparable male parameters. Several estimates (Parker, Tella et al. (a)) refer to the behavior of female heads of households, the remainder refer to the behavior of wives. Except for Parker's

---

\* Kalachek and Raines (1970), p. 180

estimates, the income coefficients virtually all fall in the range (-.2 to 0.0). Parker's nonemployment income variable however included transfer payments which are conditional on the individual's not working. Consequently, his income effect parameter has a negative bias, it reflects a simultaneously determined "outside income" and hours decision rather than a causal relationship. It seems highly likely then that the income coefficient lies in the (-.2,0.0) range.

On the other hand, the compensated substitution elasticity estimates seem to vary all over the place. Excluding Parker's estimates, which are inconsistent with the underlying theoretical structure, it seems unlikely that the elasticity is less than .3 and equally unlikely that it is greater than 1.3 for any large age or race groups.\* Furthermore it is not clear that we can differentiate the behavior of female heads from that of wives. While the range .3 to 1.3 is rather large, the "true" value clearly lies above the comparable value for males. Note also that the range of variation of the uncompensated substitution elasticity varies between (-.7 and .9).

\*Hall infers the value of  $S_{33}$  (and hence  $n_3^c$ ) from (18)  $S_{33} =$

$\frac{\partial W_3}{\partial P_3} - a_{33} \bar{W}_3$ . However, he assumes that  $\bar{W}_3 = 2000$ . Since the average woman works less than 2,000 hours per year (indeed less than 1500), his estimates of  $S_{33}$  and hence  $n_3^c$  are probably

biased up.

This range is sufficiently large to render any attempt to predict the impact of a wage subsidy scheme on work-effort of females as being virtually meaningless.

In sum our knowledge of the quantitative magnitude of the income and substitution parameters for males, based upon cross-section econometric studies, seems much more precise than our knowledge about the comparable parameters for females. Thus, while we should be able to obtain meaningful estimates of the (dis)incentive effects of various income maintenance schemes for males, it is unlikely that we will be able to obtain meaningful estimates for females. This statement should be qualified however, by our noting that we may still be able to rank programs on the basis of their relative incentive effects even if we can make no precise statements about the absolute effects.

Our knowledge of the income and substitution parameters for AFDC recipients is even more sketchy. Although, a number of cross-section econometric studies based upon survey data have been recently conducted, to date we have seen only the study by Hausman (1970), and hence we focus our attention here on it.\*

---

\* Recent cross-section econometric studies include D. Rowlett (1971), D. Saks (1971) and B. Williams. Studies have also been conducted by G. Appell (1972) and National Analysts Inc. (1971). However, the methodologies employed in the latter two studies do not permit us to infer anything about income and substitution parameters.

Hausman analyzed the labor force behavior of 2400 AFDC recipients in Alabama, Kentucky and Mississippi based upon a survey conducted in later 1967 by the Social and Rehabilitation Service division of HEW. These states were the only ones not to have 100% marginal tax rates on recipients earnings in 1967. Since he lacked wage rate data, Hausman was forced to use education levels as proxies for potential earnings. For purposes of discussion his model can be represented as,

$$(18) L = a_0 + a_1 y + a_2 t + a_3 X + e$$

where\*

L - (0,1) variable to indicate current labor force status

y - nonlabor income

t - the implicit marginal tax rate on earnings-including the loss of food-stamps

x - all other variables including education

$\epsilon$  - a random error term

Now suppose in fact, that the potential market wage ( $w^*$ ) that each AFDC recipient faces is actually independent of his(her) education level. Let the true labor supply function be given by

$$(19) \quad L = b_0 + b_1 y + b_2 w^*(1-t) + b_3 x + \epsilon^*$$

If the potential market wage is in fact uncorrelated with the independent variables (x) we can decompose the potential wage into its mean value in the sample ( $\bar{w}$ ) and a random term

(6). Substituting into (19)

$$(20) \quad L = b_0 + b_1 y + b_2 (\bar{w} + \delta) (1-t) + b_3 x + \epsilon^*$$

or

---

\*Actually Hausman uses a vector of variables rather than a single nonlabor income variable. He also experiments with a dependent variable that takes on the value 1 (employed full-time), 1/2 (employed part-time or unemployed) and 0 (not in labor force). For well known reasons, this latter treatment is not satisfactory.

$$(20^1) L = (b_0 + b_2\bar{W}) + b_1Y - (b_2\bar{W})t + b_3X + \overset{\Delta}{\epsilon}$$

$$\text{where } \overset{\Delta}{\epsilon} = \overset{\Delta}{\epsilon} + b_2\delta - b_2\bar{W}t$$

Observe that (20') is of the same form as (18) which Hausman estimates. Furthermore, it is clear that  $a_1$  will be an estimate of  $b_1$  and  $a_2$  an estimate of  $-b_2\bar{W}$ . However, from (20') we see that the marginal tax rate is negatively correlated with the residual ( $\overset{\Delta}{\epsilon}$ ). Consequently, his estimate of  $a_2$  will be biased in a negative direction and his estimate of  $b_2$  in a positive direction.

Given our assumptions, it is easy to show that

$$(21a) \quad \frac{\partial L}{\partial Y} = a_1 \quad \text{income coefficient}$$

$$(21b) \quad \frac{\partial L}{\partial W} \frac{W}{L} = - \frac{a_2}{\bar{W}} \frac{\bar{W}(1-t)}{\bar{L}} = - \frac{a_2(1-t)^*}{\bar{L}} \quad \text{uncompensated substitution effect (nu)}$$

and

$$(21c) \quad n^c = n^u - a_1\bar{W}(1-t) \quad \text{income compensated substitution effect}$$

Substituting Hausman's estimates of  $a_1$  and  $a_2$  from his Table 3 and utilizing the mean values of  $t$  and  $L$  in the sample, we find that the income coefficient lies in the range  $-.18$  to  $-.14$ . That is, a fifty dollar increase in nonlabor income per month would reduce the AFDC recipient's probability of being in the labor force by 7 to 9 percent.

---

\* Here  $W$  refers to the individual's after-tax net wage rate.

Similarly, the uncompensated substitution elasticity appears to be about .18.\* Finally, the income compensated substitution elasticity is approximately equal to\*\*

$$(21C^1) \quad n^C = .18 + .064\bar{W}$$

Assuming a mean hourly wage of \$1.50 an hour would then yield a compensated substitution elasticity in the order of .30. All of these parameters fall within the ranges of the estimates for females presented in Table 2.

We should emphasize that these estimates are based upon our interpretation of Hausman's work and require us to assure that potential wages are uncorrelated with education levels.\*\*\*, \*\*\*\* Furthermore, given the wide variability of the results in Table 2, these estimates should be considered distinctly tentative until they can be compared with the results for AFDC recipients obtained from other studies.

Finally, limited information on the labor supply responses of the low-income population can be obtained from the mid-experiment report of the New Jersey Income

---

\* However, recall that this estimate is likely to be biased in a positive direction.

\*\* Based upon  $(1-t) = -.4$  and  $a_1 = -.16$

\*\*\* For low-income households this may not be a bad assumption, as estimates of rates of return to education are often insignificant. See, for example, Bennett Harrison (1973).

\*\*\*\* Hausman interprets results as indicating an income

Maintenance experiment (Watts (1971)). An analysis of the first year's data indicated that there was no significant earnings change differential between the control and noncontrol groups (the latter containing those families receiving benefits and facing marginal tax rates). However, this result can be decomposed into two parts. First, the control group works about 12 percent longer hours per family. Second, the experimental group's wages now appear to be about 10 percent higher. Apparently then the "lump-sum" guarantee has been used to subsidize search for better paying jobs.

Unfortunately, at the time the mid-experiment report was prepared, Watts was unable to ascertain any significant variations in labor supply across treatment groups (varying according to marginal tax rate faced and income guarantee). However, this does not imply that the results of the experiment suggest only small insignificant income and substitution parameters. Rather, simply that at the time the mid-experiment report was prepared, for various reasons, nothing could be inferred. Hopefully, the final results that will be available shortly will present more definitive results and can be incorporated into later drafts of this survey.

### Summary

This paper has presented a brief exposition of the use of income and substitution parameters in estimating the impact of various income maintenance programs on work incentives. After outlining the underlying theory and discussing (as illustrations) two proposed plans, we attempted to survey the existing empirical estimates of these parameters.\*

We are confident that estimates of the income and substitution parameters for males can be specified to lie in narrow ranges. However, for married females, female heads of households, and AFDC recipients our evidence is tentative and imprecise. This suggests that we should be much more confident of our ability to predict the absolute (dis)incentive impacts of a proposed scheme on males than on females.

On the other hand, we should note that it is often possible to predict the relative impacts of several competing programs without knowing the quantitative estimates of the income and substitution parameters (e.g. Browning (1973)). Consequently, our ability to predict the relative impacts on females may not be impaired too seriously.

---

\* While we attempted to conduct a comprehensive survey, accessibility and time constraints prevented our considering the works of Christensen (1972), Leuthold (1968), Rea(1971), Rowlett (1971),Saks(1971), Williams, and undoubtedly others. Furthermore, as indicated above, later information from the "New Jersey Experiment" should be shortly available.

TABLE I  
ESTIMATES OF INCOME AND SUBSTITUTION  
PARAMETERS FOR MALES

Author(s)		$n_2^c$ Compensated Substitution Elasticity	$a_2$ Income Effect Parameter	$n_2^y f_2$ total Income Elasticity	$n_2^u$ Uncompensated Substitution Elasticity
Benfelter, Ackman	a)	.12	-.07	-.27	-.15
	b)	.06	-.10	-.06	.00
Eskin	a)	.10 (white)	-.08	-.17(w)	-.07
	b)	neg.(Black)	-.03	-.06(b)	neg
Ben, Rea, Ackman		neg		(-.08, .03)	neg
Weisher, Par- sons, Porter	a)	.04	(-.3, -.06)	-.23	-.19
	b)	-.19	)	-.08	-.27
Winkler		0.0	0.0	0.0	0.0
Greenberg, Masters		.20	-.09	-.29	-.09
Hall	a)	.06(w)	(-.20, -.05)	(-.24, -.51)	(-.45, -.18)
	b)	-.10 (b)	)	(-.12, -.28)	(-.22, -.38)
Hall	a)	.47 (w)	)	-.68 (w)	(-.21)
	b)	.27 (b)	)-.40	-.35 (b)	-.08
	c)	.52 (w)	)	-.86 (w)	-.34
	d)	.56 (b)	)	-.88 (b)	-.32
	e)	.86 (w)	)-025	(-.31, -.33)	.54
Blachek, Raines		.86 (w)	)	)	.54
	b)	.96 (b)	)	)	.64

TABLE I (cont.)

Author (s)	$n_2^c$ Compensated Substitution Elasticity	$a_2$ Income Effect Parameter	$n_2^{yf_2}$ Total Income Elasticity	$n_2^u$ Uncompensated Substitution Elasticity
Author	a) 0 <sup>C</sup>	-.17 <sup>E</sup>	-.04 <sup>C</sup>	-.04 <sup>E</sup>
	b) .34 <sup>C</sup>	-.17 <sup>E</sup>	-.34 <sup>C</sup>	.00 <sup>E</sup>
	c) -.05 <sup>C</sup>	(-.28, 0) <sup>E</sup>	(-.15, 0) <sup>C</sup>	(-.20, -.05) <sup>E</sup>
	d) .27 <sup>C</sup>	) <sup>E</sup>	) <sup>C</sup>	) <sup>E</sup>
Allen, Welch	(.2, .3) <sup>C</sup>	(-.15, -.11) <sup>A</sup>	(.75, .001) <sup>C</sup>	(.0, .2) <sup>E</sup>
Ala, Tella and Sh	(.16, .18) <sup>C</sup>	_____	(-.16, -.11) <sup>C</sup>	(0, .1) <sup>E</sup>
Authors	(0, .26) <sup>A</sup>	(-.14, -.02) <sup>A</sup>	_____	_____

calculated by Ashenfelter

calculated by Cain and Watts

calculated by Ehrenberg

TABLE 2

ESTIMATES OF INCOME AND SUBSTITUTION  
PARAMETERS FOR FEMALES

Author(s)	$n_3^c$ Compensated Substitution Elasticity	$a_3$ Income Effect Parameter	$n_3^{yf_3}$ Total Income Elasticity	$n_3^4$ Uncompensated Substitution Elasticity
Benfelter, Ackman	a) 1.2 C	n.c. A	-.28 C	.93 E
	b) (.3, 1.0) A	(-.18, -.05) E		
skin	a) .12(w) C	-.03 E	-.06 C	.06 E
	b) .58 (b) C	-.02 A	-.07 C	.51 E
ll	a) 2.5(w) C	(-45, 0.0) A		
	b) .26 (b) C	) C		
Blacheck- lines	a) (.76, .84)(w) C	) E	) C	(0, -4) E
	b) (.14, .28)(b) C	) E	) C	(-.61, -.13) E
arker	a) -.11 C	0 E	0 C	-.11 E
	b) .06 C	-.41 E	-.21 C	-.15 E
	c) -.12 C	0 E	0 C	-.12 E
	d) .40 C	-.33 E	-.46 C	-.06 E
Tella, Tella	a) (.11, 1.14) C	---- A	(-.81, -.22) C	(-.70, .98) E
reen	b) (.23, .35) C	---- A	(-.38, -.07) C	(-.15, .28) E
Posters, Inter- pretation of Dowen and Finegan and Cain	(.45, 1.3) A	(-.12, -.05) A	----	----

c. not comparable since refers to labor-force participation rate not annual hours of work.

Table 3

## Data Sources and Parameters

Assumed Constant

Authors	Data Source	Marital Status Age-Group	Parameters Assumed Constant
Folterman	a) SEO - 1967	Husband 25-64 wives not working	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ $-\frac{\partial H}{\partial Y}$
	b) Census 1960	Male SMSA LFP rates	$\frac{\partial L}{\partial Y}$ $\frac{\partial L}{\partial W}$ $-L \frac{\partial L}{\partial Y}$
Green	SEO - 1967	Husbands 20-29	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (by race)
Green, Rea, and	CPS - 1967	Males 22-54	
Shelton, Parsons, and	Nat'l Long Survey 1966-67	Urban Husbands 45-59 with earnings in 65-66 6) incomes < 10,000	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (non linear quadratic)
Linkletter	SEO- 1967	Husbands 25-61 in labor force, no disability	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (step function)
Minnberg, Kosters	SEO - 1967	Husbands, age 62	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (step fn. quadratic)
	SEO - 1967	Husbands 20-59	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (step function)
	SEO-67	Males 25-54 a) .6) incomes < pov. line a) .6) incomes > pov. line but near poverty	
Shek, Raines	CPS - 1966	Males 24-61 incomes < 3500	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (quadratic)

Table 3 (cont.)

## Data Sources and Parameters

Assumed Constant

Authors	Data Source	Marital Status Age-Group	Parameters Assumed Constant
Females			
Welfel, Man	a) Census 1950-60	LFP rates by SMSA married women	$\frac{\partial L}{\partial Y}$ $\frac{\partial L}{\partial W}$ $-L \frac{\partial L}{\partial Y}$
	b) Surveyed consumer finances 1967-69	married females	
Lin	SEO-1967	Wives 21-59	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (by race) Y
	SEO - 1967	Wives 21-59	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (step functions by race-sex)
Chok, Raines	CPS- 1966	Females 21-64 low income families	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (quadratic)
er	SEO - 1967	Female heads with children	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$
A. Tella, n	SEO - 1967	a) female heads 18-64 b) wives wages < \$3.00 hr.	

Table 3 (cont.)

## Data Sources and Parameters

Assumed Constant

	Data Source	Marital Status Age-Group	Parameters Assumed Constant
er	SEO-1967	Males with children a),b) below poverty line c),d) above poverty line	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (sometime linear)
n-Welch	1/1000 Census 1960	Employed husbands 25-65 income 10,000	$\frac{\partial H}{\partial Y}$ $\frac{\partial H}{\partial W}$ (quadratic)
a, Tella	SEO - 1967	Male Heads 18-64 wages \$3.00 hr.	

Hours

Labor force participation rate

## References

- Gary L. Appel, Effects of A Financial Incentive on AFDC Employment: Michigan's Experience Between July 1969 and July 1970 (Minneapolis, March 1972).
- Orley Ashenfelter and James Heckman, "The Estimation of Income and Substitution Effects in a Model of Family Labor Supply."
- Orley Ashenfelter and James Heckman, "Estimating Labor Supply Functions," in G. Cain and H. Watts, Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.
- Michael Boskin, "The Economics of the Labor Supply," in G. Cain and H. Watts ed., Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.
- E. Browning, "Alternative Programs for Income Distribution: The NIT and the NWT," American Economic Review, March 1973, 63, 38-50.
- E. Browning, "Incentive and Disincentive Experimentation for Income Maintenance Policy Purposes," Amer. Econ. Rev., Sept., 1971, 61, 709-713.
- Malcolm Cohen, Samuel Rea, and Robert Lerman, A Micro Model of Labor Supply, B.L.S. Staff Paper #4, 1970.
- Belton Fleisher and Richard Porter, "The Labor Supply of Males 45-59," Center for Human Resource Research, Ohio State University, April 1970.
- B. Fleisher, D. Parsons, and R. Porter, "Asset Adjustment and Labor Supply of Older Workers," in Cain and Watts ed., Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.
- I. Garfinkle, "On Estimating the Labor Supply Effects of A Negative Income Tax," in G. Cain and H. Watts, Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.

- David Greenberg and Marvin Kosters, "Income Guarantees and the Working Poor: The Effect of Income Maintenance Programs on the Hours of Work of Male Family Heads," in G. Cain and H. Watts ed., Income Maintenance and Labor Supply: Econometric Studies.
- Robert Hall, "Wages, Incomes, and Hours of Work in the U.S. Labor Force," in G. Cain and H. Watts ed., Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.
- Leonard Hausman, "The Impact of Welfare on Work Effort of AFDC Mothers," in Technical Studies, of the President's Commission on Income Maintenance Programs, 1970.
- B. Harrison, "Education and Underemployment in the Urban Ghetto," American Economic Review, December 1972, 62, 796-813.
- C. Russell Hill, "The Determinants of Labor Supply for the Working Urban Poor," in G. Cain and H. Watts ed., Income Maintenance and Labor Supply: Econometric Studies, Markham, 1973.
- Edward Kalachek and Frederic Raines, "Labor Supply of Low Income Workers," in Technical Studies of the President's Commission on Income Maintenance Programs, 1970, pp. 159-186.
- Marvin Kosters, "Effects of An Income Tax on Labor Supply," in Harberger and Bailey, The Taxation of Income From Capital, Brookings Institution, 1969, pp. 301-324.
- Sherwin Rosen and Finis Welch, "Labor Supply and Income Redistribution," Rev. of Econ. and Stat., August 1971, 278-283.
- National Analysts Inc., "Effects of the Earnings Exemption Provision Upon the Work Response of AFDC Recipients," Final Report, Dec. 1971.
- Carl Parker, "The Determinants of Hours of Work of Low-Income Family Heads: A Statistical Analysis," Oklahoma State Ph.D. Dissertation, July 1971.

Alfred Tella, Dorothy Tella, and Christopher Green, "The Hours of Work and Family Income Response to Negative Income Tax Plans," W. E. Upjohn Institute for Employment Research, 1971.

Harold Watts, "Mid-Experiment Report on Basic Labor Supply Response," Institute for Research on Poverty, Univ. of Wisconsin, May 1971.

Sandra Christensen, "Income Maintenance and the Labor Supply," Ph.D. Dissertation, University of Wisconsin, 1972.

J. Leuthoid, "An Empirical Study of Formula Income Transfers and the Work Decision of the Poor," J. H. R., Summer 1968, 312-333.

Samuel Rea, "The Supply of Labor and the Incentive Effects of Income Maintenance Laws," Ph.D. Dissertation, Harvard University, 1971.

D. Rowlatt, "Welfare and the Incentive to Work: The Alberta Case," Ph.D. Dissertation, Princeton University, 1971.

D. Saks, "The Economics of the Decision to Go on Welfare," mimeo, Sept. 1971.

Bob Williams, Princeton Ph.D. Labor Supply of AFDC Recipients.