TABLE 6A.1. LIST OF SAMPLES

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Basic sample</td>
<td>3962</td>
</tr>
<tr>
<td>II: Basic sample plus pensioners</td>
<td>4035</td>
</tr>
<tr>
<td>III: Basic sample plus pensioners, UC, PA, WC, and VD beneficiaries</td>
<td>4538</td>
</tr>
<tr>
<td>IV: I minus individuals in families with income &gt; $10,000</td>
<td>2342</td>
</tr>
<tr>
<td>V: II minus individuals in families with income &gt; $10,000</td>
<td>2372</td>
</tr>
<tr>
<td>VI: I minus individuals with WR &gt; $3.50</td>
<td>2702</td>
</tr>
<tr>
<td>VII: II minus individuals with WR &gt; $3.50</td>
<td>2751</td>
</tr>
<tr>
<td>VIII: I plus nonlabor-force participants</td>
<td>3969</td>
</tr>
<tr>
<td>IX: II minus individuals with higher than average WR and lower than average weeks worked</td>
<td>3958</td>
</tr>
<tr>
<td>X: II minus individuals in construction industry</td>
<td>3616</td>
</tr>
<tr>
<td>XI: Basic sample aggregate by wage and age groups</td>
<td>60</td>
</tr>
</tbody>
</table>

TABLE 6A.2. SEQ SAMPLE COMPOSITION BY DEMOGRAPHIC CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number in Sample</th>
<th>Percent in Sample</th>
<th>Percent Labor Supply WW</th>
<th>Percent Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>19382</td>
<td>53.10</td>
<td>35.87</td>
<td>28.66</td>
</tr>
<tr>
<td>Women</td>
<td>17117</td>
<td>46.90</td>
<td>64.13</td>
<td>72.34</td>
</tr>
<tr>
<td>Men</td>
<td>4408</td>
<td>25.75</td>
<td>15.56</td>
<td>7.41</td>
</tr>
<tr>
<td>25 to 61</td>
<td>10143</td>
<td>59.26</td>
<td>76.73</td>
<td>86.43</td>
</tr>
<tr>
<td>61 or above</td>
<td>2566</td>
<td>14.99</td>
<td>7.71</td>
<td>6.16</td>
</tr>
<tr>
<td>Married and healthy men</td>
<td>7403</td>
<td>72.99</td>
<td>76.87</td>
<td>81.72</td>
</tr>
<tr>
<td>Married and healthy men</td>
<td>1393</td>
<td>13.73</td>
<td>11.40</td>
<td>9.60</td>
</tr>
<tr>
<td>Married and healthy men</td>
<td>1347</td>
<td>13.28</td>
<td>11.73</td>
<td>8.68</td>
</tr>
<tr>
<td>Single</td>
<td>62</td>
<td>.84</td>
<td>.35</td>
<td>.16</td>
</tr>
<tr>
<td>In school or institution</td>
<td>25</td>
<td>.34</td>
<td>.09</td>
<td>.20</td>
</tr>
<tr>
<td>In Armed Forces</td>
<td>1811</td>
<td>24.46</td>
<td>18.88</td>
<td>27.60</td>
</tr>
<tr>
<td>Missing information</td>
<td>562</td>
<td>7.59</td>
<td>5.85</td>
<td>7.54</td>
</tr>
<tr>
<td>Self-employed</td>
<td>337</td>
<td>4.55</td>
<td>3.43</td>
<td>3.59</td>
</tr>
<tr>
<td>Did not work last week</td>
<td>37</td>
<td>1.11</td>
<td>.77</td>
<td>1.00</td>
</tr>
<tr>
<td>PA beneficiaries</td>
<td>49</td>
<td>.80</td>
<td>.57</td>
<td>.30</td>
</tr>
<tr>
<td>T14 beneficiaries</td>
<td>242</td>
<td>3.27</td>
<td>2.53</td>
<td>2.62</td>
</tr>
<tr>
<td>Retirement pensioners</td>
<td>82</td>
<td>1.11</td>
<td>.77</td>
<td>1.00</td>
</tr>
<tr>
<td>WC and VP beneficiaries</td>
<td>255</td>
<td>3.44</td>
<td>2.69</td>
<td>3.31</td>
</tr>
<tr>
<td>NLF participants</td>
<td>7</td>
<td>.10</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Basic sample</td>
<td>3962</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Controversy over the adoption of various proposals for a negative income tax has focused on the effect of these programs on the work effort of potential program participants. On the one hand, current welfare recipients will presumably face a lower marginal tax on earned income and perhaps a change in level of income subsidy. On the other hand, the current "working poor" will face an increased marginal tax on earned income and a hitherto nonexistent income subsidy. Though it is expected that the former group will increase its labor supply, it is widely agreed that the latter group is

Orley Ashenfelter and James Heckman

Chapter 7

ESTIMATING LABOR-SUPPLY FUNCTIONS

Orley Ashenfelter and James Heckman

Controversy over the adoption of various proposals for a negative income tax has focused on the effect of these programs on the work effort of potential program participants. On the one hand, current welfare recipients will presumably face a lower marginal tax on earned income and perhaps a change in level of income subsidy. On the other hand, the current "working poor" will face an increased marginal tax on earned income and a hitherto nonexistent income subsidy. Though it is expected that the former group will increase its labor supply, it is widely agreed that the latter group is

Orley Ashenfelter is professor of economics at Princeton University. James Heckman is an associate professor of economics at the University of Chicago and a research associate at the National Bureau of Economic Research.

likely to reduce its labor supply. With regard to this second group, the crucial question, of course, is the likely quantitative magnitude of any labor-supply reduction, because this is that will determine both the tax-revenue costs of financing the program and the effects of decreased factor supplies on the prices of the goods and services produced by industries employing low-income workers. Precisely the same issues are involved in the somewhat older question of the effect of income taxation on work effort, although no clear prediction on the direction, much less the size, of the labor-supply effects is possible in this case. Both discussions derive their frame of reference from an application of the classical theory of consumer choice to the demand for leisure or nonmarket time. Their importance for practical matters has resulted in recent years in a very substantial volume of empirical research using this basic framework. Despite minor variations, however, the basic econometric specification has changed little from that proposed in the pioneering papers of Jacob Mincer and Marvin Kosters. This state of affairs stands in rather sharp contrast to work where the classical theory of consumer choice is applied to the demand for market goods. In this latter area, a variety of functional forms and estimation procedures have been proposed with an eye toward improving the efficiency of estimation of important parameters. In somewhat the same spirit, the purpose of this paper is to present an alternative scheme for the choice of parameterization of labor-supply functions that offers some distinct advantages for purposes of estimation.

In the first section of this paper, the classical theory as applied to the supply of labor is briefly reviewed, as well as the implications of that University, 1970); and Daniel H. Saks, "Economic Analysis of an Urban Public Assistance Program" (Ph.D. Dissertation, Princeton University, 1973). Though we recognize the importance of the behavior of current welfare recipients in response to changes in the welfare system, we will follow the lead of others and ignore this important group in what follows.


7 For a comprehensive survey of this literature, see Arthur S. Goldberger, "Functional Form and Utility: A Review of Consumer Demand Theory" (University of Wisconsin Social Systems Research Institute, October 1967). Workshop paper.

theory for the effects on work effort of a negative-income-tax plan. The second section contains a discussion of the choice of parameters in labor-supply analysis for purposes of empirical implementation, while the last section contains an empirical test of the proposed procedure using micro-economic data on male heads of families from the 1967 Survey of Economic Opportunity (SEO).

I. THEORY OF LABOR SUPPLY

The force of the classical theory of labor supply resides in the assumption that the individual consumer behaves as if he maximizes a well-behaved preference function subject to a constraint on total available resources. The individual's basic resource is time, T, which may be used in work or for a variety of nonmarket activities. The consumer spends his earnings on market goods, which may be aggregated into a "composite commodity," X, with price, P, so long as the prices of the goods within this bundle do not change relative to each other. Precisely the same aggregation over all nonmarket uses of time can be performed so long as it is assumed that time may be freely substituted among its uses. This composite commodity is commonly called leisure, L, with price, W, the price of time in each of its uses. Assuming that the consumer-worker has Y dollars of unearned income, we may summarize his budget constraint as

\[ PX = W(T - L) + Y = WH + Y, \]

(7.1)

where \( H = T - L \) is the hours allocated to work. This constraint is sometimes written as

\[ PX + WL = WT + Y = F, \]

to emphasize that the consumer's "full income," \( F = WT + Y \), may be thought of as \( WL \) dollars spent on leisure and \( PX \) dollars spent on market goods. Faced with exogenous values of \( P, W, \) and \( Y \), the consumer has chosen the values of \( L \) and \( X \) that satisfy (7.1) and maximize his preference function, \( U = U(L, X) \), only if the marginal utility of leisure equals the marginal utility of income times the price of leisure, \( uL/dL = MW \), and the marginal utility of consumption goods equals the marginal utility of income times the price of consumption goods, \( uX/dX = LP \). The budget constraint, along with these latter two conditions, may be thought of

---

as three equations in the three unknowns $L$, $X$, and $\lambda$. For a given set of values of $P$, $W$, and $Y$, therefore, they may be solved for the former as functions of the latter. The first of these equations is

$$L = L(W, P, Y),$$

(7.2)

the demand function for leisure. Because $T - L = H$, we have $-dL = dH$, so that the partial derivatives of the supply function for labor,

$$H = H(W, P, Y),$$

(7.3)

will be equal and opposite in sign to those of (7.2).

Now consider the effect of a simple negative income tax on work effort. Such a program effectively changes the budget constraint to

$$PW = G + (1 - t)(WH + Y),$$

(7.4)

where $G$ is a flat grant called the “guarantee level” and $0 \leq t \leq 1.0$ is the tax rate on income. Because $WH + Y = I$ is money income before the program, and $G + I(1 - t)$ is money income after the program, the subsidy to the consumer unit is $SUB = G + I(1 - t) - I = G - tI$. Negative subsidies (positive taxes) would result if $G - tI < 0$, so it is assumed that the budget constraint (7.4) is imposed only for $I \geq G/t$, and the budget constraint (7.1) holds for $I > G/t$. The parameter $G/t$ of the program is called the “break-even” income level because persons with incomes higher than this do not participate in the program. It is interesting that increases in $G$, holding $t$ constant, increase the break-even level of income and thus the coverage of the program. Likewise, decreases in $t$, holding $G$ constant, increase the break-even level of income and thus the coverage of the program. A crucial problem for public policy, therefore, is to find satisfactory values for $G$ and $t$ that do not imply inordinately high break-even levels. Notice that (7.4) is equivalent to (7.1), except that $Y$ is replaced by $G + Y(1 - t)$ and $W$ is replaced by $W(1 - t)$. It follows that the optimum level for $H$ for the consumer who is under the program is obtained by making these substitutions in (7.3). The change in hours worked is then

$$dH = H(W(1 - t), P, G + Y(1 - t)) - H(W, P, Y).$$

(7.5)

Even assuming that $\partial H/\partial Y < 0$, so that leisure is a normal good, without further analysis it is not obvious what sign we should expect this expression to take.

Of course, the classical theory is not so empty as this. The basic result of the application of this theory to the supply of hours is the decomposition of $\partial H/\partial W$ into a substitution effect, $S$, and income effect, $(\partial H/\partial Y)H$, such that

$$\partial H/\partial W = S + H(\partial H/\partial Y),$$

(7.6)

with the important result that utility maximization requires $S > 0$. Differentiating (7.3) totally and substituting (7.5) then gives

$$dH = S(dW) + \partial H/\partial Y[dY + dW].$$

(7.6)

where we have set $dP = 0$ here and in the sequel. Suppose that we may treat $S$ and $\partial H/\partial Y$ as constants over the range of variation in $Y$ and $W$ that we wish to examine. Under these conditions, we may treat the effect of the program as producing the changes $dW = -tW$ and $dY = G - tY$.

Substituting, we have

$$dH = -tW S + H(\partial H/\partial Y)[G - t(W + Y)].$$

(7.6a)

This expression says that the change in hours worked resulting from the negative-income-tax program may be found by multiplying the negative of the tax rate times the wage rate times the substitution effect, and adding the product of the income effect and the initial subsidy ($\equiv G - tI$). The first part of this effect must be negative and the second part will be also, so long as leisure is not an inferior good. This is the conventional result—a negative-income-tax program must reduce the hours of work of rational consumer units previously not covered by such a program. Of course, the crucial determinants of the magnitude of $dH$ are the size of the substitution effect, $S$, and the income derivative, $\partial H/\partial Y$. We turn next to procedures for estimating these quantities.

II. ESTIMATING LABOR-SUPPLY PARAMETERS

The principal unsettled issue in the classical labor-supply analysis is the manner of its empirical implementation. In practice, this involves a choice of which functions to treat as constant parameters for purposes of estimation. Most studies are based on an approach suggested by Kosters,¹ which starts from a linear approximation to the labor-supply function (7.3):

$$H = H + \alpha W + \alpha Y.$$  

(7.7)

The alphas, assumed constant for purposes of estimation and observation on different sets of $H$, $W$, and $Y$, are to estimate these parameters. The scheme is equivalent to requiring that $\partial H/\partial W = \alpha_1$ and $\partial H/\partial Y = \alpha_2$.

¹Because the authors deal with cross-sectional data below, the assumption that $dP = 0$ is equivalent to the assumption that each worker faces similar prices for market goods.

be constants. Of course, these partial derivatives are not constants in the theory, and hence this particular choice of parameterization is only one of many possible empirical strategies. One obvious disadvantage with this approach is that it implies that the substitution effect, \( S_i \), varies systematically from observation to observation in the sample. In particular, from (7.5) we have for the \( i \)th observation that

\[
S_i = \alpha_i - \alpha_i H_i.
\]  

(7.5a)

\( \alpha \) is positive and \( \alpha_i \) is negative, and both are constant, which implies a numerically larger substitution effect for persons who work longer hours. Moreover, because the slope of the labor-supply function, \( \alpha_i \), often turns out to be negative, it is generally possible to choose a nonnegative value for \( H_i \) such that \( S_i < 0 \). This, of course, violates the crucial empirical prediction of the classical theory and is not a reassuring sign for the latter's use.

It is also possible to specify a linear approximation to (7.3) that will be similar to (7.7), but which uses full income, \( F \equiv W + Y \), as an independent variable:\[10\]

\[
H = \beta_0 + \beta_1 W + \beta_2 F.
\]  

(7.8)

Because substitution of the identity \( Y = F - W \) into (7.7) allows it to be rewritten as

\[
H = \alpha_0 + W(\alpha_1 - \alpha_0 T) + \alpha_0 F,
\]  

(7.7a)

it follows that (7.7) and (7.8) are identical when we set \( \beta_1 = \alpha_1 - \alpha_0 T \) and \( \beta_2 = \alpha_0 \). Moreover, so long as \( T \) is not allowed to vary in the sample, least-squares estimates of the coefficients of (7.7) will be identical to these implied linear transformations of the coefficients of (7.7). The substitution effect for the \( F \) observation from (7.8), using (7.5) again, is

\[
S_i = \beta_1 T - \beta_2 H_i,
\]  

(7.5b)

which is identical to (7.5a) after the substitutions for \( \beta_1 = \alpha_1 - \alpha_0 T \) and \( \beta_2 = \alpha_0 \). It follows that this approach to parameterization is formally identical to the preceding one:\[11\]

\[10\] Empirically the labor-supply function turns out to be backward bending.

\[1\] The average substitution effect in the sample using this approach is, from (7.5a), \( \bar{S} = \alpha - \alpha \bar{H} \) (where \( \bar{H} \) indicates mean hours of work), and is often reported, in what is obviously imprecise language, as "the" substitution parameter.

\[2\] Mincer, in "Labor Force Participation of Married Women," apparently has this in mind.

\[3\] Because the value taken on by \( T \) is arbitrary, it may be assigned the value \( \bar{H} \). In this case, the average substitution effect is just \( \bar{S} \). Of course, if \( T \) is assigned a value other than \( \bar{H} \), then \( \bar{S} \) will not equal \( \bar{S} \) and will be either higher or lower according to whether the value assigned to \( T \) is larger or smaller than \( \bar{H} \).


\[5\] In the case of a negative-income-tax experiment, \( dW = -dW \) and \( H^*(dW) + dY \) may be taken as the (initial) income subsidy, which gives a very natural interpretation to (7.9).

\[6\] This corresponds to putting the changes in the dependent variables of the analysis, \( dX \) and \( dH \), on the left, and the changes in the independent variable of the analysis, \( dW \) and \( dY \), on the right.

An alternative scheme that we have proposed is to treat \( S \) and \( \Delta H / \Delta Y = \beta \) as constants for the purpose of estimation.\[12\] To do this, we start directly with the total differential of the labor-supply function (7.6) and replace the unobservable infinitesimal changes \( dH \), \( dW \), and \( dY \) by the observable finite changes \( \Delta H \), \( \Delta W \), and \( \Delta Y \) to get

\[
\Delta H = S(dW) + B[H^*(dW) + \Delta Y],
\]  

(7.9)

where \( H^* \), the appropriate point of income compensation for a wage change of size \( \Delta W \). In a time-series or panel-data context it would be natural to treat the operator \( \alpha \) as implying first differences.\[12\] In cross-sectional data, a natural procedure is to treat these differences as deviations from the sample mean, and this is the procedure we follow.

The point of compensation, \( H^* \) in (7.9), is uniquely determined as the point of equilibrium hours in the case of infinitesimal changes. Determining this point for finite changes in the independent variables is an old, but important, problem in economics. To see the difference, differentiate the budget constraint (7.1) totally to get

\[
P(dX) - W(dH) = P(dX) + W(dL) = H(dW) + dY.
\]  

(7.10)

In (7.10), we have separated the effects of a small change in \( W \) and \( Y \) into the change in the value of expenditures on the left-hand side, which equals the change in the value of consumption, \( P(dX) \), plus the change in the value of leisure, \( W(dL) \); and the change in money income on the right-hand side, which equals the change in the value of work effort, \( H(dW) \), plus the change in nonlabor income, \( dY \).\[11\] We should like to obtain the empirical analogue of the change in money income, which is on the right-hand side of (7.10), but for finite changes. To proceed, we may write the first difference about the mean of the budget constraint (7.1) as

\[
P(dX) = \bar{H}(dW) + \bar{W}(dH) + (\Delta H)(dW) + \Delta Y.
\]  

(7.11)
This differs from (7.10), of course, because of the second-order effect, \((\Delta H)(\Delta W)\), which does not vanish on taking finite differences. Let us first separate the change in the value of expenditures from the change in money income in (7.11) by evaluating expenditures at the mean wage level. This gives

\[
P(\Delta X) - \bar{P}(\Delta H) = P(\Delta X) + \bar{P}(\Delta L) = H(\Delta W)
\]

\[
+ (\Delta H)(\Delta L) + \Delta Y = (H + \Delta H)\Delta W + \Delta Y.
\]

The deviation of money income from the mean is \((H + \Delta H)\Delta W + \Delta Y\).

This suggests using \(H + \Delta H\), which is actual equilibrium hours, as the point of compensation. On the other hand, if we separate the change in the value of expenditures from the change in money income in (7.11) by evaluating expenditures at the new \((H + \Delta W)\) wage level, we have

\[
P(\Delta X) - \bar{P}(\Delta H) - (\Delta W)(\Delta H) = P(\Delta X) - (H + \Delta W)\Delta H
\]

\[
= P(\Delta X) + (H + \Delta W)\Delta L = H(\Delta W) + \Delta Y.
\]

The deviation of money income from the mean is now \(H(\Delta W) + \Delta Y\), and this suggests using \(H\) as the point of compensation. The disparity between the two measures of money-income change occurs only because of the finite nature of the wage change.\(^{19}\)

Choosing either measure imparts a certain asymmetry to the analysis. Using the first measure, for example, if we initially raise the wage by some amount from the mean and use the final equilibrium \(H\) as the point of compensation, and then reduce the wage by the same amount using the original value of \(H\) as the point of compensation, we will not leave the consumer at the value of \(H\) from which he started. The same problem would result from using the second measure. A straightforward way to avoid this asymmetry is to use a simple average of these two possible values. Hence we define \(H^* = (H + \Delta H)/2\).\(^{12}\)

The procedure we have suggested is not, however, without its drawbacks. In particular, given the definitions \(H^*\), any disturbance term added to \(7.9\) will necessarily be correlated with the right-hand "real income" variable in \(7.9\) because of the presence of the budget.

\(^{19}\) This is precisely the problem John R. Hicks, in "The Four Consumen Surplus," The Review of Economic Studies 11 (Winter 1943): 31-41, addressed with regard to the measurement of consumer surplus for finite price changes. The first procedure corresponds to his "equivalent variation," while the second corresponds to his "compensating variation."


III. EMPIRICAL RESULTS

In principle, the classical theory and the procedures for estimation outlined above may be applied to any data on labor-supply behavior. In practice, the choice of the appropriate dependent variable for empirical implementation is more difficult. One important difficulty is the choice of a time horizon over which the decision-making process described in section I will be appropriate. Although it seems plausible to assume that the theory is appropriate to the decision about lifetime working hours, for example, it may be inappropriate to the decision about hours worked in a given year because of systematic variation in wages and family conditions over the life cycle.\(^{20}\) Here we estimate equation \(7.9\) for the annual hours of married

\(^{20}\) Or, as Jacob Mincer remarked in his paper, "Labor Force Participation of Married Women," p. 69, "Instead of serving as a determinant of labor-force behavior, it [money income] already reflects such decisions.


\(^{22}\) What we have in mind, of course, is a model in which the consumer faces a series of known (or expected) wage rates over his lifetime and determines an optimal set of annual hours so as to maximize a preference function
men in their prime working years, age 25 to 64, on the assumption that current hours of work may well be an appropriate proxy for life-cycle hours of work for this group. In essence, if a male is almost always in the labor force in this age range, as we observe, it is reasonable to expect him to work the same number of hours in each year. For married women, on the other hand, labor-force attachment is not as complete, and the hours worked in a given year may consequently be a poor proxy for the life-cycle hours of this group. We chose men with nonzero hours in the sample year on the assumption that men who did not work during the sample year were at corner solutions and do not have labor-supply functions defined for them, even though this may not be the case over a longer decision-making period. We also chose men whose wives did not work during the sample year, and we assume that the wives of these men were at corner solutions so that it is legitimate to maintain that variations in the wage rates that these wives would receive if they were in the market are of no consequence. Both of these assumptions are adopted for their tractability and not their realism.

Table 7.1 contains instrumental-variables estimates of equation (7.9) from the national probability sample component of the 1967 Survey of Economic Opportunity. Unlike most samples of this type, two separate methods exist for estimating annual hours for a worker in the sample. On the one hand, a respondent's estimate of annual weeks worked may be multiplied by his estimate of hours worked last week to obtain annual hours worked. Alternatively, because the 1967 SEO provides a particularly good estimate of the respondent's normal hourly wage, this may be divided into the respondent's estimate of annual earnings to obtain annual hours worked. Both procedures have advantages and disadvantages, but preliminary calculations did not suggest much difference in the results using the two procedures and we finally adopted the latter. As the empirical counterpart to unearned income, Y, we pooled rent, dividend, and interest that has intertemporal elements. Changes in a wage rate in one period would then have effects on labor supply in that and all other periods as well. In the empirical results reported here, age and age squared are included as regressors, which, under certain conditions, will be a satisfactory solution to this problem.


† Hall, in his essay in this volume, seems to have been the first economist to suggest this procedure.
receipts with royalty income, private-transfer receipts, and alimony payments. Workers receiving payments from work-determined, public-transfer programs, including Social Security, Unemployment Insurance, and public-welfare payments, were excluded from the sample because this income does not correspond to the earned-income concept in the classical theory and is more likely to be the result than the cause of labor-supply behavior. The sample constituted in this way contained 3,203 male workers.

The results in the first line of Table 7.1 also contain a dummy variable to allow for any differences in the hours between whites and nonwhites not accounted for by wages and incomes. As can be seen from the table, the results imply that at given wage and income levels nonwhites workers averaged about 300 hours per year less than white workers. We do not speculate on the reasons for this difference here. In the second and third lines, we add a set of dummy variables to the equation to account for differences in workers' city sizes and geographical location, on the assumption that these variables will be good proxies for differences in the price, P, of consumption goods. As can be seen from the table, most of these variables' coefficients are not estimated with much precision. In the fourth line, we also add a quadratic in the age of the worker to allow for any systematic life-cycle changes in annual hours that we have ignored. As can be seen from the table, these latter variables have highly significant coefficients and imply a steady growth in annual hours until around age 44, and a steady decline thereafter. Finally, the significance of the dummy variable for race in all of these equations suggested the possibility that the basic labor-supply parameters might differ for one reason or another as between whites and nonwhites. We consequently reestimated the equations in the first through fourth lines of Table 7.1 for white workers only; these results are contained in Table 7.2. As can be seen from this latter table, most of the estimated coefficients change very little as a result of restricting the sample in this way. Hence, we concentrate on the results in the fourth line of Table 7.1.

### Table 7.2. Instrumental-Variables Estimates of Equation (7.9) for 2,995 White Male Workers, Spouse Present but Not Working

<table>
<thead>
<tr>
<th>Estimates of:</th>
<th>Estimated Coefficients of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA</td>
<td>&lt;350</td>
</tr>
<tr>
<td>66.6</td>
<td>0.064</td>
</tr>
<tr>
<td>(17.3)</td>
<td>(0.099)</td>
</tr>
<tr>
<td>67.6</td>
<td>0.065</td>
</tr>
<tr>
<td>(17.5)</td>
<td>(0.099)</td>
</tr>
<tr>
<td>63.1</td>
<td>0.064</td>
</tr>
<tr>
<td>(17.0)</td>
<td>(0.099)</td>
</tr>
<tr>
<td>64.1</td>
<td>0.066</td>
</tr>
<tr>
<td>(17.4)</td>
<td>(0.099)</td>
</tr>
</tbody>
</table>

Note: See note to Table 7.1.

The estimates of S, the substitution effect, and β, the income derivative, are remarkably stable in these two tables at around 67.0 and 0.070, respectively; and both coefficients would clearly be judged significantly different from zero at conventional test levels. This gives a fairly small substitution elasticity (evaluated at the means) of around 0.12. Differentiating the budget constraint (7.1) partially with respect to Y gives \( \frac{\partial Y}{\partial \beta} - W(\partial Y/\partial Y) = 1 \), which implies that if consumption goods are to be normal (i.e., if \( \partial x/\partial y > 0 \)), then \( W(\partial Y/\partial Y) \) must be less than 1.0. The quality \( W(\partial Y/\partial Y) \) is not a constant in this model of course, but it clearly satisfies this constraint within the sample. Evaluated at the mean wage \($38.86\), we have \( W(\partial Y/\partial Y) = WB = 27 \), which implies that the average worker allocates 27% of each additional dollar of non-labor income to the purchase of nonmarket time and the other .73 to the purchase of consumption goods. On the other hand, the comparable estimate for \( W(\partial Y/\partial Y) \) at a wage of $2 is only .14, which implies that only .14 of each additional dollar of unearned income is allocated to the purchase of nonmarket time with the remaining .86 allocated to consumption goods. The slope of the labor-supply function implied by equation (7.9), \( (\partial Y/\partial Y) = -S \cdot H \), is also not a constant in this model, and depends on the point of compensation, H. Except for levels of annual hours below 800, this quantity is always negative in our results, which implies that we observe a backward-bending labor-supply function over most of the range of variation in the sample. The sum of the substitution elasticity and \( W(\partial Y/\partial Y) \) is equal to the wage elasticity of the uncompensated supply function.\(^{11}\) Evaluated at the mean wage and hours (2,272), this is .12 + 0.27 = 0.39 and seems broadly consistent with Sherwin Rosen's estimates of .07 to .30 from interindustrial data.\(^{12}\)

T. Aldrich Finegan's estimates of .25 to .35 from interoccupational data;\(^{13}\) Gordon Winston's estimates of .07 to .10 from intercounty data;\(^{14}\) and John Owen's estimates of .11 to .24 from U.S. time-series data.\(^{15}\)

\(^{11}\) Multiplying (7.5) by \( W \cdot H \) we have \( (W \cdot H)(\partial Y/\partial Y) = (W/H)S + W(\partial Y/\partial Y) \).


Another way to evaluate the magnitudes of our estimated labor-supply parameters is to see what they imply about the effect on annual hours worked of an illustrative negative-income-tax plan. Consider a plan with a guarantee level of $G = 2,400 and a 50 percent tax rate of, and assume the case of a worker earning one 1967 dollar per hour and working 2,000 hours per year, so that he obtains an initial subsidy of $1,400 per year. We may then make the appropriate substitutions into (7.6a) to obtain $\Delta H = -131.5$ hours, or about a 6.7 percent decline in annual hours. The same worker confronting a program with a similar guarantee level but a 66.7 percent tax rate would have a $\Delta H$ of only $-119$, because his subsidy would be much smaller. Other combinations can easily be worked out in this framework and will obviously give differing results depending on the initial wage and income level of the worker and the parameters of the plan.

IV. CONCLUSION

In this paper, we have offered an alternative scheme for the choice of parameters in labor-supply functions that offers some distinct advantages, but also disadvantages, for purposes of estimation. Our empirical results provide some evidence that the procedure we suggest for estimating labor-supply parameters may be a fruitful one. The basic results are consistent with the predictions of the classical theory of labor supply and the crucial parameters seem to be estimated with tolerable precision. Of course, much additional evidence is necessary before any firm conclusions can be drawn concerning the usefulness of our estimated parameters or, indeed, the usefulness of the classical theory for practical matters.

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Chapter 8

ASSET ADJUSTMENTS AND LABOR SUPPLY OF OLDER WORKERS

Belton M. Fleisher, Donald O. Parsons, and Richard D. Porter

I. THE ROLE OF NONHUMAN ASSETS IN LABOR-SUPPLY MODELS

The central hypothesis of this paper is that empirical research on labor supply, with particular reference to males in the age group where market work is the normal mode of behavior, has suffered from the lack of an adequate formulation of the role of nonemployment sources of purchasing.

Belton M. Fleisher is a professor of economics and Donald O. Parsons is an associate professor of economics at Ohio State University; Richard D. Porter is an economist at the Board of Governors, Federal Reserve System. This report was prepared under a contract with the Manpower Administration, U.S. Department of Labor, under authority of the Manpower Development and Training Act. Researchers undertaking such projects under government supervision are encouraged to express their own judgments. Interpretations or viewpoints stated in this document do not necessarily represent the official position or policy of the Department of Labor. Computation was financed in part by a grant from The Ohio State University Computer Center. The authors acknowledge the helpful comments of Diran Bodendorf and the assistance of William Dolch, Alan R. Garger, Philip Manogg, and Donald Smith.