LABOR SUPPLY OF HUSBANDS AND WIVES: A SIMULTANEOUS EQUATIONS APPROACH

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Abstract—Labor supply functions for married men and women are formulated as a dynamic simultaneous equations system, which is estimated using panel data. Controlling for fixed individual effects allows marginal labor supply responses to be disentangled from permanent patterns in hours worked due to assortative mating. The results suggest that the labor supply of husbands and wives without pre-school children is not jointly determined in the short run, while families with young children exhibit strong interactions in work hours and negative cross-earnings effects. Neither the joint utility model of family labor supply nor an ad hoc “traditional family” model is supported by these results.

I. Introduction

There appears to be no consensus among economists as to an appropriate paradigm of family behavior. Theoretical discussion has been dominated by the joint utility model, in which family members act collectively to maximize a single utility function. However, most empirical studies examine the labor supply of married men and women independently, treating the earnings or work hours of the spouse as exogenous to the behavior of interest. This simplification has to a large extent been motivated by convenience or lack of data, but there has also been dissatisfaction with joint utility as a theoretical construct. The endogeneity and, perhaps more important, the revocability of the marriage decision suggest that the notion of independent utilities for husband and wife be preserved.

Attempts to distinguish between joint and individual utility models on the basis of empirical tests have been inconclusive. This paper presents a new approach to estimating family labor supply models which is able to support some stronger conclusions. Regardless of the particular behavioral model chosen, we can treat the labor supply of husband and wife as being jointly determined, and specify a pair of simultaneous equations. This framework permits several models, including joint utility and a “traditional family” model, to be nested within an unrestricted specification. Simple tests of competing models are possible, and they yield some rather surprising results concerning the dissimilar behavior of families with and without young children.

Estimation of family labor supply models is complicated by the fact that personal characteristics which affect marriage formation and marriage stability are likely to be related to characteristics determining labor supply, if the sorting of individuals into households is nonrandom. Thus the interdependence of labor supply within the family becomes confounded, in a cross-section study, with the marriage selection process. In this paper, individual work choices are conditioned on the permanent characteristics of other household members. Panel data on intact households are used to observe the interactions of husband’s and wife’s labor supply decisions over time, thus controlling for the initial selection process. The use of panel data also makes possible a richer dynamic specification, so that an individual’s past labor supply may directly affect current behavior.

The next section sets up the general linear simultaneous equations model. Simple tests for joint income and direct cross-hours effects are outlined. Section III makes the system dynamic, using first differencing to control for heterogeneity and assortative mating, and lagged hours to allow for habit formation or other forms of nonseparability over time. Section IV presents results for subsamples of households with and without young children.

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1 Nerlove (1974) and Griliches (1974), among others, have criticized the joint utility model for its inability to explain or accommodate changes in household composition.

2 A survey by McElroy (1981) concludes that the specific restrictions imposed by joint utility have received little empirical support.

3 This is a problem of considerable practical importance, as it biases predictions of the effects of tax or transfer policy changes on either labor supply or household composition. Boulier and Rosenzweig (1984) and Behrman and Wolfe (1983) have noted that ignoring marital selection can result in biased estimates of the determinants of other economic decisions, such as fertility and schooling.
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children. In the absence of young children, the work hours of husband and wife appear to be independent; with young children, hours of work are jointly determined. Section V extends the estimation procedure to account for truncation of wife's hours.

II. A Simultaneous Equations Model of Family Labor Supply

In this section we develop a set of equations for hours worked by husband and wife which is general enough to nest several behavioral models, and which can be estimated by standard simultaneous equations techniques. We begin in the context of a joint utility model, which assumes that a family's allocation of time and goods can be analyzed as if a single utility function, whose arguments are total consumption and the leisure times of each member of the household, is maximized jointly by all members subject to a budget constraint in which all earnings are pooled. The familiar reduced-form leisure demand functions for husband and wife can be restated as conditional demands, which imply labor supply functions of the form,

\[
H_m = h_m(w_m, Y, w_f H_f) \\
H_f = h_f(w_f, H_m, Y, w_m H_m)
\]

(1)

where \(H_m\) represents hours worked by the husband, \(H_f\) hours worked by the wife, the \(w_i\)'s are their respective wage rates, and \(Y\) is family nonlabor income.

Conditional labor supply functions fit naturally into a simultaneous equations framework, as husband's hours are included in the wife's labor supply equation, and vice versa. Assuming linearity, we have

\[
H_m = \alpha_m + \delta_m w_m + \gamma_m H_f + \beta_m Y + \epsilon_m \\
H_f = \alpha_f + \delta_f w_f + \gamma_f H_m + \beta_f Y + \epsilon_f
\]

(2)

where the error terms are interpreted as shocks to preferences or optimization errors. Linear versions of three principal classes of family labor supply models, each commonly used to motivate empirical studies, are nested within this general system. These alternative models and the restrictions they imply on (2) are briefly described below.

A. Joint Utility

The maximization of a single utility function generates conditional demands in which spouse's wage enters only as an adjustment to income, so that \(\beta_m = \beta_m^*\) and \(\beta_f = \beta_f^*\). An additional restriction, which will not receive much attention here, is that cross-substitution effects on labor supply must be equal; that is, the effect of an income-compensated increase in the husband's wage on the wife's labor supply must be identical to the effect of an income-compensated increase in the wife's wage on the husband's labor supply. These effects themselves, however, may be positive or negative, as husband's and wife's leisure are complements or substitutes. Symmetry does not have a simple counterpart in conditional demands, but will imply restrictions on (2).

B. "Traditional Family" Model

The most common empirical specification of family labor supply treats the work hours of married men as independent of the behavior or attributes of their wives and the husband's behavior, in turn, as exogenous with respect to the wife's work decision. Husband and wife maximize utility independently, with the wife treating husband's earnings as property income. This results in an asymmetric pair of labor supply functions as in (3), with no cross-equation restrictions.

\[
H_m = h_m(w_m, Y) \\
H_f = h_f(w_f, Y + w_m H_m)
\]

(3)

The recursive nature of this model has made it a popular one for estimation, despite the apparent inconsistency that the wife shares in husband's earning but not vice versa. It might, perhaps, be regarded as an approximation to the case where

4 Usually attributed to Samuelson (1956). In Becker's (1974) formulation, joint utility is based on utility interdependence within the family.

5 Pollak (1969) introduced conditional demand functions as the appropriate alternative to ordinary demands when one or more good is "pre-allocated" or rationed.

6 See Pollak (1969) for a discussion of the properties of conditional demands. Additive separability, a frequently maintained assumption, would require that the cross-hours effects, \(\gamma_m\) and \(\gamma_f\), be zero.

7 The traditional family model is implicit in many classic labor supply studies such as Bowen and Finegan (1969) and Hall (1973). It has been revived in most of the new "second generation" labor supply studies, such as Hausman (1980, 1981), Heckman and MaCurdy (1980), and MaCurdy (1981).
changes in wife's hours are a marginal substitution of market income for the value of home production and thus have an insignificant impact on household income. In equations (2), the traditional family model requires that \( \gamma_m = \gamma_f = \beta_m = 0 \).

C. Bargaining Models

A more sophisticated set of models treats the allocation decisions of a married couple as a two-person cooperative game. McElroy and Horney note that these models are generalizations of the joint utility model, where the existence of individual threat points implies that bargained solutions need not satisfy substitution symmetry. In addition, nonlabor income received by husband or wife separately need not enter household demands symmetrically. No restrictions are implied on the form of (2), and the bargaining approach can be considered a general alternative within which the two previous models are nested.

The choice of a family labor supply model from those described above has generally been based on convenience or data availability rather than on firm evidence of conformance with reality. The traditional family model, for example, permits separate estimation of labor supply functions for married men and women. If data on one sex alone are available, or if interest centers on one, other family members can be ignored through implicit adoption of the traditional model. Both remaining models require joint estimation, but an a priori choice between them is frequently made through imposition of symmetry or other restrictions.

There have been few attempts to devise explicit tests of the alternative models and a number of obstacles to doing so. The most obvious is that the traditional model is not nested within the standard labor supply equations derived from joint utility. The use of conditional labor supply functions and the simultaneous equations model of (2) avoids this problem.

Another serious problem with such tests is the fact that the use of cross-section data confounds the labor supply estimates with the determinants of household formation. That is, unobserved permanent characteristics of husbands and wives, such as tastes for leisure or rates of time preference, are likely to be correlated due to the matching process which accompanies family formation. As an example, the usual negative effect of husband's wage on wife's labor supply has two possible interpretations; either an increase in his wage causes the wife to consume more leisure, or women who like leisure tend to marry men with high wages. The determinants of marriage are thus likely to become confused with the interdependence of short-run labor supply decisions, and cross-section estimates will generate biased predictions of family response to tax changes or other alterations of the budget set.

We isolate labor supply behavior from the assortative mating process by employing panel data on intact households to hold constant the effects of permanent characteristics and their husband-wife correlations. If we observe a sample of households over time, labor supply parameter estimates which are truly conditional on household membership can be generated by allowing each individual in the sample to have a different intercept in the labor supply equation. Any first-order correlation between unobserved characteristics of the husband and wife can be eliminated by sweeping out these intercepts, so that most of the cross-section simultaneity between labor supply behavior and the determinants of household formation will be avoided.

III. Dynamic Labor Supply Functions

Most panel data, whether monthly, quarterly, or annual, exhibit strong autocorrelation in hours worked by an individual, even after controlling for wage rates and other measurable influences. In the sample described in the next section, the correlation between hours worked in adjacent quarters is about 0.8 for both husbands and wives. There are a number of possible sources of serial dependence. Most obviously, this persistence may reflect the influence of permanent individual characteristics, such as preferences for leisure, on work choices. Alternatives include a direct influence of past hours on current hours through non-additive preferences over time, or lagged adjustment of actual to de-

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9 This point has been made by Mincer (1962).

10 With all data expressed as deviations from individual means, (2) can be considered an approximation to the total differential of an arbitrary conditional supply function.
sired hours of work. Finally, there may be serial correlation in unobserved shocks to desired hours (i.e., illness).11

Correction for heterogeneity is straightforward. If individual-specific, time-invariant effects enter the labor supply functions additively, they can be eliminated by first-differencing panel data. There is now serial correlation in the transformed errors, but in the usual situation of few time periods and many households, the equations for different time periods can be stacked and an unrestricted covariance matrix allowed with little difficulty.12 This also permits general forms of serial correlation in the original errors.

Non-additive preferences can be represented by including past labor supply in the utility function, and thus in the labor supply function. In general, the resulting specification will be equivalent to that implied by lagged adjustment of actual to desired hours. For family labor supply, we introduce lagged hours through a simple functional form known as dynamic translating, in which past leisure consumption affects the intercept of current leisure demands, and thus labor supply functions.13 Note that the changing intercepts represent true state dependence in labor supply. However, if fixed individual effects are also present but not included in the specification, the coefficient on lagged dependent variables in this specification will reflect permanent differences over the sample, as well as state dependence.14

The basic labor supply equations estimated in the next section allow both a direct dependence on lagged hours, via a linear version of dynamic translating and a time invariant fixed effect, as in (4).

\[
H_{mi}(t) = \alpha_{mi} + \sum_{\tau} \lambda_{m\tau} H_{mi}(t - \tau) + \delta_m w_{mi}(t) \\
+ \gamma_{m} H_{fi}(t) + \beta_{m} F_{mi}(t) \\
+ \beta_{m}^* w_{mi} H_{fi}(t) + \phi_{m}(t) + \epsilon_{mi}(t)
\]

\[
H_{fi}(t) = \alpha_{fi} + \sum_{\tau} \lambda_{f\tau} H_{fi}(t - \tau) + \delta_{f} w_{fi}(t) \\
+ \gamma_{f} H_{mi}(t) + \beta_{f} F_{fi}(t) \\
+ \beta_{f}^* w_{mi} H_{mi}(t) + \phi_{f}(t) + \epsilon_{fi}(t)
\]

where

\[
F_{mi}(t) = Y_{i}(t) + w_{mi}(t) \sum_{\tau} \lambda_{m\tau} H_{mi}(t - \tau)
\]

and

\[
F_{fi}(t) = Y_{i}(t) + w_{fi}(t) \sum_{\tau} \lambda_{f\tau} H_{fi}(t - \tau).
\]

The \(F_{\cdot i}'s\) are income terms adjusted for that part of own earnings which is due to habit formation. The disturbance consists of a dummy variable for each time period, \(\phi\), and a random error, \(\epsilon\), which is independently and identically distributed for all \(i\) but has unrestricted covariance over \(t\) for each individual.

First-differencing these equations yields expressions for husband’s hours and wife’s hours in each period, \(t\), which do not depend on the fixed effects, \(\alpha_{mi}\) and \(\alpha_{fi}\).

\[
H_{mi}(t) = H_{mi}(t - 1) + \sum_{\tau} \lambda_{m\tau} \Delta H_{mi}(t - \tau) \\
+ \delta_m \Delta w_{mi}(t) + \gamma_{m}\Delta H_{fi}(t) \\
+ \beta_{m}\Delta F_{mi}(t) + \beta_{m}^* \Delta \left[ w_{fi} H_{fi}(t) \right] \\
+ \Delta \phi_{m}(t) + \Delta \epsilon_{mi}(t)
\]

\[
H_{fi}(t) = H_{fi}(t - 1) + \sum_{\tau} \lambda_{f\tau} \Delta H_{fi}(t - \tau) \\
+ \delta_{f}\Delta w_{fi}(t) + \gamma_{f}\Delta H_{mi}(t) \\
+ \beta_{f}\Delta F_{fi}(t) + \beta_{f}^* \Delta \left[ w_{mi} H_{mi}(t) \right] \\
+ \Delta \phi_{f}(t) + \Delta \epsilon_{fi}(t)
\]

11 For general dynamic specifications of demand systems, see Anderson and Blundell (1982).

12 A special case of this procedure has been used in the case of life-cycle utility models with no credit constraints. Each individual’s lifetime profile of wages, other income, and preferences determine their marginal utility of wealth which, appropriately discounted, will be constant over time under perfect certainty. Judicious choice of functional form includes this term in the intercept of the labor supply equation, providing an appealing interpretation of the fixed effect in an intertemporal model. See MaCurdy (1981), and Browning, Deaton, and Irish (1985), who term the result Frisch demand functions.

No such formal interpretation is made of the fixed effects above, since Lundberg (1985a) presents evidence that a no-credit constraint model is inappropriate for this sample. However, much of the effect of lifetime wealth will be eliminated by the first-differencing—the estimated labor supply responses are short-run ones. This does not affect the implications of the household behavior models, so an explicitly intertemporal framework is not developed.

13 This method of introducing past consumption into current demands has been used extensively with the linear expenditure system. Originally proposed by Stone (1954), it has also been used by Philips (1972), and by Johnson and Pencavel (1984), who have applied it to husband’s and wife’s labor supply (but restricted to the additively separable LES). Properties are discussed by Pollak (1970). This specification is described and compared with alternatives in Pollak and Wales (1983), and is found to dominate both static forms and proportional habit formation in explaining aggregate consumption demands.

14 See Heckman (1981) for an analysis of the distinction between heterogeneity and state dependence, with particular reference to labor supply. Also Johnson and Pencavel (1984), who suggest that some of the habit formation they find in family labor supply may be due to permanent individual effects.
\[ H_{fi}(t) = H_{fi}(t - 1) + \sum_{\tau} \lambda_{fi} \Delta H_{fi}(t - \tau) + \delta_i \Delta w_{fi}(t) + \gamma_i H_{mi}(t) + \beta_i \Delta F_{fi}(t) + \beta_i^* \Delta \left[ w_{mi}, H_{mi}(t) \right] + \Delta \phi_f(t) + \Delta \varepsilon_{fi}(t). \]  

The difference operator, \( \Delta \), is defined so that \( \Delta H_{mi}(t) = H_{mi}(t) - H_{mi}(t - 1) \).

**IV. Data and Empirical Results**

In this section a time series of quarterly observations for a sample of husbands and wives is used to estimate the first-differenced simultaneous system in (5). Observations for an individual couple in different time periods can be combined into a single system of simultaneous equations. Stack- 

\[
\begin{align*}
H_{mi}(1) & \quad H_{mi}(0) & \quad \Delta H_{mi}(0) \\
\vdots & \quad \vdots & \quad \vdots \\
H_{mi}(T) & = H_{mi}(T - 1) & = \Delta H_{mi}(T - 1) \\
\Delta \phi_m(1) & \quad \Delta \varepsilon_{mi}(1) \\
\vdots & \quad \vdots \\
\Delta \phi_m(T) & \quad \Delta \varepsilon_{mi}(T) \\
H_{fi}(1) & \quad H_{fi}(0) & \quad \Delta H_{fi}(0) \\
\vdots & \quad \vdots & \quad \vdots \\
H_{fi}(T) & = H_{fi}(T - 1) & = \Delta H_{fi}(T - 1) \\
\Delta \phi_f(1) & \quad \Delta \varepsilon_{fi}(1) \\
\vdots & \quad \vdots \\
\Delta \phi_f(T) & \quad \Delta \varepsilon_{fi}(T)
\end{align*}
\]

where structural parameters other than error covariances are assumed to be invariant across time periods and over the sample.\(^{15}\) This yields a simultaneous equations system of \( 2 \times T \) equations, with the variables \( H_{mi}(1) \) to \( H_{mi}(T) \) and \( H_{fi}(1) \) to \( H_{fi}(T) \) treated as endogenous. Since spouse’s income as well as hours appears in each equation, the system is nonlinear in the endogenous variables and is estimated by maximum likelihood.

One advantage of stacking the equations for each time period in this way is that the first lag of hours, which is likely to be related to the differenced error term in each equation, is also a dependent variable of the differenced system. Thus this correlation would not induce bias in the estimated parameters, were it not for the first equation for each individual. To solve this remaining problem, two equations are added to the system, specifying \( H_{mi}(0) \) and \( H_{fi}(0) \), the lagged dependent variables from the first equation for husband’s and wife’s hours, as simple autoregressions. Thus we require \( T + \tau + 2 \) observations for each family in the sample. In this case, the lag length \( \tau \) is four quarters and \( T \) is three quarters.\(^{16}\) This gives an eight equation simultaneous system, with structural parameters estimated using three equations for husband’s hours and three for wife’s hours.

The sample consists of 381 husband–wife pairs from the financial control group of the Denver Income Maintenance Experiment. These families received only nominal payments for providing up to four years of detailed information on labor supply and other behavior. Participants in this experiment were drawn from among low-income households, and cannot be considered representative of the entire population. However, good monthly information is available on family size and composition, as well as on hours worked, wages,\(^{17}\) and other sources of income\(^{18}\) for each household member over a period ranging from 18 to 48 months. Monthly observations were aggregated to quarterly so that one year’s labor market adjustments could be represented by a manageable number of equations.

Sample selection criteria and a breakdown of lost observations are presented in the appendix. In essence, the sample is restricted to two-head households in which both husband and wife worked at some time during the four-year experimental period, and remained in the sample (as an intact household) until the end of the third year.

\(^{15}\) Each error term is assumed to be independently distributed across households, but is obviously serially-correlated for each individual as well as correlated within the household. To allow for arbitrary forms of such correlation, an unrestricted covariance matrix for the differenced error terms is estimated.

\(^{16}\) A four-quarter lag could not be rejected as a restriction on a five-quarter lag.

\(^{17}\) Wage rates are derived from a separate question in this survey, not calculated as reported income divided by reported hours. Thus a common source of measurement error in wages is absent in these data.

\(^{18}\) Other income consists of property income, earnings of other family members, etc., but excludes transfer payments, which are minimal for these intact households.
Quarterly hours worked by husband and wife during the third year are the eight dependent variables, with the preceding five quarters providing the necessary lags. Predicted wages from a regression on lagged wages and time dummies provide an hourly wage for each quarterly observation, even when the individual does not work.\(^{19}\) The families are divided into three subsamples, allowing all behavioral parameters to depend upon the maximum number of children under six years of age present in the household during the sample period. Some characteristics of the three samples are presented in the appendix.

Before presenting the dynamic simultaneous equations results, we attempt to duplicate standard cross-section joint utility results using the same data. Hours worked by husband and wife are specified as linear functions of both wage rates, nonlabor income, and observable characteristics such as age and race.\(^{20}\) In general, these results are consistent with past estimates of husband–wife labor supply interactions. The cross-wage effects are negative but not significantly different from zero in any of the subsamples.

Estimates of the dynamic equations (6) are presented in table 1. These include rather precise estimates of intra-family influences on labor supply, and permit us to draw some inferences about the alternative behavioral models. The traditional family model can be rejected for all samples. The joint utility model cannot be rejected, but the sharp contrast between the results for families with and without young children suggests that this model may be an inadequate description of family behavior.

In the subsample of families with no young children, the cross-hours effects \(\gamma_i\) are not significantly different from zero, while the cross-earnings effects \(\beta_i^*\) are insignificant or have the wrong sign. The other two subsamples, families with young children, exhibit strong and mostly positive cross-hours effects and negative cross-earnings effects. Thus the presence of young children appears to have a fundamental influence

\(^{19}\) This wage variable avoids simultaneity resulting from tied wage-hours offers. See Lundberg (1985b) for evidence that married men in this sample do face non-horizontal wage-hours offer schedules.

\(^{20}\) Details are presented in an appendix available from the author.
### Table 1: Family Labor Supply: Maximum Likelihood Simultaneous Equations Estimates

First Differences of Quarterly Hours Worked 1972:2 to 1972:4

<table>
<thead>
<tr>
<th>Children Under 6</th>
<th>0</th>
<th>1</th>
<th>&gt; 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Husband's Labor Supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda_{m1}: \Delta H_m(t - 1)$</td>
<td>0.7759*</td>
<td>-0.3228*</td>
<td>-0.1060*</td>
</tr>
<tr>
<td>(0.068)</td>
<td>(0.113)</td>
<td>(0.049)</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{m2}: \Delta H_m(t - 2)$</td>
<td>-0.4243*</td>
<td>-0.0452</td>
<td>-0.2100*</td>
</tr>
<tr>
<td>(0.067)</td>
<td>(0.069)</td>
<td>(0.073)</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{m3}: \Delta H_m(t - 3)$</td>
<td>0.1676*</td>
<td>-0.2094*</td>
<td>-0.1187*</td>
</tr>
<tr>
<td>(0.051)</td>
<td>(0.067)</td>
<td>(0.058)</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{m4}: \Delta H_m(t - 4)$</td>
<td>-0.0860*</td>
<td>-0.1495</td>
<td>-0.0466</td>
</tr>
<tr>
<td>(0.041)</td>
<td>(0.068)</td>
<td>(0.046)</td>
<td></td>
</tr>
<tr>
<td>$\delta_m: \Delta w_m(t)$</td>
<td>-33.5560*</td>
<td>5.6893</td>
<td>59.5660*</td>
</tr>
<tr>
<td>(13.226)</td>
<td>(30.267)</td>
<td>(23.337)</td>
<td></td>
</tr>
<tr>
<td>$\gamma_m: \Delta H_f(t)$</td>
<td>0.0002</td>
<td>0.4758*</td>
<td>1.1723*</td>
</tr>
<tr>
<td>(0.107)</td>
<td>(0.130)</td>
<td>(0.132)</td>
<td></td>
</tr>
<tr>
<td>$\beta_m: \Delta F_m(t) - \Delta [w_f(t)H_f(t)]$</td>
<td>0.0360</td>
<td>0.0801</td>
<td>-0.1039*</td>
</tr>
<tr>
<td>(0.023)</td>
<td>(0.087)</td>
<td>(0.049)</td>
<td></td>
</tr>
<tr>
<td>$\beta_m^*: \Delta [w_f(t)H_f(t)]$</td>
<td>0.1028*</td>
<td>0.0637</td>
<td>0.0019</td>
</tr>
<tr>
<td>(0.041)</td>
<td>(0.054)</td>
<td>(0.063)</td>
<td></td>
</tr>
<tr>
<td><strong>Wife's Labor Supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda_{f1}: \Delta H_f(t - 1)$</td>
<td>0.1306*</td>
<td>0.3053*</td>
<td>0.0164</td>
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<tr>
<td>(0.056)</td>
<td>(0.109)</td>
<td>(0.022)</td>
<td></td>
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<tr>
<td>$\lambda_{f2}: \Delta H_f(t - 2)$</td>
<td>-0.0326</td>
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<td>(0.067)</td>
<td>(0.124)</td>
<td>(0.026)</td>
<td></td>
</tr>
<tr>
<td>$\lambda_{f3}: \Delta H_f(t - 3)$</td>
<td>-0.1226b</td>
<td>-0.0404</td>
<td>-0.1141</td>
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<tr>
<td>(0.066)</td>
<td>(0.085)</td>
<td>(0.029)</td>
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<tr>
<td>$\lambda_{f4}: \Delta H_f(t - 4)$</td>
<td>0.0402</td>
<td>0.0247</td>
<td>-0.0460b</td>
</tr>
<tr>
<td>(0.097)</td>
<td>(0.103)</td>
<td>(0.024)</td>
<td></td>
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<tr>
<td>$\delta_f: \Delta w_f(t)$</td>
<td>-93.5078*</td>
<td>8.1447</td>
<td>11.0094</td>
</tr>
<tr>
<td>(24.660)</td>
<td>(26.451)</td>
<td>(15.877)</td>
<td></td>
</tr>
<tr>
<td>$\gamma_f: \Delta H_m(t)$</td>
<td>0.1322</td>
<td>-0.3031a</td>
<td>0.6146a</td>
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<tr>
<td>(0.153)</td>
<td>(0.119)</td>
<td>(0.053)</td>
<td></td>
</tr>
<tr>
<td>$\beta_f: \Delta F_f(t) - \Delta [w_m(t)H_m(t)]$</td>
<td>-0.0377</td>
<td>-0.1703a</td>
<td>0.0074</td>
</tr>
<tr>
<td>(0.034)</td>
<td>(0.056)</td>
<td>(0.052)</td>
<td></td>
</tr>
<tr>
<td>$\beta_f^*: \Delta [w_m(t)H_m(t)]$</td>
<td>0.0090</td>
<td>-0.0571b</td>
<td>-0.0893a</td>
</tr>
<tr>
<td>(0.042)</td>
<td>(0.030)</td>
<td>(0.013)</td>
<td></td>
</tr>
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**Observations:** 111

**Log Likelihood:**
- 0.5416.92
- 5440.31
- 8073.03

**Note:** Standard errors in parentheses. Coefficients on seasonal effects $\phi_m$ and $\phi_f$ not reported.

*Significant at 95% level.

bSignificant at 90% level.
LABOR SUPPLY OF HUSBANDS AND WIVES

21 Few labor supply studies have examined separately families with and without young children. Using cross-section data, Wales and Woodland (1976) found positive effects of wife's wage on husband's hours which were much stronger for families with pre-school children. Though Wales and Woodland postulated that the results might be due to assortative mating and thus spurious, they appear to be supported by these results from panel data.

V. Estimation with Truncated Hours

In this section, the simultaneous equations model is expanded to allow for the truncation of wife's work hours at zero. Inclusion of non-working wives in the sample without some sort of correction may, as is well known, result in bias in

ing of the subsamples can be rejected. These families exhibit strong interactions in labor supply decisions, in sharp contrast to families with no young children. As expected, an increase in husband's earnings tends to reduce the labor supply of wives: roughly, if husband's monthly earnings rise by $100, wife's hours will fall by 6 to 9 hours per month. Wife's earnings, however, do not have a significant effect on husband's labor supply.

The direct cross-hours effect is significant and positive in the husband's labor supply equation for both subsamples. It is also significant in the wife's equation but changes sign; husband's hours have a negative effect on wife's hours in subsample 2 and a positive effect in subsample 3. The fact that these interactions are predominately positive is a surprising result. It has been frequently noted that investigations of the cross-substitution effect within families is complicated by the fact that non-market time is not a homogeneous commodity, particularly for wives. The alternative to market work is more reasonably disaggregated into true leisure, which is enjoyed for its own sake, and non-market work or household production. We tend to think of husband's and wife's time as being substitutes in household production (including child care), and only likely to be complements in the enjoyment of leisure. If the positive substitution effect which appears for subsample 3 and husbands in subsample 2 is due to complementarities in leisure consumption, then it should show up even more strongly in subsample 1, for whom we can argue that a higher proportion of non-market time must be leisure (in the absence of pre-school children).

Could the difference in the cross-hours effect between subsamples be due to self-selection—preferences for children are correlated with tastes determining labor supply interactions? Most of the first subsample do in fact have children; 84 of 111 have children between 6 and 16 in the house-
the estimated parameters. However, the corrected estimates below confirm most of the major results reported in section IV.

Correcting for truncation is not straightforward in a fixed effects model, since first-differencing cannot be used to sweep out an individual specific intercept when latent dependent variables are present. The alternative, a nonlinear fixed effects model, produces inconsistent parameter estimates in short panels. We can, however, use somewhat simpler maximum likelihood procedures to arrive at consistent estimates of structural parameters in the husband’s labor supply equation.

The husband’s equation can be estimated in first-difference form, since truncation at zero hours is not important for married men in this sample. Combined with a reduced-form equation in wife’s hours and a participation equation, husband’s labor supply can be consistently estimated as a switching regression model with endogenous switching. Since most of the interesting findings can be verified by estimating the structural parameters of the husband’s equation alone, this should provide an adequate test for the importance of bias due to truncation in earlier results.

Omitting individual subscripts, let the wife’s participation be represented by a dummy variable \( I_f \), equal to one if the wife works, and zero if she does not, where \( I_f = 1 \) if \( u_p \geq -\sigma_f Z \) and \( I_f = 0 \) otherwise. In this probit model, \( \sigma_f \) can be estimated only up to a scale factor, so we may assume \( \text{var}(u_p) = 1 \). The two regimes corresponding to wife’s participation and wife’s nonparticipation lead to the hours equations in (7) and (8).

If \( I_f = 1 \):

\[
H_f = \sigma_f^2 X + u_f \\
H_m = h_m^1 (H_f, X) + u_m. 
\] (7)

If \( I_f = 0 \):

\[
H_f = 0 \\
H_m = h_m^2 (X) + u_m. 
\] (8)

The error terms \( u_p, u_m, u_f \) are assumed to have a trivariate normal distribution with mean vector zero. The likelihood function for the entire sample will be

\[
L = \prod_{t=0}^{\infty} \int_{-\infty}^{-\sigma_f Z} f(u_p, H_m - h_m^2(X)) \, du_p \\
\times \prod_{t=1}^{\infty} \int_{-\sigma_f Z}^{\infty} g(u_p, H_m - h_m^1(H_f, X), H_f - \sigma_f^2 X) \, du_p 
\]

(9)

where \( f \) is the bivariate normal density of \((u_p, u_m)\) and \( g \) is the trivariate normal density of \((u_p, u_m, u_f)\).

Table 2 presents the maximum likelihood estimates of parameters in the husband’s labor supply equation. A comparison of the truncation-corrected estimates with those in table 1 suggests that the principal conclusions remain unaltered, though some modifications are suggested for the third subsample. The direct effect of wife’s hours on husband’s labor supply is still positive and significant in households with one child under six. In households with no children under six, the cross-hours effect remains small and insignificant. The major change occurs in the results for households with more than one child under six. The cross-hours effect, which had been large, positive, and significant, is now negative and insignificant.

The error structure also differs substantially across subsamples. The correlation between errors in the wife’s participation equation and the husband’s hours equation is positive in the third subsample, though it is negative in the other two. The same relationship holds for the correlation between \( u_m \) and \( u_f \). Thus, there appears to be a positive relationship between husband’s and wife’s labor supply for all households with young

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22 See Tobin (1958).

23 Problems which arise in estimating a Tobit-type fixed effects model for married women are discussed in Heckman and MaCurdy.

24 The vector \( X \) includes husband’s and wife’s hours, both wages and nonlabor income, all lagged two to five quarters. The husband’s hours equation is exactly as in (5), except that observations from three quarters are pooled rather than specified as separate equations. The first lag of husband’s hours is replaced by its predicted value from a linear regression, since it is correlated with the first-differenced error. The standard errors have not been corrected for this modification, and so should be regarded as approximate.
LABOR SUPPLY OF HUSBANDS AND WIVES

TABLE 2.—TRUNCATION-Corrected Maximum Likelihood Estimates

<table>
<thead>
<tr>
<th></th>
<th>Children Under 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>$\lambda_{m1}$: $\Delta H_m(t - 1)$</td>
<td>-0.1719</td>
</tr>
<tr>
<td></td>
<td>(0.113)</td>
</tr>
<tr>
<td>$\lambda_{m2}$: $\Delta H_m(t - 2)$</td>
<td>-0.2700*</td>
</tr>
<tr>
<td></td>
<td>(0.048)</td>
</tr>
<tr>
<td>$\lambda_{m3}$: $\Delta H_m(t - 3)$</td>
<td>-0.0145</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
</tr>
<tr>
<td>$\lambda_{m4}$: $\Delta H_m(t - 4)$</td>
<td>-0.0448</td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
</tr>
<tr>
<td>$\delta_m$: $\Delta w_m(t)$</td>
<td>-21.5404</td>
</tr>
<tr>
<td></td>
<td>(32.985)</td>
</tr>
<tr>
<td>$\gamma_m$: $\Delta H_f(t)$</td>
<td>0.1976</td>
</tr>
<tr>
<td></td>
<td>(0.190)</td>
</tr>
<tr>
<td>$\beta_m^*$: $\Delta F_m(t) - \Delta[w_f(t)H_f(t)]$</td>
<td>0.0670*</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
</tr>
<tr>
<td>$\beta_m^*$: $\Delta[w_f(t)H_f(t)]$</td>
<td>0.0591</td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>&gt; 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_m$</td>
<td>131.03</td>
<td>156.66</td>
<td>171.32</td>
</tr>
<tr>
<td>$\sigma_f$</td>
<td>118.61</td>
<td>119.01</td>
<td>143.04</td>
</tr>
<tr>
<td>$\rho_{mf}$</td>
<td>-0.2668</td>
<td>-0.2194</td>
<td>0.3431</td>
</tr>
<tr>
<td>$\rho_{mF}$</td>
<td>-0.2556</td>
<td>-0.7025</td>
<td>0.3117</td>
</tr>
<tr>
<td>$\rho_{fF}$</td>
<td>-0.0141</td>
<td>-0.3109</td>
<td>0.1724</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-3597.72</td>
<td>-3599.82</td>
<td>-4994.03</td>
</tr>
</tbody>
</table>


*Significant at 95% level.

children, but it takes different forms in the two subsamples. For households with only one young child, a marginal increase in hours worked by the wife has a positive effect on husband's hours. For households with more than one young child, there is no evidence of a marginal response, but the participation status of the wife is positively related to husband's hours. These results are consistent with the explanation given in the previous section, but suggest greater indivisibilities in child-care services or perhaps a large fixed cost associated with market work for wives in the third subsample.

VI. Conclusion

This paper has used a simultaneous equations model of husband's and wife's work hours to test alternative theories of family labor supply behavior. The results indicate that the presence of young children has a fundamental effect on family labor supply interactions. Husbands and wives without pre-school children act like separate individuals—their work hours are not jointly determined. Families with young children, however, exhibit strong interactions in work hours which are generally positive and some negative cross-earnings effects. The traditional family model can be decisively rejected by these results. The fact that simultaneity in the determination of husband's and wife's hours occurs only in the presence of young children casts doubt upon the standard joint utility approach to family labor supply, in which each person's leisure time is an argument of the single family utility function. Children, rather than leisure, appear to be the important jointly-consumed commodity for husbands and wives in this sample.
REFERENCES

APPENDIX

**Table A1. — Construction of the Sample**

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Observations Lost</th>
<th>Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remained in sample till end of third year</td>
<td>79</td>
<td>524</td>
</tr>
<tr>
<td>Both husband and wife work</td>
<td>131</td>
<td>393</td>
</tr>
<tr>
<td>some time during sample</td>
<td>12</td>
<td>381</td>
</tr>
</tbody>
</table>

Note: Total two-head financial control families-DIME = 603.
<table>
<thead>
<tr>
<th></th>
<th>No Children Under 6</th>
<th>One Child Under 6</th>
<th>More than one Child Under 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean hours worked in 1972</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Husband</td>
<td>1795</td>
<td>1975</td>
<td>2048</td>
</tr>
<tr>
<td>Wife</td>
<td>1044</td>
<td>987</td>
<td>745</td>
</tr>
<tr>
<td>Predicted wage rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Husband</td>
<td>$3.57</td>
<td>$3.63</td>
<td>$3.92</td>
</tr>
<tr>
<td>Wife</td>
<td>$2.05</td>
<td>$2.15</td>
<td>$2.07</td>
</tr>
<tr>
<td>Other income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>excluding transfers</td>
<td>$893.31</td>
<td>$243.86</td>
<td>$118.79</td>
</tr>
<tr>
<td>Husband's age</td>
<td>38.4</td>
<td>34.1</td>
<td>31.8</td>
</tr>
<tr>
<td>Wife's age</td>
<td>35.6</td>
<td>31.4</td>
<td>29.0</td>
</tr>
<tr>
<td>Percent black</td>
<td>28.8</td>
<td>39.6</td>
<td>34.6</td>
</tr>
<tr>
<td>Percent Hispanic</td>
<td>23.4</td>
<td>21.6</td>
<td>28.9</td>
</tr>
<tr>
<td>Number of families</td>
<td>111</td>
<td>111</td>
<td>159</td>
</tr>
<tr>
<td>Average no. working each quarter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Husband</td>
<td>102</td>
<td>104</td>
<td>153</td>
</tr>
<tr>
<td>Wife</td>
<td>76</td>
<td>72</td>
<td>86</td>
</tr>
</tbody>
</table>