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Box 1987, Yale Station
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LABOR SUPPLY BEHAVIOR OF MARRIED WOMEN IN URBAN INDIA

R. Malathy

Yale University
and
Indian Institute of Technology, Madras

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Abstract

The labor market participation of urban women in India, though not impressive, has been increasing since the seventies of this century. Despite the many similarities that urban areas of India share with the advanced industrialized countries, no attempt has been made to apply the available labor supply models to study the labor market behavior of urban women. The purpose of this paper is to fill this gap by investigating married women's labor supply in a metropolitan area of India. Using the recent developments in econometric techniqes wage and labor supply functions are estimated under alternative specifications. This paper also examines some methodological issues such as the specification of the wage equation, the importance of sample selection bias in wage and labor supply equations, the exogeneity assumptions on experience and children variables, and the consequences of using standard Tobit and generalized Tobit formulations of the labor supply model. The empirical results show that the sample selection bias is important in wage but not in labor supply equations. The assumption of exogeneity of labor market experience and children are rejected and the estimated own wage, husband's wage and income elasticities are found to be sensitive to assumptions about the exogeneity of children and functional form of the labor supply equation.

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1. Introduction:

The dramatic expansion in women's labor force participation in the Western economies has given impetus to a large literature on the economic analysis of female labor supply. Spurred by the pioneering work by Mincer (1962), significant theoretical and econometric advances have been made and these models have been widely applied to examine labor force participation trends in the U.S. and a number of different countries. Killingsworth (1983), Heckman and Killingsworth (1986), survey theoretical and empirical research on female labor supply, and the collection of studies edited by Layard and Mincer (1985) provides interesting evidence for twelve industrialized countries.

The phenomenon of rising labor market participation of women has not totally bypassed the developing countries. In a number of these countries, economic growth has been accompanied by the entry of more women into the labor market, especially in paid employment in the urban areas. The analysis of the evolution of female employment in India and changes in it over a period of time is not easy. The two major sources of employment data, namely, the decennial Census and the National Sample Survey (NSS), lead to different conclusions about the work force participation rates (WFPR) of women. The census figures show fluctations from period to period and no clear trend is visible. Considering the last three censuses, the WFPR of urban women declined from 11.2 percent in 1961 to 7.2 percent in 1971 and increased to 10.7 percent in 1981. It would be misleading to infer from these statistics that women have been in and out of

labor force because the definition of workers is ambiguous and has changed between the censuses. The NSS started collecting data on emloyment and unemployment from 1955 onwards but the reference period adopted in the earlier surveys are different from the ones used in the comprehensive quinquennial surveys launched in 1972-73. Since then the definitions and reference period have remained stable so that the data are comparable. The NSS data indicate that the urban women's WFPR has increased from 15.53 percent in 1972-73 to 17.25 percent in 1983, an increase of 11 percent (Sarvekshana, 1988).[1]

There were very few studies in India on female labor force participation (LFP) before the 1971 census. Considerable work has since been done, but the concerns have varied. Works by Mitra et al.(1980), Sinha (1982) among others examine the changes in definition of workers and its impact on the computation of WFPR. Papola and Misra (1980) analyze the determinants of female labor supply and wage function. Some work has also been done on the effect of socioeconomic variables, such as literacy level, caste, landholding, etc., on female LFP. Economists have also been concerned with issues of occupational segregation by sex, the difference in work involvement in terms of amount and nature of tasks among landholding and landless classes, etc. These studies do provide rich insights but they are by and large at the aggregate level and there is no detailed analysis of factors influencing work behavior of women at the microeconomic level.

The only published studies, I am aware of, that have estimated labor supply functions for India, at the household level, using econometric approaches are those by Rosenzweig (1978, 1980), Bardhan (1984) and Duraisamy (1988). These studies use the neoclassical paradigm which is found to perform satisfactorily in the Indian case. They are, however, confined to rural households and

surprisingly there is no study for urban India, except the author's earlier works (Malathy, 1983; 1985). Yet it is the urban sector that shares more similarities with the industrialized countries in the sense that paid employment predominates over self employment. It may be interesting, therefore, to apply the available labor supply models to examine women's labor supply behavior in urban areas of India. One of the objectives of the present study is to investigate the role of economic constraints in explaining labor supply decisions. If economic factors do have impact on labor supply, then it implies that with economic development, more women in India would be likely to participate in market oriented activities as job opportunities become available. This would inform policy makers on the relevant program of action to improve women's well being.

Earlier works by the author estimate the wage and income elasticities of labor supply under certain restrictive assumptions. Recently, Mroz (1987) has shown that labor supply elasticities are sensitive to economic and statistical assumptions. The other objective of this paper is to examine the sensitivity of the labor supply elasticities to alternative specifications, exogeneity assumptions and estimation procedures. This could strengthen confidence in the sign and magnitude of the computed elasticities, or the contrary.

The rest of the paper is organized as follows: Section 2 presents a brief outline of the elements of labor-leisure choice theory and the problems in the estimation of wage and labor supply functions. Section 3 contains the empirical analysis and the discussion of the consequences of alternative specification and estimation methods. Lastly, Section 4 presents the summary and conclusions of the study.

2. Theoretical Consideration and Empirical Methods

The traditional theory of utility maxmisation provides the framework for analysing labor-leisure choice. The model that might be used in studying female labor supply, which emphasises the family context of decision making, has its origins in the works of Mincer (1962) and Kosters (1966). However, what is now regarded as the standard model, and applied in most studies, is the one found in Heckman (1974), Schultz (1980), and Killingsworth (1983).[2]

Stated briefly, according to the theory, the women's decision to work is made by comparing the costs and benefits of working, on the one hand, with her activities at home on the other. Thus the labor supply behavior of women, assuming flexibility to choose working hours and absence of fixed costs of work, may be characterized in terms of two functions - the reservation wage or supply function (W*) and the market wage or demand function (W).

(1) $W^* = f(Z,H)$

(2) $W = g(X)$

The two functions may be linearised and expressed as:

(3) $W^* = b_o + b_1 H + b_2 Z + u_2$

(4) $W = a_o + a_1 X + u_1$

where Z and X are the set of possibly overlapping non-market and market related characteristics respectively, H is hours of market work, u_1 and u_2 are normally distributed random error terms. The market demand wage function is assumed to be independent of hours worked. The decision to work is given by the relation of W to W^*, the condition for participation given by $W > W^*$ at zero hours of work supplied and the amount of work adjusts such that $W = W^*$. The hours of work equation may be solved out as:

(5) $H = 1/b_1 \ (W - b_0 - b_2Z) + (1/b_1) \ u_2 \quad \text{if} \quad H > 0$

$H = 0$ otherwise.

A few issues remain to be settled before the labor supply equation can be estimated. Firstly, the wage variable, which is theoretically an important variable in the labor supply equation, is surrounded by problems. It is observed only for those who work, and the observed wage for workers is measured with error because the theoretically desired hourly wage is often obtained by dividing market earnings by the relevant dimension of labor supply and errors in reporting hours worked introduce error in the wage. Several methods have been adopted in the literature to circumvent these shortcomings. One approach is to estimate reduced form labor supply equations with instruments for wage. But this does not enable measurement of the elasticities of interest directly. Some studies have restricted estimation of labor supply function to working women and use a predicted instead of observed wage for them, while others estimate labor supply equation for all women using predicted wage based on wage equation estimates from working women subsample. These procedures in turn lead to selectivity bias in labor supply and wage equations. If the bias is important, then estimates of wage equation that ignore the sample selection problem produce biased estimates of the parameters of the wage equation and hence also the wage elasticities of labor supply.

Two approaches are followed to correct for sample selectivity bias. One is the multistage estimation method proposed by Heckman (1980) in which a participation decision equation is first estimated by Probit, bivariate Probit or Logit depending on the underlying assumptions about the error term in the equation. The assumption commonly made and the one used here is that of normality of disturbance term and this implies use of maximum likelihood Probit

method. The parameter estimates from the first step yield the estimates of the inverse of Mills ratio which is introduced in wage equation as an explanatory variable and is estimated by OLS correcting standard errors appropriately. While this method yields consistent estimates, they are not asymptotically efficient. For this, the other method suggested in literature is the Full Information Maximum Likelihood (FIML) (see Griliches et al., 1978).

The problem of sample selection bias is well addressed in literature and most contemporary studies take care to correct for this source of bias. What is not well represented in existing works is the consequences of minor variations in the variables used to instrument the wage rate, and the assumptions of the exogeneity of some of the variables included in the wage and participation and hours of work equations.

The choice of variables to be included in the wage equation and in the reduced form participation equation is important because of its implications for wage and income coeffecients. Studies differ in the variables included as instruments in the wage equation. Besides the basic human capital variables, some authors have attempted to capture the possible effects of industry and job characteristics, union status etc. There is also argument for inclusion of variables representing family background, quality of schooling, etc. Another problem is that some of the variables that are treated as exogenous may not be exogenous. Often, controversial justifications are put forward by researchers for considering the variables in the reduced form as exogenous. For instance, there is evidence in literature that the labor market experience which is an important determinant of wage cannot be treated as an exogenous variable. Many researchers include potential experience (age-schooling-6) as a proxy for experience to get around this problem. Several studies also treat variables like

assets and children as life cycle decision variables and hence exogenous in estimating short run labor supply functions. Statistical tests, however, show that these variables are not exogenous. The specification of the participation equation, in turn, affects selectivity correction because identification of the wage equation is obtained either by arbitrarily fixing some factors in the participation equation as exogenous and excluding them from wage equation or by reliance on functional forms. In the present study, I explicitly deal with the issue of choice of variables to instrument the wage rate and with the endogeneity issue.

Secondly, there are difficulties associated with the dependent variable in labor supply equations, namely hours worked, which is truncated and bounded from below. The question is, are the hours worked decision and the participation decision implied by it determined by separable functions or do they arise from a common censoring process? These involve alternative formulations of the labor supply model, namely, standard Tobit and generalized Tobit, and these are dealt with below. The labor supply function is also subject to simultaneous equation bias due to potential endogeneity of some of the independent variables.

In the following section, I address the issues given below:

(1) Choice of variables in the wage equation.

(2) Selectivity bias in the wage equation and sensitivity of wage equation parameter estimates to exogeneity assumptions.

(3) Selectivity bias in the labor supply equation and sensitivity of labor supply model to exogeneity assumptions on children variables.

(4) Consequences of using standard Tobit and generalized Tobit methods of estimating the labor supply model.

3. Empirical Analysis

3.1 Data: The data for the present study come from a primary survey of households in Madras City conducted by the author. The details of the survey are described elsewhere in Malathy (1983). A total of 666 married women consisting of 244 working women and 422 not working women forms the data base for the study. The description of variables used in the rest of the analysis, their means and standard deviation are given in Table 1.

3.2 Estimation of the Wage Equation:

The appropriate wage equation for imputing a wage rate to all women is the one that is corrected for possible sample selectivity bias and endogeneity bias. The logical first step is to decide on the set of variables to be introduced in the wage equation. Setting aside for the moment, the problem of endogeneity of the instruments, I first examine alternative specifications of the wage equation and employ specification tests to choose the best fit equation for use in later analysis.

The common practice is to estimate the now familiar Mincerian semilogarithmic wage function. Following this and previous research on earnings functions the market wage function is specified as follows:

$$(7) \quad \ln W = \alpha_0 + \alpha_1 Ed + \alpha_2 EXP + \alpha_3 EXP^2 + \alpha'_4 X + \mu_1$$

where: lnW is the natural logarithm of hourly wage of wife; ED is the wife's education; EXP, EXP^2 are the labor market experience variables and its sqared term respectively, where experience is defined as the number of years the wife worked at least six months in labor market after completion of schooling; X'is a vector of variables including wife's father's and mother's education, a dummy variable denoting the wife's location of schooling (rural or urban) and

Table 1

Variable Definitions, Means and Standard Deviations

Variable	Working Women		All Women	
	Mean	Standard Deviation	Mean	Standard Deviation
Dependent				
Labor Force Participation			0.36	0.48
Annual Hours Worked	1805.87	483.84	661.61	918.55
Ln wife's hourly wage	1.12	0.77	0.62	0.77
Endogenous				
Experience (years)	9.62	5.89	3.84	5.86
Experience square	126.35	136.25	49.08	104.21
No. of children < 7 years	0.87	0.35	0.85	0.41
No. Children 8-19 years	0.87	0.61	0.90	0.73
Exogenous				
Ln husband's hourly wage	1.47	0.49	1.25	0.50
Asset (x 1000) in Rupees	42.56	60.33	48.55	59.35
Age of the wife (years)	33.10	5.77	32.80	6.79
Age square	1129.20	395.70	1122.20	461.47
Education of the wife (yrs)	11.75	4.29	10.82	4.08
Schooling dummy =1 if studied in rural area, Else = 0	0.29	0.45	0.35	0.48
Health dummy =1 if no health disability, Else = 0	0.84	0.37	0.74	0.34
Religion dummy =1 if muslim, Else=0	0.13	0.34	0.11	0.31
Father's Education	9.81	4.71	9.00	5.51
Mother's Education	5.56	4.49	4.93	4.61
Number of male dependents	0.21	0.46	0.24	0.55
Number of female dependents	0.39	0.56	0.32	0.58
Number of rooms	3.10	1.28	3.52	1.35
No. of observations	244		666	

interaction terms in some of the linear variables; α's are the parameters to be estimated and μ_1 is the stochastic disturbance term. The wage equation is corrected for selectivity bias adopting the maximum likelihood approach.

Table 2 records the various wage equation estimates corrected for selectivity bias. For comparison, OLS estimates of the wage equation are provided in the Appendix table A-1. These estimates are based on the assumption that all the explanatory variables in the participation and wage equations are exogenous.

Column 1 of Table 2 shows the effect of the basic human capital variables. These variables confirm the regularity reported in literature, namely positive (and statistically significant at 1 percent level) effect of education and experience on wage and also the concavity of the experience term. To capture the possible nonlinear effects of education, I introduced a squared term in education and interaction between education and experience. These turned out not to be significant. Wife's father's and mother's education, interaction between them and whether the school attended is located in rural or urban areas do not seem to have a significant impact on wage offers. Using a five percent level of significance, the calculated χ^2 statistics (log likelihood ratio test and F statistics in the case of OLS) do not reject the simplest model with the basic human capital variables (column 1) in favor of the alternative specifications reported in columns 2 to 6 and others which were tried but not reported. On this basis, I prefer equation 1 as the wage equation to assign a wage to all women.

Comparing the selectivity corrected estimates of the baseline equation 1 with the traditional wage equation reported in column 1 of Table A-1, it can be

Table 2

Maximum Likelihood Estimates of Wage Equation Corrected for Selectivity Bias[a]

Dependent variable: Ln hourly wage of wife

Independent Variables	1	2	3	4	5	6
Education	0.149	0.124	0.197	0.189	0.179	0.174
	(8.71)	(6.60)	(5.21)	(4.94)	(4.49)	(4.02)
Experience	0.072	0.076	0.085	0.087	0.085	0.085
	(2.62)	(2.67)	(2.78)	(2.77)	(2.72)	(2.71)
Exp. square	-0.106	-0.123	-0.114	-0.107	-0.107	-0.105
(x 10^{-2})	(-1.83)	(-1.80)	(-1.86)	(-1.71)	(-1.70)	(-1.70)
Ed. square		-0.203	-0.185	-0.172	-0.130	-0.113
(x 10^{-2})		(-1.36)	(-1.71)	(-1.08)	(-0.79)	(-0.66)
Ed. * Exp.			-0.105	-0.133	-0.113	-0.114
(x 10^{-2})			(-0.64)	(-0.85)	(-0.68)	(-0.68)
Father's Education				0.007	0.013	0.013
				(0.68)	(1.08)	(1.07)
Mother's Education				0.011	0.041	0.042
				(1.00)	(1.43)	(1.45)
F. Ed * M. Ed					-0.002	-0.003
					(-1.02)	(-1.04)
Schooling-Rural						0.045
						(0.49)
Constant	-1.233	-1.238	-1.300	-1.349	-1.371	-1.325
Rho	0.430	0.393	0.411	0.392	0.396	0.393
	(1.82)	(1.58)	(1.72)	(1.53)	(1.57)	(1.54)
Log likelihood	-331.96	-330.88	-330.65	-329.13	-328.30	-328.17
Specification Test:[b]						
χ^2		2.16	2.62	5.66	7.32	7.58
N	244	244	244	244	244	244

Asymptotic 't' values in parentheses

a. Estimates of the reduced form participation equation is given in column 1 of Table 3.

b. Likelihood ratio test (χ^2) statistics for joint significance of additional variables included in the equation.

seen that the selectivity bias in estimating wage offer equation is quite important for return to education and labor market experience.

Next, the issue, of possible endogeneity of some of the instruments in the reduced form participation and wage equations is examined. The reduced form participation equation consists of a set of variables that determine wages (the base line specification 1 of Table 2) and factors presumed to affect the wife's shadow wage, namely, husband's wage, household's stock of non-human wealth or assets,health, and fertility or the family composition variables. In the present study, husband's wage is predicted from estimates of his wage equation.[3] In distinguishing between the variables to be viewed as exogenous and those that are endogenous, it is decided to consider assets and wife's health as being predetermined. Even though there are arguments in literature favoring treatment of assets as an endogenous factor, in the absence of a satisfactory theory of life cycle savings, we presently set aside this problem.

The list of factors considered to be simultaneously determined in the system are the wife's labor market experience (defined here as actual experience) and children. Heckman (1980) and Mroz (1987) present evidence in support of the endogenity of the experience term and Mroz shows that assuming exogeneity results in an upward bias in the wage effect. Schultz (1978, 1980) is of the view that children are very likely to be endogenous and as such do not warrant inclusion as exogenous variables. In the light of these suggestions, we decide to examine and correct for endogeneity bias in these two variables. The practice in labor supply studies has been to approximate fertility by number and age of children in the household. This approach is used here for children in two age groups, less than 7 years of age and 7-19 years of

age. In deciding on the set of instruments in the experience and children equations it is necessary to find some basis for identifying these equations since almost every variable in the labor supply equation also in some sense influence fertility and wife's labor market experience. Religion, number of rooms in the house, the woman's location of residence (rural or urban) until completion of schooling and number of other dependents in the household serve as identifying instruments. In the absence of any strong suggestions from theory on identifying variables I impose these exclusion restrictions based on empirical evidence on some of these correlates.

The reduced form participation function and the wage equation are estimated under alternative specifications. The results are given in Table 3. The first set of estimates in column (1) of Table 3 treats experience and children variables as exogenous. In the next step (2) of Table 3, I relax the assumption that experience is exogenous and after testing for its endogeneity, use instrumental variables estimate of experience as a regressor. The likelihood ratio test is used to examine the endogeneity.[4] In the case of children variables, I first examine the effect of excluding the variable from the reduced form equation ((3) of Table 3) and following this, the predicted value of children is introduced ((4) of Table 3). Table A-2 in the appendix provides the reduced form estimates of experience and children variables.

The estimates of the reduced form participation equation indicate that in general labor market experience and education exert a positive effect on the probability of working. As expected, women from households with more assets, and higher husband's earnings are less likely to work. Children in both age groups diminish the probability of a woman entering the labor market. In (2), experience is treated as an endogenous variable. The likelihood ratio test

Table 3

Maximum Likelihood Estimates of Wage Equation
Corrected for Selectivity and Endogeneity Bias

Explanatory Variable	1		2		3		4	
	Part.	Wage	Part.	Wage	Part.	Wage	Part	Wage
Education	0.018	0.149	0.044	0.138	0.067	0.132	0.023	0.142
	(0.65)	(9.71)	(2.09)	(6.78)	(3.48)	(6.15)	(1.92)	(8.85)
Experience[a]	0.617	0.072	0.221	0.165	0.175	0.175	0.177	0.189
	(13.85)	(2.62)	(5.22)	(3.36)	(4.20)	(3.64)	(4.73)	(3.78)
Exp. square[a] ($\times 10^{-2}$)	-2.028	-0.106	-0.965	-0.697	-0.688	-0.808	-0.501	-0.701
	(-9.50)	(-1.83)	(-1.90)	(-2.19)	(-1.70)	(-2.41)	(-1.37)	(-1.65)
Husband's Wage[b]	-0.658		-0.420		-0.446		-0.390	
	(-3.11)		(-2.94)		(-3.30)		(-1.61)	
Asset ($\times 10^{-2}$)	-0.280		-0.250		-0.324		-0.254	
	(-1.70)		(-2.53)		(-3.56)		(-2.80)	
Children < 7[a]	-0.096		-0.141				-0.116	
	(-0.51)		(-1.91)				(-1.58)	
Children 8-19[a]	-0.197		-0.220				-0.243	
	(-2.39)		(-2.84)				(-3.06)	
Health dummy	0.529		0.616		0.663		0.601	
	(2.13)		(2.79)		(3.10)		(2.63)	
Constant	-1.335	-1.233	-1.254	-1.372	-1.695	-1.315	-1.211	-1.472
Rho	0.430		0.401		0.466		0.559	
	(1.82)		(2.03)		(2.19)		(2.45)	
Log likelihood	-331.96		-622.44		-610.73		-623.02	
Endogeneity Test[c] (χ^2):			16.37				23.15	
N	666		666		666		666	

Asymptotic 't' values in parentheses

a. Actual values in 1 and predicted values in 2, 3 and 4.

b. Predicted wage

c. Likelihood ratio test (χ^2) staistics.

applied to this equation indicates that experience is correlated with the error term of the estimating equation and hence coannot be treated as predetermined. When predicted experience replaces the actual variable, the size and significance of experience and its squared term are diminished while that of the education term is increased. The predicted experience variables also affect the coefficients and significance of other variables in the participation equation. The endogeneity of the children variable is tested in the next step. The χ^2 test statistics (using a five percent level of significance) shows that these variables are endogenous. The use of predicted children variables also affects the magnitude and significance of all the Probit coefficients.

The variables in the wage equation behave as expected and exert a statistically significant effect on the wage rate. Accounting for endogeneity of experience and children variables seem to have an impact on the magnitude and significance of the variables in the wage equation.

The endogeneity and selectivity corrected equation (4) is used to predict the wage rate which is introduced as a regressor in the labor supply equations.

3.3 Estimates of the Labor Supply Equation

The estimating equation for the labor supply function is:

(8) $H = \beta_0 + \beta_1 \ln W_f + \beta_2 \ln W_m + \beta_3 V + \beta'_4 Z + \mu_2$

where H is the annual hours worked by the wife; $\ln W_f$ is the fitted hourly market wage from equation (6); $\ln W_m$ is the husband's predicted hourly wage rate; V is the household's assets; Z' is a vector of variables denoting wife's age, squared term in age, children in two age groups (less than 7 years and 7-19 years), and health dummy variable which takes the value 1 if the wife reported good health for the most part of the year preceding the survey, 0 otherwise.

The endogeneity problem associated with the children variables is handled by: (1) explicitly omitting the variables from the set of regressors, and (2) testing for their endogenity and including the instrumental variable estimate of children as regressors .

In performing the empirical analysis we use the following procedures:

(1) Standard Tobit which consists of introducing the wife's predicted wage rate as a regressor in the hours worked labor supply equation for all individuals and estimating by Tobit.

(2) Generalized Tobit: This is a multistage procedure. As in the case of standard Tobit, the first stage is that of constructing instrumental wage variable free of selectivity and endogeneity bias. This is introduced in structural participation and hours worked decisions estimated separately in the first case for all women and in the second case only for working women. The selectivity bias in the conditional hours equation may be corrected either by using Heckman's two step method or FIML. Here I use the FIML approach.

Compared to the standard Tobit, the generalized Tobit makes less restrictive assumptions. It allows discontinuity in hours worked at the reservation wage (W^*) such that hours worked are zero below W^* and some positive amount above W^*. It also allows one to relax the assumption that the error term in the participation equation is normally distributed. Further, generalized Tobit estimated by FIML has the advantage that it yields asymptotically efficient estimators.

The results are reported in Table 4. The first set of estimates are the parameters of the standard Tobit index, in the first instance omitting children from estimation. The table values show that wife's labor supply is positively and significantly affected (significant at one percent level) by her own wage rate. Women tend to supply fewer hours as their spouse's wage and the family's stock of non-human wealth increase. However, only the asset variable is statistically significant at one percent level. The age variable and its squared term represent the life cycle effects, but they appear not to be important in choice of hours of work in the labor supply equation for all women. The health variable exerts a strong positive effect on market hours supplied by the wife.

Considering the importance of children in the labor supply decision and its possible endogeneity, it was decided to test whether this variable is correlated with the error term in the labor supply equation. The likelihood ratio test given in the table indicates that the children variables are endogenous. Hence, I use instrumental variables estimate of children in the labor supply equations. The introduction of children variables substantially affect the magnitude and significance of the wife's wage term which is about 45 percent lower in its effect compared to the figure given in coloumn 1. The age and age squared coefficients are now statistically significant in their impact on labor supply. It can be seen from the table that children increase woman's productivity at home so that she reduces her hours supplied to the market. Surprisingly, given the literature from the US and other industrialized countries, this effect comes through older children. Possibly, this is due to women being able to find substitutes for the care of preschool aged children. The stronger market work reducing effect of older children suggests that they

Table 4

Estimates of Labor Supply Equations

Explanatory Variable	Standard Tobit		Genearalized Tobit			
	Hours TOBIT	Hours TOBIT	Part. PROBIT	Hours FIML[a]	Part. PROBIT	Hours FIML[a]
Wife's Wage[b]	926.79	516.39	0.620	-153.62	0.407	-216.86
	(3.76)	(2.13)	(6.23)	(-0.97)	(2.67)	(-1.97)
Husband's Wage[b]	-425.58	-457.54	-0.454	-147.10	-0.607	-95.23
	(-1.61)	(-1.74)	(-3.47)	(-0.80)	(-4.05)	(-0.58)
Asset(x 10^{-2})	-758.751	-629.89	-0.305	-62.27	-0.200	-65.63
	(-4.22)	(-4.07)	(-3.06)	(-0.78)	(-2.09)	(-0.89)
Wife's age	99.60	398.50	0.299	95.27	0.741	120.08
	(0.81)	(2.13)	(3.48)	(1.60)	(5.61)	(1.94)
Wife's age sq.	-1.32	-6.169	-0.427	-1.09	-0.014	-1.62
	(-0.75)	(-2.06)	(-3.41)	(-1.26)	(-6.08)	(-1.48)
Children < 7[c]		-294.57			-0.776	285.84
		(-0.37)			(-1.42)	(1.44)
Children 8-19[c]		-552.66			-0.667	-100.71
		(-2.63)			(-4.57)	(-0.57)
Health dummy	560.79	649.32	0.376	104.58	0.401	114.15
	(2.07)	(2.98)	(2.63)	(2.01)	(2.85)	(2.31)
Constant	-2617.9	-6861.8	-5.839	-976.35	-12.709	-1514.02
Log likelihood	-2410.8	-2401.7	-373.29	-2183.30[d]	-358.90	-2182.50[d]
Rho				0.292		0.091
				(0.37)		(0.46)
Endogeneity Test: χ^2		8.73			7.97	14.23
N	666	666	666	244	666	244

Asymptotic 't' values in parentheses

a. Reduced form participation equation are the same as the one given in 2 and 3 of Table 3.

b. Predicted wage

c. Endogenous variables.

d. Log likelihood of joint ML estmation.

can contribute to family income and relieve the pressure on the woman to work longer hours.

A similar exercise has been carried out using the generalized Tobit approach. The structural estimates of the labor force participation decision is first presented. The dependent variable in this case is equal to one if the women is a labor force participant and zero otherwise. OLS method is inappropriate in this case and is hence estimated by Probit method. The reported probit index indicate that women are more likely to enter the labor market the higher their wage offer, other things remaining the same. As expected, the effect of husband's wage and the pure income effect acting through household's non-earned income (the stock of assets in the present case) are negative and significant at 1 percent level. Age increases the probability of participation, at a decreasing rate. Healthier women are about 38 percent more likely to work compared to their less healthy counterparts. The endogeneity test for children confirms that there is no basis for treating it as predetermined. Including children alters the size and significance of all the parameter estimates. The effects are most pronounced on the wages and asset variables. The positive effect of wife's wage is reduced by 34 percent (coloumns 3 and 5)and the negative effect of husband's wage is increased by 34 percent. Similar upward bias in the wage effect, due to treating children as exogenous is noted by Mroz for the U.S. case. As before, young children do not seem to affect the woman's participation decision while older children exert a significant deterring effect on participation decision.

Estimates of conditional hours worked (hours worked by women who work) are presented in coloumns 4 and 6, and in this case I try to correct for selectivity bias. Sample selection appears not to be an important issue in the

estimation of the coefficients of the labor supply function. None of the variables except health are significant even at ten percent level when children are ignored from estimation. This suggests that fertility plays an important role in labor supply decisions and including predicted values for children affects the size of all parameter values and also the significance of wife's wage and age variables. The uncompensated wage effect confirms the existence of a backward bending labor supply curve. A similar result is observed for Thailand (Schultz, 1989) and Columbia (Mohan, 1985).

The results of table 4 suggest that most of the response occurs in the participation rather than in the hours worked decision and hence the generalised Tobit seems to be a more preferred formulation compared to the standard Tobit that imposes the restriction that the two outcomes arise from a homogenous process.

The own wage, husband's wage and income elasticities derived from the alternative specifications and estimated using different methods are compared in Table 5. The standard Tobit gives the expected total labor supply elasticity with respect to wages/income which should be equal to the sum of participation and hours worked elasticities (generalised Tobit) with respect to the same variables if we assume that the error terms in the two equations are independent. The income elasticity in the table is calculated with reference to the asset coefficients in the labor supply equations. It can be seen from the table that the own wage, husband's wage, and income elaticities are all sensitive to estimation methods and to the assumptions about the children variables. The consequence of the treatment of children is most on the own wage elasticity, where excluding children considerably overstates the wage responsiveness of labor supply. In the case of the generalised Tobit the bias

Table 5

Wage and Income Elasticities for Alternative Specification and Estimation Procedure

Estimation Procedure/Model	Wife's wage	Husband's Wage	Asset income
Standard Tobit			
- without children	0.504	-0.232	-0.200
- with children*	0.281	-0.249	-0.166
Generalized Tobit			
(1) Probability of Working			
- without children	0.687	-0.503	-0.164
- with children*	0.451	-0.673	-0.108
(2) Conditional Hours Worked			
- without children	-0.085	-0.081	-0.015
- with children*	-0.120	-0.053	-0.015
(3) Expected Labor Supply (1+2)			
- without children	0.602	-0.584	-0.149
- with children*	0.331	-0.726	-0.092

* Corrected for endogeneity

seems to arise from the effect of children on the participation rather than on hours worked decision. Compared to the elasticities obtained in the earlier works by the author using the same date set, these are smaller is magnitude. The past work treated experience and children as exogenous explanatory variables and these seem to have considerably inflated the wage response of labor supply.

4. Summary and Conclusion:

This paper applies the currently well-developed theory of labor-leisure choice to examine the labor supply behavior of married women in urban India. The model seems to fit the data well in that some of the implications that are tested are in accordance with theoretical expectations. Overall, the results indicate certain regularities with established findings for most developed countries and the developing countries where the model has been applied. (See for instance Mohan (1985) Khandker, (1987), Sahn and Alderman, (1988).

Issues that have received attention in the present study are the specification of wage and labor supply equations, assumption of exogeneity of experience and children, and the consequences of these on wage and income elasticities. The wage equation with human capital variables, namely education, experience and experience square, emerged as the best specification. The endogeneity tests reject the null hypothesis that experience is exogenous.The results also suggest that selectivity is an important problem in estimating the female wage function but not the labor supply function. The endogeneity test statistics reported in Table 4 show that children may not be assumed as predetermined. The results of the standard Tobit indicate that treatment of children is important as endogenising the variable cuts down the positive female

wage effect by 45 percent while increasing the negative male wage effect by 7 percent. This has implications on the effect of a general wage growth on female labor supply. The wage elasticity is higher in the generalized Tobit than in the standard Tobit specification, a finding at variance with those reported in Mroz.

The computed wage and income elasticities are not directly comparable with existing ones for rural India considering differences in definition of variables, composition of sample, etc. However, apparently the labor supply elasticity is of a smaller magnitude for urban women compared to rural women (the elasticity reported in Rosenzweig from Tobit estimates for landless women is 0.7). Similar finding of better responsiveness of rural women is reported in Sahn and Alderman for the case of Sri Lanka.

An important finding is that economic constraints do affect labor supply decisions in urban areas of the developing countries. It may be relevant in this context to ask whether this exercise provides any useful pointers for the future. For instance, we may be interested in knowing whether women's labor supply in urban areas will incrase or decrease with wage growth that leaves female to male wages relatively constant. Two possibilities emerge. Considering the results of the preferred generalized Tobit model, the specification that explicitly ignores children suggests that the own wage elasticity exceeds the husband's wage elasticity on participation where most of the response occurs. This implies that a general wage growth would increase women's participation. On the other hand if we try to endogenise children then the labor supply estimates imply that a general wage gain would lead to a decline in women's participation.

The role of human capital variables in affecting woman's wage offers and the effect of wage itself on labor supply point to the importance of investment in education and also government intervention to promote schooling. Sensitivity analysis could be useful for future labor supply model formulations for women, to obtain more precise parameter estimates in both developed and developing countries.

NOTES

1. It should be noted that the Census WFPR's are defined for population in all age groups whereas the NSS rates pertain to the population in the age group 15-59.

2. Recent evidence (Schultz ,1989) suggests the usefulness of a more general bargaining framework of McElroy and Horney (1981) to model family behavior across societies. In the absence of required empirical information to verify some of the more general implications of the bargaining model, the standard neoclassical approach is adopted in this study.

3. Predicted, instead of actual, wage rate is used for all men in the sample to eliminate sources of measurement error and to purge the wage variable of transitory components. Since all men in the study are in paid employment and report a wage rate, the problem of selectivity bias does not arise. The estimates of the wage equation are reported below.

L_n Husband's Wage: $-1.219 + \underset{(11.97)}{0.164} * \text{Education} + \underset{(3.65)}{0.025} * \text{Experience}$
$\underset{(-1.21)}{-0.0003} * \text{Experience}^2$, $R^2 = 0.49$, N=666.

Figures in parentheses are the t ratios.

4. The likelihood ratio is given by $1 = [L(\omega)/L(\phi)]$, where $L(\omega)$ and $L(\phi)$ are respectively the likelihood values of the constrained and unconstrained models. It can be shown that -2 log(1) is distributed as χ^2 with degrees of freedom equal to the number of constraints (Hausman, 1978).

5. The coefficients of the Tobit model are $\delta y^*/\delta X$. The coefficients $\delta E(y)/\delta x$ may be obtained by multiplying the coefficients of the explanatory variables in the model $(B_i)$by Φ where Φ is the distribution function evaluated at the mean (Maddala, 1983).

APPENDIX

Table A-1

Regression Estimates of Wage Equations

Independent Variable	1	2	3	4	5	6
Education	0.158	0.194	0.198	0.190	0.181	0.175
	(7.13)	(6.05)	(6.00)	(5.70)	(5.30)	(4.91)
Experience	0.125	0.123	0.133	0.133	0.132	0.131
	(5.54)	(5.49)	(4.71)	(4.68)	(4.65)	(4.63)
Exp. square ($\times 10^{-2}$)	-0.292	-0.292	-0.290	-0.275	-0.276	-0.273
	(-3.04)	(-3.05)	(-3.03)	(-2.86)	(-2.87)	(-2.82)
Ed. square ($\times 10^{-2}$)		-0.214	-0.200	-0.187	-0.145	-0.126
		(-1.48)	(-1.37)	(-1.27)	(-0.97)	(-0.81)
Ed. * Exp. ($\times 10^{-2}$)			-0.092	-0.119	-0.100	-0.102
			(-0.58)	(-0.75)	(-0.63)	(-0.64)
Father's Education				0.006	0.012	0.012
				(0.61)	(1.08)	(1.06)
Mother's Education				0.011	0.041	0.042
				(1.13)	(1.60)	(1.64)
F. Ed * M. Ed					-0.002	-0.003
					(-1.26)	(-1.30)
Schooling-Urban						0.051
						(0.57)
Constant	-1.363	-1.548	-1.618	-1.647	-1.671	-1.667
$\bar{R}^2$	0.646	0.647	0.646	0.648	0.649	0.648
F	148.732	112.641	89.933	64.866	57.102	50.647
Specification Test: F-Statistics[a]		2.190[b]	1.250[b]	0.935[b]	1.487[b]	1.348[b]
N	244	244	244	244	244	244

't' values in parentheses

a. F-value for the linear restriction that the additional variables included in the equation have no effect.

b. Not statistically significant at 5 percent level.

Table A-2

Instrumental Variable Estimates of Experience and Children Equations

Variable	Experience	Children <= 7 years	Children 8-19 Years
Asset ($\times 10^{-2}$)	1.209	-0.071	0.006
	(2.84)	(-1.00)	(0.08)
Husband's Wage	14.848	1.577	2.372
	(1.49)	(0.94)	(1.34)
Wife's Age	1.195	0.173	0.609
	(4.20)	(3.63)	(12.10)
Age Square ($\times 10^{-2}$)	-0.886	-0.347	-0.864
	(-2.13)	(-4.98)	(-11.74)
Health	2.156	-0.065	-0.309
	(3.95)	(-0.71)	(-3.20)
Wife's Education	0.357	-0.035	-0.075
	(2.04)	(-1.20)	(-2.42)
Husband's Age	-0.747	-0.043	-0.038
	(-2.27)	(-0.79)	(-0.65)
Husband's Education	-2.250	-0.291	-0.349
	(-1.47)	(-1.39)	(-1.29)
Husband's Ed. x Wife's Education	0.004	0.004	-0.001
	(0.32)	(1.76)	(-0.45)
Other Males	0.411	-0.042	0.017
	(0.93)	(-0.56)	(0.210
Other Females	1.490	0.029	-0.101
	(3.60)	(0.41)	(-1.38)
Religion - Muslim	1.021	0.164	-0.048
	(1.62)	(1.56)	(-0.43)
Location - Rural	-0.837	0.037	-0.046
	(-1.84)	(0.49)	(-0.57)
Number of Rooms	-1.455	0.042	0.075
	(-7.04)	(1.20)	(2.01)
Constant	7.024	1.764	-6.157
$\bar{R}^2$	0.265	0.179	0.401
F (14,651)	18.155	11.355	32.821
N	666	666	666

't' values in parentheses

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