Labour Supply of Married Women - a Model with Permanent and Transitory Variables

A RESEARCH REPORT

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Research Series: No. 121
October, 1976.

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Labour Force Behaviour of Married Women

- A Model with Permanent and Transitory Variables

by

Naresh C. Agarwal*

The labour supply behaviour of married women presents a contrasting picture to that of other groups in the labour force. For example, according to the U.S. decennial censuses, the labour force participation rate of married women has increased by more than 500 percent over the past 70 years; for other labour force groups, the rate has either remained stable or significantly declined. The distinct labour supply behaviour of married women has motivated considerable conceptual and empirical work, more important being the studies by Mincer[1] and Cain[2]. The present study represents an extension of the theoretical approach of these studies.

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*Assistant Professor, Faculty of Business, McMaster University, Hamilton, Ontario. The author wishes to express his gratitude to Dr. Mario F. Bognanno, University of Minnesota for making available the data for the present study and also for his valuable comments on an earlier version of this paper.

[1]Mincer, Jacob. "Labour Force Participation of Married Women. A Study of Labour Supply" in Aspects of Labour Economics, National Bureau Committee for Economic Research, Princeton: Princeton University Press, 1962.

[2]Cain, Glen. Married Women in Labour Force: An Economic Analysis. Chicago and London: The University of Chicago Press, 1966.

Specifically, its chief objective is to introduce a set of permanent and transitory variables in the model of labour supply behaviour of married women. The empirical testing of the expanded model is based on data from 500 nurses registered in the state of Iowa.

Existing Theoretical Framework

The conventional theory of individual labour supply has been developed on the basis of the following assumptions:

a) The worker behaves in order to maximize his family or household utility.

b) The worker has dichotomous use of time: market work and leisure.

c) Leisure is a normal commodity.[3]

Given these assumptions, the theory of labour supply can be viewed as a specific case of the theory of consumer demand. Treating leisure as a commodity and market wage rate its opportunity price, an individual's optimum demand for leisure can be determined. The remaining available time will constitute his supply of hours for work. Figure I clearly illustrates this process Let us assume that OP is the total hours of time available to the individual and OM the total potential income if all the available hours are worked. The slope of the budget line, PM, therefore shows the existing wage rate, i.e. the opportunity cost of one hour of leisure. Given his preference schedule for leisure and labour income, the individual will reach

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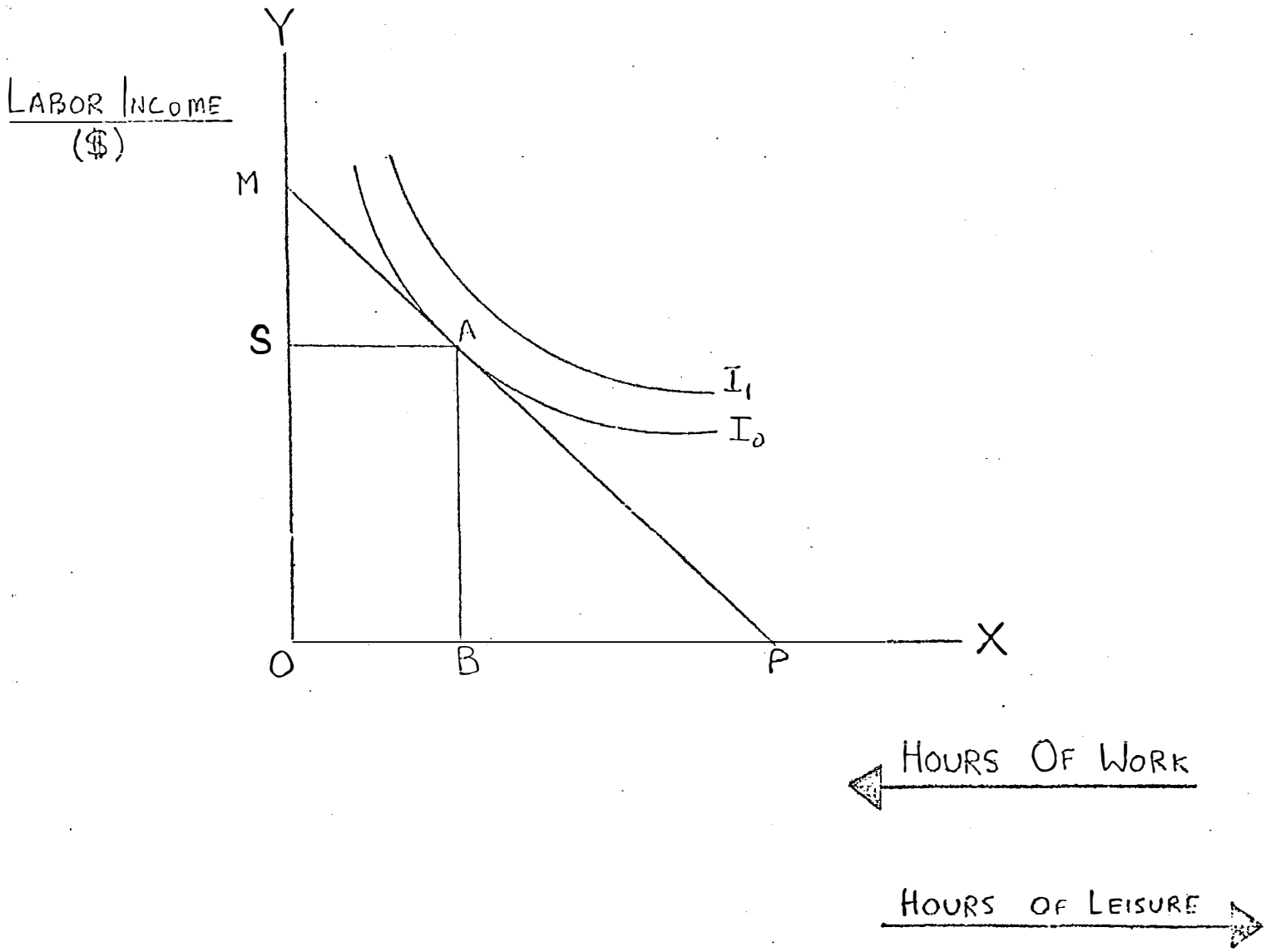
3. It implies a positive income effect, that is,

$$\frac{\Delta \text{ Leisure}}{\text{Leisure}} \Big/ \frac{\Delta \text{ Income}}{\text{Income}} > 0$$

FIGURE - I



equilibrium at point A where the marginal rate of substitution of income for leisure is equal to the slope of the budget line. At this point, the individual prefers a combination of OB leisure and OS income. This means that he will be willing to supply PB (OP - OB) hours for market work. A change in the wage rate will cause a change in the consumption of leisure and thereby a change in the supply of hours for market work via income and substitution effects. An increase in wage rate raises income which will lead to increased consumption of all normal commodities including leisure, i.e. a reduction in hours of work supplied (income effect). At the same time, the increase in wage rate also implies an increase in the price of leisure, relative to prices of other commodities. This will lead to a reduction in consumption of leisure, relative to other commodities, i.e. an increase in hours of work (substitution effect). Thus, the net effect of a change in wage rate on hours of work depends upon the relative magnitude of income and substitution effects. If substitution effect outweighs income effect, an increase in wage rate will increase the supply of hours for work. In the other case, supply of hours for work will be reduced.

The theory of labour supply so stated is appropriate for analyzing labour supply behaviour of adult males and single women but not of married women. It is so because the underlying assumption of dichotomous use of time is unrealistic for married women; in their case, another major use of time, i.e. housework, must be considered. Failure to account for variations in the family's

demand for wife-mother services of married women may bias the estimated effect of changes in wages on her hours for market work. Thus in addition to market wage, a number of other factors such as home productivity, family income and taste for market work also become relevant in analyzing labour supply behaviour of married women. Table I summarizes how these variables have been generally operationalized in previous studies on this subject.

Permanent and Transitory Income and Wage Variables

Permanent wage and family income can be defined as that wage rate and income level which a married woman expects as being " "typical" or "average" over her life time. These expectations are likely to be based on factors such as her and her family members' education level, occupational status and similar other variables. Due to prevailing labour market conditions, the current wage rate and the family income may deviate from their respective expected permanent levels. These deviations can be considered as the transitory wage and income variables. Thus, symbolically,

$$(i) \quad Y_t = Y_c - Y_p$$

$$(ii) \quad W_t = W_c - W_p$$

where Y_t, Y_c and Y_p are transitory, current and permanent family income levels respectively; and W_t, W_c and W_p are transitory, current and permanent wage rates respectively. Thus, a positive value of W_t or Y_t will imply that the current wage rate and family income are above their expected permanent levels. Negative values of W_t and Y_t will indicate the opposite.

TABLE I

A List of Conceptual Variables and Their Operational Measures

Census Data

Conceptual Variable	Operational Measure	Underlying Assumptions
Wife's market wage	Average Hourly Earnings, or == Education Level	Earnings are a constant multiple of wage rate. Higher level of education implies a relatively higher wage rate.
Family income (excluding wife's earning)	Husband's earnings	Non-labour income zero or a constant multiple of husband's earnings.
Family's demand for wife's services in the home.	Number of children below a particular age per family, or ==	Amount of mother's time needed per child is independent of number of children i.e. linear time function.
	Number of families having children below a particular age.	Number of children determined exogenously of family income, and wife's education.
Taste for market work	Number of completed years of education beyond high school, or ==	Quality of education is not important. Number of completed years of education are independent of family income and number of children.
	Location of household	Urban areas reflect a stronger taste for market work.

It can be reasoned that the labour supply behaviour will be influenced by whether a change in family income (or wages) is permanent or transitory. The rationale for distinguishing between the effects of permanent and transitory changes in family income on a married woman's labour supply behaviour lies in the nature of family consumption function. Family consumption is more likely to vary in response to permanent rather than transitory changes in income.[4] In case of a transitory reduction in income, the family may attempt to maintain its consumption level by (a) altering its asset-debt structure, involving borrowing, dissavings, and disaccumulation, and/or (b) increasing the labour force participation of wife (and other secondary workers in the family). Thus, market work by the married woman may serve as a means to maintain family consumption. However, if the income change is permanent, the family may adjust its consumption accordingly, thus exerting less pressure on the wife to vary her market work. This reasoning suggests that family income is likely to be a better predictor of the wife's labour supply behaviour, when it is broken down into its permanent and transitory components.

The justification for distinguishing between permanent (W_p) and transitory (W_t) wage changes lies in the expectation that the relative magnitudes of income and substitution effects are likely to differ in the two cases. A change in W_p will affect both the

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[4] Friedman, Milton, A Theory of Consumption Function, Princeton University Press, 1957.

short term and the long term family income, while a comparable change in W_t will affect only the former. Assuming changes in family consumption to be dependent more on the long term rather than the short term income, the income effect of a change in W_p is likely to be larger than that of a change in W_t. In contrast, the effect of a change in wage rate on the price of market goods relative to hours is independent of whether the change in wage rate is permanent or transitory.[5] Thus one can infer that substitution effect will tend to outweigh income effect for a transitory change in wage; the opposite will be more likely for a permanent change in wage.

A clear application of the above argument is provided by the case of overtime hours offered at premium wage rates - a situation analogous to a transitory wage change. It can be demonstrated that a typical worker in a position of equilibrium labour income and leisure will always choose to work overtime hours at premium wage rate.[6] In Figure II, the initial wage rate is shown by the slope of the exchange line P M. Given this wage rate, the individual reaches equilibrium at A_o where marginal rate of substitution of labour income for leisure is equal to the slope of the exchange line. The individual chooses OB_o hours of leisure and A_oB_o labour income, earned by working PB_o hours. Let us suppose that a

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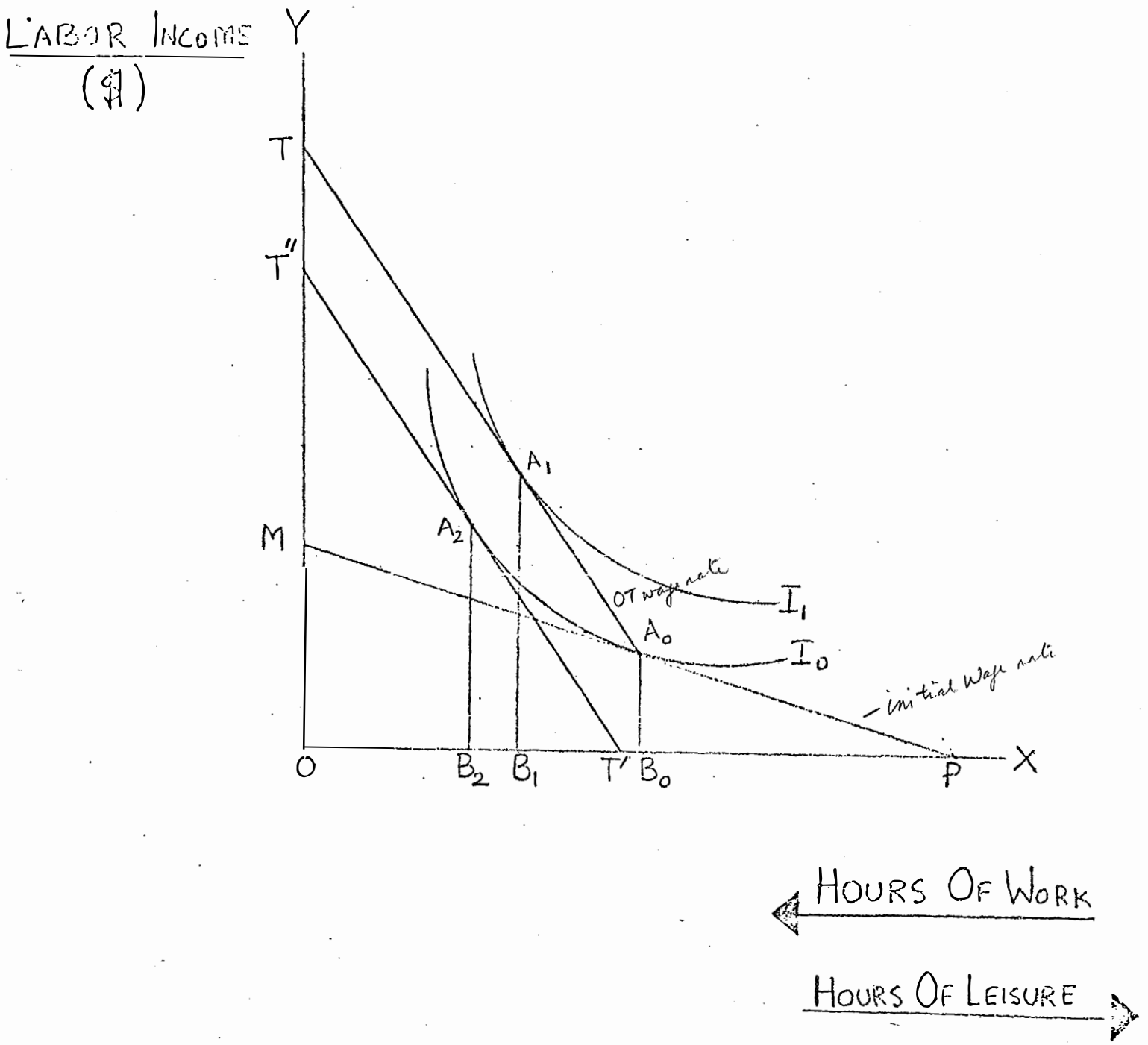
[5] Fleisher, Belton M., Economics of Labor: Theory and Evidence New Jersey, Prentice-Hall Inc., 1970, p. 51.

[6] This will be true even in the case of backward bending labour supply curve. "Overtime rates necessarily embody a much weaker income effect than straight time rates; hence the willingness to work longer hours for an overtime premium is perfectly consistent with a preference for shorter hours at higher straight time rates" T. Aldrich Finnegan "Comment: The Backward Sloping Supply Curve", Industrial Labour Relations Review, Vol.15, January 1962.

FIGURE - II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HOURS OF WORK
HOURS OF LEISURE

temporary opportunity for overtime beyond PB_o now is available at a premium wage rate, shown by the slope of A_oT. The individual is no longer in equilibrium at A_o because at that point, the slope of exchange line A_oT is greater than his marginal rate of substitution of income for leisure. The individual would gain by reducing leisure and increasing his labour income by offering more hours of work. The new equilibrium will be reached at A_1 where the individual consumes OB_1 hours of leisure ($<OB_o$), and earns A B labour income ($>A_oB_o$) by offering PB_1 hours of work ($>PB_o$). Thus, the substitution effect (movement from A_o to A_2) of premium wage rate will always outweigh its income effect (movement from A_2 to A_1). This conclusion should be interpreted only in probability terms for other types of transitory wage changes. The overtime premium wage rate represent only one type of such wage changes. Other types may involve a change in the slope of the wage line over its entire range, implying that the new wage rate applies to all work hours rather than to only the overtime hours. In such cases, there will only be a high probability that substitution effect dominates income effect.

The preceding discussion clearly establishes a case for including permanent and transitory wage and income variables in the analysis of labour supply behaviour of married women. These variables have not been neglected in the past research studies, but the manner in which they were operationalized left much to be desired. Most of the previous studies on the subject have been based on aggregative - census data. Given the nature of these data, both

permanent wage (W_p) and income (Y_p) have been approximated by group averages. In what manner do such averages represent permanent or long run wage and income levels is not entirely clear. Again, unemployment rate has been used as a joint measure of both transitory wage (W_t) and income (Y_t) variables. A rise in the unemployment rate will result in a reduction of the current income (Y_t assuming negative values) which in turn may force the wife and other secondary members to enter the labour market. This has been called the "added worker effect". In this sense, unemployment rate can be treated as a proxy for transitory income (Y_t). The same increase in unemployment also results in excess labour supply. This not only pushes the current wages down but also reduces the prospect of finding jobs, thus causing some workers to withdraw from the labour market. This phenomenon has been called the "discouraged worker effect". In this sense, unemployment rate also represents a proxy for transitory wages (W_t).

However, there may be several problems in using unemployment rate as a composite proxy for transitory wage and income variables. First is the problem of multicolinearity between the dependent variable (labour force participation rate, i.e. L/P) and unemployment rate (U/L). Since labour force (L) appears as a numerator in the dependent variable and as denominator in the unemployment variable, there is a built in negative bias in the relationship between the two variables. Second, unemployment rate may also reflect long run structural factors, rather than exclusively the short-run transitory factors. In so far as this is true, unemploy-

ment rate will cease to be a good proxy for the transitory variables (W_t and Y_t). "If area differences in unemployment represent, in large part, short-run variations in job opportunities, the levels of unemployment in the various areas in, say, 1960 should be positively correlated with changes in these rates from 1959 or from 1958 to 1960. However, I found no correlation with changes from 1959 or from 1958. At the same time, there was a strong correlation ($r = +.8$) between unemployment levels in 1957 and in 1964 in the same areas. The correlation between 1950 and 1960 was not much smaller. The conclusion must be that the unemployment rates in the areas do not reflect short-run transitory components in Y and W-----. Rather, they represent long-run structural differences among areas to which participation adjusts".[7]

Finally, there may be another problem in using unemployment rate as a proxy for the transitory variables. The unemployment statistics are collected on the criterion of "actively looking for work". The "discouraged" workers who have withdrawn from labour force will thus be excluded because they are not actively seeking work. If, however, an offer of job is made to such a worker, he or she will most likely accept it. Thus in this sense, official figures of unemployment may represent underestimates. In the same manner, the figures are likely to be over-estimates because they will tend to include added workers who normally would not be in the labour force.

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[7] Mincer, Jacob. "Labour Force Participation and Unemployment: A Review of Recent Evidence" in R.A. Gordon and M.S. Gordon (ed.) Prosperity and Unemployment, New York: John Wiley & Sons, 1966, p.77.

The Present Study

The present study is based on disaggregated data which makes it possible to include prermanent and transitory variables more directly. Permanent wage and income variables have been estimated through multiple regression analysis, regressing each of these variables on a number of independent variables. Transitory values of these variables have been obtained by deducting the permanent values from their respective current values.

The present study uses the following model to empirically analyze the labour force behaviour force of married nurses.

$$S_m = a_o + a_1 W_p + a_2 W_t + a_3 Y_p + a_4 Y_t + a_5 C + a_6 A_1 + a_7 A_2 + a_8 A_3 + e$$

where

S_m = reported hours of nursing services worked per week by married nurses living with husbands.

W_p = "Permanent" or "expected" hourly wage rate for married nurses. This series was estimated by using a regression equation which included these independent variables: education level of nurses, field of nursing, position or level in the organization, length of service, and some measures of the quality of services provided by the hospitals employing nurses.[8a]

W_t = Transitory wages for married nurses. This series was obtained by taking deviation of the current wage rate from the "permanent" or "expected" wage rate for each nurse.

Y_p = "Permanent" or "expected" income of the husband. The series was estimated by using a regression equation which utilizes

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[8a] This regression equation is a slightly modified version of the one developed by Bognanno, Mario F. "An Economic Study of the Hours of Labour offered by the Registered Nurse". Unpublished Doctoral Dissertation, University of Iowa, 1969. See Appendix A for details.

these independent variables: husband's education level and the type of his occupation.[8b]

Y_t = Transitory income of the husband measured as deviation of the current income from his "permanent" income.

C = Number of children aged six years or below.

A_1 = Nurse's age

A_2 = Nurse's age squared

A_3 = Nurse's age cube

e = Other factors.

The above model is based on a number of assumptions. First, it assumes that the actual hours worked are exactly the same as the hours supplied. Ideally, we are interested in the latter which also includes hours that a nurse may devote in searching for a job. Implicitly, then, the present model assumes zero search hours. Second, it is assumed that wages affect the quantity of labour supplied by married nurses and not vice versa. In other words, wages are treated as an exogenous variable in the present analysis. This implies a specific shape of demand function for nursing services, that is, it is perfectly elastic at any given wage rate. This is the limitation of deriving labour supply curve through a single equation regression model. Finally, several assumptions underlie the operational measures of the various independent variables in the present model. Most of these assumptions have been specified earlier in Table I.

Expected Relationship (Hypotheses)

Wage Changes

An increase in expected or transitory wages will produce

[8b] This regression equation is a slightly modified version of the one developed by Bognanno, Mario F. "Economic Study of the Hours of Labour offered by the Registered Nurse". Unpublished Doctoral Dissertation, University of Iowa, 1969. See Appendix B for details.

hours. Phase I can be characterized as the early post-marriage period in which the nurse may be involved in moving to a new place, setting up the household and child bearing and rearing. Thus, a negative relationship may exist between nurse's age and her supply of nursing hours. Phase II is the next age period in which the major responsibilities at home may stabilize or decline. In that case, a positive relationship may exist between nurse's age and her supply of nursing hours. The positive relationship is likely to continue until such an age (Phase III) when the nurse may again start preferring more leisure to market work. Figure III shows the nature of the postulated relationship. In order to get at this relationship, age was included in the regression model in simple squared and cubic forms. The predicted direction of the three regression coefficients is: a_6 (age) negative, a_7 (age squared) positive, and a_8 (age cubed) negative.

Results

Table 2 summarizes the main results of the present study. Though statistically significant, the proportion of variance explained (R^2) by the present model is only .19. The low value of R^2 is, however, quite consistent with the results of other similar studies based on disaggregative data. For example, Cain[9] analyzed the labour supply behaviour of married women on the basis of the 1958 Growth of American Families Survey data on 2,713 white wives between the ages of 18 and 39 years. Cain used this data both in aggregated (by cities)

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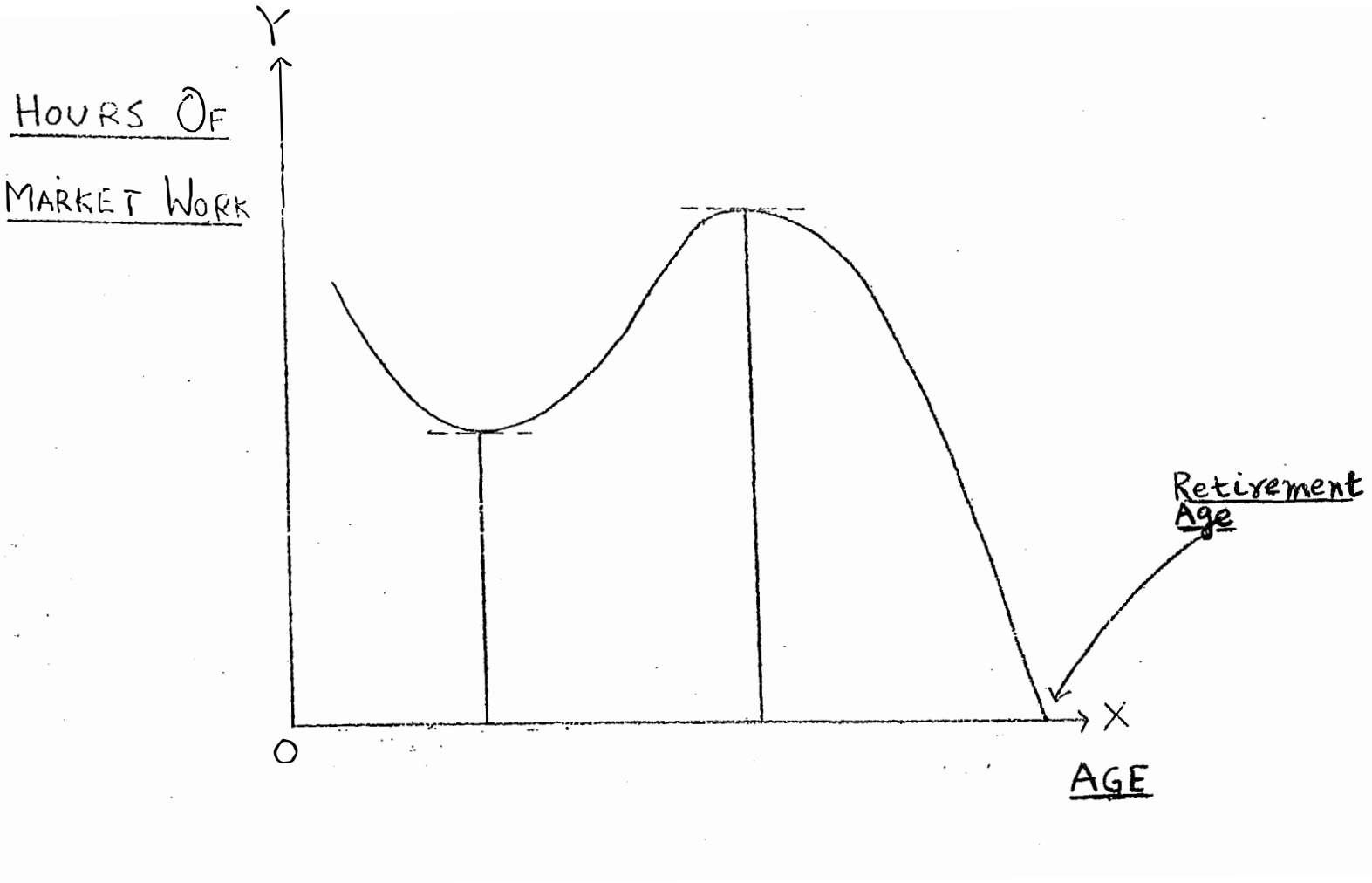
[9] Cain, opp. cit., pp. 89-115

FIGURE — III



Phase I Phase II Phase III

Table 2

Regression results for hours worked per week (S_m) by married nurses.

(N = 500)

	Unit of Measure	Coefficient	"t" Statistic
Constant	Hours/Week	190.11	-
Nurses' expected wage (W_p)	\$/hour	+ 2.01	1.87
Nurses' transitory wage (W_t)	\$/hour	- 0.64*	1.98
Husband's expected income (Y_p)	\$/monthly	- 0.004	1.54
Husdand's tranitory income (Y_t)	\$/monthly	- 0.003*	2.22
Number of children, age< 6 yrs. (C)	-	- 2.03**	3.30
Age of Nurse (A)	Years	- 12.88**	5.64
Age of nurse squared (A_2)	Years	+ 0.32**	5.43
Age of nurse cubed (A_3)	Years	- 0.002**	5.14
R		.437	
R^2		.191**	

* Significant at .05 level

** Significant at and beyond .01 level

and disaggregated forms. In the aggregated case, several regression models were tried with 2 to 4 independent variables. The values of R^2 were found to range from .37 to .73. In contrast, the disaggregated study included 3 to 12 independent variables and the values of R^2 varied between .03 to .21. In the same study, Cain also analyzed the 1960 census data in disaggregated form. Here too, the values of R^2 were found to be very low, ranging from .08 to .19. A more recent study[10] of labour supply of low income female labour utilized an extremely large sample (N=21,000) and a wide variety of independent variables including wage, income, race, residence, age, children and unemployment. Even in this case, the value of R^2 was only .17. Perhaps, the low values of R^2 in these studies result from large inter-individual variability in disaggregated data.

The other results reported in Table 2 can be interpreted as follows:

1. Although the coefficient on expected wage variable just misses statistical significance, its positive direction is consistent with the findings of earlier studies. The coefficient indicates that an increase of one dollar in the expected hourly wage is associated with a weekly increase of 2.01 hours in married nurse's market work. This implies that the positive substitution effect of a change in expected wage more than compensates the negative effect. Several factors may explain this finding e.g. significant increases in the market wage rate for women, increase in their home productivity due to the use

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[10] Kalachek, E.D. and F.Q. Raines, "Labour Supply of Low income Workers", research paper om Technical Studies, The President's Commission on Income Maintenance Programs, 1970.

of more efficient appliances and the reduction in the volume of household work itself.

The relationship between expected wage and nursing hours offered can also be expressed in elasticity terms at the point of means:

$$e = \frac{\Delta \text{ Hours}}{\text{Hours}} \Big/ \frac{\Delta \text{ Exp. Wage}}{\text{Exp. Wage}}$$

$$= \frac{\Delta \text{ Hours}}{\text{Exp. Wage}} \times \frac{\text{Exp. Wage}}{}$$

Substituting the value of coefficient on expected wage, and mean values of expected wage and weekly hours we get,

$$= 2.01 \times \frac{3.18}{29.0}$$

$$= .23$$

Thus, for every 1% increase in W_p, weekly hours offered for market work by a nurse tend to go up by .23 percent.

2. The coefficient on transitory wage, indicates that a dollar increase in it causes a reduction of .64 hours per week in married nurse's market work. It implies that the negative income effect of a change in transitory wages more than outweighs its positive substitution effect. Even though no specific hypothesis was offered in this respect, this finding is somewhat contradictory to the theory outlined earlier. Some speculations may be made here to explain this finding. It may be suggested that perhaps married working women have short term fixed income goals. Once these goals are met, subsequent increases in transitory wages may produce strong negative income effects

resulting in declining hours of market work. In addition, there is the question of the extent to which it is possible for a married nurse to frequently vary her hours of market work. Given that a married nurse also has a housewife's role, it may not be always feasible, as also economically worthwhile, for her to increase her market work off and on just to take advantage of the short term market conditions. Finally, another plausible reason for the negative coefficient on W_t may be the errors in measurement of this variable. In the present study, W_t has been computed by taking the difference between W_c and W_p. Measurement errors may thus arise due to inaccuracies in the reported monthly earnings (W_c) and also due to lack of a complete fit in estimating W_p. Thus, the difference between W_c and W_p may not be fully transitory in nature.

3. The results in Table 2 support the hypothesis of a negative relationship between a married nurse's market work and her husband's income (both permanent and transitory). This implies that leisure is a normal commodity for married nurses so that they increase its consumption as the husband's income rises. The observed coefficient of .004 in case of husband's permanent income (Y_p) indicates that every $250 increase in such monthly income would lead to a one hour reduction in the married nurse's market work. The income elasticity of market work, computed at the point of means, was - .11, implying that 1% increase in the husband's monthly income would be associated with a reduction of .11% in the wife's market work. The estimated coeffecient for husband's transitory income (Y_t) is also negative as hypothesized, and is significant at the .05 level. The implication of this result is that labour force participation by married women

does in fact serve as an alternative means to maintain current family consumption. It should also be noted that the coefficient on Y_t is smaller than that on Y_p[11] indicating that the effect of transitory component of husband's income is somewhat smaller than that of its permanent component. Cain[12], who also obtained a similar result, suggested that lower transitory effect may be partly due to errors in measurement in reported income figures. If present, these would tend to pull down the "true" transitory income effect.

4. Another important finding of the present study relates to the effect of the number of children aged six or below on married nurses' market work. The number of children variable is a proxy for demand for a married nurse's time for household work. The results reported in Table 2 show that an additional child in the said age category tends to reduce his mother's weekly market work by 2.03 hours. The obtained coefficient for this variable is significant at the .01 level and is also consistent with the hypothesis made in this regard.

5. Another demographic variable, namely age was included in the present study to measure married nurses' taste for market work. The age variable was introduced in three forms - age, age squared and age cubed. As Table 2 shows, coefficients on all the three age variables are statistically significant at the .01 level and have,

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[11] Such a comparison is permissible because Y_p and Y_t are measured in the same units.

[12] Opp. cit., p. 14.

respectively, -12.88, +0.32 and -.002 values. The interpretation of these coefficients needs some further mathematical procedures to compute the minimum and maximum values of age at which its relationship with nurses' market work changes directions. The details of the procedures are shown in Appendix C. The minimum and maximum values so obtained are 32.67 and 52.67 years respectively. This implies that up to age 32.67, a married nurse's market work tends to decline as her age increases; this relationship becomes positive over the range 32.67 years to 52.67 years; again, beyond the 52.67 years, the market work tends to decline as age increases.

6. Appendix D indicates the intercorrelations among all the explanatory variables included in the present model. None of the correlations is significant except that between the children and the age variables. In view of this, two additional regression equations were run, each including either age or the children variable. In both cases, there was a statistically significant reduction in R^2. This impies that despite the colinearity between them, both the age and the children variables should be retained in the model.

7. In order to compare the relative importance as determinants of labour supply behaviour of married nurses, partial coefficients of correlations were computed between each independent variable and the dependent variable. These cofficients, presented in Appendix E indicate the number of children below age six and nurses' age to be more significant determinants of married nurses' labour supply than purely economic factors such as wage

rate and income.

Summary

The present study of labour supply behaviour of married nurses represents an extension of the previous research by Mincer[13] and Cain[14]. In addition to the variables in their studies, a set of permanent and transitory wage and income variables were included in the present study. The empirical results point to a negative relationship between changes in transitory wage and married nurses' labour supply. This finding is somewhat contrary to theoretical expectations. Some tentative explanations of this finding were provided, including the likelihood of fixed income goals of married nurses; their limited ability to vary their hours of work to take advantage of the transitory situation in the labour market; and possible measurement errors in generating the transitory wage variable.

Other results of the present study, however, broadly confirm the a priori hypotheses and are also consistent with the findings of previous studies. The permanent wage variable was found to have a positive coefficient, implying dominance of substitution effect over income effect. The present study also found the two demographic variables, the number of children aged six years or below and nurses' age to be significant determinants of labour hours supply behaviour of married nurses. In fact, these variables appeared to exercise greater influence on married nurses' labour supply than economic variables such as wages and income.

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13. Opp. cit.

14. Opp. cit.

APPENDIX A

Regression Equation used in estimating W_p

$$W_p = a + b_1E + b_2F + b_3P + b_4L + b_5HB/N + b_6MD/N$$

Independent Variable	Coeffecient
Constant (a)	4.02
Education (E)	
1 if 2 year degree or 3 year diploma (E_1)	- .4953
1 if 4 year baccalaureate degree (E_2)	- .1276
Field of Nursing (F)	
1 if employed in hospital nursing (F_1)	- .0323
1 if employed in home nursing (F_2)	- .6302
1 if employed in office nursing (F_3)	-1.0480
1 if employed in school nursing (F_4)	- .7767
1 if employed in private duty nursing (F_5)	- .4508
Position (P)	
1 if general duty or staff (P_1)	- .8749
1 if head nurse or assistant (P_2)	- .4851
1 if supervisor or assistant (P_3)	- .3660
Length of service with present employer (L)	.0006
Ratio of hospital beds to number of nurses per county (HB/N)	.0263
Ratio of medical doctors to number of nurses per county (MD/N)	2.1120

Variables E, F and P are introduced in the equation as dummy variables.

APPENDIX B

Regression Equation used in estimating Y_p

$$Y_p = a + b_1 HE + b_2 HO$$

Independent Variable	Coeffecient
Constant (a)	599.70
Husband's education (HE)	
1 if finished high school (HE_1)	38.59
1 if finished college (HE_2)	132.50
1 if finished graduate degree or above (HE_3)	414.30
Husband's occupation (HO)	
1 if skilled laborer (HO_1)	23.37
1 if sales or clerical worker (HO_2)	98.07
1 if small business owner or manager (HO_2)	238.60
1 if manager, executive, government official (HO_4)	182.70
1 if semi professional requiring post high school education (HO_5)	72.80
1 if professional requiring bachelor or a higher degree (HO_6)	190.60

Variables HE and HO are introduced in the equation as dummy variables.

APPENDIX C

Calculation of Age-Inflection Points

$$S_m = 190.1 - 12.88A + 0.32A^2 - .0025A^3 + \ldots\ldots\ldots\ldots$$

$$\frac{dS_m}{dA} = - 12.88 + .64A - .0075A^2$$

Rewriting the above, we get

$$\frac{dS_m}{dA} = - .0075A^2 + .64A - 12.88$$

Applying here the formula for finding roots:-

$$r = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{- .64 \pm \sqrt{(.64)^2 - 4(-.0075)\ (-12.88)}}{2\ (-.0075)}$$

$$= - .64 \pm \frac{\sqrt{.4096 - .3864}}{- .015}$$

$$= \frac{- .64 \pm \sqrt{.0232}}{- .015}$$

$$= \frac{- .64 \pm .15}{- .015}$$

$$r_1 = \frac{- .64 + .15}{- .015} = \frac{- .49}{- .015} = 32.67$$

$$r_2 = \frac{- .64 - .15}{- .015} = \frac{- .79}{- .015} = 52.67$$

APPENDIX D

Inter correlation Matrix of Independent Variables

	W_p	W_t	Y_p	Y_t	C	A
W_p	-					
W_t	.070	-				
Y_p	.065	.017				
Y_t	.100	.056	-.201	-		
C	-.059	-.057	-.024	-.021	-	
A	.072	-.003	-.105	.123	-.544	-

APPENDIX E

Partial Coeffecients of Correlation based on Table 2

Independent Variable	Parital Coeffecient
W_p	.084
W_t	-.089
Y_p	-.064
Y_t	-.099
C	-.147
A_1	-.246
A_2	-.237
A_3	-.225

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