The Relationship Between Household Size, Real Wages, and Labor Force Participation Rates of Men and Women

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OF MEN AND WOMEN

To what extent, if any, does household size affect the labor force participation decisions of men and women in contemporary times? Becker (1965) argues that the allocation of time of any individual in a household depends on one's own opportunities and the opportunities of other household members. Over the past twenty-five years or so, the market opportunities and returns to women have greatly expanded. One could hypothesize, then, that decreasing household size in the United States is due in part to the increasing opportunity costs associated with child bearing.

A further argument could be made that household size is primarily responsible for the demand for household goods and services, from which we can derive the demand for time spent in household production. The purpose of this research is to test the hypotheses that: 1) increasing real wages are negatively correlated with birth rates; 2) household size is negatively correlated with participation rates for both men and women; and 3) that no difference exists between the impact of household on men's and women's labor force participation decisions.
A. Theoretical Development of the Null Hypotheses

The impact of household size and/or fertility on the leisure-market hours trade-off can be shown by maximizing a standard interdependent utility function, where consumption includes purchased and domestically produced goods and services which are a function of time spent in production of household goods. The connecting assumption to be tested is that time spent in production of household goods is positively related with household size, thus causing the participation rate to fall as household size increases.

The basic problem is to maximize an individual's utility

\[ U_i = f(l_i, C_i, U_j) \]  

where \( l_i \) is leisure time, \( C_i \) is the value of the individual's consumption, and \( U_j \) is the utility of the \( j \)th person(s) in the household. Including the utility of the \( j \)th person forces interdependence of utility between family members.

Leisure time within the utility function is simply defined as:

\[ l_i = T - (T_w + T_{1HP}) \]  

where \( T \) is total time available, \( T_w \) is time spent in wage earning, and \( T_{1HP} \) is time spent in individual non-wage production of household goods and services, noting that some of \( l_i \) and \( T_{1HP} \) may be time spent jointly with other household members.

Individual consumption, \( C_i \), is composed of purchased goods and services, \( x_i \), and the money value of goods and services produced by the household, \( Z_i \). The value of \( C_i \) can be expressed as:
\[ C_i = P x_i + Z_i \] (3)

where \( P \) is the price of consumer goods and services. The value of \( Z_i \) is assumed to be equal to the opportunity costs (disposable wages forgone) associated with the hours spent on household production, \( Z_i = w_i' T_{iHP} \), where prime values indicate disposable wages and income. The value of household production of goods and services can be expressed as:

\[ Z = w_i'T_{iHP} + w_j'T_{jHP} \] (4)

which implies that \( Z = Z_i + Z_j \).

A production constraint is imposed on (4) through the time identity in (2). A budget constraint is imposed on consumption of \( x_i \) in that

\[ P x_i = C_{p_i} = Y_d - (S + C_{pj}) \] (5)

where \( Y_d \) is the disposable income of the household, \( S \) is household saving, and \( C_{pj} \) is purchased consumption by the jth person(s).

The time constraint is directly tied to a budget constraint

\[ Y_d = (T_{i} w_i + T_{j} w_j) + Y_{ct} + Y_a - \text{Taxes} \] (6)

where disposable household income depends directly on the time allocated to market hours by the ith and jth persons, the respective wages of these persons (\( w_i \) and \( w_j \)), transfers (\( Y_{ct} \)), asset income (\( Y_a \)) and taxes (Keeley, 1981). Through the optimization process, optimal market, household production, and leisure hours are jointly determined. We can break the problem down to the very simple expression \( T_{iHP} = T - (1_{i} + T_{1w}) \) where \( T \) is fixed.
The demand for time in any of these three categories is derived from the variables in the utility function. Given the primary interests of this research, the utility of the jth individual, and the market hours of the jth person are of key importance. If the number of j persons increases in the household, then the number of hours spent caring for these persons will likely rise. This assumes that the time intensity of family care, which may or may not be linear over some range of j persons, is always positive. The need to allocate additional hours to household production will reduce optimal leisure and/or market time due to the finite nature of time. If the ith person reduces market time, then purchased consumption for all persons in the household will fall, assuming that households pool all income.

On the other hand, if the ith person reduces individual leisure, then the utility of all persons in the household will fall due to the interdependence of utility functions. Therefore, whether increasing household size causes decreases or increases in market hours and participation by one or all eligible persons in the household depends on the relative magnitude of the coefficients associated with leisure, consumption, and $U_j$.

If there are diminishing returns associated with each of these activities, then increasing household size increases competition for consumption goods, which increases the marginal utility of purchased consumption for each individual. This same process causes the marginal utility of all time uses to increase, although by possibly different rates. The activity which will ultimately
receive more time is the one with the highest marginal utility, which implies that one or both of the competing uses will receive less.

We can present these opposing effects of increasing household size graphically by assuming that $T'$, the amount of time to be allocated between the market and leisure in a typical consumption-leisure model, falls to $T''$ due to increasing $T_{\text{HRP}}$. If this occurs, then the reservation wage will rise, causing participation rates to fall for any given level of non-wage income and expected wage, assuming a fixed set of indifference curves. This effect is shown in Figure 1. A countering effect occurs because the marginal utility of consumption has increased over the entire range of possible consumption opportunities. This causes the indifference curve to flatten out, thus lowering the reservation wage and increasing participation, assuming that the marginal utility of leisure rises by less than the marginal utility of consumption. This adjustment in the indifference set also assumes that all non-earned income in the family is pooled and unchanging. This effect is shown in Figure 2. Both Figures 1 and 2 assume constant time intensities for leisure and work to finance consumption.
Figure 1. Impact on the reservation wage due to increasing demand for household production.
B. The Empirical Model

The first hypothesis can be tested in a straightforward manner, by explaining live births per 1000 population (BIRTH) as a function of real wages and other variables which capture social variations between states. Several variables were tested; however, the most significant of these were the percentage of the population classified as hispanic and/or black (MIN), and percentage of the population over the age of 65 (AGE).
Panel data from all 50 states over the period 1985 to 1989 were used to test this hypothesis. A random-effects model was selected on the basis of a Hausman specification error test which showed that the fixed-effects model had a probability of specification error of .069, given a chi-square of 7.08, df=3.

We can test whether marginal utility of purchased consumption is greater-than or less-than the marginal utility of increasing household production as \( j \) increases, the second hypothesis, by evaluating the relationship between household size and the labor force participation rate, assuming that the marginal utility of leisure is constant. To do this, we must first develop a basic model of labor force participation. The first assumption is that the reservation wage is a function of average non-wage income, which can be simply defined as the average transfer payment plus average asset income.

Further, the expected wage for the representative individual is the average wage, conditioned by the probability of receiving that wage. The probability of receiving a given wage can be defined as one minus the unemployment rate. The discussion above assumes that the indifference set remains constant in shape and placement.

With the information above, the structural model becomes

\[
LFPR = p(E(w), \bar{w}_r), \quad (7)
\]

\[
E(w) = (1-UN) \bar{w}, \quad (8)
\]
Given that this model is for a representative (average) individual, there exists a distribution around both the reservation and expected wages. Therefore, as these mean values start to converge, we would expect to observe greater overlap in their respective distributions, thus causing observed aggregate participation rates to fall.

Cross-section data for all fifty states in 1990 were used to test the second and third hypotheses. Panel data were not used due to the fact that accurate household size data are only available through the decennial census. It was decided that using the birth rate as a proxy for household size would not be appropriate as household size is determined by several factors not captured by the birth rate.

When testing for correlation between participation rates (LFPR) and household size (HHS) with these data, it is important to control for variations in income and other social differences between states.

The budget constraint was somewhat difficult to set up due to the fact that asset income variables by state were not available. Therefore, median household income (MHI) was used on the assumption that it captures variations in all forms of income.

Given that unemployment rates, participation rates, and median household income are simultaneously determined in the market, fitted values of UN and MHI must be obtained to avoid simultaneity bias. The set of instruments that were used to estimate this two-
stage least-squares model included the percentage of employment in the manufacturing, service, and agricultural sectors; percentage of the population over age 65; percentage of the population with four-year college degrees or more; percentage of the population identified as black and/or hispanic; percentage of manufacturing workers under union contracts; a dummy variable designating whether the state is a right-to-work state; state employment ratio; and state population. The AGE variable was also included in the estimated structural equation due to its significant explanatory power.

C. Results

The empirical results fail to reject the hypothesis that BIRTH is negatively correlated with real wage rates. This result supports the time allocation theories forwarded by Becker (1965), which include the general argument that the real wage represents the opportunity cost of time spent in rearing children. The results of the random-effects model are provided below in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>RWAGE</td>
<td>-0.00431</td>
<td>-3.02</td>
</tr>
<tr>
<td>MIN</td>
<td>2.513</td>
<td>1.69</td>
</tr>
<tr>
<td>AGE</td>
<td>-63.693</td>
<td>-9.53</td>
</tr>
<tr>
<td>C</td>
<td>24.51</td>
<td>24.99</td>
</tr>
</tbody>
</table>

$R^2 = .30$

$\theta = .04$
Empirical analysis fails to reject the second hypothesis, that a negative relationship exists between household size and participation rates, but only for combined and female participation rates. In both of these cases a significant negative relationship exists between household size and the participation rate. No significant relationship exists, however, between household size and male participation rates, which allows us to reject the third hypothesis that the HHS impacts on men and women are equal. Results of the combined, male, and female models are presented as Tables 2, 3, and 4 below.

### Table 2—Combined Labor Force Participation as a Function of Household Size and Other Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>( t )-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHI</td>
<td>.0000024</td>
<td>2.16</td>
</tr>
<tr>
<td>UN</td>
<td>-3.047</td>
<td>-5.25</td>
</tr>
<tr>
<td>AGE</td>
<td>- .907</td>
<td>-3.36</td>
</tr>
<tr>
<td>HHS</td>
<td>- .117</td>
<td>-2.71</td>
</tr>
<tr>
<td>C</td>
<td>1.18</td>
<td>7.78</td>
</tr>
</tbody>
</table>

\( R^2 = .45 \)

F-statistic = 15.68
TABLE 3--MALE LABOR FORCE PARTICIPATION AS A FUNCTION OF
HOUSEHOLD SIZE AND OTHER VARIABLES

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHl</td>
<td>.0000013</td>
<td>.33</td>
</tr>
<tr>
<td>UN</td>
<td>-2.60</td>
<td>-3.61</td>
</tr>
<tr>
<td>AGE</td>
<td>-.859</td>
<td>-2.56</td>
</tr>
<tr>
<td>HHS</td>
<td>-.066</td>
<td>-1.23</td>
</tr>
<tr>
<td>C</td>
<td>1.14</td>
<td>6.04</td>
</tr>
</tbody>
</table>

R² = .28
F-statistic = 7.05

Table 4--Female Labor Force Participation as a Function of
Household Size and Other Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHl</td>
<td>.000003</td>
<td>2.34</td>
</tr>
<tr>
<td>UN</td>
<td>-3.39</td>
<td>-5.06</td>
</tr>
<tr>
<td>AGE</td>
<td>-.99</td>
<td>-3.16</td>
</tr>
<tr>
<td>HHS</td>
<td>-.152</td>
<td>-3.06</td>
</tr>
<tr>
<td>C</td>
<td>1.20</td>
<td>6.86</td>
</tr>
</tbody>
</table>

R² = .46
F-statistic = 15.21

D. Interpretation of Results

A significant negative relationship exists between real wages and fertility, accounting for variations between states. These results support the relationship predicted by Becker (1965), and
Layard and Mincer (1985), that increasing wage rates provide a disincentive for having additional children. Given this information, we can explain that decreasing household size is due in part to increasing real wage opportunities for women.

The results presented above also show that while a negative correlation between household size and labor force participation exists for women, no significant relationship between these variables exists for men. This information supports the continuing existence of traditional roles of men and women in the family. It is also interesting to note that household income is also insignificantly correlated with male participation rates, which further supports the notion of the "traditional" male role of market participation, regardless of the domestic situation.

Additional information that can be extracted from these results includes the fact that a positive relationship exists between female participation and household income. We cannot discover anything about the direction of causality given the cross-sectional nature of the data. However, theory suggests that the appropriate explanation is that as women enter the labor force, household income rises. If women entered the labor force due to increasing income, this would imply that increasing non-wage income, which increases the reservation wage, increases the probability of female participation. Clearly, this is not logical.
E. Summary

The findings of this research show that while household size is negatively correlated with labor force participation rates for women, no such relationship exists for men. These findings support the notion that traditional sex roles continue to exist in households related to market work. Real wage rates are negatively correlated with the number of live births per 1000 during the period 1985 to 1989 among the fifty states. This suggests that real wages represent an opportunity cost of bearing children.
Appendix

All data related to wages, labor force participation, and employment by sector were collected from Employment and Wages: Annual Averages or Geographic Profile of Employment and Unemployment published by the Bureau of Labor Statistics. Tax data were collected from the District of Columbia which completes a yearly cross-sectional study of effective tax rates in a publication called Tax Rates and Tax Burdens in the District of Columbia: A Nationwide Comparison. The number of live births per 1000 population, by state of residence were collected from Vital Statistics of the United States, which is published by the U.S. National Center for Health Statistics. Household Income Data are from Current Population Reports, series P-60, Number 174. Household size data are from the 1992 Statistical Abstract of the United States, table 60. Data for all remaining variables were collected from the Statistical Abstract of the United States.
REFERENCES

