

**How Does Household Production Affect Earnings Inequality?
Evidence from the American Time Use Survey**

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Abstract

Although income inequality has been studied extensively, relatively little attention has been paid to the role of household production. Economic theory predicts that households with less money income will do more household production. Thus extended income, which includes household production, should be more equally distributed than money income. We find this to be true, but not for the reason predicted by theory. Virtually all of the decline in measured inequality when moving from money income to extended income is due to the addition of a large constant--the average value of household production--to money income. We also find that inequality measures are robust to alternative assumptions that can be made when generating estimates of household production.

I. Introduction

Inequality of earnings and inequality of household income have increased over recent decades, both in the United States and to a lesser extent in other industrialized countries (see Gottschalk and Smeeding 1997 for a review). In response to these developments, there has been an outpouring of research describing and trying to explain these trends. Most of these studies concern inequality in money income, where data are more readily available. However, money income is not a complete measure of economic welfare. Recent studies have attempted to describe inequality along other dimensions--for example, inequality in consumption (Johnson and Shipp 1995, 1997, and 2005; Krueger and Perri 2002) and in total compensation including fringe benefits (Pierce 2001).

Another branch of the inequality literature has incorporated the value of household production into measures of income to arrive at “extended income.”¹ This measure is sensible, because home production represents additional “income” that is available for consumption but is not included in standard measures of income. Assuming that all individuals have identical preferences and are equally productive in nonmarket work, household production models (for example, Gronau 1986) predict that high-wage workers will spend less time on nonmarket work than low-wage workers.² Extending this model to two-person households generates analogous predictions for married couples. An increase in one spouse’s wage will reduce the time that the other spouse spends in both market (if employed) and nonmarket work. It is also easy to show that, holding constant the highest wage, one-earner couples spend more time in household

¹ We use the same definition of extended income used in Jenkins and O’Leary (1996). Wolff, et al. (2004) use a somewhat different definition.

production than two-earner couples. All of these predictions lead us to expect a negative correlation between money income and time spent in household production, which implies that extended income will be more equally distributed than money income.

The ideal data for comparing these income measures would include information on income and household production for every member of the household. But time-use surveys, which are the main source of data on household production, typically have little or no income data. Moreover, time-use surveys typically collect data for only one or two days, which results in an incomplete picture of household production. Activities that are done infrequently, while accurately captured at the aggregate level, are missed at the individual level. And many time-use surveys collect data from only one household member, which gives an incomplete picture of household production at the household level.

The studies to date have taken different approaches to addressing these deficiencies. Studies by Bonke (1992), and Jenkins and O’Leary (1996), using UK data, and Wolff, Zacharias, and Caner (2004), using Danish, UK, and US data, overcame the missing data problem by using regression techniques to impute the time spent in household production. These imputation procedures smooth over the individual variation in the data and reduce measured inequality, although the Jenkins and O’Leary study perturbed the data by added a random term to the imputed values. In a more recent paper, Bonke, Deding, and Lausten (2004) multiplied each respondent’s average hours per day spent in household production by 365. This approach tends to magnify the individual variation, because it also reflects day-to-day variation given that the data contain only one or two diaries per person.

² For more details, please see the Appendix, which presents the Gronau (1986) model, extends the model to two-person households, and discusses the assumptions that drive these results.

The most common approach to the lack of income data is to match imputed values of household production to a dataset that has income data. For example, Jenkins and O’Leary (1996) matched imputed values of household production from the 1987 Social Change and Economic Life Survey to the UK 1986 Family Expenditure Survey (FES) based on individual characteristics, and Wolff, et al. (2003,2004) matched household production estimates from University of Maryland time-use surveys to the March CPS. The main drawback of this approach is that, because the time-use datasets do not have income information, income cannot be used as a covariate in the imputation process. An alternative that is usually not available is to match income data from administrative records to the time diary data. For example, Bonke (1992) was able to use income data from the register of income taxation for the respondents in the time-use survey.

One study that avoided these problems is a study by Gottschalk and Mayer (2002). They used data from Panel Study of Income Dynamics (PSID), which contains information on earned and unearned income as well as a measure of the usual amount of time spent doing household work. The drawback to this approach, as they acknowledge, is that the measure of household production leaves much to be desired. The question does not define household production, which could result in biased estimates if there are systematic differences in how respondents report. Because the question asks about time usually spent doing housework, it may be subject to recall and social desirability biases.

These studies find, as theory predicts, that the distribution of extended income is more equally distributed than money income.³ Interestingly, Jenkins and O’Leary found that the

³ Bonke (1992) found that when taxes are incorporated, extended income is less equally distributed than money income.

correlation between income and household production is essentially zero, although this may be an artifact of their inability to use income as a matching criterion.

In this paper, we use data for 2003 from the American Time Use Survey (ATUS) to construct measures of earnings inequality that include the value household production. Our paper makes two main contributions to the debate. First, although it is still necessary to impute the value of household production to fill in missing data, our imputations are an improvement because ATUS makes it possible to include earnings as a covariate in the imputation process. Second, we perform a number of sensitivity analyses that determine the extent to which these imputation procedures are likely to matter.

II. Methods

Ideally, we would have a long-run measure of household production corresponding to the time period of our income measure (in this case, annual). But the ATUS interviews only one person per household and collects only one diary per person. Thus, we can only estimate means of household production conditional on observable characteristics. We use Bonke's (1992) method of predicting household production by regression. We regress the value of household production on the log of annual family income, the log of weekly earnings, the log of non-labor income, the log of the hourly wage, dummies for employment status (2 categories), education level (4 categories), age, and the number of children zero to 5, 6 to 12, and 13 to 17. We run separate regressions by marital status and sex. For married respondents, we also include the log of spouse's weekly earnings, and log of the spouse's wage, and dummies for spouse's employment status, education level, and age.

Because of our interest in household production by income, we use a flexible specification for the log of family income. Specifically, we use Gallant's (1981) Fourier series

expansion. Transforming the log of family income into the variable $Z \in (0, 2\pi)$ and letting X denote the vector of regressors listed above, our Fourier specification is:

$$(1) \quad f(Z, X) = a + bZ + cZ^2 + \sum_{j=1}^J (\beta_{1j} \cos(jZ') + \beta_{2j} \sin(jZ')) + X\beta,$$

A function's Fourier expansion has the property that the differences between the true value of a function g and the value of its Fourier expansion f and between the derivatives of g and the derivatives of f can be minimized to an arbitrary degree over the range of the function by choosing J to be sufficiently large. It thus provides a global approximation to the true function, rather than a local approximation (as in a Taylor series expansion). We selected J by cross-validation, minimizing the sum of the squared prediction errors $\sum (y_i - \hat{y}_{-i})^2$, where $\hat{y}_{-i}$ is the leave-one-out prediction generated by omitting observation i from the regression.⁴

Using the flexible functional form in (1), we estimate the following equation to impute household production:

$$(2) \quad P_{it}^d = f(Z_i, X_i) + u_i^d \quad (d = D, E),$$

where separate equations were estimated for weekdays (D) and weekends (E) for each sex $\times$ marital status cell (8 regressions total). For each cell, we combine the predicted values from the weekday and weekend equations to generate imputed weekly value of household production for person i as follows:

$$(3) \quad \hat{P}_i = 5\hat{f}_D(Z_i, X_i) + 2\hat{f}_E(Z_i, X_i),$$

where X is appropriately defined. For married households, total household production is simply the sum of the husband's and wife's predicted values.

This imputation procedure eliminates deviations from mean household production. Because the absence of these residuals could bias estimates of income inequality, we assess the potential bias by adding a random perturbation and recomputing the inequality measures. The first step is to come up with an estimate of the upper bound for the variance of the long-term household production that was eliminated in the imputation procedure. It is useful to decompose the residual in (2) into two components as follows:

$$(4) \quad P_{it}^d = f_d(Z_i, X_i) + (m_i^d + e_{it}^d) \quad (d = D, E),$$

where the residual is equal to the sum of a person-specific fixed effect (m_i^d) and a term denoting day-to-day variation (e_{it}^d).⁵ If the $\text{Var}(m_i^d) = 0$, the residual consists entirely of day-to-day variation in household production, and our imputation procedure will generate consistent estimates of long-run household production for each observation in the sample, which in turn will result in consistent estimates of inequality measures for extended income. However, if $\text{Var}(e_{it}^d) = 0$, the residual consists entirely of a person-specific fixed effect. In this case, our procedure will underestimate the variability of long-run household production across households, and usually generate downwardly biased inequality measures.

We can use the residuals from (2) to place an upper bound on the variance of long-run household production. Letting σ_d ($d = D, E$) denote the standard deviation of the residual in (2) for weekdays and weekends, the maximum possible variance for long-run weekly household production (i.e., assuming $\text{Var}(e_{it}^d) = 0$) is $M = (5\sigma_D + 2\sigma_E)^2$. The true variance of long-run

⁴ Andrews (1991) shows this criterion is asymptotically optimal in the sense that the probability of choosing the J that minimizes the expected sum of squared errors converges to 1 as the sample size increases, even in the presence of heteroscedasticity.

⁵ More precisely, m_i is the long-run average of $P_{it} - f(X_i, Z_i)$. We do not assume that the e_{it} are independent across time.

production around its predicted value will fall between these two extremes. Perturbed values of imputed household production for single-person households are given by:

$$(5) \quad P_i^S = 5\hat{f}_D(X_i) + 2\hat{f}_E(X_i) + ks_i,$$

where $0 < k < 1$ and s_i is drawn from $N(0, M)$.

For married-couple households, the maximum possible variance for long-run production across married couple households occurs when the residuals for spouses' production are perfectly positively correlated. Extending the definition of the maximum residual variance M to include spouses, we have: $M' = (5[\sigma_{Dw} + \sigma_{Dh}] + 2[\sigma_{Ew} + \sigma_{Eh}])^2$ where σ_{ds} is the standard deviation of the residuals from (2) and subscripts denote day of week ($d = D, E$) and spouse ($s = w, h$) Total production is

$$(6) \quad P_i^M = 5\hat{f}_{Dw}(Z_i, X_i) + 2\hat{f}_{Ew}(Z_i, X_i) + 5\hat{f}_{Dh}(Z_i, X_i) + 2\hat{f}_{Eh}(Z_i, X_i) + ks_i',$$

with s_i' drawn from $N(0, M')$. We recomputed our inequality measures assuming $k = 0.25$, $k = 0.50$, and $k = 1.0$ for both singles and married couples.

III. Data and Definitions

The ATUS sample is a stratified random sample that is drawn from households that have completed their participation in the Current Population Survey (CPS), and is representative of the U.S. civilian population. The ATUS collects information on the amount of time spent in over 400 detailed activities. The ATUS time diary does not collect information about what else the respondent was doing at the time of each episode (secondary activities), but several summary questions asked at the end of the diary collect information about times and activities during which children under 13 were in their care.

ATUS also contains labor force information that is comparable to that the CPS, including employment status, usual hours worked per week, and earnings on the main job.⁶ For the respondent's spouse or unmarried partner, the ATUS collects basic labor force information--employment status (employed or not employed) and total hours usually worked per week. Earnings are available from the CPS if the spouse was employed at the time of the last CPS interview. ATUS does not collect any labor force information for other household members.

We divide the sample into single-adult and married-couple households. Our sample of single-adult households includes respondents ages 25-64 who had no spouse or unmarried partner present. Our married-couple sample includes households where both spouses are between 25 and 64. We excluded households with other adult (18+) family members in order to avoid the need to estimate the contribution of the other adult to household production.

Finally, to obtain data on unearned income, we matched the ATUS data to the March supplement. Because of the 4-8-4 rotation scheme used in CPS, only about one-third of respondents--those whose final CPS interviews were in March-June--were interviewed in March.⁷ Family income and non-labor earnings variables for the remaining two-thirds of the sample are predicted by regression using variables common to both the ATUS and the March CPS. Households with allocated family income data were excluded from the sample, and family incomes below the 1st percentile were replaced with the 1st percentile value.

Our sample consists of 10,034 observations that fit our sample inclusion criteria. Of these, 3,363 observations had income data available from the March supplement and 2,666 of

⁶ The earnings data are carried over from the final CPS interview. The earnings questions are asked in ATUS if the respondent had a new job in ATUS (either changed jobs or made a nonemployment-to-employment transition) or earnings were allocated in the last CPS interview.

these had unallocated earnings. Our first step was to use these 2,666 observations to estimate (2) for each of the sex $\times$ marital status $\times$ day cells, and determine the optimal value of J in (1).⁸ Next, we reestimated (2) over the entire sample using the optimal value of J .⁹ For this regression, we imputed income for observations that could not be matched to March or had allocated income in March.¹⁰ Coefficient estimates from this regression were used to generate imputed values of household production in (3). Our extended income measure is computed for the 3,363 values matched to the March supplement as the sum of family income from March, including allocated values, and imputed household production.

For our analysis, we used two alternative definitions of nonmarket work, which we define using the third-person criteria (Reid 1934). The first definition includes household activities (including purchasing goods and services) and care of household members done as a primary activity.¹¹ The second definition is the same, but adds child care done as a secondary activity. To avoid double counting in the second definition, we excluded secondary child care that was done at times when the respondent was engaged in household production as a primary activity.¹²

We use the replacement-cost approach to value household production. Under this approach, time spent in household production is valued at either a specialist wage that

⁷ Households are in the CPS for 4 consecutive months, out for 8, then back in for 4. Because of the lag between the final CPS interview and introduction into the ATUS, most of the ATUS respondents who were matched to March were interviewed for ATUS in June through September.

⁸ The number of observations for these regressions ranged from 180 (for single men on weekdays) to 468 (married women on weekends).

⁹ For these regressions, the sample sizes ranged from 599 to 1,831.

¹⁰ Family income was imputed using predicted values from a regression of income on covariates. As noted in Greene (2000, p. 363), including observations with imputed family income increases does not change the coefficient on the family income data, but it does increase the precision of the coefficients on the other variables.

¹¹ We exclude volunteer work and care of non-household members from all of our measures. These activities could legitimately be classified as nonmarket work, but they do not contribute directly to the household's income. In any case, the time spent in these activities is small, and their inclusion would have no effect on our results.

¹² The implicit assumption is that it is possible to hire someone to do household chores and look after household children. Alternatively, one could assume that it would be necessary to hire two people--one to do the housework

corresponds to the specific activity or a generalist wage. The specialist wages were generated using the Outgoing Rotation Group files from the CPS. We computed the hours-weighted mean wage for each 3-digit occupation. The time spent in each nonmarket activity was valued at the wage for the occupation that most closely resembles the activity.¹³ For the generalist wage, we used the average wage for Maids and Housekeepers (4230). We made no adjustments to account for differences in productivity in household production across households, although the lower productivity of non-specialists is a primary justification for using a generalist wage.¹⁴

We considered using other approaches to valuing household production. The opportunity-cost approach, which uses the individual's market wage to value the time spent in household production, has some conceptual and practical difficulties associated with it. On a conceptual level, the implicit assumption that hours of paid work are freely variable at the margin may not hold; workers, at least in the short run, may have no choice in their working hours. Perhaps more importantly, the opportunity cost approach assumes that people who are highly productive in market work are just as productive doing household work. It is hard to imagine that lawyers are 5 times more productive building a deck than a carpenter. On a practical level, it would be necessary to impute a wage for nonworkers. Another approach, taken by Gronau (1980), is to specify a functional form for the marginal product of nonmarket work, estimate the parameters of the function using time-diary data, and integrate the function for each

and one to look after the children. Given that individuals routinely perform these tasks simultaneously, the former assumption makes more sense.

¹³ This crosswalk is available from the authors upon request.

¹⁴ For example, Wolff et al. (2004) multiplied this wage by a performance index that depends on household-level characteristics as well as characteristics of household members.

individual in the sample.¹⁵ This approach has the advantage of being based in theory, but it is sensitive to the functional form of the production function.

Finally, because we are comparing extended income across households of different sizes, we adjusted extended income measures using two alternative equivalence scales. The first is the OECD equivalence scale (OECD, 2005), which is given by: $E = I / (1 + 0.7A + 0.5C)$, where A is the number of adults in the household (either one or two in our case) and C is the number of children less than 18. The second is: $E = I / \sqrt{N}$, where E is equivalent income, I is the income measure, and N is household size.

IV. Results

Table 1 shows person-weighted estimates of mean household earnings and household production for the four definitions of household production.¹⁶ Under all measures, household production is a substantial fraction of household money earnings, from 30 percent (using the generalist wage and excluding secondary childcare) to 46 percent (specialist wages and including secondary childcare). Put differently, household production comprises 23-32 percent of combined labor earnings and household production. Married households do more household production than do single households, with household production comprising 31-49 percent of money income for married couples compared to 24-33 percent for singles.

Table 2 shows results for four inequality measures: the Gini coefficient and the ratios of the 90th to the 50th percentile, the 50th to 10th percentile, and the 90th to the 10th. Moving from money income to extended income substantially reduces measured inequality. The Gini

¹⁵ Gronau points out that an alternative approach in the same vein is to specify a functional for the home production function, and then solve for the marginal product function.

¹⁶ All of our estimates are person weighted, rather than household weighted.

coefficient falls by about one-quarter whether the OECD or the square root scale is used. The effect on the 50/10 ratio is also quite dramatic, with the ratio falling by about one-third under both scales. The effect on the 90/50 ratio is somewhat smaller, with the ratio falling by about one-fifth under both scales. (All of these differences are statistically significant at the 1 percent level.) The larger effect on the 50/10 compared with the 90/50 ratio is not surprising, because we would expect household production to be a larger fraction of extended income for those lower in the money income distribution.

Relative inequality measures such as the Gini coefficient will always fall if a positive constant is added to the income of all members of the population. Jenkins and O'Leary (1996) pointed out that inequality of extended income is positively associated with the variance of household production and the correlation between money income and household production. In our data, this correlation ranges from -0.10 to 0.20 across extended income measures and equivalence scales, with the correlation positively associated with using specialist wages and negatively associated with inclusion of the value of secondary childcare. Gottschalk and Mayer (2002) also found a weak relationship between money income and household production, with high-money-income households spending more time in household production. This would seem to imply that including household production should increase measured inequality. But the value of household production is a larger fraction of money income for low-income households than for high-income households, and this effects dwarfs differences in the amount of time spent in household production by income level.

We investigate this further by adding the mean household production (normalized across households by the equivalence scale), rather than imputed household production, to household money income (row 3 of Table 2). Adding mean household production accounts for by far the

greatest portion of the effect of household production on inequality measures. None of the extended income measures that use predicted household production (row 2) produce an inequality statistic that is below the mean-household-production measure (row 3) by a statistically significant amount. In most cases point estimates for the constant-added measure are below the corresponding estimates using predicted household production, in many cases by a statistically significant amount.

Rows 4-6 of Table 2 show the effect of adding random disturbances to predicted household production as in (5) and (6). We will focus on the results in rows 4 and 5, because the results in row 6 were generated assuming the maximum possible variance of household production and are intended to be illustrative only. Adding the disturbances will increase the variance of household production but reduce the magnitude of the correlation with money income, so the direction of the effect is ambiguous if the correlation is negative. In most cases adding the disturbance increases the inequality of extended income, frequently to the extent that the inequality measures in rows 4-6 are statistically significantly greater than the constant-household-production measure in row 3. However, the differences for rows 4 and 5 ($k = 0.25$ and $k = 0.50$) are rather small and are not economically significant.

The inclusion of secondary childcare and to a lesser extent the use of specialist rather than generalist wages both tend to reduce measured inequality. In both cases this is mostly due to greater mean levels of household production. For most comparisons, it makes little difference whether the square root or OECD equivalence scale is used. The most significant exception is that for the 50/10 ratio, when the value of secondary childcare is included in household production, the OECD measure shows a greater effect of using the extended income measure and

less of a difference between the extended income measures and the constant-household-production measure.

V. Conclusion

This paper has used data from the ATUS to examine how measures of inequality of earnings are affected by using extended income, which includes household production, instead of money income. Because the ATUS only covers one day for one household member, we developed methods to impute weekly household production from the available data. The ATUS allows for better imputation than is possible with most other time-use surveys, because it contains data on earnings as well as extensive demographic information.

Consistent with economic theory, we found that adding household production to money income reduces measured income inequality significantly. But little of this effect comes from variation household production across households--virtually all of it is due to the addition of mean household production to earnings. Perturbing imputed values of household production to restore variation across households causes inequality to increase only slightly. It makes virtually no difference whether generalist or the specialist wages are used or which equivalence scale is used, although the inclusion of child care as a secondary activity matters--but only to the extent that mean household production is greater when secondary childcare is included. These findings imply that measures of extended income inequality are robust to alternative assumptions one could make when estimating household production. Clearly, trends in extended income inequality will be affected by changes in the mean level of household production, but the evidence so far suggests that changes in the correlation between money income and household production are not likely to play a large role. We intend to look into this in the next draft of this paper.

Appendix

How would we expect the inclusion of household production to affect measures of inequality? Intuitively, one might expect market earnings and household production to be substitutes for each other. Persons with high wages would specialize in the labor market and produce little in the household; persons with low wages would specialize in household production. This would seem to imply that income measures that incorporate household production would tend to exhibit less inequality than market earnings or money income. To formalize this notion, we use as our starting point one of the household production models presented in Gronau (1986). In contrast to the Becker (1965) model, goods enter into the utility function directly, but they may either be purchased or produced at home. The advantage of this approach is that it enables us to distinguish between time spent in leisure and time spent in household production. Since our goal is to add the value of nonmarket production to our measure of earnings, this distinction is important.¹⁷ Below, we present the Gronau model, extend it to two-person households, and discuss its implications for incorporating household production into estimates of earnings inequality.

We begin with a single-person household. Using Gronau's nomenclature, the utility function is given as:

$$U = U(X, L, H, N),$$

where X is the quantity of goods and services purchased in the market plus those produced at home, L is time spent in leisure, H is time spent in nonmarket production, and N is time spent working for pay. The individual maximizes utility subject to the following constraints:

¹⁷ In Becker's model individuals in a household combine time and market goods to produce commodities, from which household members derive utility. The drawback to this approach from our perspective is that it is impossible to distinguish between time spent in leisure and time spent in household production.

$$X = X_M + f(H) = W \cdot N + V + f(H)$$

$$T = L + H + N,$$

where X_M represents goods and services purchased in the market, W is the individual's market wage, V is unearned income, and $f(H)$ is the home production function ($f_H > 0$ and $f_{HH} < 0$).

There are several features of this model that are worth pointing out. First, as is evident from the first constraint, home-produced goods are perfect substitutes for market goods. This may seem unrealistic, because households clearly do not produce most of the goods that they consume. An alternative way to specify the model would be to allow goods and services to enter into the production function separately, and to assume that home production is a perfect substitute only for services. Under this specification, the qualitative results are the same [CHECK THIS], so we opted for the simpler specification. Second, the time spent in market and nonmarket work enters directly into the utility function. This allows individuals to obtain utility or disutility from these activities. We assume that, at the margin, that the marginal utility of time spent in these activities is negative, and that the disutility of work is concave ($U_H, U_N, U_{HH}, U_{NN} < 0$). Third, market goods do not enter into the production function. This is consistent with our notion that home production is a substitute for services, but abstracts somewhat from reality in that much of this production would involve the use of household capital (vacuum cleaners, stoves, dishwashers, etc.).

Solving the above maximization problem yields the following equilibrium conditions:

$$(1) \quad W = \frac{U_L - U_N}{U_X}$$

$$(2) \quad W = f_H + \frac{U_H - U_N}{U_X},$$

for individuals who are employed. For nonemployed individuals, the condition is:

$$(3) \frac{U_L}{U_X} = f_H + \frac{U_H}{U_X}$$

Differentiating equations (1) and (2) and simplifying the expressions obtains the following comparative static results:

$$(4) \frac{dN}{dW} = \frac{U_X^2}{(U_{LN} - U_{NN})U_X - (U_L - U_N)U_{XN}}$$

$$(5) \frac{dH}{dW} = \frac{U_X^2}{U_X f_{HH} + (U_{HH} - U_{NH})U_X - (U_H - U_N)U_{XH}}$$

$$(6) \frac{dL}{dW} = \frac{U_X^2}{(U_{LL} - U_{NL})U_X - (U_L - U_N)U_{XL}}$$

To sign equations (4) and (5), it is sufficient to assume that the utility function takes the following form: $U = U(X, L, H, N) = U(X, L) - C(H, N)$, where $C(H, N) = C(\alpha H) + C(\beta N)$ or $C(H, N) = C(H + N)$. Under these assumptions, the derivatives in equations (4) and (5) will be positive ($dN/dW, dH/dW > 0$). The derivative in equation (6) is negative if, in addition, $U_{XL} > 0$ (or is not too negative). Equations (4) - (6) give the standard result that an increase in the wage will result in an increase in the amount of time spent in market work and decreases in time spent in nonmarket work and time spent in leisure.

It is straightforward to extend Gronau's model to examine two-person households. Assuming that both household members share a common utility function, the maximization problem faced by the two-person household is:

$$\text{Max } U = U(X, L_H, L_W, H_H, H_W, N_H, N_W) \text{ s.t.}$$

$$X = W_H \cdot N_H + W_W \cdot N_W + V + f(H_H, H_W)$$

$$T_H = L_H + H_H + N_H$$

$$T_W = L_W + H_W + N_W,$$

where the subscripts indicate the husband (H) and wife (W). To derive comparative static results for changes in L_i , H_i , and N_i with respect to own wage, W_i , the equilibrium conditions in (1) and (2) apply so that the expressions for the derivatives are the same as in the single-person household case. At first blush, it might seem that the solution is no different than putting two single-person households together. But the common consumption of X results in interactions between time use and spouse's wage. Thus, although the derivatives are the same, the actual values they take on will differ from the single-person case. Combining equation (1) for $i, j = H, W$ yields:

$$(7) \frac{W_i}{W_j} = \frac{U_{L_i} - U_{N_i}}{U_{L_j} - U_{N_j}},$$

and combining equation (2) for $i, j = H, W$ yields:

$$(8) \frac{W_i}{W_j} = \frac{U_X f_{H_i} + (U_{H_i} - U_{N_i})}{U_X f_{H_j} + (U_{H_j} - U_{N_j})},$$

for households in which both spouses work. Differentiating these conditions and arranging terms yields the following comparative static results:

$$(9) \frac{dH_i}{dW_j} = \frac{[R_j]^2}{W_j \{[(U_{XH_i} f_{H_i} + U_X f_{H_i H_i}) + (U_{H_i H_i} - U_{N_i H_i})][R_j] - [(U_{XH_j} f_{H_j} + U_X f_{H_j H_i}) + (U_{H_j H_i} - U_{N_j H_i})][R_i]\}}$$

$$(10) \frac{dN_i}{dW_j} = \frac{[R_j]^2}{W_j \{[U_{XN_i} f_{H_i} + (U_{H_i N_i} - U_{N_i N_i})][R_j] - [U_{XN_j} f_{H_i} + (U_{H_j N_i} - U_{N_j N_i})][R_i]\}}$$

where $R_i = U_X f_{H_i} + (U_{H_i} - U_{N_i})$. If we maintain the assumptions above, and make the additional assumptions that the household utility function is separable in husband's and wife's disutility of work and that additional time spent in household production by one spouse does not reduce the marginal product of the other spouse ($f_{H_i H_j} \geq 0$), these derivatives have the expected signs ($dH_i/dW_j, dN_i/dW_j < 0$). Under the same assumptions, the derivative of own leisure with respect to spouse's wage has the expected positive sign:

$$(11) \quad \frac{dL_i}{dW_j} = - \frac{(U_{L_i} - U_{N_i})}{(U_{L_i L_i} - U_{N_i L_i}) \cdot W_j - (U_{L_j L_i} - U_{N_j L_i}) \cdot W_i} > 0$$

To derive comparative static results for the case where one spouse does not work, we combine the condition in equation (2) (for the working spouse) with the following equilibrium condition:

$$f' = \frac{U_L - U_H}{U_X}$$

Differentiating and arranging terms yields the following:

$$(12) \quad \frac{dH_j}{dW_i} = \frac{(U_{L_j} - U_{H_j})^2}{\{[(U_{H_i H_j} - U_{N_i H_j}) \cdot f_{H_j} + (U_{H_i} - U_{N_i}) \cdot f_{H_j H_j}](U_{L_j} - U_{H_j}) - (U_{L_j H_j} - U_{H_j H_j})(U_{H_i} - U_{N_i}) \cdot f_{H_i} + (U_{H_i} - U_{N_i})^2 \cdot f_{H_j H_j}\}} < 0$$

$$(13) \quad \frac{dL_j}{dW_i} = \frac{(U_{L_j} - U_{H_j})^2}{(U_{H_i L_j} - U_{N_i L_j}) \cdot f_{H_j} \cdot (U_{L_j} - U_{H_j}) - (U_{L_j L_j} - U_{H_j L_j})(U_{H_i} - U_{N_i}) \cdot f_{H_j}} > 0$$

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Table 1: Mean Annual Household Earnings and Household Production
for Different Production Measures

	Household Money Earnings	Household Production			
		Generalist Wage		Specialist Wage	
		Secondary Childcare Excluded	Secondary Childcare Included	Secondary Childcare Excluded	Secondary Childcare Included
All Households	70,492	21,396	31,303	23,273	32,758
Single-person Households	38,078	9,323	11,523	10,412	12,429
Married-couple Households	82,531	25,880	38,649	28,050	40,309

Table 2: Inequality Measures for Different Measures of Household Income

	Generalist Wage				Specialist Wage			
	Secondary Childcare Excluded		Secondary Childcare Included		Secondary Childcare Excluded		Secondary Childcare Included	
	OECD Equivalence	Sq. Root Equivalence	OECD Equivalence	Sq. Root Equivalence	OECD Equivalence	Sq. Root Equivalence	OECD Equivalence	Sq. Root Equivalence
Gini								
(1) Family income	0.419**	0.413**	0.419**	0.413**	0.419**	0.413**	0.419**	0.413**
(2) = (1) + Pred. HH production	0.333	0.328	0.303	0.304**	0.329*	0.325**	0.301	0.302**
(3) = (1) + Mean HH prod.	0.328	0.322	0.304	0.296	0.322	0.315	0.299	0.291
(4) = (2) + .25 S	0.335*	0.329*	0.306	0.306**	0.332**	0.327**	0.304	0.304**
(5) = (2) + .5 S	0.338**	0.333**	0.310**	0.310**	0.336**	0.331**	0.309**	0.309**
(6) = (2) + S	0.345**	0.340**	0.322**	0.321**	0.345**	0.340**	0.322**	0.320**
90th percentile/50th percentile								
(1) Family income	2.436**	2.386**	2.436**	2.386**	2.436**	2.386**	2.436**	2.386**
(2) = (1) + Pred. HH production	2.059	2.015	1.932	1.896	2.037	1.988	1.926	1.880
(3) = (1) + Mean HH prod.	2.061	2.020	1.967	1.924	2.035	1.996	1.950	1.908
(4) = (2) + .25 S	2.069	2.016	1.930	1.881	2.056	1.994	1.927	1.882
(5) = (2) + .5 S	2.072	2.023	1.938	1.888	2.056	2.002	1.939	1.893
(6) = (2) + S	2.079	2.032	1.965	1.912	2.077	2.021	1.974	1.921
50th percentile/10th percentile								
(1) Family income	3.262**	3.214**	3.262**	3.214**	3.262**	3.214**	3.262**	3.214**
(2) = (1) + Pred. HH production	2.097	2.068	1.895	2.030**	2.052	2.069	1.871	2.035**
(3) = (1) + Mean HH prod.	2.050	2.029	1.876	1.849	1.999	1.981	1.847	1.822
(4) = (2) + .25 S	2.092	2.102	1.899	2.052**	2.074*	2.088*	1.886	2.040**
(5) = (2) + .5 S	2.139*	2.158**	1.948*	2.092**	2.141**	2.164**	1.947**	2.094**
(6) = (2) + S	2.276**	2.299**	2.115**	2.230**	2.317**	2.353**	2.139**	2.247**
90th percentile/10th percentile								
(1) Family income	7.946**	7.668**	7.946**	7.668**	7.946**	7.668**	7.946**	7.668**
(2) = (1) + Pred. HH production	4.316	4.167	3.662	3.848**	4.181	4.112	3.603	3.826**
(3) = (1) + Mean HH prod.	4.224	4.099	3.692	3.557	4.069	3.953	3.602	3.476
(4) = (2) + .25 S	4.328	4.238	3.665	3.860**	4.264*	4.164*	3.635	3.839**
(5) = (2) + .5 S	4.431	4.365*	3.775	3.948**	4.402**	4.333**	3.776*	3.963**
(6) = (2) + S	4.732**	4.672**	4.156**	4.264**	4.812**	4.754**	4.223**	4.317**

* Significantly different from Row (3) at 5 percent level.

* Significantly different from Row (3) at 1 percent level.