

**The Valuation Of Household Production:
How Different are the Opportunity Cost and Market Price Valuation Methods?**

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Abstract: According to New Home Economics, valuations of household production based on opportunity cost and market price methods should produce similar estimates. Data from the National Survey of Family and Households are used to assess the extent to which the opportunity cost and market price methods of valuing home production are similar. This paper shows that the two approaches are not similar once one controls for personal and family characteristics, such as number of children, age, educational attainment, and gender. Ordinary least squares regression and path analysis provide an interpretation of the differences in each estimation method. The results indicate that differences in estimating techniques can be attributed to wage effects. These findings suggest that the market price method is preferable if the purpose of valuation is to incorporate estimates into national income accounts. The opportunity cost method is preferable if the purpose is to compensate for welfare loss. (JEL D13)

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I. Introduction

The idea that household production provides significant social benefits is neither new nor trivial, and attempts to quantify such benefits have proliferated in the past two decades. These attempts have been particularly important in efforts to include household production in the national income accounts or to estimate welfare loss compensation for the wrongful death of a spouse. The problem with estimating household production is that it is a non-market activity, the benefits of which cannot be measured by survey or observation. Any estimation of how much production at home contributes to the total production of goods and services in the economy must be computed indirectly. However, these attempts have produced a myriad of quantitative results, of which none have shown promise as a direct and sensible approach to the problem of household production valuation (Quah, 1986).

Traditionally, two fundamentally different approaches have been used in valuing household production. One emphasizes the opportunity cost of devoting time to household production and sets a value for such production as the income the individual could earn in the market. The other proposes that household production can be measured from services purchased through the market and which values household activities as the cost of hiring someone to do the household tasks. Of course, the question of which method is preferable is important only to the extent that the two measures produce significantly different results (Murphy, 1978).

This question is not entirely an empirical matter. The reason is that contemporary economic theories of household behavior -- particularly those associated with the New Home Economics in which households are considered to have both production as well as consumption functions -- necessitates the equality of the opportunity cost and market cost methods. In other words, the opportunity cost and the market cost methods of valuation are constrained to be equal. Consequently, differences in actual estimates obtained from each of these methods can be attributed either to measurement error or to a fundamental breakdown in current theories of household production.

The purpose of this paper is to examine the theoretical foundation for the opportunity cost and market price methods of valuing household production. The two approaches will then be examined using

data from a national survey on household behavior to assess the extent to which they two methods differ. While theory predicts that the two valuation methods should yield similar results, the findings indicate that they differ with respect to individual and family characteristics. Specifically, differences are attributed to wage effects. The findings suggest that the market price method is preferable if the purpose of valuation is to incorporate estimates into national income accounts. The opportunity cost method, however, is preferable if the purpose is to compensate for welfare loss.

The paper is outlined as follows: section II presents a short history of household production valuation methods. Section III summarizes the contemporary methods employed in modeling household production. In particular, it emphasizes the fact that both estimating methods should produce the same results. Sections IV and V describe the data used and methodology employed in testing the hypothesis that the opportunity cost and market valuation methods are identical measures, as suggested in section III. Section VI presents the results and a partial discussion of the analysis. In section VII an outline of a path analysis model is described, which is intended to show why the opportunity cost and market valuation methods may differ in reality. Finally, a summary and examination of remaining problems is given in section VIII.

II. The Historical Record of Household Production Estimates

Economists first became interested in the problem of estimating the value of household production in the late 1920's when it was suggested that household services be included in the national income accounts. However, such attempts produced crude and inaccurate estimates; hence, they were heavily discounted as important in the determination of GNP. These early attempts are summarized and discussed in Hawrylyshyn (1976), who concluded that valuation techniques resulted in estimates typically one-third the size of GNP on average. Moreover, Hawrylyshyn concluded that the opportunity cost method of valuation was upwardly biased relative to the market cost method. The reason for this bias, he argued, was that comparable levels of home production in separate households would produce different values if the individuals in each household had different marketable wages. The idea behind the valuation of household activities, he stated, was "...to replace not the mother-homemaker, but merely a portion of her services" (p. 112). The market cost method, therefore, was closest to the concept of the "dollar value of household services" -- the notion he favored.

The attempts at valuing household services subsequent to the survey reported by Hawrylyshyn have neither improved the accuracy of nor quelled the debate regarding appropriate methods of estimating the value of home production. For instance, Bell and Taub (1982) argue that current valuation methods understate the true value of household production, while Peterson (1978) contends that such methods overestimate home production. Furthermore, Ferber and Birnbaum (1980), Chiswick (1982) and Wolf (1986) point out that estimates incorporating the market cost method of valuation are preferable to opportunity cost methods, because the latter are over biased, while Murphy (1978) shows that the opportunity cost method is not significantly upward biased relative to the market cost approach.

The variety of estimates and diversity of conclusions noted above not only illustrate the fact that valuation methods produce inconclusive results, but also suggest that such methods are founded upon an inaccurate or incomplete model of household behavior. In other words, the contemporary theories which drive home-production valuation techniques fail to account for the inherent *methodological* differences in valuation techniques based on the opportunity cost of an individual's time and the market prices of household services.

III. The Contemporary Model

Contemporary models of home production typically utilize a welfare function consisting of market-purchased and home produced goods and leisure components. The utility function is then maximized, subject to budget, time, and the home-production function constraints. The marginal productivity of home-produced goods is estimated, and this estimation is used to calculate the value of home production.

The following model is illustrative of the prevailing process of valuing household production and is based on the work of Gronau (1980), Heckman (1974) and Becker (1965): Assume that welfare (U) is a function of three goods -- consumption (X), husband's leisure (L_h) and wife's leisure (L_w). The utility function is given as

$$U = U(X, L_h, L_w). \tag{1}$$

Consumption consists of both goods purchased in the market (X_m) and goods produced in the home, either by the husband (Z_h), or by the wife (Z_w), such that

$$X = X_m + Z_h + Z_w. \quad (2)$$

The husband's home production function is

$$Z_h = f(a_h X_z, P_h), \quad (3a)$$

where a_h is the fraction of market-purchased goods used for home production, X_z , and P_h is hours devoted to home production. The wife's home production function is analogous,

$$Z_w = g(a_w X_z, P_w), \quad (3b)$$

with a_w being the fraction of market-purchased inputs (X_z) used in home production, and P_w representing the number of hours devoted to home production. Furthermore, we assume that

$$a_h + a_w \leq 1, \quad (4)$$

which indicates the fraction of total inputs purchased from the market used for home production purposes. In addition to the constraints imposed by equations (2), (3a) and (3b), budget and time constraints must also be considered. The budget constraint is as follows:

$$P(X_m + X_z) = w_h h_h + w_w h_w + Y, \quad (5)$$

where P represents a vector of market prices. The market wages for the husband and wife are respectively w_h and w_w ; the hours devoted to market-supplied labor are h_h and h_w . The time constraints for the husband and wife are respectively

$$T = L_h + h_h + P_h \quad (6a)$$

$$T = L_w + h_w + P_w \quad (6b)$$

with T representing the total number of hours available. The first order conditions are given by the constraints and by:

$$d/dX: U_1 + y_1 = 0 \quad (7a)$$

$$d/dL_h: U_2 - y_5 = 0 \quad (7b)$$

$$d/dL_w: U_3 - y_6 = 0 \quad (7c)$$

$$d/dX_m: -y_1 + y_4 P = 0 \quad (7d)$$

$$d/dX_z: -y_2 f_1 a_h - y_3 g_1 a_w + y_4 = 0 \quad (7e)$$

$$d/dZ_h: -y_1 + y_2 = 0 \quad (7f)$$

$$d/dZ_w: -y_1 + y_3 = 0 \quad (7g)$$

$$d/dh_h: -y_4w_h - y_5 = 0 \quad (7h)$$

$$d/dh_w: -y_4w_w - y_6 = 0 \quad (7i)$$

$$d/dP_h: -y_2f_2 - y_5 = 0 \quad (7j)$$

$$d/dP_w: -y_3g_2 - y_6 = 0 \quad (7k)$$

$$d/da_h: -y_2f_3X_m = 0 \quad (7l)$$

$$d/da_w: -y_3g_3X_m = 0 \quad (7m)$$

where y_i is the marginal valuation of each constraint (2), (3a), (3b), (5), (6a), and (6b) respectively.

The solution of the first-order conditions (7a) through (7l) suggests that husbands and wives will allocate time between home production and market labor until the value of their marginal products in home production equals the value of their marginal products in the labor market; these, in turn, are equal to the value of the marginal rate of substitution between leisure and goods for both the husband and the wife.

For husbands we use equations (7a), (7b), (7d), (7f), (7h) and (7j) to show that

$$P(U_2/U_1) = Pf_2 = w_h. \quad (8a)$$

For wives, the solution is identical, using equations (7a), (7c), (7d), (7g), (7i) and (7k):

$$P(U_3/U_1) = Pg_2 = w_w. \quad (8b)$$

The solutions indicated by equations (8a) and (8b) suggest that valuation methods incorporating the individual's market wage rate -- the opportunity cost of devoting time to household production -- are identical to those which utilize the market value of household production at the margin -- the value attributed to home-produced goods if they were sold in the market at prevailing market prices. Stated differently, if household services were purchased from the market, the price paid for those services would be represented by the vector of prices (P). Market prices, times the quantity of household services produced at the margin (f_2 for the husband, g_2 for the wife), equals the value of the individual's time, or wage rate, at the margin. These values, when integrated over the entire range of time devoted towards household production, would give us the corresponding total value of household production.

Ostensibly, estimates of the value of household production should yield identical results regardless of the method of valuation when one considers the theory of the firm. If I operate a firm, my costs of production are reflected in the market price of the product I produce. Indeed, in perfectly

competitive markets, the market value of the good equals its marginal cost, or the economic opportunity cost of production. Therefore, applying the same analogy to home production, the "opportunity cost" method of valuing home-produced goods and services *should* be identical to "market price" method if the assumptions which govern household production are similar to those which operate in economic firms -- assumptions incorporated in the New Home Economics framework.¹

The test of whether both valuation methods produce identical results is presented in the following sections.

IV. Data

Data for this study are taken from the National Survey of Families and Households, an interview study consisting of a probability sample of 13,017 respondents representing the non-institutional population of the United States. The survey was initiated in March, 1987, and was concluded in May, 1988. In the survey, the head of the household (or main respondent) was asked how many hours he or she spent in housework on average each week. Tasks included preparing meals, washing dishes, cleaning house, doing outdoors tasks, washing/ironing, paying bills and performing auto maintenance. Data on hours spent in child care activities within the home were also compiled, but these are less precise; information on the hours spent in care for children under five years of age was provided, but hours spent with older children had to be inferred from information about time spent in activities with them. In particular, questions referring to the amount of time spent with the older child in outdoor activities, in activities at home and helping with reading, homework, and similar activities were converted into total hours spent caring for the child according to the following assignment:

Time spent with child in outdoor activities, in-home activities, and reading, homework or similar activities, during one month:

- Never or rarely = 0 hours per week per activity
- Once a month or less = 1 hour per week per activity
- Several times a month = 2 hours per week per activity
- About once a week = 3 hours per week per activity

¹ The theoretical basis of New Home Economics--commonly associated with Gary Becker, Reuben Gronau, T. W. Schultz and J. Mincer--is that households are regarded not only as consumers but also as producers of goods and services, which use non-market time and market goods as factor inputs (Quah, 1986). However, in a fundamental sense, time as a factor input is not non-market because of the opportunity cost associated with home production; work done in the home is not labor supplied to the market, thus providing a "market cost" to time as an input.

Several times a week = 6 hours per week per activity
Almost everyday = 9 hours per week per activity

The total hours per week were then multiplied by the number of older children in the home (five years of age and older). This, together with the number reported for younger children, were summed to give the total amount of time spent in child care activities. Although this measure of child care is understandably crude, it is, in the absence of more reliable data, sufficient as a proxy for the amount of time the respondent cares for each child during the week.

The analysis was restricted to individuals who were employed at least part time at the time of the survey, resulting in a sample size of 8046. This was required in order to facilitate the assumption of an interior solution to the first order conditions derived above. Data obtained included information about the number of hours the respondent spent in housework on average each week and the individual's respective hourly wage rate. Other information included the number of children in the household, and the age and the level of education of the respondent, in years.

V. Methodology

Values of home production were obtained using an opportunity cost and a market price approach. Weekly hours devoted towards the various household activities described above were summed into a single measure of weekly hours. Table 1 lists the names of the primary variables used in the proceeding analysis, with the associated means and standard deviations.

(Table 1 about here)

Equation (10a) indicates the method of valuation which incorporates the wage rate as the opportunity cost of time:

$$OPVALUE = (HOURS \times HRWAGE) \times 52 \quad (9a)$$

where OPVALUE is the value of household production, HOURS is the total number of hours devoted in the home towards home production, and HRWAGE is the individual's hourly wage rate.

Equation (10b) describes the method of valuation using the value of market supplied services:

$$MKVALUE = 52 \times \sum_i (Hours_i \times Wage_i) \quad (9b)$$

where MKVALUE is the value of home production using market prices, $(Hours_i)$ is the number of hours devoted towards the i th activity, and $(Wage_i)$ is the hourly wage rate determined in the market for each

respective activity. We expect that, other things being equal, the estimates of household production values based on both the opportunity cost and market price methods will be similar.

Table 2 indicates the hourly wage rates for the respective home activities listed above.

(Table 2 about here)

The values of home production obtained from both the opportunity cost and market price methods will be regressed on the number of children in the household, the age and educational level of the respondent using ordinary least squares analysis.² The equations to be estimated are as follows:

$$OPVALUE = a_0 + a_1NUMCH + a_2AGE + a_3EDUC + a_4Z + a_e \quad (10a)$$

$$MKVALUE = b_0 + b_1NUMCH + b_2AGE + b_3EDUC + b_4Z + b_e \quad (10b)$$

where NUMCH is the number of children, AGE is the age of the wage earner, EDUC is the educational level of the worker, Z consists of other control variables, and a_e and b_e are standard normal error terms.

The results of this analysis will shed light on the relationship between the opportunity cost and market price valuation methods. We expect that the distribution of estimates will be similar for both methods of valuation if they are indeed equivalent, as implied by New Home Economics. Any significant difference between regression coefficients not only would imply that both methods of valuing household production are not identical but also would suggest how the measures of valuation may differ. Moreover, we expect the number of children to be positively related to methods of valuing home production, since the presence of children increase the value assigned to household services. Education and age are expected to increase the value of home production, since both increase marginal productivity³ (See Gronau, 1980). In addition to this basic model, variables will also be included to test for the effects of gender and marital status, as well as to determine if non-linearity or interaction effects are present.

VI. Initial Results and Discussion

² Of course, in order to estimate the total value of household production based upon equations 8a or 8b strictly, one would need to specify a functional form of f_2 and g_2 . Alternatively, one could assume a form of the home production functions (f and g) and then derive f_2 and g_2 . (See Gronau, 1980, p. 409, for a discussion.) However, to simplify the analysis in this study, no functional form will be assumed.

³ It should be obvious that education increases marginal productivity. Age, on the other hand, could be considered a proxy for experience. Presumably, an increase in an individual's age associated with an increase in the value of household production would suggest a type of on-the-job-training occurring in in-the-home activities (ie. through the years one tends to "learn" how to do household work more effectively).

Table 3 presents both mean and median estimates of the two methods of valuing household production. In both cases the mean values exceed the median values, which indicates a distribution skewed to the right.

(Table 3 about here)

The mean scores differ by almost \$3,000 on average. However, the median values differ by less than \$10, an amount insignificant considering the fact that estimated values of household production are usually in the thousands of dollars. Assuming that the median is the better measure of central tendency, we may conclude that there is no appreciable difference ("on average") between either method of valuing household production.⁴

The similarities do not hold, however, when worker and family characteristics are considered. Table 4 gives the results of the regression of valuation estimates on number of children, age and educational level of the respondent, suggests that the "similarity" of valuation methods. The effects of the variables on both measures of household valuation produce ostensibly different results when compared across both methods of valuation. For example, age and education increase the value of household production using the opportunity cost method, while, on the other hand, they negatively affect valuation estimates from the market price method.

(Table 4 about here)

Specifically, we see that for each additional child in the home, household production values increase by \$4,563 using the opportunity cost method, while increasing only \$1,913 using the market price method. The fact that both coefficients are positive confirms our expectations -- children increase the value of home production for both valuation methods, although the effect appears to be more significant for the opportunity cost method. The effects of age and education also increase the value of home production when the value of such production is determined using the opportunity cost method; for each additional increase in years of age and of schooling, home production values increase by \$125 and \$1,047 respectively. However, age and education have different impacts when home production is valued using the market price method. We see that age increases production values by only \$1 dollar per year of age -- a trivial amount -- yet education decreases values by roughly \$100 per year of schooling.

⁴ Because the opportunity cost and market price estimates are skewed, I use the median rather than mean as the primary measure of central tendency. Thus, when I say "on average" I am really referring to

Table 4 also presents the results of OLS regression analyses testing for the non-linearity in number of children and age, as well as marital and gender effects (expanded model). Generally, gender and marital status produce significantly different effects for each measure of household production. Specifically, married women receive from valuation an additional \$284 relative to unmarried men using the opportunity cost method, while receiving approximately \$4,012 more than unmarried men when home production is valued using the market approach. Similarly, women who are currently separated, divorced or widowed (was married) will receive relative to unmarried males \$77 and \$3,502 more from the opportunity cost and market price methods of valuation respectively, and women who have never married receive \$1,032 less and \$986 more than the values for unmarried men from the opportunity cost and market price methods respectively. Moreover, married men will receive relative to unmarried men an additional \$173 more from the opportunity cost approach, while losing roughly \$1,213 when valuation is based on market prices; previously married men will receive approximately \$2,454 and \$994 from the opportunity cost and market price methods respectively. These results indicate that the opportunity cost method produces relatively higher estimates of household production for men than for women, whereas the opposite is true when valuation is determined from the market cost approach. This may be due to the fact that market wages are generally biased against women and favor men, thus producing the effect that, holding everything else constant, the opportunity cost method will produce relatively higher estimates of household production for men than for women.

Non-linearity is present for both number of children and age. The non-linear relationship between number of children and the opportunity cost method of measurement suggests that each additional child will result in a substantial increase in the value of home production -- beginning at roughly \$6,000 for the first child -- until the ninth child, when additional children actually reduce home production values. For the market price technique, additional children increase valuation estimates by about half as much as the opportunity cost method, but then declines after the sixth child. Age also has a curvilinear effect on valuation estimates. The effect is clearly important for the opportunity cost method, increasing estimates approximately \$600 per year of age, while its effect on market price estimates is clearly trivial -- each year of age will reduce values by about \$1.

the median, not mean.

The effect of education is roughly the same as indicated above -- an additional year of schooling will increase opportunity cost estimates by \$932, yet decrease market price estimates by \$113 per year.

The fact that estimates of the value of household production based on both the opportunity cost and market price methods of valuation are similar (from median scores) is not at all surprising, since this is what we predict from theory. That is, both methods of valuation produce relatively comparable results *on average*, because the average is based on an aggregation of data. However, the results of the analyses described above suggest that the distribution of individuals about the median estimates from both valuation methods are not similar when one considers factors such as age, education, gender, marital status and number of children. In other words, individuals with similar age and educational levels, or gender and marital statuses, may value home production above the median value with one method of estimation and below the median with the other method. The large sample size employed in the study, as well as the population as a whole, it appears, ensure that any difference in *particular* estimates between individuals may be netted out through the aggregation of the data.

The results of the regression of opportunity cost values on number of children, age and educational level confirm our expectations -- all three variables are positively correlated with the value of household production. However, calculations based on the market price method produce dramatically different results -- age has a trivial effect on home production values while education has an important negative correlation. That is, if both methods of valuation were indeed similar, the results of the two regressions would indicate similar findings. Yet, the impact of age and education on the value of household production is different depending on the method of valuation employed. How can this be explained?

Increases in either age or education increase marginal productivity and result in an increase in one's expected wage. This is translated into higher values based on the opportunity cost method of valuation. However, age and education may in fact have little or negative correlations with the total number of hours spent in household production activities. In this case, increases in either age or education may reduce the amount of time spent in home production, thus reducing the total value of such production for both methods of valuation. Yet, this reduction in total hours is more than offset by the increase in the wage rate, thus increasing the total value of home production based on the opportunity

cost method of valuation; but, no corresponding offset exists with the market price valuation method. The same argument may be also be made regarding gender and marital status. Being female, for instance, may result in more hours being devoted towards household production, while simultaneously resulting in a lower wage rate, thus reducing estimates based on the opportunity cost method of valuation relative to the market price method.

The results of this analysis suggest that individuals control the two basic components of valuation techniques in the opportunity cost method (hours and price -- in this case, the wage rate), but control only one in the market cost approach (hours). Consequently, the opportunity cost method is more sensitive to personal characteristics that affect wage rate, such as age and educational attainment, than the market price methods. The market price method, on the other hand, is "neutral" to these characteristics in the sense that it is based only on the amount of time devoted towards household production. This would suggest that the market price method is preferable over the opportunity cost method because the value of the marginal hour spent in home production will be the same for all households -- based on a value determined by the market. Indeed, this is exactly what Hawrylyshyn (1976), Murphy (1978), Chiswick (1982) and others have previously suggested, stating that services, not individuals, should be valued -- as determined by the market.

VII. Extended Path Analysis -- Results and Discussion

In this section an attempt is made to determine whether the distributional differences in valuation estimates, as indicated by the regression results, can be more precisely accounted for. This will be accomplished through the use of path analysis.⁵ By path analysis techniques we are able to control for the fact that wages directly affect the opportunity cost method of valuation, while only indirectly affecting the market price method. By separating out the direct and indirect effects, we can determine more precisely how such factors as number of children, education, and gender affect the opportunity cost and market price methods of valuing household production. More to the point, we expect that the explanatory variable directly affecting both estimates should converge for each variable once we control for both direct and indirect effects.

⁵ See Judge, Griffiths, Hill, Luetkenpohl, and Lee, 1985, pp. 726-768, for a discussion of path analysis.

(Figure 1 about here)

The relationship between the two methods of valuation is diagrammed in figure 1. Both the opportunity cost and market price methods of valuation are determined by the number of hours worked in the home, as well as directly by the impacts of the independent variables. The opportunity cost method of valuation is also directly affected by the individual's market wage rate and indirectly through the total amount of time devoted towards household production. The market price valuation method is not directly influenced by an individual's market wage rate; instead, the wage affects valuation only indirectly through its effect on hours spent in home production.

A new model will be tested based on the relationships between the valuation methods, hours, the hourly wage and explanatory variables. Variables included in this analysis are number of children and age, with the square of these value since they provided a more favorable fit to the data. Also included are educational level and gender. If the relationship between the opportunity cost and market price methods is as indicated in figure 1, then we expect to find the direct effects of number of children, age, education and gender each to converge to a single estimate.

First, regression analysis will be performed on a "reference" model, in which the opportunity cost and market price methods of valuation were regressed on the explanatory variables described above. The results are expected to be similar to those found table 4, except that interaction effects are not considered in the path model. Then, the model depicted in figure 1 will be estimated using path analysis, and the results of the direct effects of the explanatory variables on both valuation estimates will be compared to the reference model. The direct effects are referred to as the "focus" model. As indicated earlier, we expect each coefficient of the focus model for both the market and opportunity cost methods to converge to a single estimate of each coefficient. The reference model will be used to judge the model's effectiveness.

Specifically, four models are estimated for the path analysis (see equations 11a-11d). First, the hourly wage rate is regressed on the explanatory variables. Next, hours devoted towards household production is regressed on the hourly wage rate and the explanatory variables. Finally, the opportunity cost values are regressed on the hourly wage rate, hours and the explanatory variables, while the market price estimates are regressed on only hours and the explanatory variables.

$$\text{HRWAGE} = a_0 + a_3\text{NUMCH} + a_4\text{AGE} + a_5\text{EDUC} + a_6\text{FEM} + a_e \quad (11a)$$

$$\text{HOURS} = b_0 + b_1\text{HRWAGE} + b_3\text{NUMCH} + b_4\text{AGE} + b_5\text{EDUC} + b_6\text{FEM} + b_e \quad (11b)$$

$$\begin{aligned} \text{OPVALUE} = c_0 + c_1\text{HRWAGE} + c_2\text{HOURS} + \\ c_3\text{NUMCH} + c_4\text{AGE} + c_5\text{EDUC} + c_6\text{FEM} + c_e \end{aligned} \quad (11c)$$

$$\begin{aligned} \text{MKVALUE} = d_0 + d_2\text{HOURS} + \\ d_3\text{NUMCH} + d_4\text{AGE} + d_5\text{EDUC} + d_6\text{FEM} + d_e \end{aligned} \quad (11d)$$

Tables 5 and 6 present the results of ordinary least squares regression analysis of the model in figure 1. Specifically, table 5 indicates the results of the regression of the hourly wage rate on the explanatory variables. Age produces an important effect on the wage rate. For each year in age, the wage rate is expected to increase roughly \$0.50. Education is also important, as we would expect, indicating that an additional year of schooling will increase one's hourly wage rate \$0.78 in this sample. Gender produces the most important effect, however. Women may expect to receive relative to men more than \$3.00 less per hour -- results suggested in the preceding discussion.

(Table 5 about here)

The results of the regression of hours on the hourly wage rate and the other variables in the model are also given in table 5. The hourly wage rate has a small, yet negative effect on hours, indicating that each dollar increase in the wage rate will reduce the amount of time spent in household activities by one quarter of an hour. More importantly, however, we notice that the number of children and gender have the most significant effects on household production hours. Each child increases the number of hours by a little less than 14; the negative coefficient on the squared term suggests that hours do not begin to decline for additional children until after the 22 child -- a trivial effect in this sample. Moreover, women will devote on average 12 more hours a week towards household production than men, a result which, in and of itself, suggests that women still play the primary role in productive activities in the household, even though they work outside the home as well. The effects of age and education are relatively small here.

These results shed light on the findings indicated above -- why the opportunity cost and market price approaches produce individually different results. Gender provides an illustrative example: we see that although women work more hours in the home, because they receive a relatively lower wage than men do, the opportunity cost method of valuation will be biased against them.

(Table 6 about here)

Table 6 indicates the results of regression analysis performed on the reference and focus models. The results for the reference model are similar to the ones discussed in the preceding section. The results for the focus model, however, generally confirm our expectations -- there is a tendency for coefficient estimates to converge. In particular, we notice that the effect of hours on each estimating technique are essentially identical; an additional hour will increase valuation estimates by approximately \$300 and \$306 for the opportunity cost and market price methods respectively. The coefficient for number of children squared also indicates a convergence. Additionally, we observe that, for the variables age, age squared and education, there is a movement towards a common value. For instance, the coefficients for education in the reference model show a difference of almost 1000; the results for education in the focus model indicate a dramatic movement towards a common estimate -- the difference between the opportunity cost and market price estimates is only about 150, again supporting our hypothesis.

This effect is not apparent for number of children and gender, though. After controlling for the effect of hours and the wage rate, there is a moderate reduction in the estimated coefficient on number of children for the opportunity cost method, but the market price estimate has become negative. This may be explained as follows: children increase the total number of hours devoted towards household production. But, they take away from production activities which are associated with a higher market value (see table 2). Thus, once wages and hours are controlled for, the effect of additional children is to decrease valuation estimates based on the market price technique. The opportunity cost method, on the other hand, shows a positive impact of children on the valuation estimates, since that method is "blind" to the specific activity generating the additional hour of household production; it doesn't matter whether the hour is used to care for children or work on the car -- the "value" of the hour is the same. As it turns out, the coefficient for number of children from the market price method of valuation does not become positive until the wage rate for child care activities was almost \$30 an hour. What does this say about how economic markets "value" the care of children?

The direct effect of gender on valuation estimate is also unexpected once the impacts of hours and wages are controlled for. Particularly, the impact of gender on the opportunity cost method has become more negative, while its effect on the market price method has changed for an important positive

effect to a negative effect as well. It could be that there are additional indirect influences on gender from the labor market which were not accounted for in the development of the model in figure 1. For instance, there may be an important effect of the amount of time spent in market activities relative to home production which has not been important until now. For this we can only speculate at the moment, however.

(Table 7 about here)

Finally, table 7 presents estimates of the direct effects of the explanatory variables on the opportunity cost and market price methods of valuation based on the path model in figure 1. The coefficient estimates from the reference model are included for comparison. The estimates for the focus model include the direct and indirect effects but does not include spurious effects, the results of which suggest that most of the total effects of the explanatory variables on both valuation methods may be attributed to the path model; spurious effects are trivial.

VIII. Conclusions

According to New Home Economics, estimated values of household production based on both the opportunity cost and market price methods should be expected to yield similar results. This paper examines the effects of worker and family characteristics on both methods of valuing household production. The findings indicate that the two approaches are fundamentally different.

Moreover, this paper has shown that actual distortions in valuation estimates may be attributed to wage effects. One possible explanation is that particularly high wages -- which may account for the skewed distribution for the opportunity cost method of valuation discussed earlier -- may be a characteristic of monopoly-type rents rather than a competitive market equilibrium. That is, if some wages are not representative of market equilibrium in competitive labor markets, while estimates of the price for market-based services are, then one should expect opportunity cost and market price valuations to differ. This suggests that aggregation for national income accounts should be done through the market price method. Moreover, such calculations may also be substantially easier to calculate since information on individual wages and other personal characteristics will not be necessary to collect. However, as is often the case, the purpose of valuation is to compensate for welfare loss, as in instances of the wrongful death of the spouse or of personal injury. In these instances, the opportunity cost method

will be preferable since the purpose of valuation is to determine personal value as opposed to the value of services; that is, the opportunity cost method takes into account the individual characteristics of the person, such as age and educational attainment.

One problem still remains unanswered: the value of affectual bonds. The fact that a parent cooks the evening meal may mean something different than if an outside cook were hired to do the same. Moreover, there may be an additional value to cooking one's meal, a feeling that one is not alienated from the working process. Of course, these "values" are much more difficult to quantify, since affectual bonds may be more important than innate monetary values for household services. Consequently, more work will be needed to determine effective methods of valuing these types characteristics inherent in household production activities.

Table 1. Sample means, standard deviations and definitions of variables used for initial estimation and analysis.

Variable	Mean	Stand. Dev.
HRWAGE	8.69	7.53
HOURS	30.58	26.64
NUMCH	0.93	1.17
NUMCH*	1.88	0.98
AGE	37.38	12.17
EDUC	12.92	2.67
FEM	.522	.500

Note: N = 8122; HRWAGE = average hourly wage of respondent; HOURS = number of hours devoted towards home production each week; NUMCH = number of children in household for all households; NUMCH* = number of children in household for households with one or more children; AGE = age of respondent; EDUC = educational level of respondent; FEM = dummy for respondent is female.

Table 2. Average hourly earnings of market-supplied activities, as of December, 1987, in current dollars.

Task	Wage
Cooking meals	\$9.07
Washing dishes	4.51
Cleaning house	6.27
Working outdoors	9.50
Doing laundry	6.27
Paying bills	10.54
Maintaining auto	7.99
Caring for children	6.12

Source: Bureau of Labor Statistics, U.S. Department of Labor

Table 3. Medians, means and standard deviations of valuation estimates using opportunity cost and market price approaches.

Method	Median	Mean	Stand. Dev.
OPVALUE*	8050.00	12404.42	13980.99
MKVALUE**	8046.48	9791.21	7737.80

Note: OPVALUE = estimate of the value of home production using opportunity cost method of valuation; MKVALUE = estimate of household value using market cost method.

* based on sample size of 8046

** based on sample size of 8045

Table 4. Estimated coefficients of opportunity cost and market price methods of valuing household production.

Variable	Basic Model		Expanded Model	
	Opportunity Cost	Market Price	Opportunity Cost	Market Price
Number of children	4563.653 (123.618)	1913.069 (71.946)	6673.508 (291.448)	3594.921 (162.165)
Number of children sqd.	----	----	-734.677 (70.622)	-523.665 (39.295)
Age	125.080 (11.799)	1.011 (6.867)	696.727 (72.685)	-1.134 (40.443)
Age sqd.	----	----	-6.911 (0.848)	-0.089 (0.472)
Educational level	1046.967 (53.421)	-100.732 (31.091)	932.237 (53.622)	-113.817 (29.836)
Female	----	----	-1032.466 (618.669)	986.593 (344.235)
Married	----	----	173.141 (558.383)	-1213.156 (310.691)
Was married	----	----	2454.340 (699.258)	994.446 (389.076)
Female & married	----	----	1143.038 (725.871)	4239.128 (403.883)
Female & was married	----	----	-1345.739 (873.195)	1522.471 (485.856)
Constant	-10,010.210 (885.234)	9,293.221 (515.208)	-19,769.167 (1472.342)	7,840.8210 (819.229)
R ²	.173	.085	.198	.189

Note: standard errors in parentheses

Table 5. Estimated coefficients from the regression of the hourly wage and hours devoted towards household production as the dependent variables on the explanatory variables.

Variable	Dependent Variable	
	Hourly Wage Rate	Hours
Hourly wage rate	---	-0.260 (0.035)
Number of children	0.248 (0.149)	14.349 (0.461)
Number of children sqd.	-0.133 (0.038)	-0.649 (0.116)
Age	0.542 (0.038)	0.326 (0.120)
Age sqd.	-0.005 (0.000)	-0.004 (0.001)
Educational level	0.775 (0.029)	-0.068 (0.094)
Female (0.153)	-3.209 (0.487)	12.046
Constant	-12.065 (0.787)	8.955 (2.472)
R ²	.176	.370

Note: standard errors in parentheses

Table 6. Coefficients from the regression of the opportunity cost and market price methods of valuation on the explanatory variables.

Variable	Reference Model		Focus Model	
	Opportunity Cost	Market Price	Opportunity Cost	Market Price
Hourly wage rate	----	----	1150.423 (13.026)	----
Hours	----	----	300.763 (4.196)	306.265 (1.384)
Number of children	6707.516 (273.482)	3586.656 (153.458)	2128.640 (185.510)	-808.068 (60.684)
Number of children sqd.	-747.186 (68.945)	-531.954 (38.687)	-410.164 (43.811)	-339.895 (14.488)
Age	761.090 (70.397)	67.715 (39.502)	81.140 (45.190)	17.524 (14.772)
Age sqd.	-7.528 (0.835)	-0.783 (0.469)	-1.049 (0.534)	-0.158 (0.175)
Educational level	920.151 (53.512)	-129.956 (30.028)	108.474 (35.379)	-43.074 (11.233)
Female	-530.224 (281.504)	3869.656 (157.960)	-711.879 (190.031)	-87.186 (61.683)
Constant	-20,571.090 (1444.470)	5,992.490 (810.530)	-10,302.788 (929.754)	2,104.7510 (303.581)
R ²	.196	.173	.677	.884

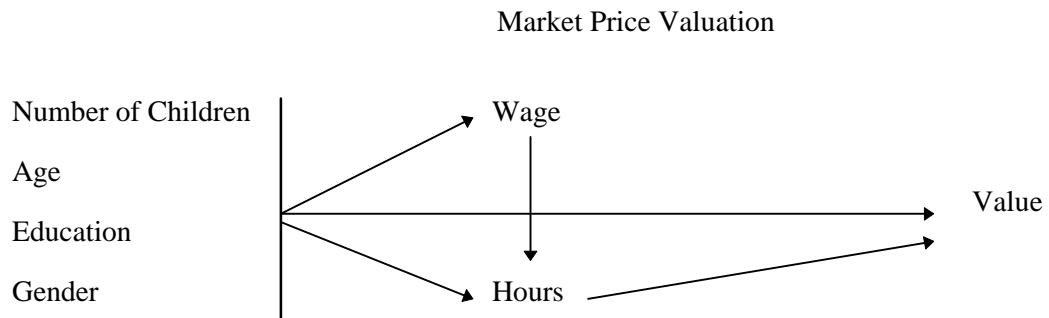
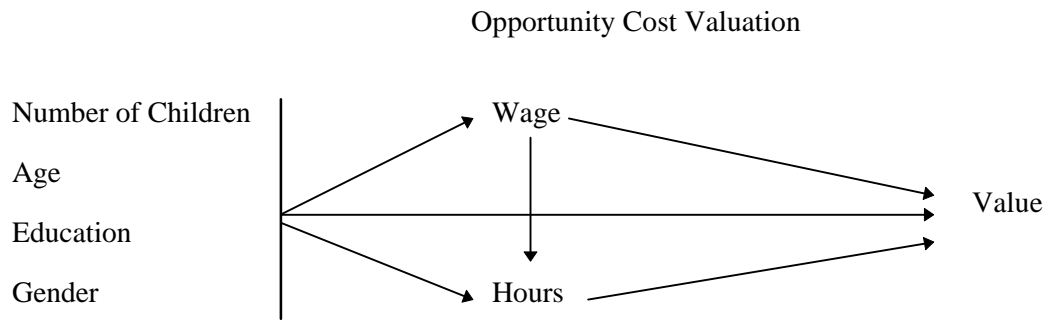
Note: standard errors in parentheses

Table 7. Full effects of explanatory variables from the path analysis on the focus model for the opportunity cost and market price methods of valuation.

Variable	Reference Model		Focus Model	
	Opportunity Cost	Market Price	Opportunity Cost	Market Price
Number of children	6707.516	3586.656	6712.602	3566.997
Number of children sqd.	-747.186	-531.954	-745.043	-528.624
Age	761.090	67.715	758.188	75.589
Age squared	-7.528	-0.783	-7.614	-0.987
Educational level	920.151	-129.956	923.750	-126.620
Female	-530.224	3869.656	-529.560	3858.976

Note: estimates for the focus model do not include spurious effects

Figure 1. Path Analysis models of the opportunity cost and market price methods of valuing household production.



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