

The welfare impact of implicit income generated from childcare in home-based employment

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For households that take care of their children when working at home, the income earned from home-based employment is twofold. While visible money income is generated from the paid employment, there is a certain amount of invisible income generated from performing childcare at the same time. The purpose of this study was to estimate the invisible income generated from performing childcare when working at home, and its impact on household welfare change at both micro and macro levels. The results show that in 1988, for a typical home-based worker who took care of his/her children when working at home, the Hicksian compensating and the Hicksian equivalent variation were about \$2564.53 and \$1651.87 respectively. At the aggregate level, for the nine states included in this study, a point estimate of the total Hicksian equivalent variation was about 80.5 million. This means, if these households could not take care of their children when working, 80.5 million dollars would need to be given to them in order to keep them as well off.

Introduction

As increasing numbers of families attempt to balance their needs for paid wages and household responsibilities, and corporations struggle with employee flexibility and global competitiveness, there has been a renewed interest in the home as a workplace.¹ While the labour force participation rate of women with young children increased dramatically in the last 30 years, childcare as an institution is facing a crisis of funding and recognition.² The gap between the demand of paid care giving and childcare service supply gives at least some households the incentives to work at home and use home-based employment as a solution to the family's needs for childcare, and therefore to eliminate or reduce childcare expenses. For these households, the income earned from home-based employment is twofold. While visible money income is generated from the paid employment, there is a certain amount of invisible income generated from performing childcare at the same time. The purpose of this paper is to estimate the invisible income generated from performing childcare when working at home, and its impact on household welfare change at both micro and macro levels. These estimates can provide a solid base for accurately assessing the value of home-based employment and its contribution to household and social welfare. The information presented here

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can also help us to evaluate better the costs and benefits of home-based employment and its related policy issues.

The literature

There is limited literature on family life and home-based employment.² Some early studies based on small samples found that a major motivation for women to work at home was to care for their children.³⁻⁶ One study by Stafford and Longstreth⁷ analysed a small sample of women who were either employed outside the home or in the home as home-based workers. The study estimated the demand for childcare services by the combined group of 193 employed women using a conditional demand function. Regression results showed that home-based workers used 224 fewer hours per year for paid childcare services than those women who were not home-based workers. Clearly, the home-based workers were supplementing or devoting their employment, family and childcare needs. However, no study has estimated the invisible income generated by this group of home-based workers and its impact on household welfare at the micro level and the impact on social welfare at the aggregate level.

Theoretical framework

Consider a model of household work decision for a family with home-based employment. If we regard the time spent eating, sleeping and otherwise maintaining ourselves as more or less fixed by nature laws, there is only limited discretionary time the household can allocate to either work or leisure. An equilibrium point can be attained when the marginal utility of leisure is equal to the marginal utility of income from paid work, and the household maximizes its total utility at this equilibrium point.

Assume the household's utility function is $U(X, H)$, where X is a vector of commodities and H denotes the time of paid work. The budget constraint may be written as $PX - wH = m$, where P is a vector of prices of goods X , and w is the wage rate. The household's compensated demand function and labour supply function can be derived from the solution to the problem:

minimize $PX - wH$ subject to $U(X, H) = u$.

The solution for this problem, obtained by solving the first-order conditions, may be written as:

$$x_i = x_i(P, w, u) \text{ for } i = 1, \dots, n, \text{ and}$$

$$H = H(w, P, u).$$

These are, respectively, the compensated commodity demand and labour supply functions.⁸

Given the fact that some home-based workers generate implicit income by working and performing childcare simultaneously, their real wage rates are higher than their

visible money wage rates. Denote the visible money wage rate as w^1 , the real wage rate is

$$w^2 = w^1 + m'/H,$$

where m' is the amount of implicit income generated from performing childcare. Thus, given the individual labour supply function, if the wage rate were only the visible money wage rate w^1 , their desired hours of working would be different from the hours under w^2 , which is the true wage rate. Note that a superscript 1 or 2 on w , P , H , m or a subscript 1 or 2 on u denote the situation under the first state without implicit income or the second state with implicit income.

The Hicksian compensating variation (HC) measure of welfare change as a result of this wage rate change is defined to be the amount of money that could be taken away from the household in the situation with the implicit income in order to leave it as well off as in the situation without the implicit income. It is, indeed, the money measure of the utility gain by performing childcare simultaneously when working at home. Making use of the expenditure function and the Hotelling's lemma, the formula of HC may be written as:

$$HC = m^2 - e(p^2, w^2, u_1) = \int_{w^1}^{w^2} H(w, p, u_1) dw.$$

Alternatively, we can also use the Hicksian equivalent variation (HE), which is the amount of income that must be given to the household in the situation without the implicit income in order to give the household the same utility level in the situation with the implicit income:

$$HE = e(p^2, w^2, u_2) - m^1 = \int_{w^1}^{w^2} H(w, p, u_2) dw.$$

However, empirically, only the Marshallian uncompensated labour supply function can be estimated from observable data and the Marshallian uncompensated worker's surplus can be computed. Following the labour economic theory, labour supply H is a function of prices, wage rate and exogenous income. Because of the cross-sectional nature of this study, prices can reasonably be treated as being constant. Therefore, the uncompensated labour supply function for an individual takes the form:

$$H = H(w, m_0),$$

with m_0 denoting the exogenous income.⁹

The relationship between these compensated welfare change measures, HC and HE , and uncompensated welfare change measure MM are illustrated in Figure 1. It shows the case in which the slope of the labour supply function is positive. All goods X are aggregated into a composite commodity, x . The diagram depicts an increase in the wage rate from w^1 to w^2 , causing the home-based worker to change labour supply from H^1 (the hours he/she would work without the implicit income) to H^2 (the current observed hours with the implicit income). The value of HC is the distance $m - e^1$ in the upper part of the figure, which is identical to the area to the left of the compensated supply curve for labour $w^1 w^2 ad$. The Hicksian equivalent variation, HE , is illustrated as the

Childcare in home-based employment

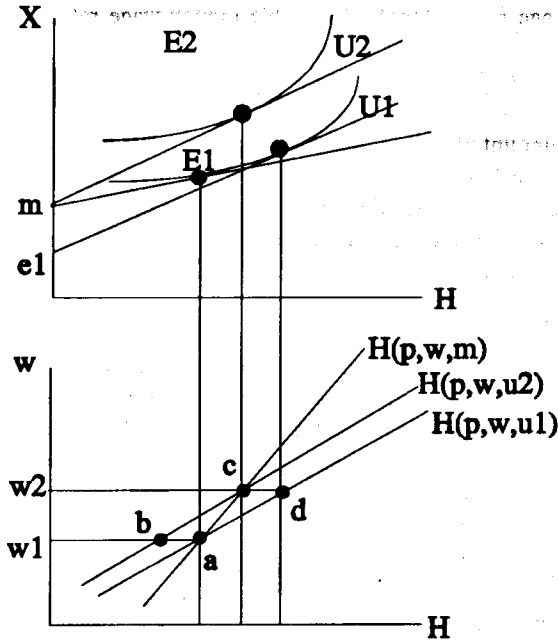


Fig. 1. Measures of welfare change owing to a wage rate change.

area w^1w^2bc . As long as the income effect for labour supply is negative, the uncompensated Marshallian worker's surplus, MM , is less than HC and more than HE , depicted as the area w^1w^2ac .

Data and methods

The data set used for this study was from a nine-state project focused on households in which at least one individual generated income by working at or from home (HBW).¹⁰ A random sample of 899 households was selected from Hawaii, Iowa, Michigan, Missouri, New York, Ohio, Pennsylvania, Utah and Vermont using stratified sampling, and each household manager was interviewed by telephone for 30 minutes in 1988. The subsample used in this study was limited to 351 households with children who needed care on a daily basis. Weights were used to correct for any unproportionately sampled strata. For detail information about the HBW data set, see Stafford *et al.* (1992).¹⁰

To come up with reasonable estimates of childcare expenses for the HBW subsample in the hypothetical situation in which they could not perform childcare simultaneously when working at home, a subsample was drawn from the National Longitudinal Survey of Youth (NLSY). NLSY is a longitudinal survey conducted by the Human Resource Center of the Ohio State University since 1979, with an initial sample size of 12 868 observations. In 1988, detailed information on childcare expenses and care arrangement

was collected for female respondents. After deleting missing data and illegible observations, the subsample used in this study contained 869 observations with households who had childcare expenses in 1988.

At the first step, an ordinary least square regression equation was estimated with weekly childcare expense per child as the dependent variable. Although in the 1988 NLSY data set, detailed information about childcare was collected, for the purpose of this study the independent variables were limited to variables contained in both the HBW and the NLSY data sets. Furthermore, since this step mainly served for prediction purposes, only variables significant at the 90% confidence level were kept in the final model.

The obtained regression model from the NLSY data set was then used to predict the hypothetical childcare expenses for the HBW subsample. Note that self-selection bias may exist because those who were home-based workers could be systematically different from those who were not. However, data set limitation prohibited conducting some common correction procedures, such as two-stage probit.

From the NLSY subsample, the mean working hours per week for the respondents were about 35 h, which were used as a reasonable mean estimate for the needed childcare hours per week. In the HBW subsample, the weekly working hours ranged from 6 h to 112 h. Some home-based workers in the sample had other non-home-based jobs, and some still used childcare services, more or less. Therefore, to come up with plausible estimates of the implicit income, 35 h were used as a cut-off point. That is, if the home-based worker worked more than or equal to 35 h per week, his/her yearly implicit income was computed using the following formula:

$$m' = \frac{35 - \text{HRSBABYSIT}}{35} * \text{PEXPENSE} * \text{REQCARE} * 52,$$

where *HRSBABYSIT* is the weekly hours the household hired a baby sitter; *PEXPENSE* is the predicted care expense per child using the regression equation estimated from the NLSY sample; *REQCARE* is the number of children in the household who needed care on a daily basis.

If the home-based worker worked less than 35 h per week at home, then the actual hours of working were used to substitute for the 35 h in the above formula. The implicit income was then added to the after-tax income of the home-based worker and his/her wage rate was adjusted.

The second step was to estimate the individual labour supply function of home-based workers. Neoclassical labour economic theory suggests that the individual labour supply function is band backward shaped. Empirically, however, no plausible suggestion of the bending point can be found in the literature. After careful study of the data plot, a pattern was found such that, among the home-based workers in the sample, the business owners and the paid employees tended to respond differently to changes in wage rates. While the paid employees tended to work more with higher wage rates, the business owners took the opposite approach. Based on this phenomenon and also on the belief that these two groups might have different labour supply behaviours, the

sample was disaggregated into a business owner subsample of 263 observations and a paid employee subsample of 88 observations. Ordinary least square regressions were used to estimate labour supply equations for these two groups.

At the third step, the Marshallian worker's surplus change, MM , was estimated for each observation based on their estimated individual labour supply function:

$$MM = \int_{w_1}^{w_2} H(w, m_0) dw.$$

In order to get a better welfare measure, Hicksian compensated welfare change was computed using Willig's approximation formula.¹¹ For mathematical feasibility reasons, the approximate formula for constant income elasticity was used and the average of the two bound elasticities served as the constant income elasticity:

$$HC = MM - \frac{1}{2} \frac{\eta}{m^0} \frac{MM^2}{m^0},$$

$$HE = MM + \frac{1}{2} \frac{\eta}{m^0} \frac{MM^2}{m^0}.$$

Since in labour supply studies, income effect is usually negative, HC is generally larger than MM , and HE smaller than MM .

At the last step, based on the available sample incidence information, a point estimate of the aggregate welfare change for these nine participating states was provided.

Results and discussion

Descriptive statistics and estimation of implicit income

The final regression equation of childcare expenses estimated using the NLSY subsample took the form:

$$PEREXP = b_1 * \ln(TOTALY) + b_2 * HOMEADUL + b_3 * WORKHRS + b_4 * REQCARE + b_5 * AREA + e,$$

where $PEREXP$ is the weekly childcare expense per child; $TOTALY$ is the total family after-tax income in 1988; $HOMEADUL$ is a dummy variable indicating if there was an adult or adults who was or were out of the labour force in the household; $REQCARE$ is the number of children who required care; and $AREA$ is a dummy indicating whether the household was living in a rural area or in an urban area.

This regression had an adjusted r^2 of 0.20 and every variable kept in the equation was significant at the 90% confidence level. The results of this regression were used to compute the implicit income for home-based workers in the HBW sample using the formula presented in the Data and methods section. The estimated implicit income m' and with other descriptive statistics of the sample are reported in Table 1.

An average home-based business owner worked about 32.68 h a week, while an average paid employee worked about 34.40 h a week, with no statistically significant

Table 1. Selected sample statistics: mean and standard deviations

	Business owners (<i>n</i> = 263)	Paid employees (<i>n</i> = 88)
Work hours per week	32.68 (19.74)	34.40 (22.09)
Wage without implicit income	\$14.18 (18.47)	\$10.42 (7.20)
Wage with implicit income	\$15.37 (18.58)	\$11.53 (7.32)
Exogenous income	\$24 876 (19 080)	\$24 024 (19 183)
Proportion male	60%	55%
Age (years)	38.22 (9.08)	36.23 (7.02)
Family size	4.39 (1.35)	4.20 (0.96)
Proportion having other jobs	28%	29%
Proportion high school education	28%	29%
Proportion some college education	32%	29%
Proportion college education or more	23%	29%
Number of children requiring care	2.02 (1.07)	1.77 (0.84)
Proportion hiring babysitters	37%	42%
Estimated weekly implicit income	\$39.31 (19.49)	\$42.78 (20.89)
Estimated annual implicit income	\$2033.74 (1837.09)	\$2318.51 (2270.77)

difference. The average wage rate was higher for the business owner group (\$14.18 and \$15.37 without and with implicit income) than that for the paid employee group (\$10.42 and \$11.53 respectively). The demographic characteristics for these two groups were very similar. The proportion using childcare was higher for paid employees than for business owners, but the average hours of childcare services were higher for business owners who used care services than for the corresponding paid employees. An average paid employee generated slightly more implicit income (\$2318.51 per year) than an average business owner (\$2033.74 per year).

Estimation of the labour supply functions

The ordinary least squares method was used for the estimation of the two labour supply functions for the two groups using the adjusted wage rate including implicit income. The dependent variable was the actual hours of work per week. As suggested by the theory, wage rate, total exogenous income and other demographic variables (representing individual preferences) were included as independent variables. Nature log forms of the wage rate and the exogenous income were used to capture possible non-linear relationships between the wage rate and working hours. The variables used in the labour supply equations and the regression results are reported in Table 2.

The regression model had a fairly good fit, and the key variables, wage rate and exogenous income, were significant. It is interesting that, although the mean wage difference was not substantial for the business owner group and the paid employee

Childcare in home-based employment

Table 2. Estimated labour supply functions (OLS)

Variables	Business owners (<i>n</i> = 263)		Paid employees (<i>n</i> = 88)	
	Coefficient	<i>t</i> -value	Coefficient	<i>t</i> -value
Intercept	49.60***	6.321	27.67**	2.105
Log of wage rate with implicit income	-6.62***	-5.130	3.36*	1.816
Log of exogenous income	-1.04***	-2.747	-1.18**	-1.993
Being male	14.96***	6.275	23.67***	5.588
Age	-0.01	-0.108	-0.26	-0.947
Family size	0.59	0.747	2.99	1.567
Having another job	-14.29***	-5.725	-6.80*	-1.795
Having high school education	-1.77	-0.528	0.16	0.029
Having some college education	-1.05	-0.328	-11.63**	-2.074
Having college or more education	5.22*	1.736	-3.23	-0.599
<i>F</i> -value	11.919***		10.337***	
Adjusted <i>r</i> ²	0.2734		0.4913	

*** Statistically significant at 99% level; ** statistically significant at 95% level; * statistically significant at 90% level.

group, their labour supply behaviour tended to be very different. The partial effects of the wage rate on labour supply hours was not a constant. At sample mean levels, for business owners, the partial effect was -0.43, implying that at sample mean levels, one dollar increase in wage rate would cause a 0.43-hour decrease in weekly working time. On the other hand, for paid employees, at sample mean levels, one dollar increase in wage rate would cause a 0.29-hour increase in weekly labour supply. The exogenous income elasticity depended on current working hours. At sample mean levels, the income elasticity was -0.032 for the business-owner group and -0.034 for the paid employees. For those who worked only a few hours a week, for example, 6 h a week, the income elasticity was as high as -0.17.

Estimation of welfare change as a result of implicit income

Based on the results of the estimated labour supply functions, household welfare change as a result of implicit income was calculated. Since two major independent variables 'Being male' and 'Having other jobs' were significant dummy variables in the labour supply equations, indicating that labour supply behaviour was different between men and women and also between those who had other market jobs and those who had not, welfare changes were computed for eight further disaggregated subgroups. The estimated Marshallian and Hicksian welfare measures are presented in Table 3.

Table 3. Estimated annual mean welfare change per household with implicit income generated by performing childcare and working simultaneously

	Business owners		Paid employees	
	No other job	Have other jobs	No other job	Have other jobs
Marshallian Welfare Change (MM)				
Male	2449.72	1534.78	4218.24	2896.40
Female	1637.38	897.84	1185.13	928.18
Hicksian Compensating Variation (HC)				
Male	3418.27	1573.16	5471.57	3723.72
Female	1658.80	879.86	1187.29	928.20
Hicksian Equivalent Variation (HE)				
Male	1645.28	1496.40	3067.84	2207.09
Female	1616.52	879.83	1182.97	928.15

The overall weighted mean Marshallian worker's surplus for the whole sample was \$2023.32. The corresponding Hicksian compensating variation, *HC*, and Hicksian equivalent variation, *HE*, were \$2564.53 and \$1651.87. This means, holding other things unchanged, on average, \$2564.53 could be taken away from a typical home-based worker in this sample with implicit income in order to leave his/her household as well off as in the situation without the implicit income. Alternatively speaking, assume the household did not generate implicit income from performing childcare when working at home, \$1651.87 must be given to this household to let it attain the current utility level with implicit income.

The subgroup of male paid employees with no other market job had the highest mean welfare change. Home-based workers who did not have other market jobs generated more implicit income and had more welfare gain than those who had other market jobs. Further, on average, men generated more implicit income and had more welfare gain than women. This may be caused by the fact that men worked much longer than women, and many women were only part-time employees and spent the rest of the time fully on family duties (including childcare). If this were the case, the value of this pure household production cannot be reflected in the implicit income computation and its welfare contribution is not captured in this study.

Welfare change at the aggregate level

Using the incidence rate information collected in the pilot study of the HBW data,¹⁰ the population size of households with home-based employment for the nine participating states could be estimated. This made it possible to estimate the aggregate welfare change resulting from performing childcare simultaneously when working at home.

The estimated population size for households with home-based workers was 1 248 495 for the nine states in the sample, and the estimated proportion of the subpopulation with at home childcare was 0.3904. Thus a point estimate of the total Hicksian compensating variation was about 1.25 billion. For Hicksian equivalent variation, a point estimate was 80.5 million. This means, if these households could not take care of their children when working, 80.5 million must be compensated to them in order to keep them as well off as if they could perform childcare when working at home, a number too large to be ignored!

Conclusions and limitations

In this study, the compensated and uncompensated welfare changes for households with home-based employment and performing childcare simultaneously when working at home were estimated. The results show that performing childcare when working at home did have an important welfare impact on the economic status of the households by increasing the household well-being both at the individual level and at the aggregate level by a substantial amount. Therefore, when analysing the welfare status of this group of households for the purpose of either intra-group (group of households with home-based employment) or intergroup comparisons, using only money income will substantially underestimate the true welfare level of this group and influence the goodness of the comparison.

Some limitations of this study need to be kept in mind. First, when estimating childcare expenses, self-selection bias, which may well exist in this case, was not considered. In addition, owing to the limitation of the data set, variable selection was limited so that the childcare expense regression did not have a very good fit (with an adjusted r^2 at 0.20). Economies of scale were not considered. A justification for this is that, if children were sent to day care, there was no discount for sending more than one child from a household. Second, the assumption of 35 h care a week was based on the average working hours per week of the parents. This was a very simplified assumption and better estimates may be obtained if feasible data were available. Further research is needed to go in more detail into labour supply behaviour of the subgroups, and studies on the determinants of the magnitude of the welfare change will be very useful.

Nevertheless, the estimates presented in this study can provide some insights into the impact of this implicit income on the welfare status of the relevant households at both the individual household level and the aggregate level. These estimates can provide a base for accurately accessing the value of home-based employment and its contribution to household and social welfare. The information presented here can also help us to evaluate the costs and benefits of home-based employment and its related policy issues better.

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