INDICES OF HOUSEHOLD WELFARE AND THE VALUE OF LEISURE TIME

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Abstract—Leisure-inclusive welfare indices, such as the real wage index, have been previously investigated only with aggregate data. Using micro data, however, these indices show the effects of increasing labor market employment of household members. Real wage, expenditure, and nonlabor income indices are compared across six types of husband/wife households. These indices are also compared to ad hoc real wage and leisure-exclusive index measures. Doubt is cast on past results based upon aggregate data.

I. Introduction

A true leisure-inclusive welfare index indicates the compensatory change in wage rates, goods consumption, or nonlabor income required to enable the household to attain some reference period utility given an exogenous change in wage rates and prices. Although these indices are theoretical constructs for the measurement of individual or household welfare changes, empirical analyses of these indices have relied upon aggregate time series data. These data provide information on national average changes in wage rates, goods consumption, and hours worked, but do not capture changes in hours worked at the household level due to increased labor market participation. While the entry of many new part-time workers into the labor market may decrease the national average of hours worked per week, there may be a decrease in leisure for many households. In addition, the aggregate time series approach ignores differences across households in demographic attributes, and the occupations and industries in which household members are employed.

To address these issues, two large cross-sections of household data, the 1972 and 1980 BLS Consumer Expenditure surveys (U.S. Bureau of Labor Statistics (1978)) were used to calculate three types of leisure-inclusive welfare indices (the real wage index, goods consumption, and nonlabor income indices) for each of six household demographic groups. Households comprising a husband and wife with zero or more dependent (non-working) children were considered as the basic decision-making units. In this household approach two real wage indices could be constructed—that of the husband and that of the wife, since the labor services of the two individuals may be valued differently.

The remainder of the paper is organized as follows. In section II the leisure-inclusive welfare indices are developed theoretically. The fixed weight bounds on the true indices and the limitations of these indices in the context of a more general (but as yet undeveloped) intertemporal behavior framework is discussed. In section III the data and empirical results are discussed and analyzed. A summary and conclusions follow in section IV, along with suggestions for future research.

II. Leisure Demand and Household Welfare

Assume that each household comprises a married couple of working age and zero or more dependent children.[1] Each household functions as a decision-making unit in the choice of commodity expenditures as well as the labor market participation of both the husband and wife. Household utility may thus be expressed by

$$U = u(x, L_f, L_m), \tag{1}$$

where $x = (x_1, \cdots, x_n)$ represents the quantities of each of n market commodities consumed, L_f = leisure time of the female spouse, and L_m = leisure time of the male spouse. The budget constraint facing this household is given by

$$\begin{aligned} px + (w_f L_f + w_m L_m) &= w_f T + w_m T + M \\ &\equiv Y \end{aligned} \tag{2}$$

where $p = (p_1, \cdots, p_n)'$ = the vector of market

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[1] The basic model applies equally well to single person households. However, the labor market constraint of a 40-hour work week will be a more important limiting factor in this case where potential secondary earners are absent.

prices for the commodities x, w_f = the market wage for the female's labor, w_m = the market wage for the male's labor, T = the total amount of time available for both work and leisure for each spouse (assuming $T_f = T_m$), and M = nonlabor income. The right hand side of equation (2), Y, which is exogenous to the household, is termed "full income" (Becker (1965)) to distinguish it from market income

$$M + w_f(T - L_f) + w_m(T - L_m).$$

Given p, w_f, w_m, T, and M, the household's utility maximization problem is given by (3) below.

$$\max_{x, L_f, L_m}\{u(x, L_f, L_m) \mid px + (w_f L_f + w_m L_m) \leq w_f T + w_m T + M\}; \quad 0 \leq L_f, L_m \leq T, x \geq 0. \quad (3)$$

The solution of (3) derives the optimal quantities of leisure time (L_f^*, L_m^*), and market commodities x^* which correspond to the maximized level of utility $U^* = u(x^*, L_f^*, L_m^*) = u^*(p, w_f, w_m, M, T)$.

As for nearly all analyses of leisure/commodity demands (Blundell and Walker (1982), Johnson and Pencavel (1984), Phlips (1978)), this basic framework assumes that T does not include home production or nonmarket labor. If we assume that nonmarket labor is fixed, then the labor/leisure choice model is unaffected since neither leisure nor market labor may be substituted for nonmarket labor. Recent studies indicate, however, that leisure and home work exhibit substantial jointness as production inputs to household utility (Graham and Green (1984)), so that an increase in market labor must decrease leisure as well as home production and thus the utility from both.

Given this model, a number of indices for evaluating a welfare change from time period 0 to period 1 can be constructed, based on any of the exogenous variables in the model.[2] These true leisure-inclusive welfare indices each have corresponding fixed weight indices which do not require estimation of the expenditure function as bounds. The formulas for these fixed weight (nonparametric) indices and their relationship to the true measures discussed below are given in table 1. Since T remains constant across periods, it will be dropped as an explicit argument in the discussion.

The real wage index (Pencavel (1977), Cleeton (1982)) is based upon the minimum wage function, which defines the minimum hourly wage rate required to enable achievement of utility level U^* given any vector of the remaining exogenous variables. For a household with two (potential) earners, there exist two minimum wage functions, $\hat{w}_f$ and $\hat{w}_m$, given by equations (4a) and (4b):

$$\hat{w}_f = w_f(p, w_m, M, U^*) \quad (4a)$$

$$\hat{w}_m = w_m(p, w_f, M, U^*). \quad (4b)$$

[2] Indices based upon the observable parameters (market wage rates, prices, and nonlabor income) are more useful than indices which require specifying a value for T. (See Riddell (1983), pp. 351–352.)

TABLE 1.—FIXED WEIGHT AND NONPARAMETRIC INDEX NUMBER FORMULAS

Index	Fixed Weight Index	Bounding Property	Comments
1) Allen real wage	$W_i^L = (p^0x^1 - M^0 - w_j^0h^1)/w_i^0h_i^1$	$\geq W_i^{LA}$	Cleeton (1982)
	$W_i^P = w_i^1h_i^0/(p^1x^0 - M^1 - w_j^1h_j^0)$	$\leq W_i^{PA}$	
	$W_i^F = (W_i^L \cdot W_i^P)^{1/2}$	nonparametric true index for W (Fisher ideal index)	Riddell (1983)
2) Traditional "real wage"	$TRW_i^P = (w_i^1/w_i^0)/(p^1x^0/p^0x)$	not derived from theory	Pencavel (1977)
3) Diewert-Malmqvist expenditure	$E^L = p^0x^1/(p^0x^0 + \sum_{i=m}^{f} w_i^0(h_i^1 - h_i^0))$	$\geq E^{LM}$	Riddell (1983)
	$E^P = (p^1x^1 + \sum w_i^1(h_i^0 - h_i^1)/p^1x^0$	$\leq E^{PM}$	
4) Allen nonlabor income	$M^L = p^0x^1 - \sum w_i^0(h_i^1 + h_i^0))/M^0$	$\geq M^{LA}$	Riddell (1983)
	$M^P = M^1/(p^1x^0 - \sum w_i^1(h_i^0 + h_i^1))$	$\leq M^{PA}$	
5) Goods-only quantity	$Q^L = p^0x^1/p^0x^0$	subindex of E^L	Diewert (1981)
	$Q^P = p^1x^1/p^1x^0$	subindex of E^P	
	$Q^F = (Q^L \cdot Q^P)^{1/2}$	nonparametric true subindex of E (Fisher ideal index)	Riddell (1983)

For each worker, the Laspeyres-Allen real wage index, W_i^{LA}, is defined by comparing the period 0 wage rate w_i^0 $(i = f, m)$, to the minimum wage rate required under the period 0 vector (p^0, w_j^0, M^0), $(j \neq i)$ in order to attain utility level $U^1 = U(p^1, w_m^1, w_f^1, M^1)$. The Paasche-Allen real wage index, W_i^{PA}, compares the period 1 wage rate w_i^1 to the minimum wage rate required under period 1 vector (p^1, w_j^1, M^1) in order to attain utility level $U^0 = u(p^0, w_m^0, w_f^0, M^0)$:

$$W_i^{LA} = w_i(p^0, w_j^0, M^0, U^1)/w_i^0 \qquad (5a)$$

$$W_i^{PA} = w_i^1/w_i(p^1, w_j^1, M^1, U^0); \qquad i \neq j. \qquad (5b)$$

These indices differ from the "traditional real wage" measures which merely deflate wage changes by price changes. These traditional measures are typically defined by the ratio of the average change in wages (w^1/w^0) and a consumer price index. In the context of a two-wage household, this traditional index is given as (6) below:

$$TRW_i^P = (w_i^1/w_i^0)/(p^1x^0/p^0x^0) \qquad (6)$$

where TRW_i^P = the Paasche traditional real wage index and p^1x^0/p^0x^0 is the Laspeyres price index for market commodities. Unlike (5b), these indices ignore the welfare implications of nonlabor income and the labor/leisure decision (Pencavel (1977)).

Analogous to the minimum wage functions is the minimum nonlabor income function, $\hat{M} = M(p, w_f, w_m, U^*)$ which serves as the basis for the Laspeyres-Allen and Paasche-Allen nonlabor income indices, M^{LA} and M^{PA}, below:

$$M^{LA} = M(p^0, w_f^0, w_m^0, U^1)/M^0; \qquad (7a)$$

$$M^{PA} = M^1/M(p^1, w_f^1, w_m^1, U^0). \qquad (7b)$$

The index M^{LA} compares the minimum value of nonlabor income required under period 0 prices and wages for U^1 to be attained to the actual period 0 value of M. The index M^{PA} makes a comparison of the actual value of M^1 to the minimum value of M needed to attain U^0 under period 1 prices and wages (Riddell (1983), pp. 348–349).

For this index the value of M^t represents nonlabor income spent in period t on the consumption of goods and services, i.e., it must satisfy the budget constraint (2) for that period. Because of the single period framework of index number comparisons, saving and dissaving (transfer of consumption between time periods) cannot be explicitly recognized. Lacking a firm theoretical basis for a complete intertemporal index (see Galatin (1973)), of which the measures presented here are partial indices (Pollak (1975)), the interpretation of M^{LA} and M^{PA} as welfare measures is constrained by this single period approach. In the intertemporal view, these measures may well be meaningless since the value of M^t may indicate expenditure of interest income or dissavings and its relationship to utility in period t may be positive or negative.

A third basis for welfare comparison, total commodity expenditure, provides a set of leisure-inclusive indices which can be compared to similar indices which ignore the labor-leisure choice. Following Diewert ((1983), p. 208), the household's conditional consumption deflation function D is defined as

$$D(U, x, h_f, h_m) \equiv \max_k\{k: u(x/k, h_f, h_m) \geq U^*, k > 0\} \qquad (8)$$

where U^* is the reference utility level, and the hours of work: $h_m = -(T - L_m)$, and $h_f = -(T - L_f)$. Given U^*, x, h_f, and h_m, definition (8) provides the value of the deflation factor k which enables U^* to be achieved by $(x/k, h_f, h_m)$. Based upon this, the Laspeyres-Malmquist and Paasche-Malmquist consumption quantity indices are given by E^{LM} and E^{PM}, respectively, below:

$$E^{LM} = D(U^1, x^1, h_f^1, h_m^1)/D(U^1, x^0, h_f^0, h_m^0) = D(U^0, x^1), \qquad (9a)$$

$$E^{PM} = D(U^0, x^1, h_f^1, h_m^1)/D(U^0, x^0, h_f^0, h_m^0) = 1/D(U^1, x^0). \qquad (9b)$$

If the contribution of leisure consumption to utility is ignored, Malmquist quantity indices analogous to equations (9a) and (9b) can be constructed by leaving the arguments h_f and h_m out of the utility function and assuming that both labor and nonlabor income are exogenous.[3] These leisure-exclusive indices Q^{LM} and Q^{PM} represent subindices of the indices E^{LM} and E^{PM}, respec-

[3] The indices Q^{LM} and Q^{PM} are the quantity index counterparts to the Paasche and Laspeyres true cost-of-living or price indices, respectively (see Diewert (1981), p. 171).

tively (Pollak (1975)). Thus, a comparison of E^{LM} to Q^{LM} and E^{PM} to Q^{PM}, will provide evidence on the importance of changes in leisure consumption to welfare. If, for example, $E^{LM} > Q^{LM}$, then the quantity index in terms of goods only is understating welfare increases by ignoring increases in leisure.

The real wage and consumption quantity change indices may also be approximated by superlative index forms such as the Fisher ideal index. The Fisher quantity index, defined as the geometric mean of the corresponding Laspeyres and Paasche fixed weight quantity indices, provides an exact measure of the true welfare change for a homogeneous quadratic cost (expenditure) function (Diewert (1983)). The Fisher formulas are provided in table 1. For the nonlabor income indices, however, superlative indices cannot be constructed since either M^P or M^L may be negative in value (Riddell (1983)).[4]

III. Empirical Analysis

To calculate the leisure-inclusive household welfare indices for U.S. consumers two large micro data sets based upon the 1972 and 1980 Consumer Expenditure Interview Surveys (U.S. Bureau of Labor Statistics (1978)) were employed. Each data set contained information on family demographic attributes, expenditures, and the earned income and employment status of family members. Expenditures on market goods were disaggregated into 53 categories (the maximum level of disaggregation possible for a continuous set of 1972–1980 price indices). Because of changes in the measurement of housing expenditures for homeowners, only renters were included in the two CE samples.[5]

To examine demographic differences in the welfare indices, the two data sets were subsetted according to race and household type. Each household was defined as either white or nonwhite, based upon the race of the "reference person" (head of household). Household types were defined as husband/wife couples with: (1) no children present; (2) oldest child under age 6; (3) oldest child age 6–17, with no children in the labor market. Households with the oldest child over 18 were not included because of small sample size.

The price indices for the 53 goods and services were derived from the national average BLS consumer price index series for urban consumers (CPI-U). An index for the changes in wage rates, 1972–1980, was calculated from tabulations of the BLS Current Population Survey data (U.S. Bureau of Labor Statistics (1982)) on median full-time weekly earnings by occupational category. A wage rate index was calculated for each of the 11 occupational categories and then a weighted average of these 11 wage rate indices was taken for the husband and for the wife in each of the demographic groups of the 1972 and 1980 household data base.[6] The weights were defined by the proportion of working husbands and wives in each demographic group employed in each of the 11 occupational categories. Thus, for each race/family type subset, two wage index series, w_f and w_m, were constructed. For the 1972 CE households the 1972 occupational compositions were used, and for the 1980 households the 1980 occupational compositions were used to provide the weights. In a sense, the occupational mix of workers in each survey year represents a selected "market basket" of occupations for that year of data. Because of data limitations, wage rates were not adjusted for taxes.[7]

Using the mean earned income, mean wage indices and market goods expenditures by household group, the welfare indices defined in table 1

[4] If wage rates are rising relative to prices, then it is possible for the value of the minimum wage $\hat{M}$ to be negative, reflecting welfare gains to consumers (Riddell (1983), p. 149).

[5] The BLS currently uses a "rental equivalence" approach to define housing expenditure for homeowners. Under this approach, housing services are defined by the implicit rent of owner-occupied dwelling (see Gillingham (1983)). The implicit rent data for 1980 CE households were not available.

[6] These categories, and their wage indices for 1980 (1972 = 100) are as follows: (1) professional and technical workers, 174.5; (2) managers and administrators, 173.4; (3) sales workers, 175.5; (4) clerical workers, 173.6; (5) craft and kindred workers, 188.4; (6) nontransport operatives, 189.9; (7) transport operatives, 184.9; (8) nonfarm laborers, 179.5; (9) private household workers, 170.2; (10) other service workers, 170.2; (11) farm workers, 205.0.

[7] In studies using aggregate data an average tax rate was assumed, a procedure which is inappropriate for a household level approach where taxes can vary substantially across households.

Under a progressive tax system, it is expected that the pre-tax (unadjusted) wage indices will overstate the post-tax or net wage rate increases. Therefore pre-tax real wage indices should overstate welfare gains relative to their post-tax counterparts.

TABLE 2.—WELFARE INDICES BY DEMOGRAPHIC GROUP, 1972 TO 1980

Race:	White			Nonwhite		
Family type:	1	2	3	1	2	3
Index:	No Children	Oldest Child < 6	Oldest Child 6–17	No Children	Oldest Child < 6	Oldest Child 6–17
Allen real wage:						
W_m^L	103.6	94.0	103.6	80.1	99.0	100.4
W_m^P	100.7	93.7	99.2	86.8	96.4	97.8
W_m^F	102.1	93.8	101.4	83.4	97.7	99.1
W_f^L	106.4	77.8	107.9	68.6	97.0	101.1
W_f^P	101.2	71.1	94.8	78.2	93.1	92.6
W_f^F	103.8	74.4	101.1	73.8	95.0	96.8
Leisure-inclusive quantity:						
E^L	102.3	96.0	102.2	88.5	99.3	100.3
E^P	100.4	95.2	99.4	84.9	97.7	98.3
E^F	101.3	95.6	100.8	86.7	98.5	99.3
Leisure-exclusive quantity:						
Q^L	109.9	98.7	104.5	103.2	101.0	94.6
Q^P	107.9	98.3	101.5	102.3	99.0	93.6
Q^F	108.8	98.5	103.0	102.7	100.0	94.1
"Traditional" real wage[a]						
TRW_m	98.4	97.8	96.4	99.8	98.1	97.6
TRW_f	95.9	94.4	93.8	97.0	95.7	96.8
Nonlabor income:						
M^L	194.6	71.0	119.0	−99.3	85.0	111.5
M^P	108.4	72.1	96.2	−68.6	66.6	69.5

[a] Based upon 1972 occupational distribution.

were calculated and the results are presented in table 2.

Among the indices which incorporate the labor–leisure choice, it can be seen that the real wage indices W_i^L, W_i^P, and W_i^F and the consumption quantity indices E^L, E^P, and E^F follow a similar pattern across demographic groups. That is, only for white family types 1 and 3 are welfare increases generally indicated. For childless couples, this may be due to greater discretion in the choice of consumption and leisure. For families whose oldest child is between 6 and 17, both spouses are generally older and thus in a higher income cohort than the family type 2 group. For family type 2, those with dependent children all under age 6, real wages have declined. This is probably due to both a relatively large increase in market labor by the wives and the relatively young age of workers in this group.[8] Similarly, a decline in leisure among nonwhite female spouses contributed to the values of the real wage indices for these groups.

The traditional real wage indices, TRW_m and TRW_f, are all less than unity, indicating that price changes are exceeding changes in nominal wage rates over the 1972–1980 period for all demographic groups. For the 1980 households, the increase in working females in lower-paying occupations is probably responsible for the value of $TRW_f < TRW_m$.[9] Although Pencavel's (1979, 1979a) results led to the conclusion that the utility-based real wage indices exceeded those of the naive traditional real wage indices, the results in table 2 do not permit this general conclusion. For the white family type 2 and nonwhite family type 1 households the W_i^P indices are smaller than their TRW_i counterparts.

The consumption quantity indices E^L, E^P, and E^F can be compared to the leisure-exclusive quantity indices Q^L, Q^P, and Q^F. With the exception of nonwhite family type 3, the leisure-inclusive indices are smaller than their leisure-exclusive in-

[8] The increased employment of wives was generally in the sales, clerical, and service worker categories (see note 7).

[9] Both white family types 2 and 3 experienced relatively large increases in employment by wives. For family type 2, about 40% of the female spouses worked in 1972 and 65% worked in 1980. Among nonwhite households the increase was more modest—from about 60% to about 75%.

dex counterparts. This reflects the observation that, for most household types, labor force participation has increased and leisure consumption thus decreased. This result contrasts the conclusions of Pencavel (1979a), Riddell (1983), and Coles and Harte-Chen (1985), which relied upon aggregate time series data. Rebasing to 1972, Riddell's (1983) results showed values of $E^L = 116.5$, $E^P = 113.4$, $W^L = 117.9$, and $W^P = 128.6$ (where W^L, W^P are aggregate real wage indices) for 1980, using Canadian data. He compared these to values of $Q^L = 106.6$ and $Q^P = 105.4$, which are similar to those reported here for some demographic groups. In addition, to the extent that the pre-tax wage rate indices overstate the changes in post-tax hourly compensation, the E^L, E^P, and E^F indices reported here overstate those which would result from the use of a post-tax wage index. Thus, the differences between the post-tax E and Q indices are probably somewhat larger than those observed for the pre-tax indices here.

The nonlabor income indices M^L and M^P also differ from those calculated on the basis of aggregate time series data. In most cases both M^L and M^P are positive, indicating that both the numerator and denominator of equations (7) and (8) are positive. For some households, the M^L index is greater than 100.0, indicating that the nonlabor income actually spent in 1980 exceeded that which would restore 1972 expenditure and leisure patterns at 1980 prices and wages. If Riddell's assertions are accepted the M^P index indicates a welfare decrease from 1972 to 1980 for all but white family type 1 households. For nonwhite family type 1, both M^P and M^L are negative, reflecting the fact that M^1 was negative for this group, and a positive increase in M would be needed to compensate welfare losses to this group. Given that changes in savings and expenditure from unearned income have probably occurred in response to changing intertemporal factors (e.g., interest rates on financial assets and loans), the welfare interpretation of these "one-period" indices is dubious. However, Riddell's (1983) expectations and empirical findings of a large positive value of M^L and a corresponding negative value of M^P, both due to rising wages, are not borne out here.

IV. Conclusions

In the foregoing analysis welfare indices which incorporate leisure as a utility-yielding commodity were calculated for several demographic groups of husband–wife households. Using two sets of cross-sectional data on households permitted changes in the employment and earnings of both spouses to be explicitly included. In addition, differences in the welfare changes across different race and family composition groups could be assessed.

The results indicate that some of the conclusions based upon time series data of national aggregates may be misleading. In particular, although the national average of hours per week worked has declined over time, increases in labor force activity at the household level have occurred, decreasing household-level leisure consumption. In addition, much of this increased employment, especially by women, is in occupations with more slowly rising wages. As a result leisure-inclusive welfare indices, including the real wage index, indicate decreases in the welfare of many demographic groups, as well as smaller welfare increases (larger decreases) than those indicated by a leisure-exclusive welfare index.

Further research, both theoretical and empirical, is planned which will address some of the issues and deficiencies in these indices. First, an intertemporal framework which can incorporate savings and lifetime planning of labor and leisure consumption is needed. Second, the relationship between leisure, home production, and market earnings in the household's utility maximization calculus merits further empirical analysis. Among the empirical issues, the inclusion of taxes into the index framework and the estimation of indices for other household groups (including homeowners) is planned. The empirical results in this paper, however limited, do indicate that further investigation is warranted before using real wage indices as policy tools.

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