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Author(s): Janet E. Kohlhase

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# LABOR SUPPLY AND HOUSING DEMAND FOR ONE- AND TWO-EARNER HOUSEHOLDS

Janet E. Kohlhase\*

*Abstract*—The jointness of labor and housing decisions is explicitly modelled in a consumer demand framework. Behavior of seven demographic groups differentiated by marital status, employment status and the presence of children is estimated from a micro data set. Results indicate that (1) decisions regarding work hours and housing consumption are interdependent choices and (2) responses to market signals differ significantly by demographic group. Results are likely to be superior to single equation studies or studies based on aggregate data.

## I. Introduction

SINCE World War II the United States has experienced tremendous social changes. Foremost among these has been the dramatic increase in the labor force participation of women and the changing demographic profile of the population. In 1950, women comprised 29% of the civilian labor force and by 1980 they accounted for over 42%. A substantial portion of that increase has been due to the labor force participation of married women. By 1980 two-earner households outnumbered one-earner households in the category of married households; between 1950 and 1980 the percentage of wives employed more than doubled, from about 24% to over 50%.<sup>1</sup>

Concomitant with the expanding labor market experience of women has been the change in family composition. In particular, the percentage of households headed by unmarried individuals has increased, most notably in the category of female-headed households. In 1960 female-headed households comprised 9.3% of all U.S. families. By 1980 that figure had increased by more than one-half, to 14.6%. Moreover, the percentage of children living with an unmarried parent more than doubled from 9.3% in 1960 to 19.7% in 1980. These and other changes in the distribution of household types are associated with rising divorce and sep-

aration rates, increasing age at first marriage and decreasing fertility rates.<sup>2</sup>

These far-reaching changes have had an immense impact on housing markets and are seemingly responsible for the current restructuring of American cities. The shape of employment opportunities has been radically affected by this altered structure. Given the profound structural changes, it is likely that demographic groups react differently to labor and housing markets in today's cities. Studies show that women's work experiences differ from those of men.<sup>3</sup> However, no study has examined the broader problem of how interrelated work and housing decisions differ by demographic group. Thus, this research is performed to characterize the effects of the new demographic structure of the working age population on labor supply and housing demand in today's urban areas.

This research is pioneering in that the jointness of the labor-housing decision is explicitly modelled in a consumer demand framework. Household decisions regarding work hours may feed back on decisions regarding housing consumption, and choices of housing consumption may influence employment decisions. For example, those workers participating in higher paid jobs are able to afford more housing services; and often the motivation for increased work hours is to support the annual consumption of housing services. In a sense, housing consumption may be viewed as being indicative of the long-run income prospects of households.

The simultaneity of labor supply-housing consumption decisions has for the most part been ignored in the economics literature. The tradi-

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\*University of Houston.

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<sup>1</sup> *Employment and Training Report of the President*, 1981, tables A-4, B-1.

<sup>2</sup> 1970 *Census of Population Special Report, Series P-E, No. 2a*, table 2A-7. *U.S. Statistical Abstract*, 1981, tables 70, 81, *Social Indicators*, 1976, tables 1/7, 2/3, 2/8, 2/9, and *U.S. Statistical Abstract*, 1978, table 114.

<sup>3</sup> Women typically earn less, work fewer hours and participate in different industries than men (*Current Population Reports*, Series P-60, No. 116, and *Employment and Earnings*, May 1978, p. 34). Women commute shorter distances to work than men. In addition, unmarried employed women are more likely to have dependent children than are single employed males (*Employment and Earnings*, April 1978, table 66).

tional Alonso-Muth type of urban model ignores these dependencies while concentrating on aspects of location. Most previous studies model housing demand in a single equation framework. (See, for example, Mayo (1981), Polinsky and Elwood (1979), Polinsky (1977), and the references cited therein.) Although studies of labor supply model the simultaneity of the participation–hours worked decision (Heckman (1974)), the relation of employment decisions to housing and other good consumption has not been thoroughly examined. Some previous research examines labor supply decisions within the framework of consumer demand systems, but either uses aggregate data or does not focus on housing consumption as one of the “other goods.” (See Abbott and Ashenfelter (1976), Wales and Woodland (1976, 1977), and Barnett (1981).) Only Wales (1978) and Kohlhase (1982) have used micro data to examine labor and housing decisions within a consumer demand theory framework. The present work extends this line of analysis to combine aspects of urban and labor research and emphasizes the comparisons of results across demographic groups.

In order to incorporate these ideas, household decision models are presented in the framework of consumer demand systems. Section II examines the simultaneity of household decision making while accounting for the locational aspects of the consumer choice problem. Section III describes the data and estimation of linear translog (LTL) demand systems for seven demographic groups differentiated by marital status, employment status and presence of children. In section IV results are discussed; it is found that the seven demographic groups significantly differ in their response to changes in prices and income. The implication of the findings are discussed in the conclusion, section V.

## II. Problem Definition

Household decision models are developed in which urban households choose housing, hours of leisure and other goods given workplace–residence separation. Commuting costs are explicitly treated as a fixed cost (Cogan, 1981) of market work. Linear translog demand systems are specified for seven demographic groups. The estimation of these systems allows the comparison of behavior across

demographic groups within the theoretically consistent framework of consumer demand systems.<sup>4</sup>

It is assumed that the demographic profile of the urban area is exogenously determined. The city is composed of households of seven demographic types: unmarried males, unmarried females with children, childless unmarried females, traditional (only the male head is employed) couples, traditional families with children, two-earner couples and two-earner families with children. Moreover, it is assumed that the participation decision is given and that at least one member of the household is employed, workplace is fixed and residence ring (radius of a given distance from the workplace) is fixed.

Households choose their annual consumption of housing, goods and services, and leisure of the wage earners<sup>5</sup> by maximizing a household quasi-concave utility function.<sup>6</sup> One-earner households maximize

$$U = U(L_h, r, x) \quad (1)$$

<sup>4</sup> An alternative methodology for examining the impacts of demographic variables on consumer choice is to incorporate demographic variables explicitly into the demand equations by use of scaling or translating certain parameters of the demand system (Pollak and Wales, 1980). The present approach is more general; in effect all parameters are assumed to be functions of demographic variables. Moreover, Barnes and Gillingham (1981) reject demographic scaling and translating in favor of estimating separate demand systems for each subgroup.

<sup>5</sup> Implicit in the analysis is the assumption that households continuously consume their temporal equilibrium housing services and leisure hours. The temporal equilibrium is defined with respect to the households' current economic and demographic characteristics. Results are to be interpreted as long-run responses by the demographic groups.

Dynamic models of labor supply are fairly well-developed in the literature (Killingsworth, 1983), however dynamic models of housing demand are in their infancy (pioneered by Houthakker and Taylor, 1970; their lack deplored by Mayo, 1981). It is beyond the scope of this paper to explicitly model the dynamics of the joint decisions. Moreover, data set limitations made only one year available with a detailed spouse interview, a necessary element in the comparison of one- and two-earner households.

<sup>6</sup> A household utility–household budget constraint model is assumed here. The approach differs from other approaches to household behavior such as the individual utility–household budget and related bargaining models (see Killingsworth (1983) and cited references). Two important areas of difference concern the effects of changes in other's wage and non-wage income on individual leisure hours. In the household utility model the (compensated) cross-substitution effects of wage changes of either spouse are equal but of indeterminate signs. However, in the individual utility approach the indirect income effects are not necessarily equal, and if leisure is normal, are negative. Secondly, non-wage income changes are “public goods” in the household utility model, but can be individual-specific in the latter two approaches.

while two-earner households maximize

$$U = U(L_h, L_s, r, x) \quad (2)$$

in which

$L_h$  = annual leisure hours of head, net of commuting time

$L_s$  = annual leisure hours of spouse, net of commuting time

$r$  = housing services, number of rooms

$x$  = Hicksian composite good (with a normalized price), defined as expenditures net of housing and commuting costs.

The decision variables in equations (1) and (2) must satisfy time and budget constraints. (For brevity only the two-earner model will be presented. The one-earner model is derived by eliminating the spouse's variables in the following.) The two-earner household faces (budget)

$$dt_h + dt_s + p_r r + x = N + w_h j_h + w_s j_s \quad (3)$$

(time)

$$T = L_h + j_h + c_h \quad (4)$$

$$T = L_s + j_s + c_s \quad (5)$$

in which

$d$  = distance to work, assumed fixed

$t$  = annual transport cost per two miles

$dt$  = annual money cost of commuting to and from work

$p_r$  = price of housing services<sup>7</sup> per room

$N$  = annual nonwage income

$w$  = hourly wage rate

$j$  = annual hours worked in a market

$c$  = annual commuting hours to and from work, assumed fixed

$T$  = annual time endowment net of sleeping and eating time

$h$  = head

$s$  = spouse.

The time and income constraints can be combined into a modified "full-income" constraint (Becker, 1965) by assuming the household "buys" back the leisure time and commuting time of the

market worker at the wage rate. The two-earner full-income constraint can be expressed as

$$w_h T + w_s T + N = w_h L_h + w_s L_s + w_s c_s + w_h c_h + p_r r + x + dt_h + dt_s. \quad (6)$$

Since workplace-residence separation is fixed, the two-earner full-income net of commuting costs is

$$F \equiv N - dt_h - dt_s + w_h(T - c_h) + w_s(T - c_s) = w_h L_h + w_s L_s + p_r r + x. \quad (7)$$

The time constraints in equations (4) and (5) involve three uses of time: leisure, employment and commuting (which fixes residential location). Ideally it would be of interest to develop an urban model which would simultaneously clear land and labor markets (Madden (1980) and Madden and White (1980)); the attempt to endogenize all three uses of time greatly complicates the analysis and will not be attempted here.<sup>8</sup> To simplify the analysis of the time allocation problem, one of the three uses of time can be fixed and the other two determined simultaneously. For example, White (1977) fixes work hours in order to compute bid rent functions for one- and two-earner households. In contrast, this study fixes commuting hours since labor supply issues are of major concern.

By performing the constrained maximization of equations (1) and (2), demand equations for housing, leisure, and the composite good can be derived in terms of full-income and prices. In what follows, a translog indirect utility function is specified, yielding the linear translog (LTL) demand system.<sup>9</sup>

The LTL system is derived from the generalized translog indirect utility function (Christensen, Jorgenson and Lau, 1975) upon which restrictions are imposed. Let the generalized translog indirect

<sup>8</sup> Oi (1976), Wales (1978), and Wales and Woodland (1977) have examined three uses of time within the framework of consumer demand systems. In order to derive results, all three papers needed to impose identifying restrictions on one of the time uses. Moreover, both Oi and Wales include commuting time in the utility function. If commuting is a "bad" rather than a "good," its inclusion in the utility function may cause theoretical problems. Though little theoretical work has been done in this area, it is likely that regularity conditions may not hold.

<sup>9</sup> The linear expenditure system (LES) is rejected by the data. The LTL generalization of the LES is chosen over the QES generalization because the LTL captures more complex cross-price effects than does the QES while allowing more complicated income effects than the LES. In particular, cross-price effects between housing and leisure, and leisure of the head and spouse are of major concern here.

<sup>7</sup> In this model, housing price is assumed to be predetermined. Lack of available data on housing and neighborhood characteristics precluded estimating house price as a function of distance and these characteristics. Other dependencies have been ignored such as the dependence of  $w_h$  and  $w_s$  on distance from work (to induce commuting to nonlocal employment).

utility function (income form) be

$$\begin{aligned}
 V(P, F) = & \ln(F - \sum p_k \gamma_k) \\
 & + \ln(F - \sum p_k \gamma_k) \sum \sum \beta_{kj} p_k \\
 & - 1/2 [\ln(F - \sum p_k \gamma_k)]^2 (\sum \sum \beta_{kj}) \\
 & - \sum \alpha_k \ln p_k - 1/2 \sum \sum \beta_{kj} \ln p_k \ln p_j
 \end{aligned} \tag{8}$$

in which

- $P$  is a vector of prices
- $F$  is full income as defined in (7)
- $\sum p_k \gamma_k \equiv \sum_k p_k \gamma_k$
- $\sum \sum \beta_{kj} \equiv \sum_k \sum_j \beta_{kj}$
- $j, k = 1, 2, 3 \dots m$
- $m \equiv$  number of goods.

By imposing the restrictions  $\beta_{jk} = \beta_{kj}$  (for Slutsky),  $\sum \alpha_k = 1$  (for adding up) and  $\sum \beta_{kj} = 0$  for all  $j$  (linear Engel curves) and applying Roy's identity, the LTL system is derived. The LTL system can be expressed in quantity, expenditure or share form. In the share form estimated here, the expenditure on each good is divided by the given total expenditure.

$$\begin{aligned}
 z_i &= \frac{p_i x_i}{F} \\
 &= \frac{p_i}{F} \gamma_i + \frac{1}{F} \left( \alpha_i + \sum_k \beta_{ki} \ln p_k \right) \\
 &\quad \times (F - \sum p_k \gamma_k)
 \end{aligned} \tag{9}$$

where

$$i, k = 1, 2, 3, 4, \quad \text{e.g., } (r, L_h, L_s, x).$$

### III. Empirical Implementation

#### A. Data

Wave IX of Survey Research Center's *Panel Study of Income Dynamics* (1976) is used to analyze the behavior of the seven demographic groups. The 1976 wave provides a unique opportunity to analyze the two-earner households since only in that wave were separate head and spouse interviews obtained. Because this study examines urban phenomena, the national random subsample is further limited to those families living less than 30 miles from a city of 50,000 or more. To be included in the analysis, the earner must have reported wage, distance to work, and housing data.

Hence, the final sample sizes range from 94 for unmarried females to 397 for traditional families with children (appendix table A1).

Two variables are constructed from the data, annual price-per-room and annual money-cost of commuting. Price-per-room for renters is simply annual rent divided by the number of rooms. For homeowners, reported house value is assumed to reflect capitalized maintenance, property tax, other expenditures, and location factors and is converted to a flow value by application of the present value formula. Since the sample is from 1976, a 10% interest rate is used to obtain imputed rent<sup>10</sup> from the present market value of the home. The annual money cost of commuting ( $dt_h, dt_s$ ) is derived from reported weeks worked, distance to work, and mode of travel.

#### B. Estimation

1. *Maximum Likelihood:* A Maximum Likelihood (ML) procedure is employed to account for the nonlinear parameters and cross-equation restrictions inherent in the demand systems. Each equation is written in share form to reduce possible heteroskedasticity; and stochastic forms are created by adding a disturbance term to each equation. It is assumed that the errors are multivariate normally distributed,  $U \sim \text{iid}N(0, \Omega)$ , within each model.

Since the "expenditures" add up to full-income net of commuting for each observation, the covariance matrix is singular and nondiagonal. Thus, for efficient estimation, one equation must be arbitrarily dropped. A desirable property of ML is that parameter estimates are invariant to which equation is eliminated.<sup>11</sup> Hence, in the models estimated, the composite good equations are dropped. The remaining system is estimated by maximizing the concentrated likelihood function based on the observed sample values.<sup>12</sup>

2. *Implications:* Output from the estimated demand systems offers insight into the framework discussed in section II. An examination of the correlation of residuals across equations lends support to the assumption of the co-determination of

<sup>10</sup> Sonstelie and Portney (1980) and Linneman (1980) agree that imputed rent rather than house value should be used in studies of housing demand.

<sup>11</sup> See the appendix, Pollak and Wales (1969).

<sup>12</sup> Parameter estimates of the LES and LTL and elasticities based on the LES are available from the author upon request.

TABLE 1.—ELASTICITIES<sup>a</sup> OF HOURS EMPLOYED

Group	Total Income <sup>b</sup>		Own Price		Cross Price			
	Head's Hours	Spouse's Hours	Head's Hours with Respect to Head's Wage	Spouse's Hours with Respect to Spouse's Wage	Head's Hours with Respect to Spouse's Wage	Spouse's Hours with Respect to Head's Wage	Head's Hours with Respect to House Price	Spouse's Hours with Respect to House Price
Unmarried Males	-.139		.026				.058	
Childless	(.125)		(.031)				(.024)	
Unmarried Females	-.263		.106				.050	
with Children	(.167)		(.158)				(.041)	
Childless	-.378		.011				.088	
	(.082)		(.003)				(.020)	
Traditional Families	-.086		-.078				.019	
with Children	(.039)		(.030)				(.067)	
Childless	-.123		.007				.024	
	(.123)		(.033)				(.014)	
Two-Earner Families	-.013	-.076	-.002	-.086	-.004	-.194	.008	.058
with Children	(.039)	(.088)	(.023)	(.044)	(.012)	(.062)	(.008)	(.015)
Childless	-.102	-.028	-.107	-.028	-.059	-.046	.022	.015
	(.049)	(.073)	(.029)	(.013)	(.017)	(.042)	(.008)	(.014)

<sup>a</sup>Elasticities are evaluated at group means. The numbers in parentheses are linearized approximate standard errors of the elasticities.

<sup>b</sup>Based on Cain and Watts (1973), see footnote 16.

labor and housing decisions. Furthermore, demographic groups are found to be unique.

The systems approach employed here is superior to single-equation studies which ignore leisure-consumption tradeoffs. The simple correlation of residuals across equations illustrates the problem with single equation approaches. The correlations of the residuals of leisure of the head and residuals of housing are negative with values ranging from  $-0.10$  to  $-0.40$ . The correlations of the residuals of leisure of the spouse and residuals of housing are less prominent but positive, about  $0.03$ . Moreover, positive correlations exist between leisure of the head and leisure of the spouse for the two-earner models, about  $0.15$  for each. Thus, studies which impose separability and ignore the joint nature of household decisions will yield inefficient estimates.

Likelihood ratio tests show the demographic groups to have different tastes. These tests allow differentiation only among the subgroups whose behavior has been estimated by the same model with the same number of parameters.<sup>13</sup> For example, to test if all five one-earner subgroups really belong in a single category, the maintained hypothesis is that all parameters are the same over the five one-earner subgroups, and the alternative

hypothesis is that each subgroup has unique tastes. The likelihood function under the maintained hypothesis is estimated by pooling all one-earner observations. The likelihood function under the alternative hypothesis is the joint density of the likelihood function obtained by estimating the subgroups individually.

$\chi^2$  values for one-earner and two-earner models are greater than their corresponding table values at the  $0.005$  significance level. Thus, within the class of one-earner households, the five subgroups defined by sex, marital status, and presence of children have significantly different tastes. Furthermore, within the class of the two-earner households, the presence of children does significantly alter tastes.

Further support for subgroup uniqueness is provided in tables 1 and 2 where linearized standard errors<sup>14</sup> for the elasticities are provided. Bands of confidence around each elasticity show most housing and total income elasticities to be unique. Thus different demographic groups do behave differently in today's urban markets.

<sup>14</sup> If it is assumed that values of variables are constant and that parameters are random, then an estimate of the variance may be obtained by a first-order Taylor series expansion and application of results regarding sums of random variables (Klein, 1953). Let  $A$  and  $B$  denote vectors of parameters related by  $A = f(B)$ . For any estimate of  $B$ , an estimate of  $A$  is defined as  $\hat{A} = f(\hat{B})$ . The approximate variance is  $V(\hat{A}) = D'V(\hat{B})D$ , where  $V(\hat{A})$  and  $V(\hat{B})$  are covariance matrices and  $D$  is the gradient of  $f(B)$ .

<sup>13</sup> See Deaton (1978) for suggestions on how to test non-nested models. The approach seems to be inappropriate for testing differences in parameters between one-earner and two-earner subgroups.

TABLE 2.—ELASTICITIES<sup>a</sup> OF HOUSING DEMAND

Group	Money Income <sup>b</sup>	Own Price	Cross Price	
			Rooms with Respect to Head's Wage	Rooms with Respect to Spouse's Wage
Unmarried Males	.662	-.565	.437	
Childless	(.147)	(.089)	(.088)	
Unmarried Females	.310	-.351	.369	
with Children	(.106)	(.114)	(.099)	
Childless	.130	-.275	.109	
	(.062)	(.069)	(.068)	
Traditional Families	.400	-.030	.137	
with Children	(.050)	(.034)	(.044)	
Childless	.456	-.329	.336	
	(.089)	(.076)	(.066)	
Two-Earner Families	.277	-.031	.153	.057
with Children	(.043)	(.016)	(.031)	(.015)
Childless	.413	-.058	.248	.135
	(.070)	(.010)	(.045)	(.028)

<sup>a</sup>Elasticities are evaluated at group means. The numbers in parentheses are linearized approximate standard errors of the elasticities.

<sup>b</sup>Full income elasticity multiplied by the ratio of total family income to full income.

#### IV. Results

##### A. Employment

Tables 1 and 2 report uncompensated wage and income elasticities of labor supply, and price and income elasticities of housing. Many market workers, including some females, are found to be on the backward bending portion of their labor supply curves. Evidence of inelastic housing price and income responses offers insight into the debate over size of housing elasticities. It is shown that the presence of children and an additional earner are associated with small responses to changes in prices and income. Single males are found to be the most responsive group. Cross-price effects are found to be particularly significant between leisure of the head and housing price.

Responses to changes in own wage vary widely over the demographic groups. Heads of households in three demographic groups are on the backward bending portion of their labor supply curves with elasticities ranging from  $-0.002$  to  $-0.107$  while heads in the other groups have positive elasticities ranging from  $0.007$  to  $0.106$ . Single females with children have the largest response,  $0.106$ ; if their wages doubled, they would increase their work effort by over 10%. Unmarried women have a positive response to wage changes,  $0.011$  and  $0.106$ , while married women display negative responses to wage changes,  $-0.028$  and  $-0.086$ .

An important result of the joint analysis is that some women are on the backward bending portion

of their labor supply curves. The few other cross-section studies that find women to be on the backward bending portion of their labor supply curve are also modelled in a household utility framework; and as in this study, the women are found to be in two-earner households.<sup>15</sup> For example, based on a translog indirect utility function, Wales and Woodland (1977) find the wage elasticity to be  $-0.03$  for working wives in households with children. In their 1976 study, Wales and Woodland also find married females to be on the backward bending portion of their labor supply curve, reporting a  $-0.02$  wage elasticity derived from a generalized Cobb-Douglas indirect utility function. Married women with children are found to be more than twice as sensitive to wage changes when housing is explicitly controlled for ( $-0.08$  vs.  $-0.03$ ).

Unlike the results for married women, the simultaneous approach does not find markedly different results from the rest of the literature for men. See summaries by Cain and Watts (1973), Borjas and Heckman (1978) and Killingsworth (1983). For example, Borjas and Heckman assert that based on a cross-section of prime-aged males, acceptable estimates of own wage elasticities range from  $-0.07$  to  $-0.19$ . Elasticities for males in

<sup>15</sup> See table 1.6 in Smith (1980) and tables 3.3 and 4.3 in Killingsworth (1983) for further examples. Ashworth and Ulph (1981) also find negative elasticities for women based on the individual utility-family budget constraint model.

traditional families with children and in childless two-earner couples fall within the reported range.

Important behavioral insights uncovered by this study concern cross-wage effects between market workers in two-earner households. All cross-wage responses are negative, implying a reduction in work effort when the spouse's wage rises, showing that the work hours are gross complements. In general, husbands are less responsive to changes in their wives' wages than vice versa. Husbands and wives in two-earner families with children behave dramatically different when the wage of their spouse changes; wives' work effort would decrease by almost 20% if their husbands wage doubled, while husbands work hours would imperceptibly decrease if their wives' wage doubled.

All market workers have income responses consistent with the notion of leisure being a normal good but again these responses vary widely by demographic group. All income responses of labor supply are negative, but small ( $-0.013$  to  $-0.378$ ), implying a fall in work hours and, therefore, an increase in non-work hours as nonwage income rises. To facilitate comparison with income responses reported in other studies, total income elasticities are computed.<sup>16</sup> Though the measure is not problem free,<sup>17</sup> the elasticities for males in this study (except for males in two-earner families with children) fall within the range  $-0.06$  to  $-0.29$  reported by Borjas and Heckman (1978).

### B. Housing

The income elasticities of housing in table 2 offer insight into the debate in the empirical literature on housing demand.<sup>18</sup> The inelastic results found here support the conclusion by Polinsky (1977) and Polinsky and Elwood (1979) that micro studies are likely to yield income elasticities less than one. However, the money income elasticities of housing reported here are generally lower than

those found in other micro data studies (see also Mayo, 1981). This may occur because the new labor supply patterns, especially of women, profoundly impact household behavior. This study is pioneering in that it models the labor-housing decision jointly while most other studies use single equations to study only housing demand. Based on single equation estimates, Polinsky and Elwood (1979) report the income elasticity of housing to be about 0.8. The only other study jointly estimating labor supply and housing demand, Wales (1978), reports a money income elasticity of 0.7 for one-earner households who own homes.

The values of money income elasticities of housing do not support theoretical predictions often found in the urban economics literature. Muth (1969) and other urban economists maintain that the income elasticity of housing is about or slightly greater than one. This study finds that most money income elasticities are less than 0.5. Another hypothesis of urban economics is that the rich live further out from the central business district because they have more elastic income responses. In this sample, the two-earner families with children (and most likely to live in the suburbs) average the highest money income yet have the second smallest money income elasticity of housing.

Although the quantity demanded of housing is relatively price inelastic for all demographic groups, the elasticities differ between the groups and range from  $-0.03$  to  $-0.565$ . The own price elasticities of housing reported here are generally smaller than those reported in previous studies. Polinsky (1977) concludes that the price elasticity of housing is  $-0.75$ . This is too high by half when the labor supply response is modelled jointly. Wales (1978) finds the own price elasticity of housing for one-earner families to be  $-0.18$ , which is in the range of elasticities found here.

The importance of modelling labor supply and housing demand jointly is shown by the large cross-price elasticities between housing and leisure. The positive elasticities range from 0.057 to 0.437 and indicate that housing and leisure hours are gross substitutes, and thus that housing and work hours are gross complements. As the wage earned in the labor market rises so does housing consumption. From examination of the elasticities for two-earner households, it appears that housing consumption is more sensitive to the increased wage of the head than of his spouse. Elasticities

<sup>16</sup> The total income elasticity defined by Cain and Watts (1973) equals the conventionally measured income elasticity weighted by the fraction that earnings is of the income variable used. In practice, the elasticities are evaluated at the means so the above reduces to weighting the income derivative by the wage rate.

<sup>17</sup> Atrostic (1982, p. 436) argues that the total income elasticity is really not independent of the income measure used since parameters estimated are sensitive to the measure of income.

<sup>18</sup> To facilitate comparisons with results from single-equation housing demand studies, the money income elasticity is computed by multiplying the full-income elasticity by the ratio of family money income to full-income.

for the male heads in two-earner families with children and childless families are 0.153 and 0.248, respectively, while elasticities for their spouses are 0.057 and 0.135.

### V. Conclusion

Two major contentions of this research are that (1) decisions regarding work hours and housing consumption are interdependent choices and (2) responses to market signals differ significantly by demographic group. The analysis in sections III and IV supports these contentions. Moreover, the analysis is accomplished within a theoretically consistent framework that accounts for locational aspects of the consumer choice problem.

The consumer demand system approach specifically accounts for the jointness of labor supply and housing demand. Results are superior to single equation studies of either labor supply or housing demand which ignore leisure-consumption trade-offs. The findings of significant correlations between residuals of the demand equations show that household decisions regarding labor supply and housing demand are not separable but feed back upon each other. Further support is demonstrated by the significant cross-price elasticities of housing with respect to wages.

Modelling the joint decisions yields new insight into the different behavior of the seven demographic groups. The presence of children and the presence of an additional earner are associated with smaller responses to changes in prices and income. Single males, the least duty-bound group, are the most responsive to market signals. Market earners in all demographic groups would decrease work effort if nonwage income would increase, but the groups are split over the effect of wages on work effort. One significant finding is that women in female-headed households react differently to increases in wages than women in two-earner households. Married women would decrease their work effort if their wage rose, while unmarried women would increase their market hours. In short, the housing and labor market behavior of one-earner households significantly differs from that of two-earner households.

By relating implications of the changing demographic structure to changing work and housing patterns, important insights can be gained into the dynamic housing and labor markets of today's

cities. Aggregate studies which ignore these differences are likely to misrepresent overall responses in labor and housing markets. Policy makers must be sensitive to the different responses to market signals by different demographic groups. The theoretically consistent framework presented here provides a methodology for analyzing the differences in market behavior.

Important future research will be to specifically model the dynamic adjustments experienced by households. Not only should consumption be made dynamic along such lines as habit formation or stock adjustment models, but the relation of demographic status to labor supply and housing demand should be explicitly treated. A possible framework would be to treat divorce as an unanticipated shock and the birth of children as a planned change in household status. The present research represents a first step toward understanding the complexities of family labor and housing decisions.

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## APPENDIX

TABLE A1.—AVERAGE HOUSING, EMPLOYMENT AND INCOME CHARACTERISTICS FOR SEVEN DEMOGRAPHIC GROUPS

	Unmarried Males		Unmarried Females		Traditional Families		Two-Earner	
	Childless	With Children	Childless	With Children	Childless	With Children	Childless	Childless
<b>Housing</b>								
Own home (percent)	0.18	0.43	0.27	0.70	0.66	0.80	0.57	
Number of rooms	3.9 (1.8)	4.9 (1.5)	3.9 (1.5)	5.8 (1.4)	5.3 (1.5)	6.1 (1.2)	5.2 (1.2)	
Annual (or imputed) rent	1829 (1107)	2276 (1309)	1847 (1205)	3311 (2272)	3122 (1985)	3530 (2727)	3102 (1879)	
<b>Employment</b>								
Miles to work head	7.4 (7.3)	6.6 (5.4)	7.1 (7.8)	10.8 (10.7)	8.7 (8.3)	10.5 (10.8)	9.8 (9.2)	
Miles to work spouse						6.9 (6.5)	9.3 (7.1)	
Annual work hours head	1888 (609)	1680 (561)	1732 (578)	2227 (619)	2096 (659)	2190 (564)	2129 (652)	
Annual work hours spouse						1387 (690)	1596 (602)	
Annual commuting hours head	142 (122)	143 (106)	143 (120)	174 (136)	158 (119)	173 (141)	161 (121)	
Annual commuting hours spouse						112 (102)	149 (115)	
<b>Income</b>								
Hourly wage rate head	5.72 (3.50)	4.04 (2.08)	4.53 (2.86)	7.12 (3.95)	6.87 (3.83)	6.80 (3.45)	6.14 (3.17)	
Hourly wage rate spouse						4.00 (2.29)	4.64 (3.63)	
Family income <sup>a</sup>	12,294 (7,916)	8,903 (4,552)	10,009 (12,708)	19,366 (13,730)	20,625 (14,957)	22,690 (13,507)	22,034 (12,187)	
Full income net of commuting	33,964 (20,713)	25,195 (12,670)	27,584 (18,899)	42,514 (23,755)	42,594 (22,829)	63,632 (26,623)	63,060 (30,477)	
Sample Size	107	94	156	397	119	324	192	

Note: Standard deviations are in parentheses.

<sup>a</sup> Family income is defined as the sum of taxable incomes of the household head and spouse plus total transfers.