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Life Cycle Consumption, Labor Supply and Housing

Yannis M. IOANNIDES *

ABSTRACT. – We use pooled panel data for 1970-1981 from the Panel Study of Income Dynamics to estimate preference parameters and study the interaction between housing and labor supply. We treat housing as quasi-fixed during residence spells. The data pertaining to households with positive net worth give a much better fit than those with negative, for a system in first-differences of nonhousing expenditure and the share of leisure. Good results are obtained for single-equation estimations for the share of leisure.

Cycle de vie, offre de travail et logement

RÉSUMÉ. – On utilise des données de panel sur la période 1970-1981 provenant du Panel Study of Income Dynamics pour estimer les préférences et étudier les interactions entre l'achat d'un logement et l'offre de travail. On suppose que la consommation de logement est quasi-fixe pendant toute la durée d'une occupation. L'estimation d'un modèle exprimé en différences premières des dépenses hors logement et de la part du loisir aboutit à des résultats de meilleure qualité lorsque l'on considère les ménages dont le patrimoine net est positif plutôt que ceux à richesse nette négative. L'estimation d'un modèle séparé pour expliquer la part du loisir donne des résultats satisfaisants.

* Y. M. Ioannides : Professor of Economics, Athens School of Economics and Business and Virginia Polytechnic Institute and State University, and Research Associate, National Bureau of Economic Research, Cambridge, Massachusets.

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1 Introduction

In this paper we use micro data from the Panel Study of Income Dynamics to study the path of total spending by households and its allocation to various categories of goods. We emphasize that the path of total expenditure may be affected markedly by the timing of housing decisions, especially for those households which may be subject to liquidity constraints. In estimating behavioral parameters of households we explore the implications of the quasifixity of housing consumption during residential spells. We estimate a system of simultaneous equations for the path of nonhousing expenditure and its share which goes to leisure. The model confirms that the time of adjustment in housing consumption is associated with a discontinuity in the path of nonhousing expenditure. The data pertaining to households with positive net worth give a much better fit for the system in first-difference form than for those pertaining to non-positive net worth. Good results are obtained for single-equation estimations of the change in housing consumption when moves occur and of the share of total nonhousing expenditure which goes to leisure.

Recent research on intertemporal optimization is basically inspired by Modigliani's life cycle hypothesis. The life cycle model, a forward looking theory, has become an even more powerful methodological tool since it has adopted the treatment of expectations proposed by HALL [1978]. However, it is only recently that this approach has been extended to deal with consumption from durables, too. In addition to MANKIW [1982, 1985] noteworthy are contributions by BAR-ILAN and BLINDER [1986] and BERNANKE [1984, 1985], who deal empirically with the adjustment costs in the stock of durables, and HAYASHI [1984] who makes durability endogenous.

The remainder of this paper is organized as follows. Section 2 presents the model and discusses the problems which its estimation poses. Section 3 discusses the data and some auxiliary estimations, Section 4 presents the empirical results, and Section 5 concludes.

2 A Dynamic Model of Life Cycle Consumption, Labor Supply and Housing Decisions

In a discrete-time dynamic programming formulation of consumer lifetime allocation decisions households make a sequence of joint choices of consumption of leisure, housing and other goods. This sequence may be revised whenever new information becomes available. If households face transactions costs with a lump-sum component, which is especially relevant when durables are emphasized, they would be inhibited from adjusting their desired bundle in line with changing exogenous variables (Hu [1980, 1986]). Transactions costs may also be real, in the sense of directly affecting a household's utility. Housing services are produced from a durable good, whose quantity may be changed only by incurring costs. Thus a primary impetus to move is to adjust housing consumption over the life cycle. Depending upon the structure of preferences, an adjustment of the entire bundle may then be called for (Amundsen [1985]; Hu [1986]). A job change necessitating geographical relocation may also force an adjustment in the desired bundle. In either case, given a move a household would make an optimal decision in the light of all available information.

We fix ideas and set notation in a non-stochastic framework by stating the household's problem as in Hu [1986]. Lifetime horizon is finite, T, and lifetime utility is additively separable, with utility per period specified by a restricted indirect utility function as a function of non-housing consumption expenditure, $G(t)$, and of housing services derived from housing stock, $z(t)$, $u(G(t), z(t))$. We suppress for simplicity the dependence of $u(.)$ on the price vector. A unit quantity of housing stock emits one unit of housing services per period. $G(.)$ is defined to include expenditure on leisure. The typical household chooses housing consumption for each spell $\{z_j\}$, non-housing expenditure in every period $G(t)$ and times when spells begin $\{t_j\}$ so as to maximize:

$$(1)\qquad \sum_{j=1}^{j=n} \sum_{t=t_j}^{t=t_{j+1}-1} (1+\delta)^{-t} u(G(t), z(t)) D(t) + (1+\delta)^{-T} u_B(A(T), z(T)),$$

where $z(t)=z_j(1+z_e)-(t-t_j)$, $t_j \leqslant t \leqslant t_{j+1}-1$; $D(t)$ is a taste shifter possibly reflecting demographic characteristics; $u_B(A(T), z(T))$ denotes the value of bequests as a function of the components of terminal net worth, and δ is the rate of time preference. The household starts with an initial wealth endowment $(A_0, z(0))$ and is constrained in each period by a budget constraint allowing financial asset accumulation:

$$(2)\qquad \begin{aligned} &P_z(t) z(t) + G(t) \\ &= P_x(t) + g(t) + (1+r(t-1)) A(t-1) - A(t) \\ &\quad + r_H(t-1) H(t-1) w(t-1) + H(t-1) w(t-1) - H(t) w(t), \\ &\qquad t_j \leqslant t \leqslant t_{j+1};\ t=0 \leqslant t_1;\ t_n \leqslant t_{n+1} = T. \end{aligned}$$

In (2), the endowment of leisure is normalized to 1, $P_x(t)$ is the price of leisure, $P_z(t)$ is the opportunity cost per period of a unit of housing services, $w(t)$ is a dummy variable equal to one if the household owns its home in time period t, $g(t)$ is income in the form of transfers (or gifts), $A(t)$ denotes the value of the portfolio of assets (possibly including non-occupied housing stock) held for investment purposes after payments and, possibly, any retrading in period t have been completed, $r(t-1)$ is the real aggregate rate of return earned on the previous period's portfolio, $H(t)$ is housing equity in period t, and $r_H(t-1)\,H(t-1)$ stands for implicit income in the form of services from housing equity. For renters, $H(t)=0$, while for homeowners, it depends on $F(z)$, the quantity of housing stock required to produce z units of housing services, and on the terms of financing. If t is a year of move, $t=t_j$, $K(t)$ denotes lump-sum transactions costs, and k denotes transactions costs per unit of housing stock (such as realtor commissions) we have that:

$$A(t_j+0)+H(t_j+0)=A(t_j)+H(t_j)-K(t_j)-kz_j,$$

where values at t_j+0 denote values after the necessary expenditures associated with a move have been made. Therefore, in general, the choice of z affects the r. h. s. of (2), too. It is easy to generalize the definition of current utility – as with the profit function in McFADDEN [1978] – so as to express involuntary unemployment by taking leisure as quasi-fixed, too.

Capital market imperfections may be represented by the terms of financing and by adjoining a constraint on the amount of debt a household is allowed to hold. *E.g.*, $A(t)\geqslant 0$, if a household may not borrow at all, or $W_N(t)=H(t)+A(t)\geqslant 0$, if a household may borrow against housing equity. We shall say in this paper that the household is liquidity constrained when such a constraint on net worth is binding. Alternatively, capital market imperfections may be expressed by different interest rates for borrowing and lending (HAYASHI [1985 *b*]; KING [1986]).

The above formulation differs from HU [1986] only slightly. Hu's paper is more general than AMUNDSEN [1985] and BAR-ILAN and BLINDER [1986]. It is clear from this literature that closed-form solutions can be obtained only in very special cases of utility and transactions costs specifications. There exist hardly any empirical implementations of such dynamic models with (or even without) an emphasis on housing decisions. The challenge ahead of us is to develop a dynamic estimation framework.

We use the general model outlined above to develop an estimation framework. Below in subsection *a* we specify preferences by assuming a functional form for nonhousing expenditure G, the variable component of the restricted expenditure (cost) function. Then we elaborate on the implications of that assumption in a static context. Subsection *b* highlights the dynamics of nonhousing expenditure for the deterministic case, and *c* develops the econometric model.

a. Preferences

We assume a functional form for the rationed expenditure function per period, RCF, as follows. If $V(z, C, 1-X)$ is the unrestricted direct utility function, and u the level of utility then:

$$\begin{aligned} & RCF(u;\ P_z,\ z;\ P_C,\ P_X) \\ (3)\qquad & =P_z z+\min\,[CP_C+(1-X)\,P_X\,|\,V(z,\ C,\ 1-X)\geqslant u] \\ & =P_z z+G(u,\ z;\ P_C,\ P_X), \end{aligned}$$

where P_C, P_X, P_z denote the price of all other consumption, leisure and housing services, respectively.

Following DEATON [1981], p. 67-68, we assume for the function G in (3), the rationed cost function less the cost of housing (the "rationed" good), a general flexible functional form analogous to the Almost Ideal Demand System, namely:

$$\begin{aligned}(4)\qquad &\log G(u, z; P_C, P_X)\\ &= \alpha_0 + (\alpha_C + \eta_C z) \log P_C + (\alpha_X + \eta_X z) \log P_X\\ &+ 1/2 \sum_{k=C,X} \sum_{j=C,X} \Gamma^*_{kj} \log P_k \log P_j\\ &+ \beta_0 P_C^{\beta_C} P_X^{\beta_X} [u + \Theta_0 z + 1/2\,\Theta_1 z^2 + 1/2\,\Theta_2 uz].\end{aligned}$$

G (.) as a restricted expenditure function should be decreasing and convex with respect to z, which can be ensured by suitably constraining the parameters (DEATON [1981]). Furthermore, regarded as a function of prices, G has all the standard properties of a cost function. These imply the following parameter restrictions. For adding up the α's sum to 1, the η's to 0, the Γij's with respect to i to 0, and the β's to 0; for homogeneity the Γij's to 0 and for the symmetry conditions to hold $\Gamma ji = \Gamma ij$, where $\Gamma ji = (\Gamma^* ij + \Gamma^* ji)/2$.

The function G(.) contains all information needed to define the demand functions of the unrestricted goods in every period, that is nonhousing consumption and labor supply. Their budget shares as a proportion of total nonrationed expenditure are given by $S_i = \partial \log G / \partial \log P_i$. That is:

$$(5)\qquad S_C = \alpha_C + \eta_C z + \Gamma_{CX} \log P_X + \Gamma_{CC} \log P_C + \beta_C \log (G/P);$$

$$(6)\qquad S_X = \alpha_X + \eta_C z + \Gamma_{XC} \log P_C + \Gamma_{XX} \log P_X + \beta_X \log (G/P);$$

where $\log P = \alpha_0 + \Sigma(\alpha_k + \eta_k z) \log P_k + 1/2\,\Sigma\Sigma\,\Gamma_{kj} \log P_k \log P_j$, with the summations taken over C, X. Finally, the utility enjoyed in period t is obtained by inverting (4) :

$$\begin{aligned}(7)\qquad u(G; z, P_C, P_X) = [&\log G - (\Theta_0 z + 1/2\,\Theta_1 z^2)\,B\\ &- \log P]/(1 + 1/2\,\Theta_2 z)\,B,\end{aligned}$$

where $B = \beta_0 P_C^{\beta_C} P_X^{\beta_X}$, log P as defined above, and the time subscripts of all period-specific variables are suppressed. The nonhousing expenditure share equations (5), (6) are linear in parameters, except for the term log P.

b. The Dynamics of Nonhousing Expenditure

The functional specification of preferences as in (4) implies that utility per period within a particular residense spell, given in (7), is a logarithmic function of nonhousing expenditure G. As a result, the path of the optimal value of $G(t)$ within a spell may be characterized in some detail. [See ARTLE and VARAIYA [1978]]. For simplicity let us consider a household that is found renting when observations start. The optimal nonhousing expenditure is continuous and typically of the form:

$$(8.1)\quad \begin{cases} \log G(t) = -\log L_1 + (r-\delta)t - \log B_t - \log(1 + 1/2\,\Theta_2 z_t), \\ \qquad 0 \leqslant t \leqslant t_1^*, \end{cases}$$

$$(8.2)\quad \begin{cases} \log G(t) = \log [P_X(t) + g(t) - P_Z(t) z_t], \\ \qquad t_1^* \leqslant t \leqslant t_2^*, \end{cases}$$

$$(8.3)\quad \begin{cases} \log G(t) = -\log L_2 + (r-\delta)t - \log B_t - \log(1 + 1/2\,\Theta_2 z_t), \\ \qquad t_2^* \leqslant t \leqslant T, \end{cases}$$

where T is the length of the residence spell, and

$$r - \delta \approx \log(1+r) - \log(1+\delta).$$

Financial assets decline until t_1^*, remain at 0 during $[t_1^*, t_2^*]$ and start rising again in the remainder of the horizon. Depending upon A_0 and the characteristics of the bequest function u_B, it is quite possible that t_1^* and t_2^* (which are endogenous) are such that one or two of the above intervals are empty. The set of budget constraints corresponding to consecutive periods during which financial assets are positive can be reduced to a single equivalent one by eliminating $A(t)$ for the intermediate periods and leaving only the beginning and the end ones.

The expressions $L_1((1+\delta)/(1+r))^t$ and $L_2((1+\delta)/(1+r))^t$ denote the Lagrange multipliers of the expenditure constraint in the respective phases. For completeness, we mention that the Lagrange multipliers satisfy the equation:

$$(9)\qquad L_t - L_{t+1}(1+r)/(1+\delta) + \mu_t = 0,$$

where μ_t is a Lagrange multiplier that corresponds to the liquidity constraint. It is positive when $W_N(t) = 0$, and is equal to 0, when $W_N(t) > 0$. That is, during consecutive periods of unconstrained behavior, the Lagrange multiplier follows a geometric sequence. This is not so when the liquidity constraint is active. It is clear from (8.1-3) that nonhousing expenditure as a function of exogenous variables during any residence spell has the same functional form whenever net worth is positive, with the only differences being the Lagrange multipliers L_1 and L_2. In contrast, nonhousing expenditure when net worth is positive is exogenous and simply equal to total income net of housing expenditure.

If in the optimal solution liquidity constraints are never active or when they are not imposed at all, optimal nonhousing expenditure is still given by an expression like (8.1) or (8.3), but starts at an initially higher value. The respective Lagrange multiplier reflects the higher initial value of $G(t)$. The constraint induces the consumer to save more at the early part of a residence spell and increase consumption later. It is, thus, possible in principle to detect the existence of liquidity constraints by comparing observed expenditure to the predicted form, for the constrained and the unconstrained case, and by comparing intercepts (or introducing appropriate dummies) among those who are never constrained, on one hand, and constrained in at least one period, on the other. We pursue such considerations further in the following subsection.

c. The Econometric Model

The proposed model is novel in a number of ways and thus poses some complex econometric issues. With an eye towards simplification, we first assume households act with perfect foresight. With behavioral parameters distributed across the sample, uncertainty affects only the econometrician. We then consider an alternative source of randomness that may be important for intertemporal allocation decisions, that is, expectational errors. We obtain an estimation equation for the path of nonhousing consumption of unconstrained households, which is the same under both alternative informational assumptions.

Equations like (8.1) and (8.3) hold during periods of unconstrained behavior (that is, whenever net worth is positive), *regardless of whether any constrained behavior is ever experienced.* The impact of liquidity constraints is reflected on the magnitudes of the Lagrange multipliers L_1 and L_2: *Cet. par.*, expenditure is larger if net worth is unconstrained than if net worth is constrained and that constraint is binding for at least one period. Because of the endogeneity of the regime-switching times, in order to estimate (8.1) or (8.3) we must modify the fixed effects techniques which are now widely used by the labor economics literature [1].

It is useful to consider first that households have perfect foresight and specify the taste parameter β_0 as a function of exogenous characteristics and of a stochastic term, which is known to the decision maker – the household knows its taste – but not observable by the econometrician. That is, we assume that $\log \beta_0 = Q_i b_0 + b^*$, where b^* is normally distributed across the sample with zero mean and variance σ_b^2, Q_i is a vector of time-invariant characteristics of household i, and b_0 is a vector of parameters. Therefore, over a set of consecutive periods of unconstrained behavior we have:

$$(10) \qquad \log G_i(t) = -\log L_i + (r-\delta)t - Q_i b_0 - \log\left(1 + \frac{1}{2}\Theta_2 z_i(t)\right)$$
$$- \beta_C \log P_C(t) - \beta_X \log P_X(t) + R_i(t) f + b^* + \varphi_i(t),$$

In (10) we have included the time-varying terms $R_i(t) f$, where f is a vector of parameters, in order to account for year-specific effects (e. g. interview wave dummies). The term $\varphi_i(t)$ accounts for errors in measuring nonhousing expenditure and is assumed to be normally distributed with mean 0 and constant variance σ^2.

The fixed effect in (10) is *spell-specific* and consists of two parts. One part reflects time-invariant (possibly, only, within the particular spell) characteristics. The other comes from the Lagrange multiplier associated with the expenditure constraint characterizing a set of consecutive periods of unconstrained behavior within the particular spell. Housing consumption $z_i(t)$ may vary exogenously during a particular residence spell.

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1. Heckman and MaCurdy [1980] and MaCurdy [1983]. Blundell and Walker [1986] utilize total expenditure from cross section data to estimate behavioral parameters.

The subtlety here must be emphasized, namely that particular periods during the panel when (10) holds are endogenous and therefore may not be the same across households. In the present paper we eliminate fixed effects by first differencing (10). In order to account for the endogeneity of $z_i(t)$ when a residential move occurs in period (year) t, we instrument the change in housing consumption, $Dz_i(t) = z_i(t) - z_i(t-1)$, when a household moves. When no move occurs in two successive years, any change in real housing consumption which may occur is treated as exogenous. Thus first differencing (10) yields:

$$(11) \qquad \mathrm{Dlog}\,G_i(t) = (r-\delta) - \frac{1}{2}\Theta_2\, Dz_i(t) - \beta_C\, \mathrm{Dlog}\, P_C(t) - \beta_X\, \mathrm{Dlog}\, P_X(t) + DR_i(t)\, f + \varphi^*,$$

where φ^* is normally distributed with mean 0 and variance $2\sigma^2$. The approximation

$$\frac{1}{2}\Theta_2\, Dz_i(t) \approx \log\left[1 + \frac{1}{2}\Theta_2\, z_i(t)\right] - \log\left[1 + \frac{1}{2}\Theta_2\, z_i(t-1)\right]$$

is quite good, as the exogenous change in z (because of depreciation, changes in relative prices, etc.) from year to year is small.

If we relax the assumption of perfect foresight on which the development of (10) is based, we must pose the maximization problem (1) in a stochastic environment. We express randomness solely through an expectational error. The optimization conditions are:

$$(12.1) \qquad \partial u/\partial G\, t(t) = L_t;$$

$$(12.2) \qquad L_t = -\mu_t + ((1+r)/(1+\delta))\, E_t[L_{t+1}].$$

The stochastic equation for marginal utility (12.2) is a straightforward, but novel extension of MACURDY [1983] and BROWNING *et al.* [1985] and amounts to a generalization of the Euler equation. It was also developed independently by ZELDES [1985].

If we know that, for a number of consecutive periods, the individual exhibits unconstrained behavior, the necessary conditions imply $\mu_t = 0$. Thus equations (12.1, 2) yield the martingale property for marginal utility with respect to nonhousing expenditure. That is:

$$1/G(t)\,B(t) = ((1+r)/(1+\delta))\, E_t[1/G(t+1)\,B(t+1)],$$

which may be written as:

$$(13) \qquad (G(t+1)\,B(t+1))^{-1} = ((1+\delta)/(1+r)\; G(t)\; B(t))^{-1} + \varepsilon_{t+1}.$$

The disturbance ε_{t+1} satisfies $E_t[\varepsilon_{t+1}] = 0$ and is thus uncorrelated with any variable known by time period t. By defining the LHS of (13) as equal to $(1+\tau_{t+1})(1+\delta)/((1+r)\; G(t)\; B(t))$ we introduce [2] a multiplicative error term

2. This follows BROWNING, *et al.* [1985]. The linearization employed by ZELDES [1985] and MANKIW [1985] is somewhat more elaborate, yet essentially equivalent.

τ and rewrite (13). Thus we obtain a regression equation which is the identical to (11). The error term τ is related to ε:

$$((1+r)/(1+\delta))\, G(t)\, B(t)\, \varepsilon_{t+1} = \tau_{t+1}.$$

As ZELDES [1985] argues [3], testing for the validity of $E_t[\tau_{t+1}]=0$ may be used to test for the significance of liquidity constraints. If we know which households are unconstrained, then we can estimate (11) with data pertaining only to the unconstrained ones. We can then use the estimated coefficients to compute predicted residuals τ_{t+1} for those households which are presumably constrained. A positive mean for τ_{t+1} implies an active liquidity constraint in period t. This method is hampered by the need to split the sample which introduces complicated sample selection bias. This criticism also pertains to previous work by the author (HENDERSON and IOANNIDES [1985; 1987]) and to HAYASHI [1985 *a*]. We are dealing with this problem elsewhere (IOANNIDES [1987 *b*]).

We have derived regression equation (11) for nonhousing expenditure which holds under both alternative informational assumptions for the decision maker, namely perfect foresight and expectational errors. This equation does not hold when liquidity constraints are active. Nonhousing expenditure is exogenous during those periods of constrained behavior.

Given nonhousing expenditure, its share which goes to leisure is obtained from (6). Thus if G is exogenous, (6) yields a regression equation for S_X:

$$\begin{aligned} S_X = {} & (\alpha_X - \alpha_0 \beta_X) + (\Gamma_{XC} - \beta_X \alpha_X) \log P_X + (\Gamma_{XX} - \beta_X \alpha_C) \log P_C \\ & + \eta_X Z + \beta_X \log G - \beta_X \eta_X Z \log P_X - \beta_X \eta_C Z \log P_C \\ & - \frac{1}{2} \beta_X \Gamma_{XX} (\log P_X)^2 - \frac{1}{2} \beta_X \Gamma_{CC} (\log P_C)^2 \\ & - \frac{1}{2} \beta_X (\Gamma_{XC} + \Gamma_{CX}) (\log P_X)(\log P_C) + \varepsilon_S. \end{aligned} \tag{14}$$

The disturbance ε_S above is simply a measurement error. If, on the other hand, nonhousing expenditure is endogenous, (10) and (14) may be treated as a system of simultaneous equations [4]. We may thus estimate jointly (11) and the first-differenced version of (14).

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3. The tests carried out by ZELDES [1985] generally support a role for liquidity constraints. Zeldes' tests identify deviations from the Euler equation by splitting the panel data into two groups according to wealth income ratios and by comparing their behavior. He finds first that the Euler equation explains the behavior of the "unconstrained group", those with high wealth-to-income ratios, but not of the constrained one, second that part of the consumption growth which is unexplained by the Euler equation is negatively correlated with present income, for the constrained group, and third, that there is one-sided inequality in the Euler equation for the constrained group but the bias is small and statistically insignificant.
4. This resembles the approach taken by the research on production and investment decisions in the short- vs. the long-run. See KULATILAKA [1986] for a recent review. The assumption of normality of the error in the share of leisure equation does not seem in practice to cause any problems (WOODLAND [1979]).

In our model of intertemporal optimization, the time periods when liquidity constraints are active are endogenous. We do not, however, explore this feature of our model in this paper. In its full generality this problem may be tackled by models of switching regressions with unknown or imperfectly observable regimes. We are working with such an approach elsewhere. Also endogenous are the lengths of residence spells. We have investigated separately their determinants by means of a semi-Markov model of residential mobility and housing tenure choice (HENDERSON and IOANNIDES [1985], IOANNIDES [1987 *a*]).

In this paper we emphasize the estimation problems posed by the quasi-fixity of housing during residential spells and the impact of liquidity constraints. In dealing with the latter we follow earlier work and split the pooled panel data into observations associated with predicted net worth being positive or zero. We then compare the respective estimates for the system of simultaneous equations. All behavioral coefficients, except Θ_0 and Θ_1, can be identified, directly or indirectly, provided that all constraints implied by the theory are imposed.

3 The Data

Our data from the Panel Study of Income Dynamics (PSID) covers the years 1970-1981 for families who had the same head during that period and lived in one of the following SMSAs: San Francisco, Los Angeles, San Diego, Hartford, Washington, Atlanta, Chicago, Indianapolis, Kansas City, Baltimore, Boston, Detroit, Minneapolis, St. Louis, Newark, New York, Cleveland, Dayton, Philadelphia, Dallas, Houston, Seattle, Lancaster and Orlando. The SMSAs were chosen on the basis of availability of housing price data. We do not allow for household heads to change, as we would have, otherwise, to account for household formation and dissolution. This introduces, of course, sample selection which is not corrected for.

Some of the variables used are drawn directly from the PSID, and need not occupy us here. The price for nonhousing goods P_C is from the BLS data for urban households. The prices for renting and owning are the same as those constructed in HENDERSON and IOANNIDES [1985, 1987]. For the price of leisure as an explanatory variable, P_X, we are interested in a *marginal* concept that is uncorrelated with other exogenous variables. Therefore we instrumented, for every year during 1970-1981, the logarithm of the maximum of the average hourly earnings of spouses – which are available in the PSID and are independent of reported earnings and hours worked – against a vector of socioeconomic characteristics such as age, family size, marital status, education, and race and sex of the household head. The fits obtained in those regressions [5] were generally very good, with R^2's ranging between .31 and .41 and very high t-statistics. The expenditure on leisure as a dependent variable is considered on an annual basis and computed as: {[annual family labor income]/[sum of annual hours employed by both spouses as a proportion of total number of hours in the year]} – annual earned income. We are, of course, aware of the possibility that the errors-in-variables caused by this procedure may be serious, but we make no attempt to account for such errors.

Annual nonhousing expenditure – which, as can be seen from (7), contains expenditure on leisure – was computed as the sum of the consumption of leisure and other income transfers, minus annual housing expenditure, minus the net change in financial assets during the year, $A(t) - [1 + r(t-1)]\,A(t-1) = A(t) - A(t-1) -$ [asset income received in period t]. In addition, in order to account, in constructing annual nonhousing expenditure, for changes in the wealth of homeowners in the form of housing equity we assume that $P_Z Z_i = r_H(t-1)\,HE_i(t-1)$, and subtract the changes in housing equity $HE_i(t) - HE_i(t-1)$ as well. Information on housing equity in forms other than owner-occupied homes is not available in our data. The share of leisure was computed as the ratio of the expenditure on leisure (which, by construction, is normalized on an annual basis) over annual nonhousing expenditure.

Financial assets in each year are based on reported asset income in PSID, which are converted to asset stocks by dividing by the 12-month Treasury Bill rate (and then normalizing by the price of all other goods). Housing equity is calculated by subtracting remaining mortgage principal due from housing values (and then normalizing). Predicted values (based on a Tobit model) are used for both financial assets and housing equity. The Tobit results are reported in the Appendix of HENDERSON and IOANNIDES [1987]. ZELDES [1985] has followed a similar, but somewhat simpler, procedure in converting asset income flows to stocks of financial assets.

We now discuss some key characteristics of the panel data by looking at averages for the pooled data from the entire period 1970-1981. Note that our sample is not representative of the entire U.S. population. We chose to include only households which had the same head throughout the panel. Owners comprised 54%, with average total wealth (that is, earned income wealth plus housing equity plus financial assets) equal to $219374, of which 5% was in the form of housing equity and 2% in the form of financial assets. Age was equal to 47.3 years, education of the head of household (*hhh*) equal to 11.32 years. Men totaled 66.60% of household heads. Average annual asset income was $1834, among those with positive amounts, and total income, net of taxes, was $11,769. Average annual hours employed were 1921 for the *hhh* and 546 for the wife. The average share of leisure was computed at 87.2%, which is not surprising, given its definition. A total of 57.2% of *hhh*'s were married and the average family

5. The first-stage results are available from the author on request.

size was 3.45 members. By looking at the development of these characteristics in the panel we note that family size decreases, financial and housing equity wealth increase, and earned income wealth decreases as age increases. Real housing prices and expenditure fluctuate quite a lot.

4 Empirical Results

Estimation results with (10), that is regressing the natural logarithm [6] of nonhousing expenditure against the logarithms of the prices of nonhousing consumption and of leisure, and a number of socioeconomic variables with the pooled data produced good fits [7] and very high t-statistics. However, with fixed effects not accounted for those single equation estimates are unreliable. For this reason we do not report them here. In Table 2 we report instead estimation results for Equations (11) and the first-difference version of (14) as a system, which were obtained by three stage least squares. Table 1 contains the first-stage results from instrumenting the change in housing consumption $DZ_t = Z_t - Z_{t-1}$ when it is endogenous. We discuss the latter first.

There is serious evidence that increases in family size and a household's head getting married both increase housing consumption. The coefficient of current and lagged tenure mode suggest the following interpretation. Transitions from owning to renting increase housing consumption, as households are flush with funds from selling their homes, and transitions from renting to owning seem to have the opposite effect, based at least on years with statistically significant coefficients. This result seems to contradict the "saving up" hypothesis that households rent first in order to save up to buy later. Transitions from owning to owning seem to have a positive effect for many of those years when fits are best. This agrees with casual empiricism. As for the effects of housing prices, we see that renting prices have the anticipated signs when coefficients are significant, but owning prices give a much less consistent picture. Finally, the coefficient of total current income is, as expected, typically positive and significant.

The results we report in Table 2 pertain separately to the subsamples of observations in the pooled panel data with positive and nonpositive net worth. The weighted R^2 for the system is very small for constrained

6. Zeldes's use of food consumption as a measure of total consumption, like HALL and MISHKIN [1982] does raise questions. Our construction, on the other hand, of the total nonhousing consumption variable depends critically on the construction of the stock of financial assets variable, essentially the same variable Zeldes uses to separate the sample into a potentially constrained group and an unconstrained one.
7. It should be mentioned that alternative specifications were also tested, e.g., the one in ZELDES [1985], but gave results which were inferior to the ones we report.

TABLE 1

Change in Housing Expenditure after a Residential Move

Year.	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972
Intercept.	−.485	.494	.222	.014	.703	−.344	.187	.0279	.288	.298
	(.93)	(.73)	(.44)	(.03)	(1.59)	(.62)	(.41)	(.67)	(.61)	(.74)
Age hh.	.0070	.0080	−.0009	−.0008	−.0026	.00053	.00028	.00034	−.0089	.006
	(1.25)	(1.27)	(.19)	(.19)	(.70)	(.11)	(.07)	(.09)	(1.96)	(1.65)
Wife's age.	−.025	−.011	.0056	−.0077	−.011	.0024	−.0015	−.0035	.0066	−.006
	(2.54)	(1.04)	(.69)	(1.12)	(1.80)	(.27)	(.17)	(.63)	(1.05)	(1.03)
Family Size.	.084	−.031	.076	−.062	−.0027	.074	.0043	.0075	.042	.047
	(1.79)	(.38)	(1.42)	(1.12)	(.05)	(.98)	(.10)	(.15)	(.71)	(1.29)
Family Size-1.	−.031	.046	−.062	.084	.0014	−.025	−.0030	.0033	−.048	−.018
	(.77)	(.56)	(1.32)	(1.62)	(.03)	(.32)	(.08)	(.07)	(.82)	(.48)
Marital Status.	2.53	.820	.110	.741	.614	.476	.182	.511	−.168	.113
	(3.28)	(1.50)	(.28)	(2.08)	(1.71)	(1.07)	(.37)	(1.82)	(.52)	(.41)
Marital Status-1.	−.36	−.630	−.248	−.604	−.493	−.142	−.311	−.126	−.025	−.091
	(1.77)	(2.28)	(1.19)	(2.31)	(2.14)	(.57)	(1.78)	(.67)	(.10)	(.53)
Education of hh.	.0053	−.031	.037	−.00009	−.0064	.0030	.0050	.0081	.0065	.0091
	(.24)	(1.24)	(2.22)	(.00)	(.41)	(.15)	(.33)	(.57)	(.40)	(.81)
Wife's Education.	−.110	.019	.0028	.0005	.0076	−.033	−.021	−.0026	.0054	−.0072
	(2.84)	(.46)	(.18)	(.03)	(.40)	(1.22)	(.82)	(.20)	(.35)	(.71)
Race of hh.	.048	.179	−.133	.018	.057	.006	.072	−.011	−.083	−.147
	(.32)	(1.05)	(1.10)	(.17)	(.14)	(.05)	(.70)	(.13)	(.78)	(2.04)
Sex of hh.	−.222	.507	−.147	.0066	.018	−.0015	.071	−.101	−.166	.263
	(1.21)	(2.50)	(.99)	(.05)	(.14)	(.00)	(.59)	(.92)	(1.06)	(2.38)
Own.	−.351	−.264	−.679	−.221	−.451	−.153	−.170	−.124	−.055	−.0041
	(2.30)	(1.47)	(4.53)	(2.06)	(3.94)	(1.27)	(1.72)	(1.26)	(.51)	(.06)
Own-1.	.162	.788	.398	.317	.628	.435	.137	.008	.065	.061
	(1.00)	(4.66)	(2.91)	(2.46)	(5.33)	(2.89)	(1.18)	(.09)	(.55)	(.68)
Price of renting.	−.00061	.00021	.00026	−.00074	−.00061	.0015	−.00071	−.0015	.00012	.0008
	(2.02)	(.43)	(.68)	(2.27)	(1.25)	(.95)	(1.87)	(2.20)	(.26)	(2.33)
Price of renting-1.	.00045	−.00048	−.00044	.00087	.00046	−.0013	.00047	.0014	.0002	.0008
	(1.36)	(.87)	(1.03)	(2.62)	(.84)	(.80)	(1.15)	(1.89)	(.03)	(2.2)
Price, owning.	.00023	−.00019	−.00008	−.00008	−.000014	.0007	−.0001	.00014	.00008	−.0002
	(2.47)	(1.34)	(.64)	(.85)	(.18)	(2.20)	(.55)	(.50)	(.23)	(1.05)
Price, owning-1.	−.00013	.0002	.0002	.00006	−.00006	.0006	.0002	−.00017	−.00019	.0001
	(2.01)	(1.14)	(1.35)	(.73)	(.33)	(1.87)	(1.10)	(.56)	(.52)	(.88)
Income.	.0003	−.000037	.00001	.000001	.00002	.000002	−.000001	−.000002	.00002	.0000
	(3.06)	(3.90)	(1.50)	(.36)	(2.02)	(.15)	(.16)	(.31)	(1.88)	(2.94)
R^2 adjusted.	.2507	.3072	.1286	.0674	.1677	.1545	.0235	.0353	.0406	.0976
Observations.	77	111	139	130	163	143	162	175	153	174
F.	2.52	3.90	2.207	1.552	2.93	2.54	1.23	1.38	1.38	2.11
(significance).	(.005)	(.0001)	(.007)	(.089)	(.0003)	(.0017)	(.249)	(.1545)	(.155)	(.0090)
SSE.	21.008	61.677	36.900	29.188	50.902	51.604	36.348	34.646	38.969	26.84

Absolute value of t statistic in parentheses.

households, and equal to .065 for unconstrained ones. Thus a vastly better fit is obtained for the system of equations when it is supposed to hold than when it is not.

In addition to the independent variables in Equation (11) which are predicted by our theory we introduced in estimating (11) the following variables : a set of dummy variables for the different waves of interviews which make up the bulk of the data used in these regressions; a variable to denote whether the household moved in the respective year; age of the household head [which implies a quadratic term in Equation (10)]; and, a set of variables to denote changes from the preceding year in education of the head of household, in family size, in marital status and in housing tenure mode. We discuss first the results for these variables.

Many of the interview wave dummies are significant. The coefficient of the year-of-move dummy is negative and significant, implying that *cet. par.* the adjustment in housing expenditure "jolts" the path of optimal nonhousing expenditure. The coefficients of variables measuring change in socio-economic characteristics and of age are typically very significant for unconstrained households, but not so for the constrained ones. The household head's getting married reduces nonhousing expenditure, and a change from renting to owning increases it, perhaps because of the associated increase in wealth. Age has a negative and very significant. Somewhat surprisingly, an increase in the spouse's education has a negative and very significant effect.

We now turn to estimates of the coefficients of the utility function. All the constraints implied by the theory are imposed. Namely, the coefficients of $D\log P_X$ in (11) and of $D\log G$ in (14) must sum to 0. The coefficients of $\log P_C$ and $\log P_X$ in (11) must sum up to 0. The sum of the coefficients of $\log P_X$ and $\log P_C$ in (14) must equal the coefficient of $\log P_X$ in (11), which is implied by $\alpha_X + \alpha_C = 1$ and $\Gamma_{XC} + \Gamma_{XX} = 0$. The coefficients of $Z\log P_X$ and $Z\log P_C$ in (14) must sum up to 0. In (14) the coefficients of the squares of the log prices must be equal, and the coefficient of one of the squared log prices plus twice the coefficient of the product of the log prices must be equal to 0. As one might expect, the restricted estimates are very different from the unrestricted ones. The estimates for β_X and β_C are very significant. The implied elasticity of the share of leisure with respect to nonhousing expenditure is equal to $-.33$ and $-.38$ for constrained and unconstrained households respectively. The estimate of Θ_2 is not significantly different from zero. The results do not throw, unfortunately, any light on the interaction between housing and utility in the restricted expenditure function.

Table 3 reports estimation results for the share of leisure equation in first-difference form. We stressed above that such an equation always holds whether or not a household is constrained (See also ALLESSIE and KAPTEYN [1986]). These results are of particular interest. The best fit with respect to *t* statistics is obtained for the subsample of those with positive net worth. However the R^2 and the F statistic is much higher for the constrained subsample. The coefficient of the logarithm of nonhousing expenditure is very significant and its numerical value is in the same range as the corresponding estimates in Table 2. The corresponding coefficient

TABLE 2

Joint Estimation of Non Housing Expenditure and the Share of Leisure (First Differences)

	II: Net Worth ⩽0		III: Net Worth >0	
Dependent variable	DLog G	DS_X	DLog G	DS_X
Intercept.	.19	.06	1.32	.006
	(4.76)	(1.64)	(7.54)	(1.13)
DLog P_C.	−.38	.09	−.33	.073
	(2.83)	(.32)	(12.35)	(1.89)
DLog P_X.	.38	.29	.33	.25
	(2.83)	(1.00)	(12.35)	(5.79)
DZ.	.03	−.02	−.002	−.016
	(1.02)	(−.23)	(.17)	(1.77)
D (Family Size).	−.02		.004	
	(1.54)		(.60)	
D (Marital Status).	−.03		−.28	
	(.42)		(7.98)	
D (Tenure Mode).	.05		.04	
(Own = 1, owning).	(1.32)		(2.59)	
D (Education of Household Head).	.22		.071	
	(1.50)		(.59)	
D (Education of Spouse).	−.01		−.03	
	(1.32)		(8.58)	
Age of Household Head.	−.002		−.001	
	(2.28)		(3.11)	
Year of Move.	−.04		−.02	
	(2.04)		(1.94)	
Wave = 1972.	−.06		−.03	
	(2.02)		(1.76)	
Wave = 1973.	−.03		−.04	
	(1.02)		(2.44)	
Wave = 1974.	−.07		.0003	
	(2.28)		(.02)	
Wave = 1975.	−.01		−.02	
	(.23)		(1.25)	
Wave = 1976.	.004		−.02	
	(.12)		(1.35)	
Wave = 1977.	−.005		−.02	
	(.15)		(1.52)	
Wave = 1978.	−.066		−.03	
	(1.90)		(2.04)	
Wave = 1979.	.11		−.02	
	(3.20)		(1.34)	
DLog G.		−.38		−.33
		(2.83)		(12.35)
D(Z Log P_C).		−.02		−.01
		(.43)		(2.56)
D(Z Log P_X).		.02		.01
		(.43)		(2.56)
D(Log $P_C)^2$.		−.02		−.004
		(1.27)		(1.80)
D(Log $P_X)^2$.		−.02		−.004
		(1.27)		(1.80)
D(Log P_C Log P_X).		.01		.002
		(1.27)		(1.80)
Variance.	.221	.640	.127	.023
Correlation Coefficient.	−.137		−.737	
Number of Observations.	3221		5383	
Weighted R^2, System.	.007		.065	
Weighted MSE, System.	1.019		1.471	

Absolute value of t statistic in parentheses.

TABLE 3

The Share of Leisure in Nonhousing Expenditure (First Differences)

	I Net Worth ≤0	II Net Worth >0
Intercept	.081	−.023
	(2.04)	(5.78)
DZ	−.034	−.008
	(.37)	(.81)
D Log P_C	−8.744	.023
	(.98)	(.02)
DLog P_X	2.845	−.425
	(.61)	(.79)
DLog G	−.508	.026
	(17.23)	(6.71)
DZ Log P_C	.071	−.032
	(.38)	(2.04)
DZ Log P_X	−.057	.028
	(.36)	(2.17)
D(Log P_C^2)	.747	.207
	(.99)	(2.37)
D(Log P_X^2)	.077	.174
	(.24)	(3.80)
D(Log P_{CX} Log P_X)	−.491	−.344
	(.59)	(3.07)
Observations	3221	5383
R^2 adjusted	.083	.036
F	33.45	23.61
Significance level	.0001	.0001
Root MSE	.794	.104

Absolute value of *t* statistic in parentheses.

is also significant for the unconstrained subsample though its magnitude is small. The hypothesis that the coefficients are equal across the two subsamples is rejected, by means of the conventional F test at the one percent level of significance. We interpret these findings as evidence in favor of the endogeneity of nonhousing expenditure for unconstrained households. This combined with the vastly better fit for the system in the case of unconstrained households supports the conclusion that liquidity constraints matter.

5 Conclusions

We use pooled panel data from the Panel Study of Income Dynamics to study the interaction between housing and nonhousing consumption decisions in a life cycle context. Our model predicts a path for total consumption expenditure, net of housing expenditure, and its share which goes to leisure. The structural form for the latter remains the same regardless of the functional form of the former, which may in fact change depending upon whether households are liquidity constrained. Housing consumption is adjusted when households change residence but is assumed to remain unchanged during residence spells. The data pertaining to households with positive net worth give a much better fit for the system of simultaneous equations for nonhousing expenditure and its share which goes to leisure in first-difference form than those pertaining to non-positive net worth. Good results are obtained for single-equation estimations of the change in housing consumption when moves occur and of the share of total nonhousing expenditure which goes to leisure.

Our results regarding housing consumption are novel, in the context of both the housing literature and life cycle theory and largely in agreement with intuition. As for the impact of liquidity constraints on life cycle decisions our methods suggest that it is significant.

Our approach here emphasizes the quasi-fixity of housing consumption during residential spells, while life cycle consumption proceeds in a forward fashion. We have, however, considered all changes in hours worked as voluntary and have dealt neither with the labor force participation decision, nor with a possible simultaneity between residential moves and job changes. Liquidity constraints may in fact exacerbate the impact of involuntary changes in employment, as the latter interfere with households' plans of life cycle wealth accumulation. Finally, our results depend critically on the construction of the nonhousing expenditure variable, and especially the prediction for the stock of financial assets. Enhanced data sets must be explored in future work.

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