Time Use, Consumption and Saving over the Life Cycle

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Abstract

Time use data are an important input to modelling life cycle labour supply, consumption and saving decisions because they provide information on the allocation of time to the home production of substitutes for market output and on pure leisure. They are also essential for modelling the costs of children and for testing alternative life cycle hypotheses. This paper combines income and expenditure with time use data to model household members as jointly choosing life cycle time paths of time use, consumption and saving. The analysis allows straightforward resolution of a number of puzzles identified in the literature but yields results that do not appear to support the hypothesis of a perfect capital market.

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1 Introduction

Time use data are an important input to modelling household labour supply and consumption decisions because they provide information on the allocation of time to the home production of substitutes for market output and to leisure.[1] They are also essential for measuring the costs of children because a large component of family resources involves the allocation of time directly to child care. The aim of this paper is to demonstrate the importance of data on these time allocations for modelling life cycle consumption and saving behaviour and for testing alternative life cycle hypotheses. We also show that a modelling approach incorporating consumption derived from the allocation of time to domestic work and child care can resolve a number of puzzles that have been the focus of much of the literature on the life cycle model of consumption choice.

The core of the life cycle model[2] is the hypothesis that the household chooses its consumption at any point in time in the light of its entire lifetime income stream, using the capital market to decouple current consumption from current income, so keeping its discounted marginal utility of consumption constant over time. However, almost invariably consumption is measured as expenditure on market output only, and the income stream that appears (usually exogenously) in the model is market wage income. When the predicted consumption and saving paths are compared to the data there are striking differences, which are then presented as puzzles in need of explanation.

A key puzzle is the *excess sensitivity* of consumption to income, in the sense that current consumption seems to track current income more closely than would seem to be implied by optimally relating consumption to *lifetime* income. Both are found to exhibit a "hump" or inverted U-shape with respect to the age of the household head. The response to this has been numerous theoretical and empirical studies that formulate more complex models by introducing different assumptions concerning, for example, the discount rate,

[1] This was fully recognised in the formulation of the Gronau (1977) model. See, also, the Gronau (1986) survey of the household production literature.

[2] For a comprehensive survey of the theory and evidence see Deaton (1992). Browning and Lusardi (1996) provide a more concise survey of saving behaviour. See also the interesting survey by King (1985) and accompanying comment by Diamond (1985), who both emphasise, as we do in this paper, the heterogeneity of household consumption behavior.

within-period preferences, the role of demographics, the strength of the precautionary motive in the early phase (the buffer stock model) and of saving for retirement in the later phase,[3] liquidity constraints, and the complementarity of consumption and labour supply due to costs of working[4].

Here we propose that the excess sensitivity puzzle can be resolved by using a measure of *full consumption*, defined as the household's expenditure on domestic production in addition to market output, as the consumption variable. This argument bears a superficial resemblance to the model of Baxter and Jermann (1999). They explain the tendency for consumption of market goods to track income by arguing that as the wage rate rises over the life cycle, goods produced in the household become more expensive, and therefore substitution toward market goods takes place.[5] However, the problem with this theory is that domestic production is carried out predominantly by the female partner, and the data indicate that the average female wage does not rise - if anything it tends to fall - in phases following the arrival of children because of reduced participation and hours of work. This is missed in the Baxter and Jermann analysis because of their use of the representative agent model. At the very least, a two-person model is required.

We use time use data to construct a measure of full consumption and show that this resolves the excess sensitivity puzzle. The analysis is conducted within the framework of a model that takes account of the multi-person nature of the household. As in Apps and Rees (2001), an important feature of our model is the characterisation of the life cycle not in terms of calendar years, but rather in terms of six phases through which a typical family goes over its lifetime. Essentially we are saying that the important differences between households at different stages of the life cycle are not captured sufficiently sharply by differences in calendar age of the head of the household, but rather depend more on whether or not they have children, and on what stage the children are at. By organising the data in this way we are trying to bring out more clearly than in the existing literature the

[3] See Attanasio, Banks, Meghir and Weber (1999), Carrol (2001) and, for avery recent econometric study supporting this thesis, Gourinchas and Parker (2002).

[4] See, for example, Blundell, Browning and Meghir (1994).

[5] In a sense they are spelling out a source of the non-separability between consumption (of market goods) and household non-labour time that was the basis for Heckman's (1974) contribution. He showed that the positive correlation between current income and consumption over the life cycle obtained by Thurow (1969) would be generated, in the non-separable case, by the age profile of wage rates.

effects of children on the time allocation and labour supply decisions of the household, and, through that, on its income stream and saving decisions.[6]

We show that changes in female labor supply corresponding to the basic transitions in the life cycle defined in this way are what drive market consumption and saving decisions. In this, wage rates play an important role, but not the one envisaged in Baxter and Jermann. The household deals with the child care costs created by the advent of children by having the spouse with the lower wage, typically the wife, switch a substantial amount of her time from the market to the household, and this tends to lower her wage. Subsequent changes in her market labour supply and use of her time in household production drive both the process of income growth and growth of market consumption. The covariance of these variables is a joint result of the underlying process of changes in time use, rather than a case of one variable responding to the other.

While we resolve the excess sensitivity puzzle in this way, our results lead to a new puzzle. We find that full consumption tracks total time allocated to work - market and domestic - and that both are strongly humped shaped: total hours of work rise, and leisure declines, quite dramatically with the arrival of children. We find this effect is particularly strong for mothers and interpret it as evidence of some kind of capital market imperfection. After all, why would new mothers choose to work longer in this phase of the life cycle than in any other, if the capital market allowed borrowing at a reasonable interest rate to finance bought-in child care.

Having identified a U-shaped profile of leisure expenditure, we go on to investigate the costs of children and the extent to they can explain the fall in leisure in the early child rearing phases if, in fact, borrowing is too costly. We derive measures of child costs using data for home child care time and an intra-family "sharing rule" for the assignment of market consumption and domestic output (excluding child care) that draws on an equivalence scale used elsewhere in the life cycle literature. We then compute a full consumption profile for the adults by subtracting child costs and find that it tends to match their leisure profile. We interpret this as further evidence of a capital market imperfection, inducing parents to cut back on both leisure and full consumption, to finance the cost of child care. We also draw on detailed

[6] More recently, Browning and Ejrnaes (2002) also argue for an explanation of consumption behaviour based on demographics rather than the precautionary motive. However, the analysis is limited to market consumption expenditures.

data on government taxes and benefits and report the life cycle profile of government support for the costs of children. The result reveals a wide gap in support for market child care relative to home child care in the early child rearing phase. A gap of this kind can be expected to reinforce the effects of high borrowing costs on female labour supply and leisure in an imperfect market.

The preceding discussion describes the average household. There is, however, a high degree of heterogeneity in female labour supply and, consequently, in domestic work and child care, across households with the same wage rates and demographic characteristics. This means that any estimate of child costs based on market expenditures alone will provide a result that is relevant for very few households - the majority will be spending either far more or far less, depending on the labour supply of the mother and the household's corresponding substitution of market for home child care. In our modelling approach we attribute this within-phase heterogeneity to differences in domestic productivities.[7] We also show that there are differences in saving. Most saving appears to be carried out by households in which there is a significant market labour supply of the secondary earner. The standard modelling framework, in which the only explanatory variables are demographics, wage rates and non-labour incomes, cannot account for these across-household variations.

The paper is organised as follows. In the next section we present a general model of the household's decisions on consumption, saving and time allocations over the life cycle. In section 3 we formulate a simplified empirical version of the model that allows us to address the issues of central interest while simultaneously dealing with the limitations of the available data. In Section 4 we describe the data and present life cycle profiles of consumption, saving, labour supply and domestic work, obtained by combining information household consumption expenditure and time use from two complementary surveys. Section 5 presents parameter estimates for the empirical specification of our within-period demand system and the findings from a comparative analysis of predicted and reference profiles of consumption. The results do not support the perfect capital market hypothesis. Instead, they highlight a role for government, particularly in the area of support for market child care, in reducing the distortionary effects of an imperfect capital market on life

[7] The idea draws on the model in Becker (1976), which distinguishes between market and domestic productivities.

cycle labour supply, consumption and saving decisions. Section 6 concludes.

2 Theoretical Model

The household has a lifetime of $T+1$ periods, with $t = 0, 1, ..., T$ denoting the period. As outlined, we distinguish six phases of the household's life cycle, which form a partition of the set of time periods:

- $\phi_1 = \{0, .., \tau_1\}$: the two-person household has no children;
- $\phi_2 = \{\tau_1 + 1, .., \tau_2\}$: there are children of pre-school age;
- $\phi_3 = \{\tau_2 + 1, .., \tau_3\}$: the children are in primary school or early high school years;
- $\phi_4 = \{\tau_3 + 1, .., \tau_4\}$: the children are at high school or have left school;
- $\phi_5 = \{\tau_4 + 1, .., \tau_5\}$: the children have left home, both adults are of working age;
- $\phi_6 = \{\tau_5 + 1, .., T\}$: the adults are retired, receive a pension and may supply market labour.

Household types are indexed by $h = 1, .., H$, and differ according to the value of the domestic productivity parameter k_h.

The household maximises its utility over its lifetime

$$u_h = \sum_{t=0}^{T} \rho^t \sum_{i=1}^{K} \varphi_{ih} u_i(x_{iht}, y_{iht}, z_{iht}; \phi_j) \tag{1}$$

where ρ is a time preference discount factor, x is consumption of the market good, y is consumption of the domestic good and z is consumption of pure leisure. The distributional weights φ_{ih} sum to one, are taken as fixed throughout, and reflect the hypothesis that the household seeks a Pareto efficient allocation of its resources. The individual utility functions u_i are strictly increasing in the consumption goods and leisures and are strictly quasi concave. Households are assumed to have identical preferences in any given phase of the life cycle. The phase indicator ϕ_j, $j = 1, .., 6$ allows for changes in preferences across phases associated with the presence of children of different ages.

In phases 1, 5 and 6 there are no children in the household. The index $i = 1, 2$, always refers to adults. In phases 2, 3, and 4, there are $K - 2 > 0$ children in the household, and their utility functions are therefore included in u_h in these phases. We can think of setting $\varphi_{ih} \equiv 0$ for $i > 2$ in the childless phases. u_h is clearly a simple form of "social welfare function" for the household, *i.e.* a *household welfare function.*

Each individual i has the time constraint[8]

$$a_{iht} + l_{iht} + z_{iht} = A \quad h = 1, .., H \quad t = 0, ..., T \tag{2}$$

where l denotes a market labour supply, a the supply of labour to domestic production and A is total available time. The production functions of the household good are

$$\sum_{i=1}^{K} y_{iht} \equiv y_{ht} = f(a_{1ht}, a_{2ht}; k_h) \quad h = 1, .., H \;\; t = 0, ..., T \tag{3}$$

and are assumed to be linear homogeneous and strictly quasi concave. We now consider the alternative models. Note however that for $t \in \phi_6$, the retirement phase, $l_{iht} = 0$, and so in periods corresponding to this phase a_{iht} and z_{iht} are the only time use variables.

The budget constraints in each period are then

$$\sum_{i=1}^{K} x_{iht} + s_{ht} = \sum_{i=1}^{2} w_{it} l_{iht} + (1 + r) s_{h,t-1} + P_t \quad t = 0, ..., T \tag{4}$$

$$s_{hT} = 0; \quad s_{h,-1} = 0 \tag{5}$$

where w_{it} is i's net of tax market wage at t (we thus allow the possibility of changes in the wage over time), s_{ht} is saving (> 0) or dissaving (< 0) at $t = 0, 1, ..., T$, $P_t \geq 0$ is a lump sum government transfer in each period, which in the retirement phase is the pension payment, and r is the one-period market interest rate, assumed constant over time. To be consistent with the assumption that there is no bequest motive, which implies saving at zero in the last period of life, we also assume there is no inherited wealth, so that assets are also zero at the beginning of period 0. These constraints can be

[8]For children, $l_{iht} = a_{iht} \equiv 0$, although we realise that children often do household chores, and may well supply labour to the market (especially in developing countries). This is just a useful simplification in the present context.

collapsed in the usual way into the wealth constraint

$$\sum_{t=0}^{T} \delta^t [\sum_{i=1}^{K} x_{iht} - \sum_{i=1}^{2} w_{it} l_{iht} - P_t] = 0 \tag{6}$$

where $\delta = (1+r)^{-1}$ is the market discount factor.

The household maximises (1) subject to (2), (3) and (6). The first order conditions (assuming only interior solutions) for this are

$$\begin{aligned}
\rho^t \frac{\varphi_{ih} \partial u_i}{\partial x_{iht}} - \lambda_h \delta^t &= 0 \quad i = 1,..,K \; t = 0,..,T & (7)\\
\rho^t \frac{\varphi_{ih} \partial u_i}{\partial y_{iht}} - \mu_{ht} &= 0 \quad i = 1,..,K \; t = 0,..,T & (8)\\
\lambda_h w_{it} \delta^t - \pi_{iht} &= 0 \quad i = 1,..,K \; t = 0,..,T & (9)\\
\rho^t \frac{\varphi_{ih} \partial u_i}{\partial z_{iht}} - \pi_{iht} &= 0 \quad i = 1,..,K \; t = 0,..,T & (10)\\
\mu_{ht} \frac{\partial f}{\partial a_{iht}} - \pi_{iht} &= 0 \quad i = 1,..,K \; t = 0,..,T & (11)
\end{aligned}$$

together with the constraints. Here λ_h is the household's marginal utility of wealth and the μ_{ht}, the Lagrange multipliers associated with the production function constraints, give the discounted marginal utility of the domestic output. The π_{iht} are the Lagrange multipliers associated with the time constraints (2).

We see from (7) that the marginal utility of consumption of the market good, weighted by the ratio of discount factors $(\rho/\delta)^t$, must be constant over time, and equal to the marginal utility of wealth, but since this marginal utility of market good consumption is in general a function of the consumption of both market and household goods, as well as leisure, this does not imply constancy of the time path of market consumption, even within a given phase ϕ_j. The optimal consumption paths depend on the implicit price of the domestic good (recall the market good is numéraire). Thus, define

$$p_{ht} \equiv \frac{\mu_{ht}}{\lambda_h \delta^t} = \frac{w_{it}}{\partial f / \partial a_{iht}} \tag{12}$$

as the *current value implicit price* of the domestic good, which is equal to the undiscounted marginal cost of the domestic good. In general this will depend on the level of output of the domestic good, as well as on the after-tax wage rates and the marginal productivities, which in turn depend on the

productivity parameters k_h. The first two conditions then yield the standard condition for within-period consumption choices

$$\frac{\partial u_i/\partial y_{iht}}{\partial u_i/\partial x_{iht}} = p_{ht} \tag{13}$$

The time paths of consumption of both goods will depend on how this price varies over time, as well as on how transitions between phases of the life cycle change the relative preferences for market and household goods. Differences across households in this price will lead to differences both in their within-period time and consumption allocations and in their time profiles of consumption, even given identical preferences across households. At given wage rates, a household with higher productivity in household production will have a lower value of this price and therefore will have a higher demand for domestic output, assuming this is not a Giffen good. This does not necessarily imply that this household will have a higher domestic time input - lower market labour supply - however, because higher productivity implies that a given domestic output can be produced with a smaller time input. Thus we cannot say *a priori* that households with higher (lower) female labour supply are those with higher (lower) productivities in domestic production.[9] With a given domestic productivity, the higher the wage rate, the higher the price of the domestic good, but since household income is also higher, the net effect on the demand for the domestic good is ambiguous. However, the assumption that labour supply increases with the wage is equivalent in this model to assuming that demand for the household good falls with wage-induced increases in its price.

The conditions (7) - (11) assume no corner solutions, and in particular (9) rules out (except trivially) households with a zero market labour supply.[10] For these however we simply have the condition

$$w_{it} \leq \omega_{iht} \tag{14}$$

where $\omega_{iht} \equiv \pi_{iht}/\lambda_h \delta^t$ is the current money value of foregone leisure and the implicit price of the household good is defined as

$$p_{ht} \equiv \frac{\mu_{ht}}{\lambda_h \delta^t} = \frac{\omega_{iht}}{\partial f/\partial a_{iht}} \tag{15}$$

[9] For a formal proof, see Apps and Rees (1999).

[10] Such corner solutions may of course be especially relevant in the retirement phase. Note however that in the data, earnings from market labour supply are still positive for many households in the retirement phase.

Then, condition (13) still applies, with the implicit price of domestic output now determining the time paths of consumption of the market and household goods and leisure.

It will be useful for what follows to reformulate this model, by exploiting the separability between within-period and across period decisions. First, in each period $t = 0, ..., T$, for any given output of the domestic good the household chooses its allocations of time inputs to solve:

$$\begin{aligned} minC_{ht} &= \sum_{i=1}^{2} w_{it} a_{iht} && (16) \\ s.t.\ \ y_{ht} &= f(a_{1ht}, a_{2ht}; k_h) && (17) \end{aligned}$$

yielding, because of the linear homogeneity assumption, input demand functions $a_{iht}(w_{1t}, w_{2t,} y_{ht}; k_h)$, and total cost functions $p_{ht}(w_{1t}, w_{2t}; k_h) y_{ht}$, with p_{ht} the implicit price of the household good. Defining c_{ht} as total consumption expenditure in each period, and taking this as fixed for the moment, the household solves its within period allocation problem

$$\begin{aligned} max \sum_{i=1}^{K} \varphi_{ih} u_i(x_{iht}, y_{iht}, z_{iht}; \phi_j) &= u_{ht} && (18) \\ s.t.\ \ \sum_{i=1}^{K} x_{iht} + p_{ht} y_{ht} + \sum_{i=1}^{2} w_{it} z_{iht} &= c_{ht} && (19) \end{aligned}$$

yielding demand functions

$$\begin{aligned} &x_{iht}(p_{ht}, w_{1t}, w_{2t}, c_{ht}; \phi_j, \varphi_{ih}), \\ &y_{iht}(p_{ht}, w_{1t}, w_{2t}, c_{ht}; \phi_j, \varphi_{ih}), \\ &z_{iht}(p_{ht}, w_{1t}, w_{2t}, c_{ht}; \phi_j, \varphi_{ih}), \end{aligned}$$

and an indirect utility function

$$u_{ht}(p_{ht}, w_{1t}, w_{2t}, c_{ht}; \phi_j, \varphi_{ih}).$$

Note that a fully equivalent way of generating these demands is by assuming that the household in each time period first shares its income among its members, who then solve their individual utility maximisation decisions subject to budget constraints defined on these income shares.[11] This is in fact the approach adopted in the empirical analysis below.

It is convenient to suppress the prices and wages, which are exogenously given throughout, in the indirect utility function, as well as the distributional weights, and to write it as $v_{ht}(c_{ht}; \phi_j)$.

[11] See Apps and Rees (2002) for the details of this formulation in a multi-person household with children.

The household then solves its intertemporal optimisation problem

$$max u_h = \sum_{t=0}^{T} \rho^t v_{ht}(c_{ht}; \phi_j) \quad (20)$$

$$s.t.\ c_{ht} = A \sum_{i=1}^{2} w_{it} + (1+r) s_{h,t-1} - s_{ht} + P_t \quad t = 0, ..., T \quad (21)$$

$$s_{hT} = 0 \quad s_{h,-1} = 0 \quad (22)$$

Given the assumptions on $u(.)$ and $f(.)$, it is straightforward to show that the solution to this three-stage procedure is precisely that given by conditions (7)-(11).

3 Empirical Specification

We introduce a number of simplifying assumptions in formulating an empirical model within the theoretical framework set out above to deal with limitations of the available data. A key problem is missing information on the consumptions of family members. With access to time use data we have information on two assigned goods, leisure and child care. However, data on the individual consumption of these goods alone are not sufficient for the identification of individual preference parameters. Nor do they permit the estimation of the parameters of an intra-household sharing rule.[12] We therefore specialise the model in several respects.

We first compute the costs of children in each household, as detailed in Section 4. We then treat total child costs as a lump sum transfer from parents, which we hold constant in the simulations. This leaves us with the within-phase consumption and leisure demands of parents for estimation, and we estimate these as a two-adult household model.

In the general formulation of the model in Section 2, a phase parameter allows for the way household preferences might change with the age of children. We assume that changes in household preferences over the life cycle largely reflect the changing needs of children rather than those of the adults. Since the consumption cost of children is treated as a lump sum transfer from parents, we specify a system in which household preference parameters are constrained to be identical across phases. We later relax this assumption by

[12] For a proof, see Apps and Rees (1997).

introducing error terms, in order to construct reference life cycle profiles that match the data.

3.1 Within-period Production and Demand System

Given that the data limit us to the estimation of a household demand system, the usual parameter restrictions for aggregation are required. However, these are valid only if family members face the same prices. This condition is not satisfied if the two adult members face different prices (wage rates) for leisure. To deal with this problem, full income is defined on the basis of a time constraint of 14 hours per day, which means that each adult is given a fixed allocation of 10 hours of "own time" (pure leisure and/or sleep), and the residual of leisure time beyond own time is specified as an input to the production of a general leisure good, z, which can be consumed by either adult family member.

The Almost Ideal (AI) demand system is selected for estimation of within-period preference parameters. Suppressing the household type and phase subscripts, the indirect utility function for adult $i, i = f, m$, takes the form

$$u_i(q, p, c_i) = (\ln c_i - \ln a_i(q, p))/b_i(q, p) \tag{23}$$

where c_i is adult i's full consumption and p and q are the prices of the domestic good and leisure, respectively. The price indexes $a_i(q, p)$ and $b_i(q, p)$ are assumed identical, and given by

$$\ln a(q, p) = \alpha_0 + \alpha_z \ln q + \alpha_y \ln p + 0.5\gamma_{zz} \ln^2 q + \gamma_{zy} \ln q \ln p + 0.5\gamma_{yy} \ln^2 p \tag{24}$$

$$\ln b(q, p) = \beta_z \beta_y \ln q \ln p \tag{25}$$

where α_0, α_j, γ_{jl} and $\beta_j, j, l = x, y, z$, are parameters. The restrictions for adding up are $\sum \alpha_j = 1$, $\sum \beta_j = 0$ and $\Sigma\gamma_{jl} = 0$, for symmetry, $\gamma_{jl} = \gamma_{lj}$, and for homogeneity, $\sum \gamma_{jl} = 0$.

Household demands in share form are

$$S_z = \alpha_z + \gamma_{zz} \ln q + \gamma_{zy} \ln p + \beta_z \ln(c/a(q, p)) + \varepsilon_z \tag{26}$$

$$S_y = \alpha_y + \gamma_{yy} \ln p + \gamma_{yz} \ln q + \beta_y \ln(c/a(q, p)) + \varepsilon_y \tag{27}$$

$$S_x = \alpha_x + \gamma_{xz} \ln q + \gamma_{xy} \ln p + \beta_x \ln(c/a(q, p)) + \varepsilon_x \tag{28}$$

where $S_x = x/c$, $S_z = qz/c$ and $S_y = py/c$. Given adding up, we need only estimate the share equations for leisure and the domestic good.

On the production side of the model, we specify Cobb-Douglas functions for leisure, z, and the domestic good, y, as

$$s_z = \sigma_z + \xi_z \tag{29}$$

$$s_y = \sigma_y + \xi_y \tag{30}$$

where $s_z = w_2 z_2/(w_1 z_1 + w_2 z_2)$ and $s_y = w_2 a_2/(w_1 a_1 + w_2 a_2)$. The implicit prices, p and q, are computed for each record as functions of wage rates and the production parameters specific to each record, together with a scaling factor, consistent with the CD form. Using actual rather than predicted production parameters implies that the unobserved domestic productivity for each record is systematically related to the error term of the relevant production share equation. Thus, for example, households in which the female partner specialises in domestic work will, ceteris paribus, be found to have a larger production share, and therefore a lower domestic price, due to a higher domestic productivity. This specification, of course, gives rise to an endogeneity problem. However, with missing data on domestic productivity, there is inevitably a trade-off between parameter bias due to omitting this variable and that due to computing a domestic price in this way. Our model implies that the former is the more serious.

3.2 Intertemporal Demand System

Introducing the phase subscripts into the above indirect utility function we can write it as

$$u_t = \hat{a}_j(q_t, p_t) + \frac{\ln c_t}{b_j(q_t, p_t)} \quad j = 1, .., 6 \tag{31}$$

with

$$\hat{a}_j(q_t, p_t) \equiv \frac{-\ln a(q_t, p_t)}{b_j(q_t, p_t)} \tag{32}$$

The solution to the household's problem yields the life cycle and across-household profiles of total consumption, and the estimated demand and labour supply functions within periods can then be used to derive profiles of market and domestic consumption, saving, labour supplies and leisures.

Given the assumed functional form for indirect utility, the first order conditions for this problem are

$$\frac{\rho^t}{\delta^t b_j(q_t, p_t) c_t} = \lambda \quad t \in \phi_j, \; j = 1, .., 6 \tag{33}$$

$$\sum_{t=0}^{T} \delta^t c_t \;=\; W \equiv \sum_{t=0}^{T} \delta^t (A \sum_{i=1}^{2} w_{it} + P_t) \tag{34}$$

where W is "full wealth". The important thing to note is that the marginal utility of consumption expenditure in each period depends on the prices of the domestic good, p_t, and leisure, q_t, and therefore on the wage rates and the domestic productivity. Thus the entire time profile of total consumption, as well as its allocation within each period as between market and domestic consumption and leisure, depends on this productivity. The solution of the system is given very simply by

$$c_t = \alpha_t c_T \tag{35}$$

$$c_T = \frac{W}{\sum_{t=0}^{T-1} \delta^t \alpha_t + \delta^T} \tag{36}$$

$$\alpha_t \equiv \left(\frac{\rho}{\delta}\right)^{t-T} \frac{b_6(q_T, p_T)}{b_j(q_t, p_t)} \;\; t \in \phi_j, \;\; j = 1, .., 5 \tag{37}$$

4 Data and Evidence on Life Cycle Profiles

This section discusses data sources, sample selection and the criteria used to split the data samples into the six life cycle phases according to the presence and ages of the children, as defined in the model. The section then presents life cycle profiles of consumption, time use and saving across the six phases and discusses the way in which the profiles differ from the evidence on life cycle behaviour presented in the literature. We also describe the important heterogeneity in the allocation of time to market labour supply, domestic work and leisure, and in saving, across households.

4.1 Data, sample selection and phase definition

Ideally, we would estimate the preceding model on panel data. Given that they are not available, we use micro-level cross section data. We draw on two complementary surveys, the Australian Bureau of Statistics (ABS) 1997 Time Use Survey (TUS) and the ABS 1998 Household Expenditure Survey (HES).[13] Information on time use collected by diary in the TUS is merged

[13]The analysis is, in effect, based on a single cross section (all results are presented in 1998 prices) and therefore does not take account of cohort effects. While we recognise that

with data collected by interview on household consumption expenditure, individual incomes and earnings in the HES.[14]

The time use data are collected for ten activity categories,[15] which we group into four: market work, general domestic work, domestic child care and leisure. The TUS also collected data by interview on "usual hours of work". Both surveys provide information on a common set of demographic, education and occupation variables. In addition, the HES provides estimates of indirect government taxes and benefits as well as detailed data on direct taxes and benefits.

We select matching samples of two-adult households from these datasets excluding only those in which the female partner is aged from 35 to 44 years and there are no children. Our reason for omitting these households is that they are likely to represent couples who have decided not to have children and, ideally, we would like to exclude all such households. The sample drawn from the HES contains 3994 records and that from the TUS, 1922 records.[16]

These matching samples are split into the six life cycle phases as follows. Phase 1 comprises couples in which the female partner is aged under 35 years and there are no dependent children present. Phase 2 includes all couples with at least one child under 5 years who is not yet at pre-school. Phase 3 represents couples with at least one child under 10 years at school or pre-school and phase 4 is defined as couples with older dependent children still living at home. Phase 5 comprises couples selected on the criteria that the female partner is aged 45 years or more, there are no dependent children present and, in the case of couples in which the male partner is aged 55 or more, at least one partner is not in full or semi retirement or "out of the

cohort effects can be important, it does not seem to us that they would alter the direction of our key results.

[14]For details, see Apps and Rees (2002).

[15]The activity episode classification distinguishes between labor market activities and nine major categories of non-market activities. Market hours are calculated as the sum of time allocations to all subcategories of labor market activities excluding travel to work and job search. Domestic work is computed as the sum of time allocations to the categories "domestic activities"and "purchasing goods and services". Domestic childcare is the category "child care/minding". For each episode, information is recorded for a "primary" and, if relevant, a "secondary" activity. Where primary and secondary activities are reported, the weighting used is 0.6:0.4.

[16]There are 124 records excluded from the HES full sample of two-adult households and 68 from the TUS sample, on the criteria that no children are present and the female partner is aged from 35 to 44 years.

workforce". Phase 6 includes all couples in which the male partner is 55 or older, and both partners are in full or semi retirement or report being unemployed or "out of the workforce". The cell sizes for phases 1 to 6 in the HES sample are 385, 708, 609, 737, 757 and 798, and in the TUS sample, 186, 336, 302, 342, 350, and 406, respectively.

4.2 Life cycle profiles

Table 1 reports life cycle profiles of median net household income,[17] market goods expenditure and saving (computed as the difference between income and consumption) in columns 1 to 3, respectively, for the HES sample. The profiles in columns 1 and 2 are depicted in Figure 1 and confirm the excess sensitivity puzzle. They show the strong tendency of household consumption to track net household income. However they differ in an important respect from those reported in the literature, which typically show a single "hump". The dip in net income following the arrival of children in phase 2, together with the slight fall in consumption, is missed in the literature due to defining the life cycle on the calender years of the reference adult. Under this definition the fall in household income after the arrival of children is "averaged out". Young households making very different labour supply and domestic work choices - *i.e.*, on the one hand, couples with no children and both partners in market work and, on the other, those with young children and only one partner, usually the male, in market work - are grouped together.[18]

The average number of children in phases 2 to 4 is shown in column 4. Column 5 gives an estimate of the costs of children in terms of market consumption expenditure only. This is calculated using the equivalence scale applied by Blundell et al.(1994) who argue that when consumption is deflated by an appropriate equivalence scale, the data provide support for the assumption of a perfect capital market. The study shows that deflating by "equivalent" household size, equal to the number of adults plus 0.4 times the number of children, "removes most (if not all) of the 'hump' shape in consumption". Here, however, it is evident that once the dip in consumption following the arrival of children is identified, child costs measured in this way

[17] Net household income includes all government direct (cash) benefits but not indirect benefits through, for example, the eduation and health systems.

[18] Because saving is positive on average across these groups, this has been taken as evidence of the precautionary motive for saving (see, for example, the buffer-stock model of Carrol, 1994, and Gourinchas and Parker, 2002).

cannot help to smooth consumption sufficiently to provide support for the perfect capital market hypothesis.

Table 1 and Figure 1 about here

While it is clear that market income and consumption are strongly associated with the number of dependent children, the profiles of these variables in Table 1 can give an entirely misleading picture of the true paths of income and consumption, and of the impact of demographic variation, because they exclude the implicit income derived from, and expenditure on, domestic work and child care. It is also important to take account of the household's implicit expenditure on leisure because, as the time use data we now present indicates, leisure as well as domestic work cannot be assumed to be separable from market consumption and labour supply.

Table 2, columns 1 to 3 and 5 to 7, report weighted data means for male and female time allocations to market work, general domestic work and child care for the TUS sample. Total male and female hours of work are shown in columns 4 and 8, respectively. Comparing these hours profiles with those for net income and consumption in Table 1, it is immediately apparent that much of the variation in net income across phases 1 to 5 reflects changes in female labor supply or, more specifically, the reallocation of time from market to domestic work and child care by the secondary earner after the arrival of children. Across these phases, there is relatively little variation in male market hours, but large changes in the hours of the female partner, which are negatively related to her hours of work at home. These very different male and female time allocations are shown graphically in figures 2 and 3. Figure 2 depicts the female partner's life cycle profiles of labour supply, domestic work and child care, and domestic work alone. Figure 3 presents the corresponding profiles for the male partner.

Table 2 and Figures 2 and 3 about here

The strong negative relationship between female labour supply and domestic hours of work (including child care) supports our proposition that the two types of work are close substitutes once there are children present. The most dramatic substitution occurs in phase 2, reflecting the fact that young children generate a high demand for care. This can in general be provided at home or bought on the market, but these time use data show that there is a very large domestic supply of child care. The data also show that *total* female hours of work rise and leisure falls dramatically with the arrival of children, and this is then steadily reversed over successive phases of the life cycle. Male total hours of work and leisure show a similar pattern but to

a lesser degree. We interpret these U-shaped leisure profiles as evidence of some form of capital market imperfection.

Before investigating this further, we attempt to derive a truer picture of household consumption over the life cycle by constructing a measure of full consumption incorporating an opportunity cost for domestic time. We compute the latter instrumenting for male and female wage rates and taking account of effective tax rates. Indirect government benefits are also included. These are important because they are large, averaging over $12,000 per household in the sample, they vary quite dramatically across phases, and they tend to vary inversely with the household's cost of domestic child care across phases 2 to 4.

The life cycle profiles of government taxes and benefits provide an insight into the possible role and significance of these policy instruments in the presence of some form of capital market imperfection. Table 3 presents data means for household private income, direct taxes net of direct benefits, and indirect government benefits[19], in columns 1 to 3, respectively. Column 4 shows separately the data means for indirect eduction benefits, which we later treat as benefits assigned to the children. Column 5 presents the profile of total "net tax" computed as the sum of direct and indirect taxes, less direct and indirect benefits. The profile indicates a significant redistribution of the tax burden from the phases in which children are present to those in which they are not, prior to retirement.

Table 3 about here

However these data also indicate that, in phases 2 to 4, the families least advantaged are those in phase 2. From column 4 it can be seen that indirect government benefits are particularly high in phases 3 and 4. This is due largely to public spending on education and the child care that it provides. Families with children at school or in tertiary education receive by far the largest support from public spending on education - in the order of $8,000 to $9,000 p.a. This contrasts with an average spending of only $1,093 per family on child care and education in the pre-school phase.[20] It is therefore

[19] The HES estimate of indirect government benefits covers non-cash benefits and services for education, health, housing and social security and welfare. For details of the calculation of these benefits, see ABS (2001).

[20] Note that the data means for indirect government benefits include medical costs. In phase 2 these include costs for the birth of a child. Furthermore, $4052 of the average spending in phase 2 represents education benefits for school aged children who are also present in the household. Thus, if we subtract medical costs and spending on school

not surprising to find that families in phase 2 allocate a very large share of their resources to child care.

Table 4, column 1, presents a profile of household full consumption expenditure excluding indirect government benefits and column 2, a profile including them. In contrast to market consumption expenditure in Table 1, it can be seen that full consumption expenditure tracks total hours of work. Indirect government benefits have an impact. When they are omitted, the peak in full consumption appears in phase 2, coinciding with the peak in total hours of work. The peak shifts to phase 3 when they are included. Columns 3 and 4 present profiles of expenditure on domestic work including child care and column 2, for child care separately. Because much of the time allocated to work at home is allocated to child care in phases 2 and 3, household expenditure on domestic child care is a major component of total domestic consumption expenditure in these phases.

Table 4 and Figure 4 about here

To examine further whether the data support consumption smoothing in a perfect capital market, we now investigate what happens to the profile of adult full consumption. We calculate this by subtracting the total costs of children from household full consumption in column 2. Total child costs are obtained by summing the time cost of parental care (column 2), government education benefits (column 3) and the children's shares of the remaining market and domestic consumption expenditures as determined by the equivalence scale used in the Blundell et al. study, which sets the cost of child to 0.4 that of an adult.[21] The result for 2-adult full consumption is in reported in column 5 and, together with that of household full consumption (columns 2), depicted in Figure 4. The U-shaped profile indicates that the parents' full consumption tends to track their leisure, suggesting that parents cut back on both consumption and leisure, instead of borrowing more, in order to support their children in the early child rearing phases.

The explanation for this that we suggest is that parents face high borrowing rates in the earlier phases, particularly in phase 2, together with a lack of

aged children, it becomes evident that government assistance for families with very young children in no way matches the resources allocated to those with older children.

[21] We obtain average costs of \$44758, \$45762 and \$16480 in phases 2 to 4, respectively, which are in line with our estimate of a "sharing rule" in Apps and Rees (2002) based on an individualistic model and survey data that also include domestic work, child care and leisure.

access to good quality, affordable market child care.[22] Because there is very little government support for child care, and very high effective tax rates apply to the incomes of mothers who work,[23] the household's optimal choice is, first, to reallocate the mother's time from market to household work, since she generally faces a lower wage rate, and secondly, for both parents, but especially the mother, to work longer hours in total, and so reduce leisure, in phase 2.

In later years, the cost of children to parents is substantially reduced by public funding of education and the child care it provides. In other words, when the child reaches school age the public education system takes over many of the child-minding activities that the household itself has to undertake for pre-school children. This allows the female partner to expand her market labor supply in phase 3 while simultaneously reducing total hours of work. The effect is accentuated in phase 4. Household income, labor supply and market consumption expenditure all peak in phase 4, with teenaged children living at home, while saving is at its peak in the following phase, when the children have left home but market labor supply is still high. Thus, the profile of total hours of work, together with that of adult full consumption in column 4, is, we argue, to a significant extent an outcome of an imperfect capital market and variations in the public funding of the costs of children. Once the children have reached school age, access to public education and the child care it provides allows parents to maintain family consumption without cutting back excessively on leisure.[24]

The preceding life cycle profiles describe the average household. The

[22] To appreciate the inefficiencies and consequent high cost of market child care, one need only consider the impact that government financial support, central planning and regulation has had on primary school care and education, and what would happen to female labour supply and school attendance if that sector had been treated in the same way as child care.

[23] Like the US and Germany, Australia has a tax-transfer system that is, in effect, a system of joint taxation, due to recent reforms to family payments within the income tax system. Married mothers who work lose around half their earnings in taxes and reduced family payments, and so many cannot meet the cost of formal child care out of their net incomes.

[24] Further evidence in support of this argument can be found in the detailed data on saving and borrowing available in the HES. These indicate that a notable feature of the household's capital market behaviour is substantial long term saving in the form of house purchase, usually mortgage financed, and saving for retirement in a compulsory or strongly tax-advantaged contractual scheme, combined with short term borrowing, often at high interest rates, which is at its peak when the children are young.

data show that there is a very high degree of heterogeneity in respect of female labor supply, domestic work and saving behaviour across households with the same wage rates and demographics, which is concealed in these results. In our view it is essential to formulate a model that can take account of this heterogeneity. The underlying idea implied by our model is that households choose lifetime paths of male and female labor supplies, saving and consumption of household and market goods, given wage rates (net of taxes), interest rates and productivities in household production. Differences in domestic productivities across households lead to differences in choices of these endogenous variables, for households facing the same wage and interest rates and capital market conditions.

To give an indication of the empirical importance of this heterogeneity we take matching HES and TUS samples of "in-work" households and construct life cycle profiles for two groups defined according to female labour supply, as an indicator of domestic productivities. We are limited to this strategy for defining household types because of missing data on domestic output.

Ideally we would like to distinguish between those households in which female labor supply is zero or "marginal"[25] throughout the life cycle, and those in which it is significant and relatively large over the entire life cycle. This categorisation requires panel data. Since we have access only to cross section data, we present profiles for "in-work" households in phases 2 to 5 selected on the criterion that the male partner's "usual hours of work" exceed 25 per week. The HES sample contains 2384 records (approximately 600 in each phase) and the TUS, 1215 records (approximately 300 in each phase). We partition each sample into two groups of equal size within each phase according to the female partner's "usual hours of work".

Table 5 presents data means for the allocation of time to market work, domestic work, child care, and total hours of work, in the same format as Table 2, for phases 2 to 5. Panel A gives the results for households in which the female partner supplies relatively little or no market labour and Panel B, for those in which she is employed full-time or works relatively long part-time hours.[26] We label the former "traditional" and the latter, "non-traditional". Note that, in contrast to female hours, there is little within-phase variation in average male hours between types.

[25] In the Heckman (1993) sense.

[26] Part-time employment status is defined as 1-34 hours of work per week and full-time as 35 hours of work or more per week.

Tables 5 about here

Table 6, columns 1 to 3, presents data means for market, domestic and household full consumption (including indirect benefits), in phases 2 to 5, with Panel A again reporting results for traditional households and Panel B, for non-traditional households. Columns 4 to 6 give median saving, data means for all taxes net of benefits, and the average number of children in each phase for each household type. From column 4 it is evident that non-traditional households save far more than traditional households.[27] This is a result we might expect, since income generated by household production is not directly saveable, though to the extent that it substitutes for expenditure on market goods it could permit saving. It might also be anticipated that non-traditional households would have higher levels of full consumption since, as Table 5 shows, they work much longer hours and, as indicted in column 6 of Table 6, they have similar family responsibilities. However, this is not the case. The two household types have almost the same level of household full consumption expenditures, with the non-traditional type having slightly lower levels in each phase.

Table 6 about here

An explanation for this result can be found in the profiles of data means for all taxes net of benefits in column 5. The profiles indicate a large transfers of resources from non-traditional to traditional households through the tax-benefit system. This outcome is achieved by very high effective tax rates on the earnings of married mothers, through a combined income tax and family payment system in which eligibility for the latter is defined on household income and the income of the spouse.[28] The result is that non-traditional households pay much more in income taxes, because they earn more by working longer hours, but receive very little in family payments or compensation

[27] These findings are open to the objection that the reported differences in saving between the groups are overstated, because households may switch type across the life cycle. For example, traditional households in later phases in which they are the minority may have been non-traditional in earlier phases. Evidence from panel data for the Netherlands suggests that female labour supply exhibits a considerable degree of consistently in respect of "type" as defined here (see Voicu and Buddelmeyer, 2002). In other words, mothers who work in phase 2 typically continue to work until retirement, and conversely in repect of those who are not in the workforce in phase 5.

[28] The Australian personal income tax is based on the individual. However, when combined with the relatively new system of family payments, which are highly targeted on joint and second earner income, the overall system is one of joint taxation, as in the US and Germany.

for the cost of child care.[29] In phase 2, for example, the traditional household receives, on average, an overall net benefit of $1836 whereas the non-traditional household has a net loss of $6670, a difference of over $8,500. In phase 3 the gap is around $6500 and in phase 4, almost $9000. The disparity can be expected to carry over to the retirement phase because, with higher levels of saving, non-traditional households are less likely to be eligible for the income tested age pension. In effect, non-traditional households save for their own retirement and contribute to financing pensions for traditional households, by working longer hours and paying higher taxes. Under these conditions, small differences in domestic productivities are likely to be sufficient to give rise to the considerable heterogeneity in female labour supply decisions that we observe.

5 Results

The empirical specification of our model in Section 3 shows how the optimal path of life cycle total consumption, c_t, $t \in \phi_j$, $j = 1, .., 6$, depends on the marginal utility of consumption in each phase, as a function of the discount factors $\delta(t, j)$, $t = 0, ..., T$, and the price index $b_j(q_t, p_t)$, which in turn depends on the on the price of domestic output and leisure, p_t and q_t, and therefore on wage rates and domestic productivities. The first part of this section presents the parameter estimates for the within-period demand system, which are used to solve for the domestic prices and to compute this price index. The second reports the simulation results for total and full consumption profiles assuming a perfect capital market, and then compares them with references profiles derived from the data.

5.1 Demand System Parameters

The within-period demand system is estimated on data for a sample of "in-work" two-adult households in phases 1 to 5 selected from the HES on the

[29] This highly unequal distribution of the tax burden between non-traditional and traditional households is a relatively recent phenomenon in Australia, and has been largely a consequence of reducing the overall progressively of the tax-transfer system, as in other OECD countries, notably the US. In effect, lower rates at the top of the distribution of income have been funded by raising taxes on working married women. It is important to see the issue in this context, and not in terms of a conflict between non-traditional and traditional households.

criteria that the male partner's usual hours of work exceed 25 per week, neither adult is unemployed, earnings from wages/salaries are the primary source of income, and earned and unearned incomes are non-negative. The sample contains 2163 records. A matching sample is selected from the TUS and information on time use from this sample combined with the data in the HES sample by instrumenting for male and female leisures, as noted in Section 2.[30]

The data on earnings and hours are used to compute hourly earnings as the measure of the gross wage. The system is estimated on predicted wage rates, net of taxes, to avoid parameter bias arising from the endogeneity of earnings, and with the female wage corrected for selectively. Child costs, calculated as outlined in the preceding section, are subtracted from household market and domestic consumptions to obtain 2-adult consumption.

We estimate the system on all records ignoring corner solutions on the assumption that domestic work is analogous to a particular type of employment. Under this assumption, corner solutions are potentially a general problem, arising in respect of both market and domestic work choices. We take the view that dealing with the issue here is outside the scope of the present study. Table 6 reports the parameter estimates of the system. All are significant at well above the 5 per cent level. The intercept term, α_0, is set at log (20,000). The cost function is concave for almost all records.

Table 7 about here.

5.2 Intertemporal Profiles of Consumption

The first step in the analysis is the construction of reference or baseline profiles for total consumption. This involves computing $c_t,\ t \in \phi_j,\ j = 1,..,6$, as set out in equation (21). The calculation uses sample data means for time allocations, wage rates and the tax-transfer system in each phase, and median saving in phases 1 to 5. Consumption in phase 6 is obtained by compounding up previous saving/borrowing at the discount rate, and will therefore depend on the rate specified. For this calculation we treat short term borrowing for financing compulsory superannuation payments and the capital component of mortgage repayments as exogenous amounts subtracted from income in the preretirement phases (i.e., as taxes), compounded up and added back into P_t in phase 6.

[30] For details see Apps and Rees (2001, 2002).

Table 8, column 1, presents the reference profile for 2-adult total consumption for all households in the sample, using a real interest rate of 1.0 per cent. Column 2 gives the profile for 2-adult full consumption expenditure and column 3, the reference profile for total household consumption expenditure. The latter is computed as the sum of total 2-adult consumption expenditure and the transfer parents make to the children to cover their full consumption costs. To obtain a profile of 2-adults total consumption that matches the data in phases 1 to 5, it is necessary to solve for error terms on the preference parameters of the price index, $\beta_j, j = z, y, x$. In other words, holding prices constant, the perfect capital market hypothesis can only be maintained if we allow adult preferences to vary across the life cycle. We also compute a reference profile for a real rate of 0.1 per cent. Since again we incorporate error terms to match the data in phases 1 to 5, the result differs in phase 6 only, for which the result is \$111,327.

Table 8 about here

Table 9 reports predicted profiles for the same consumption expenditure variables. Panel A presents results for a real rate of 1.0 per cent, and Panel B, for a real rate of 0.1 per cent. The predictions are based on sample means for time allocations, wage rate, taxes, transfers and indirect government benefits, but not the data on saving. Instead the estimated preference parameters, $\beta_j, j = z, y, x$, with error terms omitted, are used to derive total consumption, c_t. The costs of children computed for the reference case are assumed to remain constant. Figure 5 depicts graphically the 2-adult reference and predicted profiles for the two real rates of interest. The reference profiles are strongly U-shaped across phases 1 to 5, as we would expect from the evidence in Section 4. In contrast, the predicted profiles indicate strong consumption smoothing on a per capita adult basis. The slope in each case reflects the real rate of interest, with the higher rate yielding the steeper slope.

Table 9 and Figure 5 about here

Figures 6 and 7 compare graphically the reference and predicted profiles of household and 2-adult full consumption expenditure, for the selected real interest rates of 1.0 per cent and 0.1 per cent, respectively. The predicted profiles for adult full consumption and leisure again indicate smoothing, which is clearly inconsistent with the data. The figures illustrate some of the implications of the perfect capital market hypothesis. Because the hypothesis generates a smooth profile of 2-adult full consumption, adding in the costs of the children's full consumption gives a more strongly humped shaped pro-

file of household full consumption across phases 1 to 5 than indicated by the data. In other words, evidence of a more humped shaped profile of full consumption across the phases in which children are present is required in order to support the assumption of a perfect capital market. Alternatively, to maintain the perfect capital market hypothesis, it is necessary to introduce, quite arbitrarily, changes in adult tastes which imply that they choose optimally to have much lower levels of consumption and leisure in the phases in which children are present, particularly immediately after they arrive.

6 Conclusions

In this paper we have presented a descriptive picture of a household's time allocation, income and consumption over the life cycle, defined in terms not of calendar years, but of key phases in the evolution of the family. This picture helps resolve some of the "puzzles" that have been noted in the existing literature, but suggests a new one: why, in the phase in which the household has pre-school children, are there such dramatic changes in time allocations, consumption and saving, and why is there a dramatic fall parents' full consumption and leisure in the phase immediately following the arrival of children. Our comparison of reference and predicted life cycle consumption profiles, based on modelling the household's life cycle allocation of time to domestic as well as market work, suggests that the standard assumption of a perfect capital market is untenable. The results have interesting implications for public policy, at a time when declining fertility is seen as the major cause of population ageing, and consequential problems in sustaining social security programs, such as Pay-As-You-Go pension systems. Greater support for households during the critical second phase we have defined could help overcome the problems presented by an imperfect capital market and reduce the costs of having children. This should be a fruitful area for future research.

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TABLE 1 Median net income, market consumption and saving
($pa, 1998)

Life cycle phase	Net market income 1	Market cons expend 2	Saving (1 - 2) 3	# dep kids 4	Market child costs 5
1	51688	40422	7852	-	-
2	39520	38577	1092	2.01	11061
3	44720	42312	2652	2.16	12765
4	52000	50721	1196	1.62	12412
5	46644	39682	5148	-	-
6	18980	22695	-2392	-	-
All	40664	38249	1508	-	-

Figure 2: Median net income, h'hold market consumption, 2-adult market consumption and saving

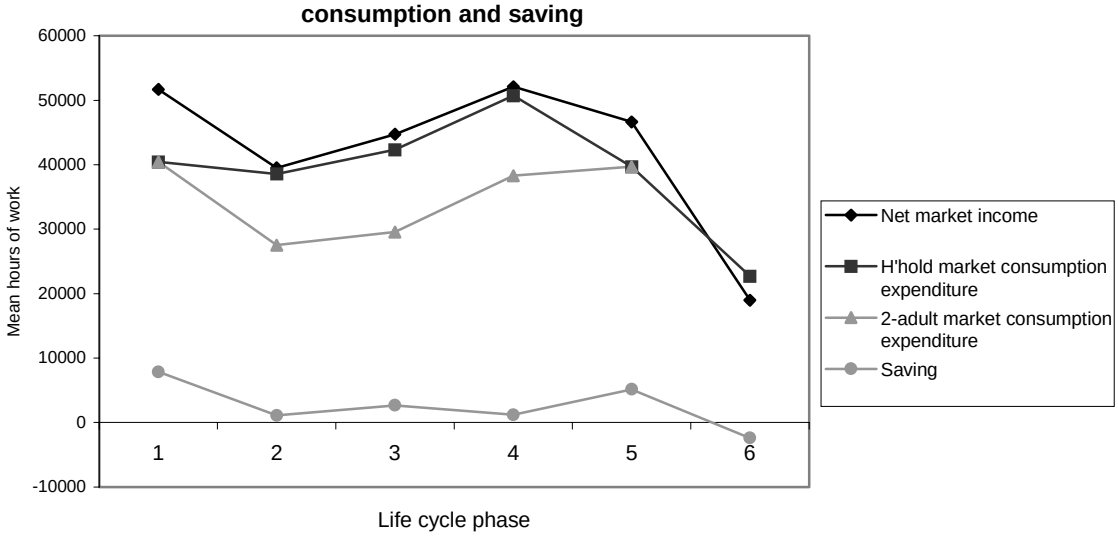

TABLE 2 Market work, domestic work and child care* (pa)

	Male hours of work				Female hours of work			
Life cycle phase	Market 1	Domestic 3	C'care 3	Total 4	Market 5	Domestic 6	C'care 7	Total 8
1	2134	585	-	2737	1619	937	-	2579
2	2011	656	876	3543	490	1337	2253	4079
3	2102	732	689	3524	671	1466	1447	3584
4	2002	791	198	2992	1085	1561	366	3012
5	1931	848	-	2779	949	1670	-	2618
6	107	1419	-	1526	123	1782	-	1905
All	1599	875	298	2772	720	1487	688	2897

*weighted data means

Figure 2: Female hours of market work, domesitc work and child care (pa)

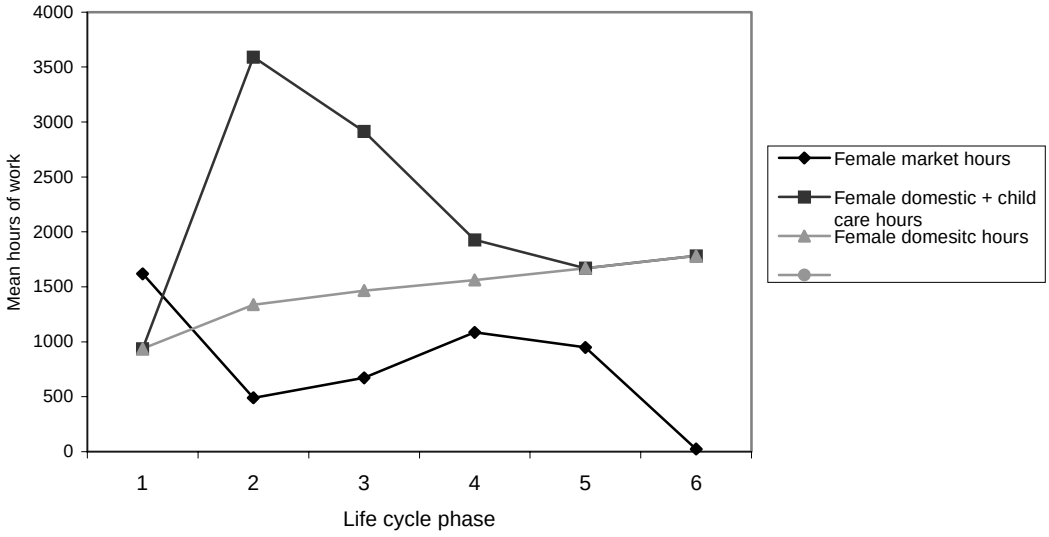

Figure 3: Male hours of market work, domesitc work and child care (pa)

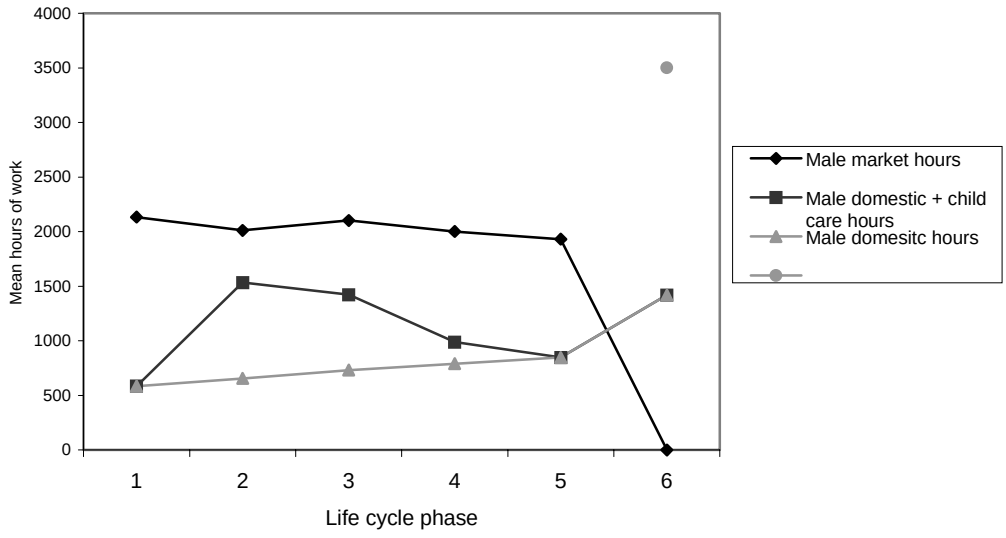

TABLE 3 Private incomes, taxes and benefits* ($pa, 1998)

Life cycle phase	Private income 1	Direct taxes-direct benefits 2	Indirect benefits 3	Indirect govt educ benefits 4	All taxes-benefits 5
1	64890	14844	4380	-	15380
2	49918	7522	13727	5142	-1367
3	57816	10046	17903	11843	-2428
4	67636	13023	18021	12160	1010
5	61802	12726	5357	-	12932
6	14502	-7948	10620	-	-15198
All	38368	7539	12048	-	492

*Data means

TABLE 4 Domestic and full consumption expenditure* ($pa, 1998)

Life cycle phase	Domestic Cons expend 1	Domestic child care 2	H'hold full cons expend 3	H'hold full cons+benefit 4	Adult full consumption 5
1	16340	-	60172	64552	64552
2	54710	31815	97664	111391	51243
3	49254	24939	96383	114286	54034
4	31962	6749	87082	105103	66016
5	23370	-	68776	74133	74133
6	32056	-	60260	70902	70902
All	35509	-	78960	91008	63946

*Data means

Figure 4: Life cycle household and 2-adult full consumption profiles ($pa, 1998)

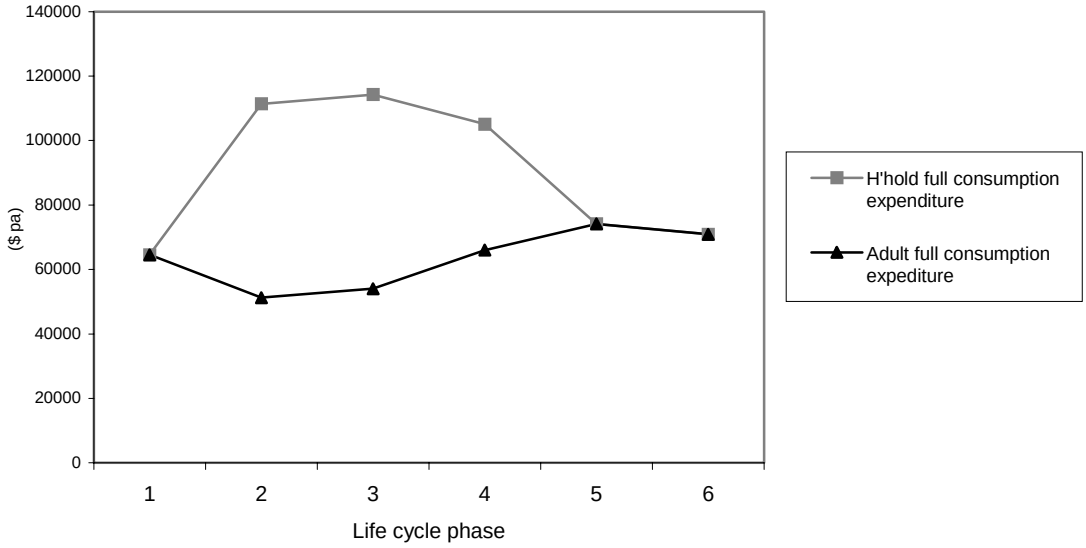

TABLE 5 Market work, domestic work and child care, by household type (pa)

	Male hours of work p.a.				Female hours of work p.a.			
Life cycle phase	Market 1	Domestic 3	C'care 3	Total 4	Market 5	Domestic 6	C'care 7	Total 8
Panel A: Traditional households								
2	2200	635	782	3618	22	1462	2542	4026
3	2277	666	585	3529	73	1712	1640	3425
4	2174	789	213	3177	460	1791	464	2715
5	2044	768	-	2812	132	2036	-	2168
Panel B: Non-traditional households								
2	2207	615	941	3764	1158	1171	1973	4303
3	2244	692	764	3701	1432	1213	1313	3958
4	2289	711	178	3278	1773	1334	301	3408
5	2228	844	-	3071	1781	1357	-	3138

*weighted data means

TABLE 6 Consumption, saving and taxes, by household type ($pa,1998)

Life cycle phase	Market cons expend 1*	Domestic cons expend 2*	H'hold full cons+benefits 3*	Saving 4**	All taxes-benefits 5*	# dep kids 6*
Panel A: Traditional households						
2	41115	56769	111397	104	-1836	2.10
3	44245	53647	115097	2392	-2265	2.21
4	54067	32433	104334	-260	1445	1.66
5	42698	24524	72472	4680	12287	-
Panel B: Non-traditional households						
2	48475	47860	109207	4836	6670	1.87
3	52130	39858	109309	5304	4290	2.10
4	61392	24623	103233	5356	10344	1.60
5	50289	16876	72116	10244	18123	-

*Data means ** Medians

TABLE 6 Demand system parameters

Parameter 1	Estimate 2	Std error 3
α_z^0	0.3391	(0.0251)
α_y^0	0.3295	(0.0152)
γ_{zz}^1	0.0423	(0.0189)
γ_{yy}^1	0.1397	(0.0121)
γ_{yz}^1	-0.1086	(0.0125)
β_z^1	0.1683	(0.0064)
β_y^1	-0.1840	(0.0061)
Log L	4588.62	

TABLE 8 Reference life cycle consumption profiles, $pa (1998)

Life cycle phase	2-adult total consumption exp, c_t 1	2-adult full consumption exp 2	Leisure expenditure 3	Household full consumption exp 4
1	126107	75707	50396	75707
2	80119	48364	31755	108512
3	89232	55041	34190	115306
4	109334	62437	46889	101523
5	119418	69890	49524	69890
6	108780	56342	52433	56342

TABLE 9 Predicted life cycle consumption profiles, $pa (1998)

Life cycle phase	2-adult total consumption exp, c_t 1	2-adult full consumption exp 2	Lesiure expenditure 3	Household full consumption exp 4
Panel A: Real interest rate = 1.0 per cent				
1	131483	80283	51197	80283
2	120760	72638	48120	132793
3	115941	71511	44430	131776
4	108835	62197	46636	101282
5	99077	57984	41094	57984
6	83376	44365	39011	44365
Panel B: Real interest rate = 0.1 per cent				
1	112818	67924	44890	67924
2	110350	65824	44527	125976
3	111797	68950	42844	129217
4	110731	63276	47454	102362
5	107745	63049	44695	63049
6	100365	51984	48376	51984

Figure 5: Life cycle profiles of 2-adult total consumption

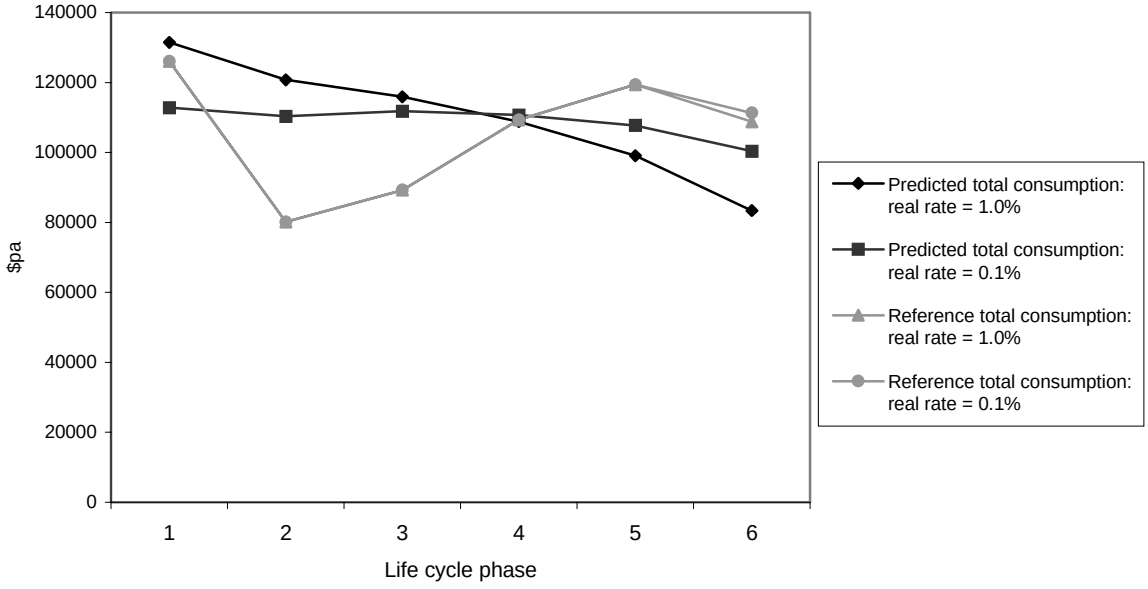

Figure 7: Reference and predicted life cycle full consumption profiles
Real interest rate = 1.0%

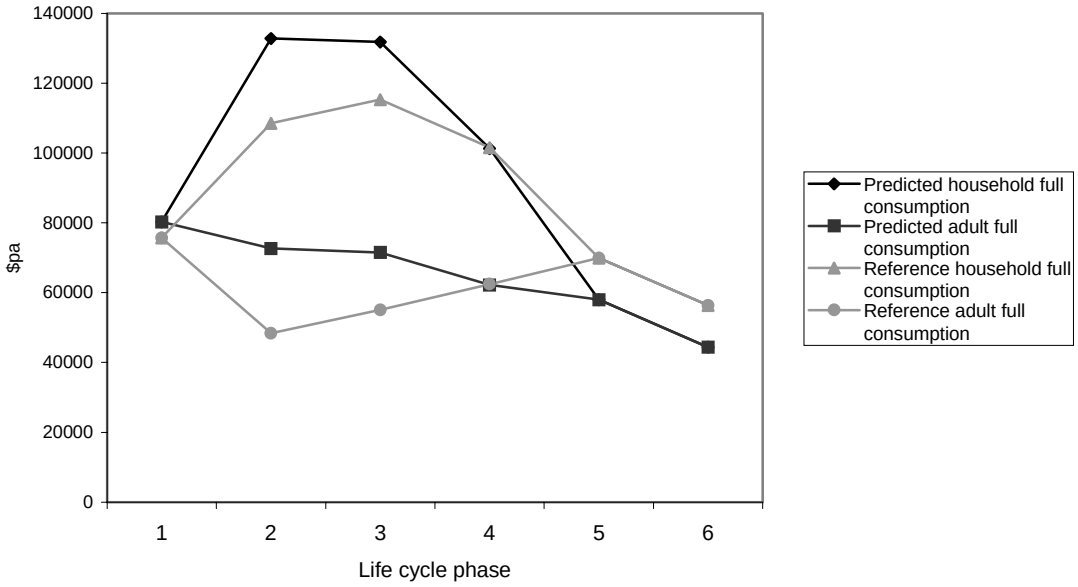

Figure 6: Reference and predicted life cycle full consumption profiles
Real interest rate = 0.1%