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Consumption over the Life Cycle: Facts for France

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Consumption over the life cycle: facts for France

Abstract

This paper uses repeated cross-sections of the INSEE Household Budget Survey to estimate life cycle profiles of consumption, controlling for cohort and time effects. We construct age profiles for total and nondurable consumption as well as expenditure patterns for consumer durables. We find significant humps over the life cycle for total, nondurable, and durable expenditures. Changes in household size account for about one half of these humps.

Keywords: Consumption, Life Cycle, Durables, Non-Durables

La consommation au cours du cycle de vie : un examen sur données françaises

Résumé

Ce texte utilise les coupes répétées de l'enquête Budget des Familles pour estimer des profils de consommation sur cycle de vie contrôlant les effets de l'âge et de la période. On construit des profils des dépenses par âge pour la consommation totale et la consommation de biens durables. On trouve des profils en cloche pour la consommation totale, la consommation de biens non durables et la consommation de biens durables. Les variations de la taille du ménage expliquent environ la moitié de ces variations par âge.

Mots-clés : Consommation, Cycle de vie, Biens durables, Biens non durables

Classification JEL : D12, D91, E21

Contents

1 Introduction

This paper uses repeated cross-sections of the INSEE Household Budget Survey (HBS) data to estimate life-cycle profiles of consumption, controlling for cohort and time effects. We document age profiles for total and nondurable consumption, as well as expenditure patterns for consumer durables.

The aim of the paper is twofold.

First, we want to establish life-cycle facts on French households behavior and provide an empirical ground to the discussion over consumption/saving patterns and determinants. This is part of a project aiming at a comprehensive longitudinal exploitation of household surveys.

Second, we want to provide empirical life-cycle consumption profiles that can be used to assess the ability of quantitative life-cycle simulation models[1] to match French data. These models typically abstract from business cycle fluctuations, cohort effects, and differences in household size. Comparing model-generated life-cycle consumption patterns with their empirical counterparts therefore requires removing these effects. In this paper, special emphasis is placed on the comparison between different approaches to control for changes in demographics over the course of life.

This study draws from the life-cycle literature with respect to both its theoretical background and its empirical methodology.

Formalized by Modigliani (Modigliani and Brumberg, 1954), the life-cycle hypothesis (LCH) argues that people maximize the utility derived from their current and future consumptions, postulating that the main motivation for saving is to accumulate ressources for later expenditures[2] (*e.g.* to finance consumption during retirement). The LCH provides a flexible framework to analyse household consumption behavior[3]. In a given household's environment, choices regarding, notably, how much to consume and how much to save or how much wealth to hold in risky assets could be formalised as an intertemporal maximization problem. Deaton (1992, 2005) provides a detailed presentation and an extended discussion of the LCH.

As regards the empirical methodology, we draw inspiration from the Poterba (1994) and the Börsch-Supan (2003) collections of country studies providing detailed evidences on life-cycle pattern of consumption in six OECD countries[4]. Other sources of inspiration include Attanasio *et al.* (1999), Deaton (1985), Deaton and Paxson (1994, 2000), Fernadez-Villaverde and Krueger

[1]See, among other references, (simulation models) Deaton (1991), Carroll (1997) and (estimated models) Gourinchas and Parker (2002), Cagetti (2003).

[2]Along with this intuition, we should mention the permanent income hypothesis (PIH) put forward by Friedman (1957) to emphasize smoothing at higher frequencies (typically at business cycle frequency). Both LCH and PIH are embodied in our theoretical background.

[3]Departing from the simple 'textbook' example, the model fits the main empirical evidences *e.g.* Deaton (1991) and Carroll (1997) highlight the role of precautionary motive in shaping consumption pattern, Attanasio *et al.* (1999) argue that, in addition to introducing precautionary motive, allowing for demographics to affect household preferences generate hump-shaped consumption profiles consistent with empirical evidences. This framework was later extended to portfolio decisions (see Haliassos and Michalides, 2002, or Cocco *et al.*, 2005) and portfolio decisions joint with housing tenure decisions (see Cocco, 2005, Nichols, 2004, or Yao and Zhang, 2005). Browning and Crossley (2001) argue that the life-cycle framework provides a relevant way of thinking and representing many life-cycle choices, including consumption, saving but also education, marriage, fertility, or labor supply.

[4]Germany, Italy, Japan, United Kingdom, and the United States are examined in both. Canada appears only in Poterba (1994), while the Netherlands appear only in Börsch-Supan (2003).

(forthcoming), Gourinchas and Parker (2002), Jappelli (1999), Jappelli and Modigliani (2005). More generally, as an attempt to provide facts on the consumption pattern over the life-cycle, we adopt a rather descriptive approach.

We show that, as already documented in other countries, the consumption profile of French households also presents the typical hump-shaped pattern[5]: total consumption culminates in the early 40s, peaking at a level 30% above its 'beginning of life' level (consumption at 25), and declines smoothly afterwards, falling back to its 'beginning of life' level at 60. The hump-shape profile is found in both total consumption and non-durable consumption. However, non-durable consumption presents a sharper profile (it culminates 40% above its 'beginning of life' level).

Scrutinizing consumption profiles of different education and occupational groups delivers further insight into life-cycle patterns. Most notably, the upper the educationnal achievement the higher the hump and the sharper the profile: high school or college graduates profiles presents a marked increase with a mid-life consumption level twice to three times their 'beginning of life' level. This is consistent with impatient[6] and prudent[7] households facing liquidity constraint ('buffer stock' saving behavior).

However, while consistent with LCH intuitions, the observed pattern could also relate to a simpler demographic explanation: the hump-shaped profile could be attributable to changes in household size and composition. Controlling for these changes does not wipe out the whole bump. However, the profile peaks later (around 60 in most specifications) and demographic changes account for roughly one half of the hump.

The rest of the paper is organized as follows. Section 2 describes the HBS data and identifies relevant empirical concepts. Section 3 discusses the specification used to recover life-cycle patterns. Special attention is given to the identification of age, time and cohort effects. Section 4 presents the empirical findings. Section 5 deals with the dynamics of demographics over the life-cycle. Section 6 concludes.

2 Data and Empirical Issues

Although generally overegarded, data and empirical issues are in fact rather important matters while looking at consumption patterns. Mapping the information collected through the surveys to the relevant theoretical concept deserves some attention.

2.1 Relevant concepts and empirical definitions

The data used collects household expenditures. Yet, expenditures and consumption, while overlapping concepts, are not to be confused. First, some recorded items (mortgage downpayments) are clearly savings. Some others (durable expenditures) are linked to current consumption but also to future consumption. Consider for example the purchase of a car: althought the expenditure is recorded only once, the household will benefit from transportation services over several

[5]Previous studies on France found similar result, see Bodier (1999) and Lollivier (1999a).

[6]Attitude toward future: when anticipating a permanent increase in income in the future, the household is willing to borrow against futur income to adjust its consumption.

[7]Attitude toward risk: the household is willing to (self-)insure against risks.

years. For such reasons, it is conceptually appealling to look at non-durable consumption and expenditure on durable goods separately.

Furthermore, expenditures (even correctly classified) can still be a poor proxy for consumption. Agiar and Hurst (2005) argue that consumption is the output of a 'home production' involving both time and expenditure and that, to some extent, it is possible to achieve the same consumption by purchasing goods or producing them. While important to explain some patterns (*e.g.* expenditure dropping at retirement), we do not attempt to tackle this issue in this paper which we consider as a first exploration.

2.2 The Household Budget Survey

For this study, we use the INSEE Household Budget Survey (HBS), which collects household incomes and expenditures and which is used for several different topics (*e.g.* calculation of the weights of the consumer price index, national accounts, etc.).

The HBS has a long record among household surveys, with the first version of this survey carried out in the late XIXth century. We use the last five surveys carried out about every five years, *i.e.* in 1978-1979, 1984-1985, 1988-1989, 1994-1995 and 2000-2001.

The HBS is considered exhaustive in the sense that it covers all expenditures and resources. For a given survey, expenditures are collected during a one-year period, in eight successive one-month-and-a-half waves. Major expenditures are collected during an interview, whereas other expenditures are collected in a leaflet filled by the interviewees during a two-week period. Raw data are corrected in order to calculate an annual amount of expenditures.

There has been no major shift in methodology during the period of the surveys we use (1978-2001) so that, using low level coding (three-digit nomenclature), the construction of comparable data sets on household expenditure is possible.

The comparability issue is important since we use the five HBS surveys in a pseudo-panel approach. The HBS does not constitute a proper panel but a series of independent cross-sections. Every fifth year a different sample of 10,000 households (*i.e.* 25,000 to 30,000 individuals) is observed. As it is not possible to follow households over time, we aggregate households (by birth year of the 'reference person', also referred as 'household head' hereafter) to track cohorts of households over time.

3 Disentangling Life-Cycle Profiles

A straightforward way to document life-cycle profiles is to plot consumption against age. Even if this sounds intuitive, this simple illustration is subject to various (well-known) difficulties (*e.g.* recovering an age pattern from cross-sections or controlling for temporal trends in the data). We thus need to sketch out the underlying theoretical model to derive the specification of life-cycle patterns and discuss the assumption required for identification.

3.1 Modelling life-cycle consumption patterns with pseudo-panel data

Households' consumption/saving behavior is determined by various motives (see Browning and Lusardi, 1996, for a comprehensive description). However, three main motives can be identified: households save (i) to smooth (the marginal utility of) consumption overtime (*the* basic *life-cycle motive*), (ii) to (self) insure against unemployment risk, health risk and longevity risk (*the precautionary motive*), and (iii) to bequeath wealth to their heirs (*the bequest motive*). In addition, institutions in which households operate contribute to shape their decisions. Among them, financial market imperfections (namely, liquidity constraints) are likely to play a decisive influence. Our landmark theoretical model is an extended version of LCH, with a dominant life-cycle motive but where the precautionary motive and the bequest motive are to play a role.

As a starting point, we assume consumption for a household i aged $a_{i,t}$, born in year $b_{i,t}$ (and observed at date $t = b_{i,t} + a_{i,t}$), $C_{i,t}$, to be a function of lifetime resources/permanent income (as expected at t) denoted $H_{i,t}$, and of age, $a_{i,t}$:

$$C_{i,t} = f(a_{i,t}, H_{i,t}) \tag{1}$$ [8]

We further assume, according to the basic intuition of LCH, that (i) the *level* of lifetime resources determines the *level* of consumption and that (ii) the age *profile* does not depend on the *level* of lifetime resources, implying the following specification:

$$C_{i,t} = f(a_{i,t})H_{i,t} \tag{2}$$

$H_{i,t}$ denotes lifetime resources (or, equivalently, a measure of permament income) as expected at t. *A priori* $H_{i,t}$ is not invariant in t. The realisation of permanent shocks can move $H_{i,t}$ either up or down over time[9]. A convenient decomposition of permanent shocks distinguishes idiosyncratic and common ('macro') shocks, respectively $\Psi_{i,t}$ and Θ_t, so that $H_{i,t}$ evolves as:

$$H_{i,t} = H_{i,t-1}\ \Psi_{i,t}\ \Theta_t$$

However, as a first approximation which will be relaxed later, we assume that $H_{i,t} = H_i$, *i.e.* $H_{i,t}$ is time-invariant. Hence, our specification becomes:

$$C_{i,t} = f(a_{i,t})H_i \tag{3}$$

The function $f(.)$ describes how lifetime resources are allocated to consumption over the course of life[10]. $f(.)$ captures the life-cycle pattern we are trying to recover.

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[8] In a more descriptive (and a-theoretical) approach, a general specification can be:

$$C_{i,t} = f(a_{i,t}, b_{i,t}, t) + \varepsilon_{i,t}$$

where $\varepsilon_{i,t}$ captures the distance between the conditional expectation of $C_{i,t}$ and its observation. This is rather equivalent since further assumptions and restrictions are required for the estimation, most of them based on arguments similar to ours, since we relate the level of lifetime resources/permanent income and cohorts.

[9] In other words, the level of $C_{i,t}$ can be permanently affected by, say, an unemployment spell.

[10] Ignoring bequests, the intertemporal budget constraint would imply a condition on $f(.)$ over the lifetime: $\int f(a)da = 1$.

In the standard 'textbook' life-cycle model, $f(.)$ would be constant. However, there are reasons to believe that it is not the case : (i) tastes and preferences can change with age, especially when (3) is applied at the household level and (ii) liquidity constraints (absent from the 'textbook' model) are likely to shape $f(.)$.

We detail (i) later on when discussing the implications of dealing with *household* consumption rather than *individual* consumption. The main point here is that (systematically) changing household composition provides a rationale for changing marginal utility of consumption, generating a hump-shaped consumption profile.

Regarding (ii), liquidity constraints take two forms. The softest one is the obligation to repay all debts with probability one at the time of death (see Carroll, 1997). In a more stringent version, liquidity constraints prevent household (net) wealth from falling below a given threshold (see Deaton, 1991). Carroll (2001) shows that both forms deliver pretty similar patterns. The basic effect of liquidity constraints is to strengthen the precautionary motive, leading to some 'buffer stock' behavior (households hold wealth as a buffer against - negative - income shocks, generating 'excess sensitivity' of consumption to income and 'income tracking'). In a word, as changing composition of households, liquidity constraints are likely to generate a hump-shaped $f(.)$.

Finally, the role of the bequest motive may be important to explain wealth holding patterns but its implications for the age profile of consumption/saving may not be important. It could be argued that the bequest motive can play some role at older age but then, it is hard to draw clear-cut conclusions (the precautionnary motive[11] could as well account for higher saving among older households).

The convenience of (3) is that the logarithm of consumption can be expressed as the sum of an age-specific function and (the logarithm of fixed) lifetime resources:

$$c_{i,t} = \phi(a_{i,t}) + h_i \tag{4}$$

where lower case denotes the logarithm of the upper case variable.

With panel data, it would be straightforward to estimate (4) by regressing $c_{i,t}$ on (a relevant functional form of) age and household-specific fixed effect to capture the effect of household permanent income. Lacking such data, we can still estimate (4) using cohort information: taking averages at time t across all households born in year b (thus at age a) gives:

$$c_{b,t} = \phi(a) + h_b \tag{5}$$

which can be estimated using pseudo-panel methods by regressing $c_{b,t}$ (the average logarithm of consumption for each cohort/age cell) on (a relevant functional form of) age and cohort-specific dummies. Provided that the underlying theoretical framework is correct, $\phi(.)$ captures the life-cycle path of consumption (including the effects of preferences[12] and of the interest rate[13]) while the cohort effects mainly reflect the effects of economic background (growth, institutions, etc.) on each cohort permanent income.

At this point, two other important points deserve further discussion. So far, no clear distinction is drawn between a household and an individual. More precisely, the framework is

[11]See health risk and longevity risk of the elderly.
[12]Regardless of any systematic impact of changes in household composition.
[13]Implicitly, we assume constant real rate of return on assets.

correctly designed for individuals and applied to households. The confusion is rather usual but requires a more precise investigation of the possible consequences and limits of this shortcut. Another point is the inclusion of a time effect (for theoretical or practical reasons) that raises identification problems.

3.2 Dealing with household consumption

As already mentioned, available data collect expenditures at the household level rather than at the individual level, hence, only household consumption patterns can be recovered. As usual, we relate household consumption to the age of the household head ('reference person'). This identification raises concerns on relevance and implied selection biases.

Extending our framework from individuals to households needs to acknowledge possibly changing household preferences over its 'life-cycle'. For instance, marginal utility is likely to be affected by household composition (and possibly age)[14]. Formally, $\phi(.)$ may not be invariant to household composition. The fact that household composition displays systematic changes over the life-cycle makes it difficult to disentangle a life-cycle pattern from a demographically-driven evolution. A first attempt to tackle this issue is to rescale consumption using equivalence scales. Perhaps more accurately, (5) can be modified to include cell averages of demographic variables (*e.g.* numbers of adults and children). Another (extrem) way to think about this aggregation problem can be to postulate that households are a 'veil' on individual decisions and to recover individual consumptions. For this first pass, we abstract from these issues and leave them to a more extensive discussion in section 5.

A similar problem arises from the identification on household head age. For example, age difference between spouses can trigger different saving behaviors (*e.g.* (*ceteris paribus*) the younger the wife, the longer widowhood to expect, leading to greater precautionary savings). However, age differences between spouses are not that important and do not display great disparities. For individuals aged 30 and older, the average age of household heads is close to theirs (see fig. 1 in the Appendix). Alike, households with more than two adults are rare. Eventually, assuming that $\phi(.)$ is a function of the age of the household head appears rather standard and quite robust.

The potential selection biases implied by the household level approach are more problematic. Movements into and out headship as well as movements out of the population of surveyed households alter the consistency of the defined cohorts.

A first bias arises from the decision to leave one's parents: it is likely that youngest independent heads (or their parents) have specific characteristics (see Laferrère, 2005, for a discussion of this topic). However, the fraction of people within each age group who are household heads is rather constant after 30 and up to old age (see fig. 2 in the Appendix). Keeping only households whose age is over 25, we have fair reasons to believe that the selection bias at the lowest end of the age distribution is not compromising our estimations.

Another possible (and eventually more worrying) selection bias appears at older ages. Even though the fraction of household heads does not decline among the elderly (it even increases probably due to widowhood), and even though we do not observe a massive trend of older

[14] In other words, consumption 'needs' and 'wishes' can depend on age and household composition.

parents moving to their adult children (even though the elderly tend to live in households with - relatively - younger heads, but it is unclear whether this is a life-cycle pattern - some elderly moving to their children - or a cohort pattern - the older generations tend to live more often with their children than the younger ones), there might be a notable selection bias as there is some evidence that the elderly prefer to live by themselves as long as they can (and then, in most case, live in retirement home hence exiting the population potentialy surveyed) and differential mortality is correlated with wealth. In both cases, high savers are more likely to survive as independant households, implying potential bias at the upper end of the age distribution. Yet, so far, we did not find any proper control : this limitation should be kept in mind when looking at the results.

3.3 Controlling for age, cohort and time effects

Until now, we have left potential time effects aside. Still, such effects can emerge from theoretical considerations (or be required for practical purpose since survey design or precision have changed over time; however, working on consumption only, we are fairly confident in overall comparability). Nevertheless, the problem can be partly dealt with by including time effects in (5). Relaxing our simplifying assumption that $H_{i,t}$ is time invariant and allowing for idiosyncratic and 'macro' shocks to affect household permament income, (4) becomes:

$$c_{i,t} = \phi(a_{i,t}) + h_{i,t-1} + \psi_{i,t} + \theta_t \tag{6}$$

which, when taking averages for all households from cohort b at time t, leads to:

$$c_{b,t} = \phi(a_{b,t}) + h_b + \theta_t \tag{7}$$

This specification is subject to collinearity between age cohort and time effects. The identification requires additional restrictions. Precisely, Deaton and Paxson (1994) show that, if time effects are left unrestricted, any trend in the data can be attributed to time effects or a combination of age and cohort effects. They impose the following restriction[15]: time effects sum to zero and are orthogonal to a time trend, forcing any time trend to appear as a combination of age and cohort effects (and therefore to be predictable). Then, time effects just reflect 'macro' shocks that affect all households in the same way (or the residual influence of measurement errors between surveys). Formally, they impose:

$$\sum_{t=t_0}^{t_j} \theta_t = 0$$

$$\sum_{t=t_0}^{t_j} t\theta_t = 0$$

where θ_t denotes the year t effect[16].

[15]An alternative restriction allowing past 'macro' shocks to have a lasting effect is proposed by Jappelli (1999).

[16]Practically, the identification constraints are implemented through dummies' transformations:

$$d^*_{t_0} = d^*_{t_1} = 0$$

$$d^*_{t_j} = d_{t_j} - \{\frac{t_j - t_1}{t_1 - t_0} d_{t_1} - \frac{t_j - t_0}{t_1 - t_0} d_{t_0}\} \ \forall j \geq 2$$

where d_{t_j} is the usual year t_j dummy.

In any case, these restrictions should not be over interpreted. First, as already mentioned, the hypothesis that 'macro' shocks affect all households in the same way regardless of age is at least debatable. Then, more practically, with only five cross-sections, it is tenuous to recover correct business-cycle effects. A clearer (and valid) interpretation is to consider our year effects using the Deaton and Paxson (1994) identification constraints as a control for measurement errors and differences between surveys.

4 Empirical Findings

In this section, we present the most important results of our estimation. Further details are provided in the Appendix.

4.1 Life-cycle consumption

Controlling for cohort and time effects, we find a clear hump-shaped life-cycle profile for consumption (see fig. 3 in the Appendix). Mean annual total (household) consumption presents a 25% increase from around 20,000 euros[17] at the age of 25 to over 25,000 euros in the early 40s. It declines afterwards, falling under its 'beginning of life' level (consumption at 25) after 60 (see fig. 4 in the Appendix). This pattern is well-known and has been documented in other OECD countries (though the peak tends to occur in the late 40s in the US, see Borsch Supan, 2003, or Fernandez-Villaverde and Krueger, forthcoming).

Age and cohort effects are always jointly significant. The cohort effects imply that the profile changes in a 1.0-1.5 range, younger cohorts being richer in terms of lifetime ressources. This reflects the effect of growth on lifetime ressources, notably the post-WWII expansion. However, the cohort effects are rather flat for generations born after 1940 (or younger than 20 in 1960). It seems that, for these generations, growth have not materialized in higher permanent income[18].

Year effects are far smaller (-2.0% / +4.0%). They do not have any clear business cycle interpretation. Though somewhat unsatisfactory, this is not a surprise: the nature and quality of the data along with the limited number of cross-sections make them more likely to control for differences between surveys than to capture the effects of macroeconomic conditions.

Estimated profiles of different education groups[19] reveal huge disparities. Behind differences in level (see fig. 5 in Annex), the profiles differ notably. We observe that the first education groups (high school degree or less) still present a hump, but markedly smaller. Consumption peaks around 40 at 10% to 25% above its 'beginning of life' level and then declines to fall down to 60% to 70% of its initial level at 80. On the contrary, the highest education group exhibits a huge hump. College graduates consume around 50 almost twice more than what they used to

[17]The figures in this section are averages across the last 15 cohorts born 1960 to 1975.

[18]Cohort effects even tend to decrease for younger cohorts (born after 1970), a puzzling fact already noted by Lollivier (1999a). Still, this should be taken cautiously since cohort effects are estimated with few points (sometimes only one) for the younger generations. Deaton (2005) discusses extensively the gap between micro and macro sources of consumption growth over time.

[19]We distinguish between basic school-leaving qualification (*certificat d'étude*), junior high school (*CAP*, *BEP*, *BEPC*), high school (*baccalauréat général*, *baccalauréat professionnel*), and college (post *baccalauréat* studies).

consume in their mid 20s. The decline afterwards is more progressive and consumption never falls behind its mid 20s level.

These results are consistent with liquidity constraints playing an important role in shaping life-cycle consumption profiles. Since higher educational achievement comes along with steeper income profiles (and possibly income risk, both temporary and permanent), in the presence of liquidity constraint (inability to borrow against future income), the corresponding consumption profile is expected to track income. We regard these results as suggestive albeit indirect evidence consistent with the presence of liquidity constraints leading to 'buffer-stock' saving for prudent and impatient households whose income is expected to grow.

Previous evidence emphasizes the evolution of mean comsumption along the life cycle. We should also mention that dispersion around this profile grows with age. Figure 6 in the Appendix plots the ratio D9/D1 (ratio of the ninth/upper decile of consumption in a given cohort observed at age a_t over the first/lower one) against age, revealing a clear pattern of growing consumption inequality. The consumption inequality pattern is consistent with an income process combining both permanent and transitory shocks. Altogether, it appears that the LCH framework seems to account rather well for the patterns revealed in the French data.

4.2 Non-durable consumption

Non-durable consumption exhibits a similar (and even steeper) hump-shaped pattern. Year effects present a similar pattern as well as cohorts effects for the older generations. For the younger generations, the cohort effect suggests a more pronounced decline in lifetime ressources (see fig. 7 and 8 in the Appendix). The hump-shaped pattern is consistent with available evidences from other countries. However, compared to total consumption, we would have expected a smoother (or at least identical) profile, not a sharper one. Should this be regarded as further (indirect) evidence of 'buffer-stock' saving emerging from liquidity constrained on impatient but prudent households, the question remains open.

Investigating the life-cycle profile by educational achievement or restricting to food items only tends to confirm the basic insight: total consumption and non-durable consumption have rather similar profiles, the latter the steeper (see fig. 9 in the Appendix).

5 Hump and Family Size

The humps documented in section 4 come along with changes in household composition (see fig. 10 and 11 in the Appendix), as we already mentioned. Households with different sizes and compositions can derive different marginal utilities from the same consumption expenditures. LCH only predicts that marginal utilities should be smoothed over time, not expenditures *per se*. Attanasio *et al.* (1999) argue that a life-cycle model with uncertainty and time-varying demographic factors (*i.e.* varying marginal utility) can satisfactorily match the hump-shaped observed pattern. They attribute steepness to uncertainty and emphasize the role of demography[20] in determining the timing of the peak. In this last section, we attempt to quantify how much of the changes in consumption pattern can be explained by demography.

[20]Demography is used as a short cut for changes in size and composition of the household.

5.1 Controlling for family size: Equivalence scales

A first (and easy to implement) control for change in household size is to re-scale consumption. The use of equivalence scale has a long tradition. The basic idea is to measure the change in expenditures needed to keep the welfare of a household constant when its sizes varies. The most simple rescaling is to consider *per capita* consumption. This scale assumes constant return to scale. However, there are (both theoretical and empirical) reasons for challenging this view. Indeed, the estimated life-cycle profile using *per capita* consumption is rather strange and does not deserve further comments.

Usual equivalence scales map household composition to an equivalent 'number of adults living alone' through some simple formulas based on expert evaluation. We use several usual equivalence scales (Oxford/OECD scale, OECD modified scale, square scale and the NAS scale), all delivering rather similar results. Denoting na and nc the number of adults and children in the household, we have:

$$\begin{aligned}
household\ size &= na + nc \\
Oxford/OECD\ scale &= 1 + 0.7(na-1) + 0.3nc \\
OECD\ modified\ scale &= 1 + 0.5(na-1) + 0.3nc \\
square\ scale &= \sqrt{(na+nc)} \\
NAS\ scale &= (na + \lambda nc)^{\sigma}\ /\ \lambda = 0.7,\ 0.65 < \sigma < 0.75
\end{aligned}$$

All estimated profiles are similar (see fig.12 in the Appendix). They are relatively smoother than the uncontrolled profiles (presenting a 15%-20% peak above the mid 20s level) and peak later in life (around 55-60). Remarkably, contrary to the uncontrolled profile, they never fall behing the initial level. They are robust to changes in the definitions (*e.g.* change in the child/adult threshold). This basic approach suggests that demography accounts for about 70% to 80% of the hump (defined as the amplitude (minimum level/maximum level) of the profile) and plays some role in determining the timing of the peak.

However, the use of equivalence scales is not unproblematic. Those based on expert judgment should be questioned for their artificial and conventional construction while those based on data mining typically use similar data. In such a case, we have an endogeneity problem when rescaling the data using scales constructed with the (kind of) data we rescaled.

5.2 Demographic changes and preferences

Attanasio *et al.* (1999) address the issue from another perspective. Acknowledging the dependency of marginal utility to demography, they specify the instantaneous utility function as dependent on demography and derive a tractable specification for the estimation. In a similar manner, we introduce controls for household size and composition (*e.g.* $\log(n)$, $\log(na)$, $\log(nc)$, etc.) directly into the estimation.

These specifications also deliver smoother profiles, peaking later than the uncontrolled profiles. More precisely, while the uncontrolled profile peaks in the early 40s 30% above its mid 20s level, all controlled profiles display a peak at or after the mid 50s which is never above 20% of the initial level. As was noted for the rescaled profiles, the controlled profiles never fall behind the 'beginning of life' level. The hump of the controlled profiles is considerably smaller: when controlling for demographic changes, 65% to 80% of the uncontrolled hump vanish (see fig. 13 in the Appendix).

6 Conclusion

After this first empirical investigation, it appears that the life-cycle consumption pattern of French households displays a significant hump. Both total consumption and non durable consumption peak in the early 40s, respectively 30% and 40% above their levels at 25 and, then, steadily decline afterwards down to 70% (resp. 80%) of their initial levels. The same kind of pattern is also documented in other OECD countries (see Poterba, 1994, and Börsch-Supan, 2003).

However, changes in the composition of the household throughout its lifepath (*e.g.* birth of children ('moving in' the household) who, later, leave the parental household) can explain part of this humpy profile. Indeed, controlling for the 'demographic' life-cycle of the household, either with equivalence scale or using the changing preferences approach emphasized by Attanasio *et al.* (1999), we find that consumption (equivalent adult consumption or the marginal utility of consumption) peaks later (55-60), exhibiting a less pronounced hump (some 15% to 20% above the level at 25) and a smaller, smoother decline afterwards. Notably, it should be stressed that consumption never falls behind its initial level. This suggest that, even though household consumption expenditure markedly decreases at old age, well- being might remain close to its 'working age' level. On the whole, it looks like households smooth consumption in wider proportions than one could guess at first sight.

Investigating life-cycle consumption patterns for specific education groups shows that more educated households tend to exhibit a larger hump. This pattern might be related with 'buffer stock' saving behavior of impatient and prudent households enjoying growing income and facing liquidity contraints (so that borrowing against future income appears too risky or simply impossible).

Finally, an interesting and puzzling fact is found in the evolution of cohort effects. While mean lifetime consumption steadily increases for cohorts born between 1900 and 1940 (the later enjoying a 1.5 higher consumption compared to the former at the same age), such increase ceased for cohorts born after 1940. Mean lifetime consumption is virtually unchanged for all cohorts born between 1940 and 1975. Cohort effects in non durable consumption even exhibit a decline for younger cohorts. This should be interpreted cautiously but this fact has already been documented (see Lollivier, 1999a) and definitely deserves further attention and investigation.

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Appendix: Estimations results and graphs

Dependant variable : Log total consumption

	Coef.	Std. Err.	t	P> $\|t\|$	[95% Conf. Interval]	
intercept	14.88051	1.54655	9.62000	0.00000	11.82999	17.93103
age	-0.66587	0.16742	-3.98000	0.00000	-0.99610	-0.33565
age squared	0.03043	0.00704	4.32000	0.00000	0.01654	0.04432
age**3	-6.315E-04	1.433E-04	-4.41000	0.00000	-9.143E-04	-3.488E-04
age**4	6.060E-06	1.420E-06	4.28000	0.00000	3.270E-06	8.850E-06
age**5	-2.200E-08	5.430E-09	-4.05000	0.00000	-3.270E-08	-1.130E-08
Year controls						
ddp_y1979	(dropped)					
ddp_y1984	(dropped)					
ddp_y1989	0.01076	0.00817	1.32000	0.18900	-0.00536	0.02689
ddp_y1994	0.03737	0.00603	6.20000	0.00000	0.02547	0.04927
ddp_y2000	-0.02163	0.00512	-4.23000	0.00000	-0.03173	-0.01154
Cohort controls						
d_by1901	-0.06984	0.07036	-0.99000	0.32200	-0.20862	0.06894
d_by1902	-0.13385	0.07091	-1.89000	0.06100	-0.27372	0.00602
d_by1903	-0.08618	0.07155	-1.20000	0.23000	-0.22730	0.05494
d_by1904	-0.18476	0.07214	-2.56000	0.01100	-0.32705	-0.04247
d_by1905	-0.06812	0.06173	-1.10000	0.27100	-0.18989	0.05364
d_by1906	-0.05802	0.06242	-0.93000	0.35400	-0.18114	0.06510
d_by1907	0.04315	0.06308	0.68000	0.49500	-0.08128	0.16758
d_by1908	-0.01625	0.06365	-0.26000	0.79900	-0.14180	0.10930
d_by1909	0.00099	0.06410	0.02000	0.98800	-0.12545	0.12743
d_by1910	0.05493	0.05918	0.93000	0.35500	-0.06181	0.17166
d_by1911	0.07546	0.05978	1.26000	0.20800	-0.04245	0.19337
d_by1912	0.12558	0.06028	2.08000	0.03900	0.00668	0.24448
d_by1913	0.09634	0.06068	1.59000	0.11400	-0.02334	0.21602
d_by1914	0.18944	0.06098	3.11000	0.00200	0.06917	0.30971
d_by1915	0.13002	0.05790	2.25000	0.02600	0.01581	0.24422
d_by1916	0.20951	0.05837	3.59000	0.00000	0.09437	0.32464
d_by1917	0.25665	0.05876	4.37000	0.00000	0.14075	0.37255
d_by1918	0.27482	0.05907	4.65000	0.00000	0.15831	0.39132
d_by1919	0.20834	0.05930	3.51000	0.00100	0.09136	0.32531

	Coef.	Std. Err.	t	P> $|t|$	[95% Conf.	Interval]
d_by1920	0.25419	0.05948	4.27000	0.00000	0.13686	0.37151
d_by1921	0.24823	0.05728	4.33000	0.00000	0.13525	0.36121
d_by1922	0.24220	0.05766	4.20000	0.00000	0.12847	0.35593
d_by1923	0.29610	0.05798	5.11000	0.00000	0.18174	0.41046
d_by1924	0.27183	0.05824	4.67000	0.00000	0.15695	0.38672
d_by1925	0.27379	0.05846	4.68000	0.00000	0.15848	0.38911
d_by1926	0.29915	0.05865	5.10000	0.00000	0.18347	0.41483
d_by1927	0.33105	0.05880	5.63000	0.00000	0.21506	0.44704
d_by1928	0.32661	0.05894	5.54000	0.00000	0.21036	0.44287
d_by1929	0.32302	0.05906	5.47000	0.00000	0.20653	0.43952
d_by1930	0.35232	0.05917	5.95000	0.00000	0.23560	0.46904
d_by1931	0.37076	0.05928	6.25000	0.00000	0.25383	0.48770
d_by1932	0.34043	0.05939	5.73000	0.00000	0.22328	0.45758
d_by1933	0.37587	0.05951	6.32000	0.00000	0.25850	0.49324
d_by1934	0.37229	0.05962	6.24000	0.00000	0.25469	0.48990
d_by1935	0.34852	0.05974	5.83000	0.00000	0.23067	0.46636
d_by1936	0.36843	0.05987	6.15000	0.00000	0.25034	0.48652
d_by1937	0.38511	0.06000	6.42000	0.00000	0.26676	0.50347
d_by1938	0.34979	0.06014	5.82000	0.00000	0.23117	0.46842
d_by1939	0.36688	0.06028	6.09000	0.00000	0.24798	0.48578
d_by1940	0.35760	0.06042	5.92000	0.00000	0.23842	0.47678
d_by1941	0.43125	0.06057	7.12000	0.00000	0.31179	0.55072
d_by1942	0.42424	0.06072	6.99000	0.00000	0.30448	0.54400
d_by1943	0.41499	0.06086	6.82000	0.00000	0.29495	0.53504
d_by1944	0.45094	0.06101	7.39000	0.00000	0.33060	0.57128
d_by1945	0.38673	0.06116	6.32000	0.00000	0.26610	0.50736
d_by1946	0.43720	0.06131	7.13000	0.00000	0.31628	0.55812
d_by1947	0.43004	0.06145	7.00000	0.00000	0.30883	0.55126
d_by1948	0.40740	0.06161	6.61000	0.00000	0.28588	0.52891
d_by1949	0.43284	0.06176	7.01000	0.00000	0.31102	0.55466

	Coef.	Std. Err.	t	P> $\|t\|$	[95% Conf. Interval]	
d_by1950	0.39636	0.06193	6.40000	0.00000	0.27421	0.51850
d_by1951	0.37492	0.06210	6.04000	0.00000	0.25243	0.49742
d_by1952	0.35996	0.06230	5.78000	0.00000	0.23708	0.48283
d_by1953	0.41650	0.06252	6.66000	0.00000	0.29317	0.53983
d_by1954	0.37688	0.06280	6.00000	0.00000	0.25301	0.50076
d_by1955	0.36939	0.06369	5.80000	0.00000	0.24375	0.49502
d_by1956	0.35259	0.06386	5.52000	0.00000	0.22663	0.47856
d_by1957	0.39673	0.06406	6.19000	0.00000	0.27038	0.52307
d_by1958	0.39617	0.06429	6.16000	0.00000	0.26936	0.52297
d_by1959	0.36816	0.06459	5.70000	0.00000	0.24076	0.49556
d_by1960	0.36615	0.06549	5.59000	0.00000	0.23697	0.49533
d_by1961	0.38033	0.06565	5.79000	0.00000	0.25083	0.50983
d_by1962	0.35078	0.06585	5.33000	0.00000	0.22089	0.48067
d_by1963	0.42594	0.06611	6.44000	0.00000	0.29554	0.55634
d_by1964	0.32810	0.06648	4.94000	0.00000	0.19696	0.45923
d_by1965	0.36277	0.06962	5.21000	0.00000	0.22546	0.50009
d_by1966	0.36235	0.06981	5.19000	0.00000	0.22466	0.50004
d_by1967	0.38471	0.07006	5.49000	0.00000	0.24651	0.52290
d_by1968	0.40439	0.07043	5.74000	0.00000	0.26546	0.54332
d_by1969	0.39179	0.07101	5.52000	0.00000	0.25172	0.53186
d_by1970	0.36964	0.07914	4.67000	0.00000	0.21354	0.52573
d_by1971	0.46516	0.07937	5.86000	0.00000	0.30861	0.62170
d_by1972	0.42620	0.07970	5.35000	0.00000	0.26900	0.58341
d_by1973	0.41651	0.08024	5.19000	0.00000	0.25825	0.57477
d_by1974	0.37119	0.08111	4.58000	0.00000	0.21120	0.53117
d_by1975	0.35332	0.08254	4.28000	0.00000	0.19052	0.51613

Specification tests

null: [a, a2, a3, a4, a5]=0

$$F(4, 191) = 118.05\ (Prob > F = 0.0000)$$

null: [cohort controls]=0

$$F(75, 191) = 7.08\ (Prob > F = 0.0000)$$

null: [year controls]=0

$$F(3, 191) = 20.73\ (Prob > F = 0.0000)$$

Log non durable consumption

	Coef.	Std. Err.	t	P> $\|t\|$	[95% Conf.	Interval]
intercept	14.22485	1.54332	9.22000	0.00000	11.18071	17.26899
age	-6.615E-01	1.671E-01	-3.96000	0.00000	-9.910E-01	-3.319E-01
age squared	3.193E-02	7.028E-03	4.54000	0.00000	1.807E-02	4.579E-02
age**3	-6.866E-04	1.430E-04	-4.80000	0.00000	-9.687E-04	-4.044E-04
age**4	6.780E-06	1.410E-06	4.80000	0.00000	3.990E-06	9.560E-06
age**5	-2.520E-08	5.420E-09	-4.65000	0.00000	-3.590E-08	-1.450E-08
Year controls						
ddp_y1979	(dropped)					
ddp_y1984	(dropped)					
ddp_y1989	-0.01228	0.00816	-1.50000	0.13400	-0.02837	0.00381
ddp_y1994	0.03311	0.00602	5.50000	0.00000	0.02123	0.04498
ddp_y2000	-0.01135	0.00511	-2.22000	0.02700	-0.02142	-0.00127
Cohort controls						
d_by1901	-0.12777	0.07021	-1.82000	0.07000	-0.26626	0.01072
d_by1902	-0.15453	0.07076	-2.18000	0.03000	-0.29410	-0.01495
d_by1903	-0.12533	0.07140	-1.76000	0.08100	-0.26615	0.01550
d_by1904	-0.21108	0.07199	-2.93000	0.00400	-0.35307	-0.06909
d_by1905	-0.10428	0.06160	-1.69000	0.09200	-0.22579	0.01723
d_by1906	-0.06479	0.06229	-1.04000	0.30000	-0.18765	0.05808
d_by1907	0.01220	0.06295	0.19000	0.84600	-0.11197	0.13637
d_by1908	-0.07123	0.06352	-1.12000	0.26400	-0.19652	0.05406
d_by1909	-0.03033	0.06397	-0.47000	0.63600	-0.15650	0.09584
d_by1910	0.02107	0.05906	0.36000	0.72200	-0.09542	0.13757
d_by1911	0.03822	0.05965	0.64000	0.52200	-0.07944	0.15588
d_by1912	0.08664	0.06015	1.44000	0.15100	-0.03201	0.20529
d_by1913	0.08303	0.06055	1.37000	0.17200	-0.03641	0.20246
d_by1914	0.16684	0.06085	2.74000	0.00700	0.04682	0.28685
d_by1915	0.10087	0.05778	1.75000	0.08200	-0.01310	0.21483
d_by1916	0.16785	0.05825	2.88000	0.00400	0.05295	0.28274
d_by1917	0.21915	0.05864	3.74000	0.00000	0.10349	0.33480
d_by1918	0.21673	0.05894	3.68000	0.00000	0.10047	0.33300
d_by1919	0.16498	0.05918	2.79000	0.00600	0.04826	0.28171

	Coef.	Std. Err.	t	P> $|t|$	[95% Conf.	Interval]
d_by1920	0.21873	0.05936	3.68000	0.00000	0.10165	0.33581
d_by1921	0.19006	0.05716	3.33000	0.00100	0.07732	0.30281
d_by1922	0.20155	0.05754	3.50000	0.00100	0.08806	0.31504
d_by1923	0.23369	0.05786	4.04000	0.00000	0.11957	0.34781
d_by1924	0.19963	0.05812	3.43000	0.00100	0.08498	0.31427
d_by1925	0.21465	0.05834	3.68000	0.00000	0.09957	0.32972
d_by1926	0.23768	0.05853	4.06000	0.00000	0.12224	0.35312
d_by1927	0.26638	0.05868	4.54000	0.00000	0.15063	0.38212
d_by1928	0.24569	0.05882	4.18000	0.00000	0.12968	0.36170
d_by1929	0.26074	0.05894	4.42000	0.00000	0.14449	0.37699
d_by1930	0.29048	0.05905	4.92000	0.00000	0.17401	0.40696
d_by1931	0.30347	0.05916	5.13000	0.00000	0.18678	0.42016
d_by1932	0.28466	0.05927	4.80000	0.00000	0.16775	0.40157
d_by1933	0.29233	0.05938	4.92000	0.00000	0.17521	0.40946
d_by1934	0.29463	0.05950	4.95000	0.00000	0.17727	0.41199
d_by1935	0.26687	0.05962	4.48000	0.00000	0.14928	0.38447
d_by1936	0.28698	0.05975	4.80000	0.00000	0.16913	0.40482
d_by1937	0.29703	0.05988	4.96000	0.00000	0.17892	0.41513
d_by1938	0.26686	0.06001	4.45000	0.00000	0.14848	0.38523
d_by1939	0.27521	0.06015	4.58000	0.00000	0.15656	0.39386
d_by1940	0.25861	0.06030	4.29000	0.00000	0.13968	0.37754
d_by1941	0.33531	0.06044	5.55000	0.00000	0.21609	0.45452
d_by1942	0.32100	0.06059	5.30000	0.00000	0.20149	0.44050
d_by1943	0.30661	0.06074	5.05000	0.00000	0.18681	0.42640
d_by1944	0.35604	0.06088	5.85000	0.00000	0.23595	0.47613
d_by1945	0.28038	0.06103	4.59000	0.00000	0.16000	0.40076
d_by1946	0.32732	0.06118	5.35000	0.00000	0.20665	0.44798
d_by1947	0.31946	0.06133	5.21000	0.00000	0.19850	0.44043
d_by1948	0.29220	0.06148	4.75000	0.00000	0.17094	0.41347
d_by1949	0.31081	0.06163	5.04000	0.00000	0.18924	0.43238

	Coef.	Std. Err.	t	P> $|t|$	[95% Conf.	Interval]
d_by1950	0.28511	0.06180	4.61000	0.00000	0.16322	0.40700
d_by1951	0.27245	0.06197	4.40000	0.00000	0.15022	0.39469
d_by1952	0.24896	0.06217	4.00000	0.00000	0.12634	0.37158
d_by1953	0.29883	0.06239	4.79000	0.00000	0.17576	0.42190
d_by1954	0.24698	0.06267	3.94000	0.00000	0.12336	0.37059
d_by1955	0.26197	0.06356	4.12000	0.00000	0.13660	0.38734
d_by1956	0.23228	0.06373	3.64000	0.00000	0.10658	0.35799
d_by1957	0.28072	0.06392	4.39000	0.00000	0.15464	0.40680
d_by1958	0.25293	0.06415	3.94000	0.00000	0.12639	0.37947
d_by1959	0.24029	0.06445	3.73000	0.00000	0.11316	0.36742
d_by1960	0.23951	0.06535	3.66000	0.00000	0.11060	0.36842
d_by1961	0.23380	0.06552	3.57000	0.00000	0.10457	0.36303
d_by1962	0.21922	0.06571	3.34000	0.00100	0.08961	0.34884
d_by1963	0.26615	0.06597	4.03000	0.00000	0.13602	0.39628
d_by1964	0.18702	0.06634	2.82000	0.00500	0.05616	0.31788
d_by1965	0.21910	0.06947	3.15000	0.00200	0.08207	0.35613
d_by1966	0.19283	0.06966	2.77000	0.00600	0.05543	0.33024
d_by1967	0.22062	0.06992	3.16000	0.00200	0.08271	0.35853
d_by1968	0.22336	0.07029	3.18000	0.00200	0.08472	0.36200
d_by1969	0.21088	0.07086	2.98000	0.00300	0.07110	0.35066
d_by1970	0.21740	0.07897	2.75000	0.00600	0.06163	0.37316
d_by1971	0.27079	0.07920	3.42000	0.00100	0.11457	0.42701
d_by1972	0.24940	0.07954	3.14000	0.00200	0.09252	0.40628
d_by1973	0.20605	0.08007	2.57000	0.01100	0.04812	0.36398
d_by1974	0.11582	0.08094	1.43000	0.15400	-0.04383	0.27547
d_by1975	0.11722	0.08237	1.42000	0.15600	-0.04524	0.27968

Specification tests

null: [a, a2, a3, a4, a5]=0

$$F(4, 191) = 181.30 \ (Prob > F = 0.0000)$$

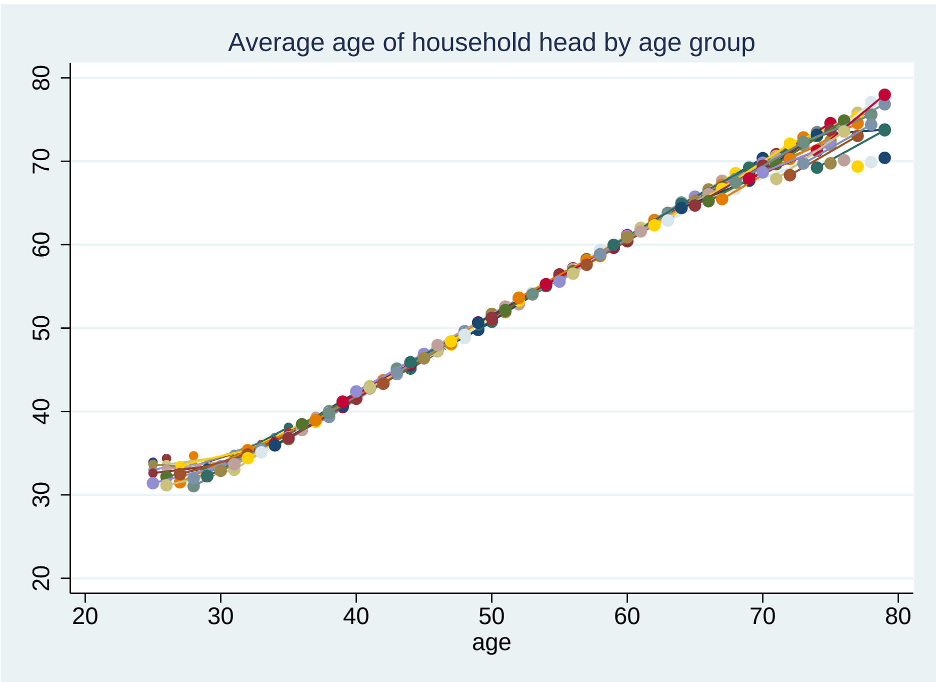
null: [cohort controls]=0

$$F(75, 191) = 6.40 \ (Prob > F = 0.0000)$$

null: [year controls]=0

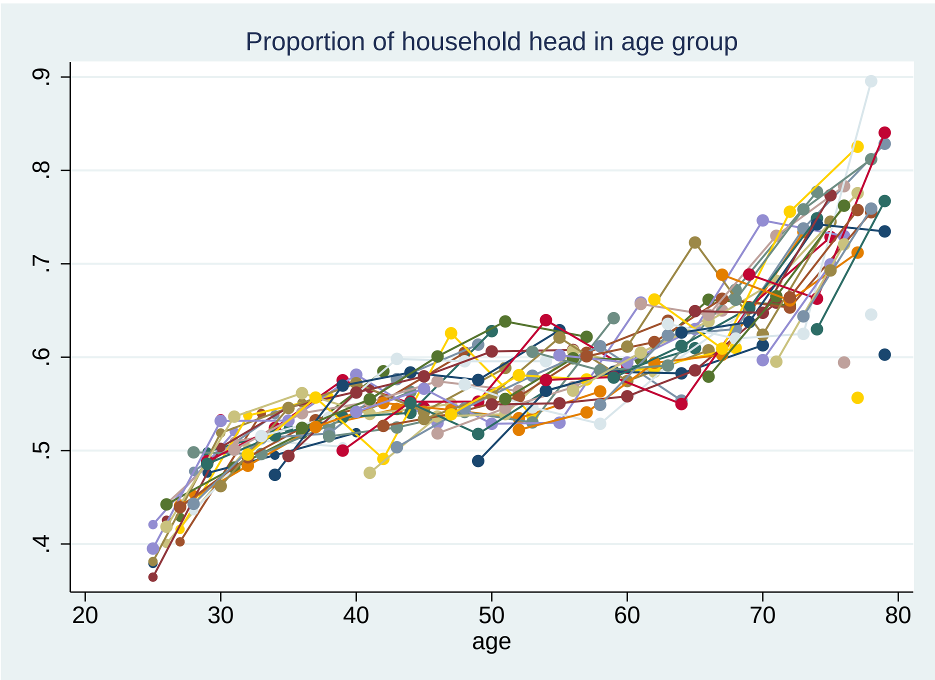
$$F(3, 191) = 16.31 \ (Prob > F = 0.0000)$$

Figure 1: Average age of household head by age group



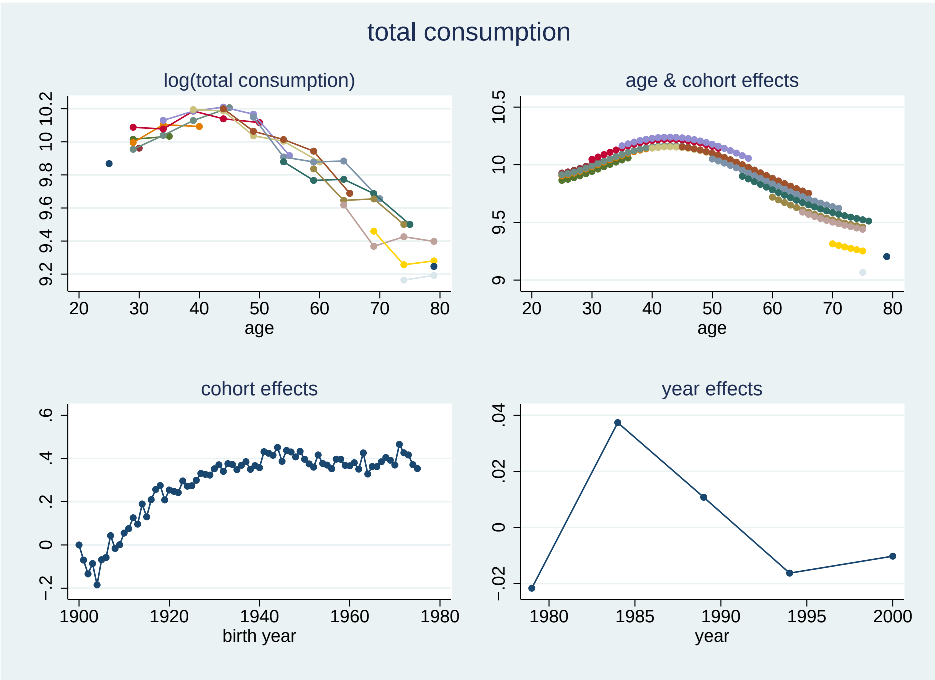
Lecture: Whatever the cohorts (presented in various colors) people aged 25 live in a household whose head is aged 32 (mean age). People between 30 and 70 live in households whose head's age is close to their (less than 2 years older).

Figure 2: Proportion of household heads in age groups



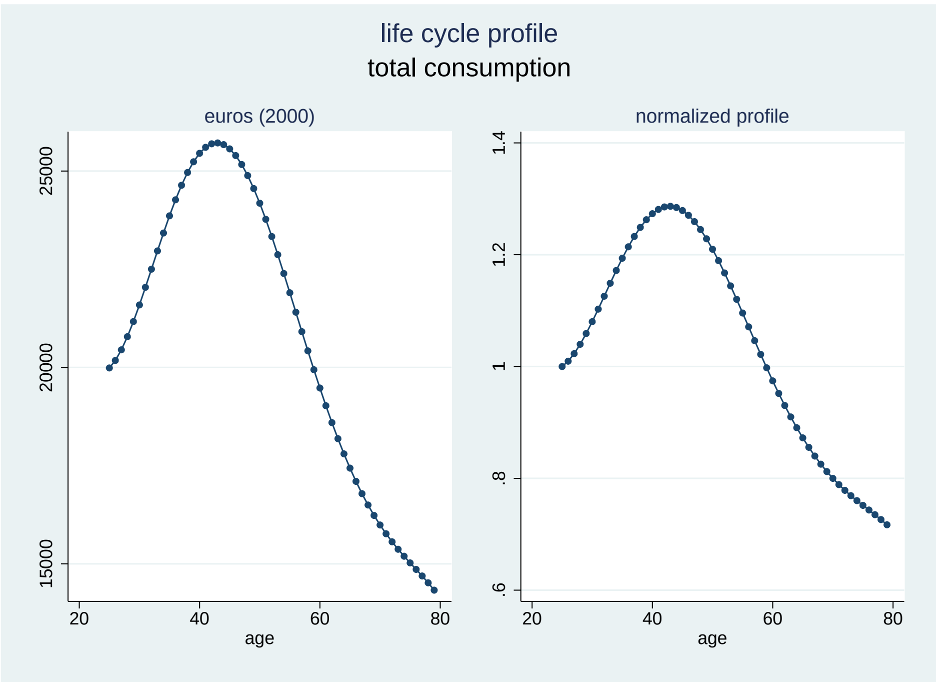
Lecture: Less than 45% of people aged 25 are heading a household. This proportion is growing with age, after 30, more than 50% of people are household heads.

Figure 3: Total consumption - summary of estimations



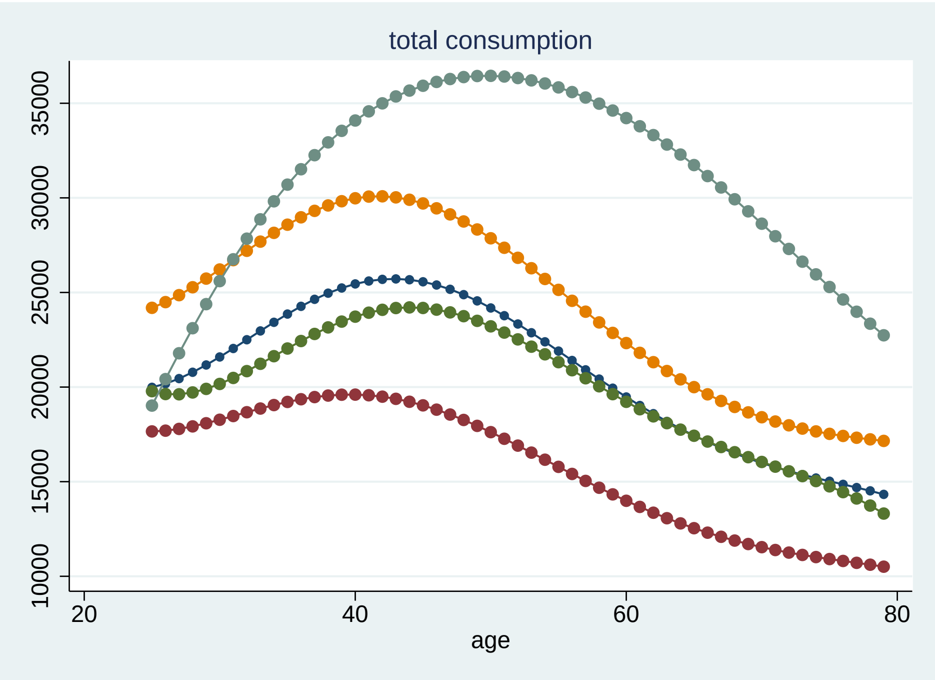
Lecture: The upper left figure displays observed log total consumption for various cohorts. The upper right figure displays estimated life-cycle profiles for the corresponding cohorts. The lower left figure shows cohort effects (in logs, normalised for the 1900 cohort): compared to cohorts born before 1910, cohorts born in the late 40s enjoy a 50% higher lifetime consumption level. However, cohorts born after 1950 have roughly the same lifetime level. The last (lower right) figure displays year effets.

Figure 4: Total consumption - life cycle profile



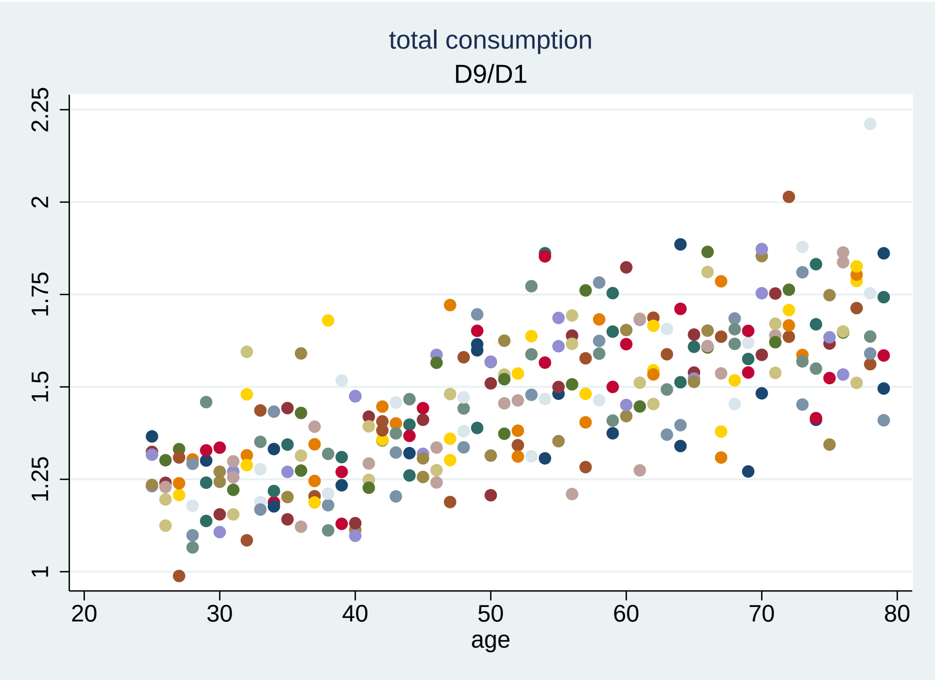
Lecture: The left figure displays estimated log total consumption life-cycle profile in (2000) euros for an average cohort (profile averaged across the last 15 cohorts, born between 1960 and 1975). The right figure shows the normalized profile (rescaled on consumption at 25).

Figure 5: Total consumption - level by education group



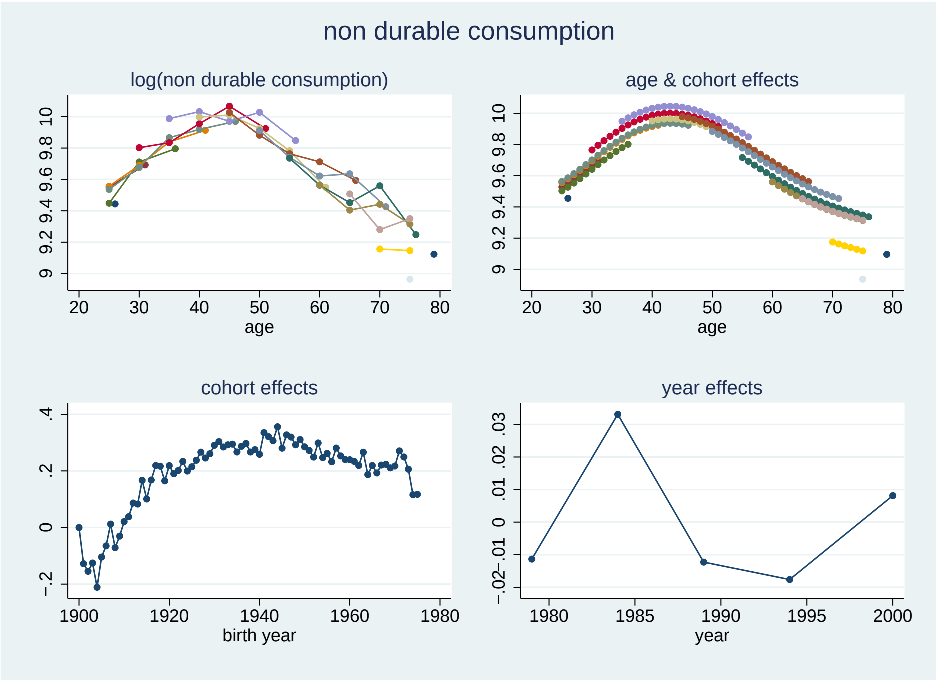
Lecture: The median dark blue profile figures out the estimated mean life-cycle profile. The other are profiles by education achievement (descending): college (light blue), high school (orange), junior high school (green), and basic school leaving qualification (red).

Figure 6: Total consumption - D9/D1



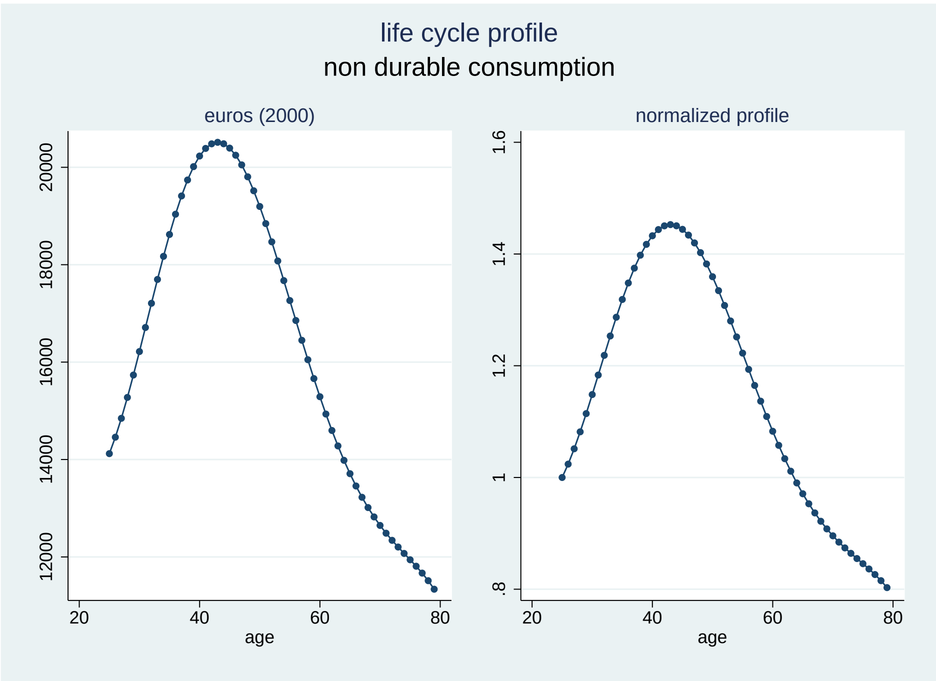
Lecture: Each dot figures out the ratio of the ninth (upper) decile of total consumption on the first (lower) decile for a given cohort observed at a given age. Consumption inequality grows with age but, at first sight, there does not appear any systematic shift across cohorts toward more inequality.

Figure 7: Non durable consumption - summary of estimations



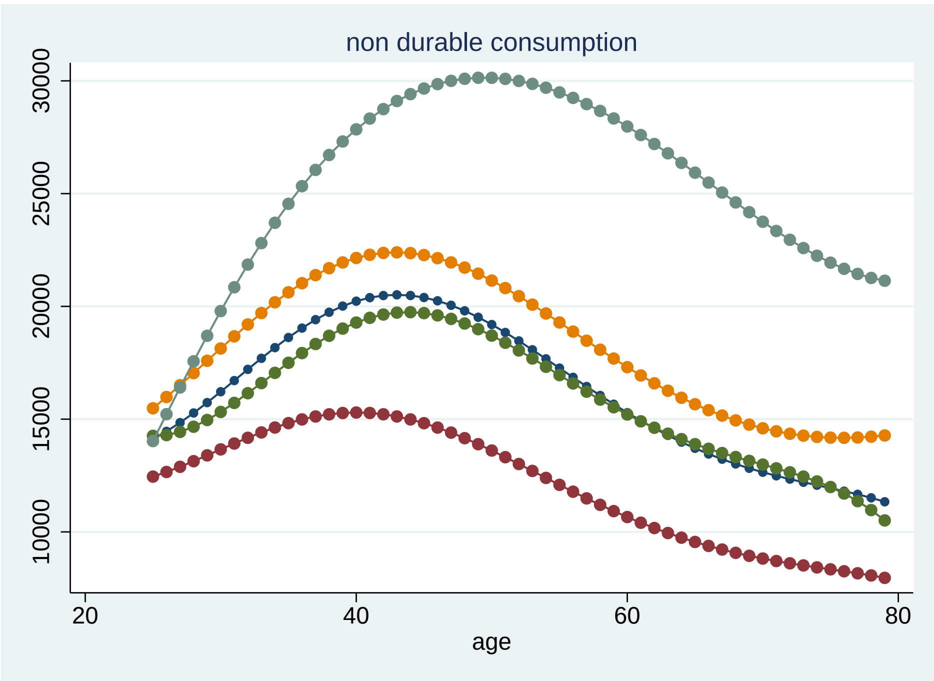
Lecture: See fig. (3).

Figure 8: Non durable consumption - life cycle profile



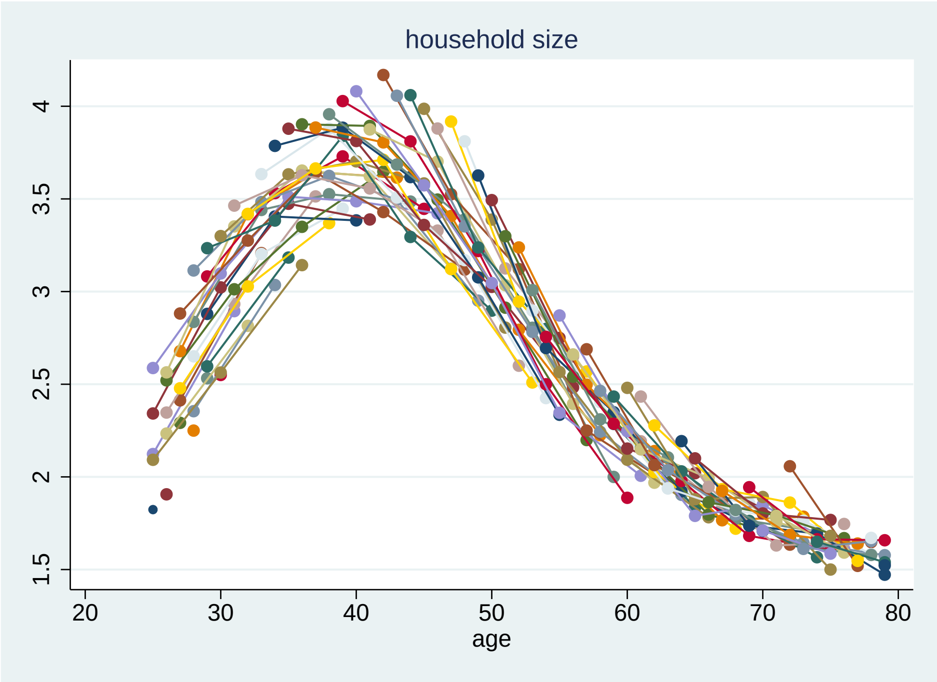
Lecture: See fig. (4).

Figure 9: Non durable consumption - level by education group



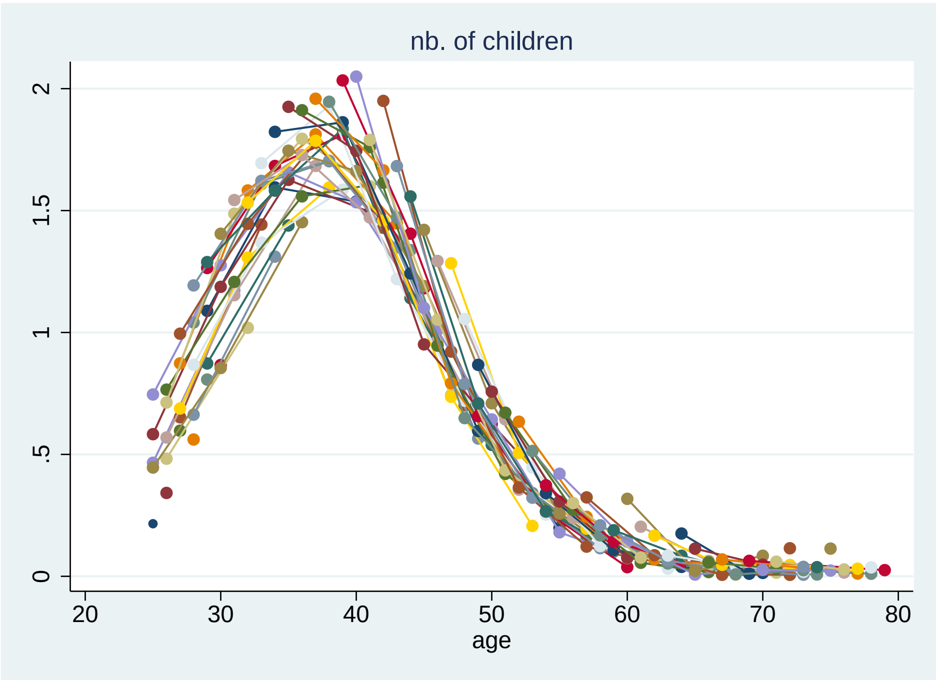
Lecture: See fig. (5).

Figure 10: Household size



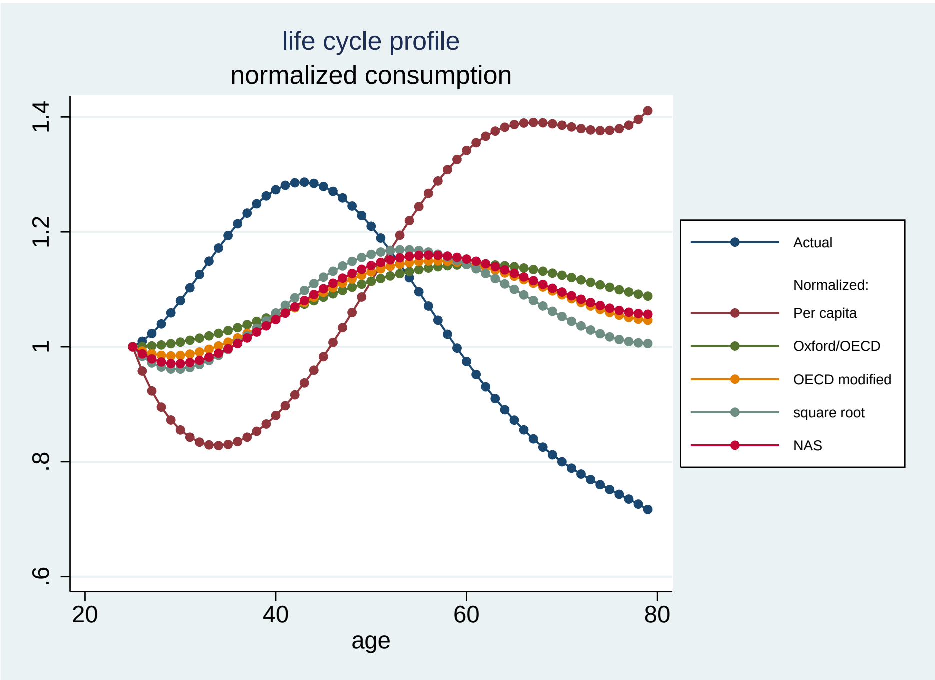
Lecture: On average, households whose head is 25 correspond to 2 people living together. Bigger households are observed for heads in their early 40s.

Figure 11: Number of children



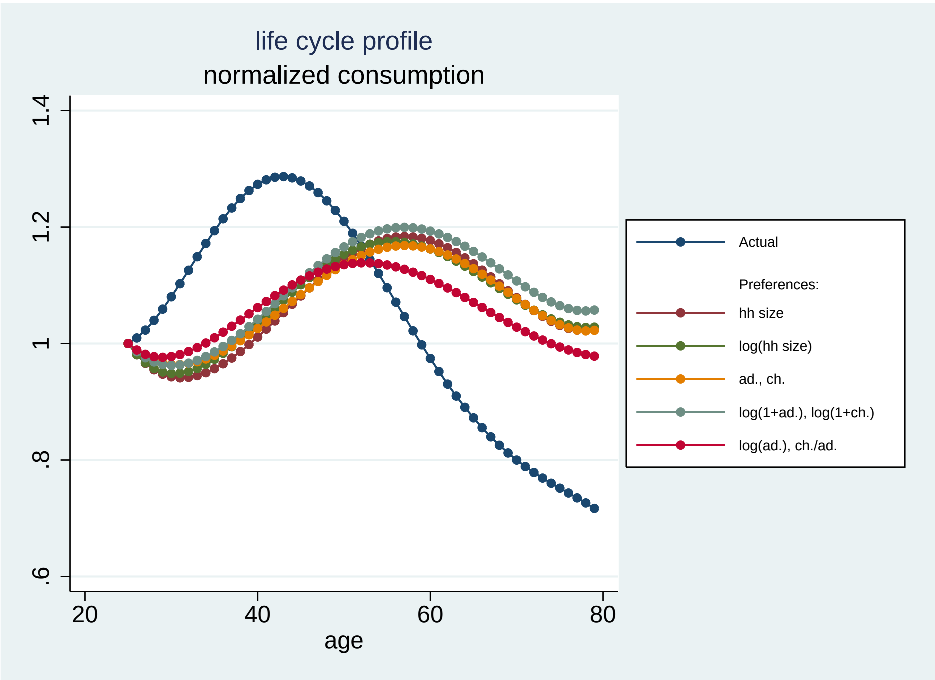
Lecture: No more than half of households whose head is 25 already have child (the average number of children for those households is around 0.5). The average number of children living in their parents' household reaches a peaks between 1.5 and 2 when their parents are in their early 40s. Afterwards, as we observe fewer births and as existing children are growing older (eventually becoming adults), the number of co-resident children is declining.

Figure 12: Total consumption - life cycle profile using equivalence scale



Lecture: The dark blue profile figures out the estimated mean life-cycle profile. The other are estimated rescaled profiles using various scales (descending): per capita (dark red), Oxford/OECD (green), NAS (red), OECD modified (orange), and square root (light blue).

Figure 13: Total consumption - life cycle profile controlling for preferences



Lecture: The dark blue profile figures out the estimated mean life-cycle profile. The other are estimated profiles introducing various controls for demographic changes in the estimation (descending): log of the number of adults and log of the number of children (+1) (light blue), log of the household size (green), household size (dark red), number of adults and number of children (orange), and log of the number of adults and ratio of the number of children to the number of adults (red).