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NOTES AND COMMUNICATIONS

EXPLAINING THE *HUMP* IN LIFE CYCLE CONSUMPTION PROFILES

Summary

This paper documents life cycle (or age) profiles of (log) household income, durable and non-durable consumption for Dutch households after explicitly controlling for time (or business cycle) effects and birth cohort effects. We find that both measures of consumption as well as income is clearly hump shaped over the life cycle. Hence, real consumption per household seems to track income over the life cycle. This empirical regularity is hard to reconcile with basic specifications of the life cycle model. We further document life cycle profiles of demographic and labor supply variables. We argue that part, but not all, of the hump in consumption may be explained by household composition variables. Durable consumption per adult equivalent stays approximately flat until age 60 after which it drops dramatically. This phenomenon may be partly explained by a decrease in work related durable expenditures after retirement. Non-durable consumption per equivalent adult increases steadily until age 55 and stays approximately flat after that.

Key words: consumption, life cycle profiles, durables

JEL Code(s): D12, D91

1 INTRODUCTION

This paper examines the life cycle profiles of durable and non-durable consumption expenditures using a series of repeated cross sections drawn from the Dutch consumer expenditure survey [source: Statistics Netherlands]. The relevance of our study can be motivated in at least three ways.

Firstly, the consumption profiles provides prima facie evidence for the validity of the baseline life cycle model, the general framework for analyzing household consumer behavior over the life cycle. This model assumes that the agents maximize intertemporally additive expected utility, subject to a lifetime budget constraint. Moreover, the model assumes perfect capital markets (no liquidity constraints), complete markets and within period utility functions that are additively separable between non-durables, durable service flows, leisure and demographics. A key prediction of this version of the life cycle model is that changes in (the marginal utility of) non-durable consumption are uncorrelated with predictable changes in income. Like other studies (see e.g. Fernandez-Villaverde and Krueger (2007)) we find however, that consumption seems to *track* income. An empirical regularity that is hard to reconcile with these basic specifications of the life cycle model.

Similarly, empirical studies using UK and US data typically find that both nondurable consumption and income drops at retirement (see e.g. Banks et al. 1998; Bernheim et al. 2001). One could be tempted to interpret these findings as evidence for the hypothesis that people have not saved enough for retirement. However, such policy relevant conclusions should be drawn with great caution, simply because these are based on a very simple version of the life cycle model.

Secondly, we assess the relevance of possible extensions to the basic life cycle model. The fact that consumption seems to track income over the life cycle may be explained by non-separabilities in the utility function. We report for example, that household size is also hump shaped over the life cycle and can account for a part of the hump shape in consumption.

Thirdly, the age-consumption profiles are useful empirical benchmarks for comparing the life cycle predictions of macro simulation models such as the one constructed by Auerbach and Kotlikoff (1987) and the GAMMA model of the Netherlands Bureau for Economic Policy Analysis (CPB) (see Draper and Amstrong (2007)). These models typically abstract from business cycle-, cohort- and demographic effects. In our empirical analysis we explicitly control for these effects. Predictions from these macro economic models may therefore be readily compared with their empirical counterparts that we document in this paper.

In this paper we borrow heavily from Fernandez-Villaverde and Krueger (2007) who analyze the US consumer expenditure survey. This allows to compare our findings based on Dutch data with those of Fernandez-Villaverde and Krueger (2007). Such a comparison is interesting since Dutch households face an institutional environment (e.g. capital markets and pension systems) that is quite different from the American one. Like Fernandez-Villaverde and Krueger (2007), we find that after controlling for cohort and time effects, both durable and non-durable consumption show a clear hump shape over the life cycle. Only part of the hump can be explained by changes in household composition. Moreover, the data suggest that durable consumption is at least partly work related as durable consumption drops dramatically around retirement.

The paper is organized as follows. First we describe the data we use in Section 2. In Section 3 we provide some details on the econometric methodology. Especially, we pay attention to our method to disentangle age, period and cohort effects. Moreover, we document the consumption and income profiles as functions of age and birth year respectively. Finally, we study the effects of controlling for family size. In Section 4 we discuss possible additional explanations for explaining that part of the hump that cannot be attributed to a change in household size. Finally we summarize and conclude in Section 5.

2 THE DATA

The data used for this study are drawn from the Dutch budget survey (Budgetonderzoek) which is held by Statistics Netherlands at an annual basis. We use 23 waves that cover the period 1978–2000. The survey collects data on 2000 to 3000 individual households per wave. Only in the year 1991, the budget survey has been conducted among about 1000 households. The survey relates expenditures on a very detailed set of consumption categories to information on household composition and income. Furthermore, the survey contains information on income, family composition and background information on all members of the household (age, education etc.). In addition the data contains information on whether the household head, and the partner work fulltime, part time or not at all.[1]

The budget survey is not entirely representative for the Dutch population of households. One of the reasons for this is that every 5 years Statistics Netherlands constructs a weighting scheme from the budget survey which is used for price index calculations of the employed. To this end households where the head of the household is employed are oversampled in 1980, 1985, 1990, 1995 and 2000. Moreover, other types of households are overrepresented in some other waves (see Kalwij et al. (1998) for more details). Therefore, we use in our analysis the sample weights provided by Statistics Netherlands. Some sample selections have been applied. Firstly, we have excluded the households whose head is younger than 21. Secondly, those households with heads born before 1906 or after 1970 are also removed from the sample. Thirdly, the expenditure data of a few households showed some serious inconsistencies and are also removed from the sample.

Nondurable consumption is constructed as the sum of the expenditures on all non-durable items. Non-durable items are defined to depreciate within a year. They include among other things expenditures on food, clothing and rent (or imputed rents for house owners). It is reasonable to assume that non-durable *expenditures* and non-durable *consumption* are approximately equal. For durable consumption this is different. By definition, durable consumption items do not depreciate within a year. Durable expenditures therefore do not equal durable consumption services. Households are assumed to derive utility from the service *flow* of the durable stock. The flow however, is typically not recorded in expenditure surveys. It is important to keep this in mind

1 For the 1988–1991 waves the data also contains information on actual hours of labor supply by both the head and the partner. The dummies however can explain approximately 80% of the variation in hours of labor. See De Ree and Alessie (2008) for more details.

when analyzing the life cycle patterns of durable consumption *expenditures*. Durable expenditures include expenditures on cars, furniture, but also investments in schooling.

The Dutch consumer expenditure survey is unique in the sense that it contains for home owners direct data on the rental value of their dwellings.[2] In other words, contrary to Fernandez-Villaverde and Krueger (2007) we observe the service flow from the durable stock 'housing'. We have added this service flow to our measure of nondurable consumption. Utility theory suggests that this is a reasonable procedure. We also performed a sensitivity analysis with a nondurable consumption measure that excludes both the rent and the rental value.

The income and expenditure series are expressed in 1978 prices using the consumer price indices published by Statistics Netherlands (source: http://statline.cbs.nl/).

3 CONSUMPTION OVER THE LIFE CYCLE

At the minimum, one has to control cohort and calendar year effects if one estimates life cycle profiles of (non)durable consumption and income. People coming of age in different times have different preferences towards e.g. risk. Generations who endured the Great Depression in the 1930s might be more thrifty or more risk averse than other cohorts. An alternative view is that whereas preferences may be identical across cohorts, the economic conditions of the past are very different from the present. These considerations lead to the supposition of cohort or generation effects. Furthermore, calender year or business cycle effects might also seriously distort the cross-sectional life cycle profiles of consumption. In the subsequent econometric analysis, we explicitly account for cohort and business cycle effects that have taken place within the sample period (1978–2000).

Moreover, we allow for a reasonably flexible relationship between consumption or income on the one hand and age, year of birth and time on the other. We adopt the following empirical specification for consumption or income[3] (denoted by x_{it}):

$$\ln x_{it} = m_1(cohort_i) + m_2(age_{it}) + \phi_t D_t + \varepsilon_{it} \qquad (1)$$

$m_1(cohort_i)$ is a linear spline with nodes at 1915, 1925, 1930, 1935, 1940, 1945, 1950, 1955, 1960, 1965, and 1970. $m_2(cohort_{it})$ is a linear spline with

2 This rental value has been assessed by real estate agents.

3 The same empirical specification forms the basis of all figures we report in this paper. Note that we did not constructed logs of the demographic variables and the participation rates.

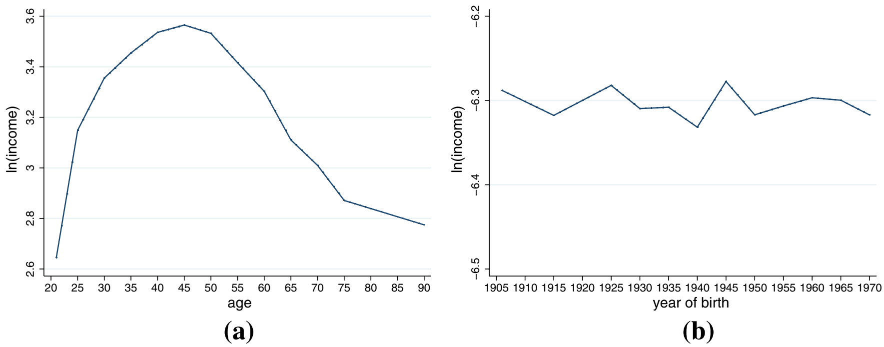

Figure 1 – Log household income as a function of (**a**) age (*left panel*) and (**b**) the year of birth of the household head (*right panel*)

nodes at 25, 30, 35, 40, 45, 50, 55, 60, 65, 70 and 75 years of age.[4] ε_{it} is a random error term. We have computed standard errors that are robust to the presence of heteroscedasticity and of within cohort correlations. Note that our empirical specification precludes interactions between age and cohort effects.

Age, cohort and calender year effects are not separately identified because they are linearly dependent (i.e., age + cohort = calender year). We follow a method of disentangling age, period and cohort effects that has been proposed by Deaton and Paxson (1994). This method is used in many papers (e.g., Attanasio (1998) and Fernandez-Villaverde and Krueger (2007)). The method boils down to imposing additional assumptions on the time dummies. The time dummies are constructed to be uncorrelated with a time trend and normalized such that they add up to zero (Deaton and Paxson 1994). This assumption for example implies that all 'trending' we find is interpreted as a cohort effect.

Figure 1 shows the predicted logarithm of real income as a function of age and year of birth respectively. Figure 1 reveals that real household income is strongly hump-shaped over the life cycle. Between age 21 and 25 the yearly growth rate in household income is equal to a rather extreme 12.5% and between age 25 and 30 to 4.1%. After, the annual growth rate is lower and household income tops at age 45. We more or less follow Fernandez-Villaverde and Krueger (2007) by defining the size of the hump as the difference between income at age 21 and income at the top (age 45). As can be inferred from Figure 1, the hump in log household income is about 0.92. This means that between age 21 and 45 income increases by 150%

4 We have experimented with more flexible specifications (i.e., additional nodes in the spline function of age). This however, barely affected our empirical results.

$(= (e^{0.92} - 1) * 100)$.[5] Between age 50 and 80 income steadily decreases with 50% $(= e^{-0.69} - 1) * 100)$. We would also like to stress that our estimate of the life cycle profile of income is rather precise (i.e the standard errors of our estimated age coefficients are small). In other words, our finding of a hump-shaped age-income profile is not merely due to sampling error.

We do not find important cohort effects for income, implying that real income *per household* has not increased on average over the sample period. One would expect that younger generations have a higher income than the older ones (ceteris paribus) (see e.g. Kapteyn et al. 2005). However, it should be realized that households have decreased in size over the sample period. Where real income *per household* has not increased over generations, real income *per capita* did. We return to this issue in the next sections. The time pattern of the estimated year dummy coefficients (not reported here) basically follows the business cycle.[6]

The second set of graphs we show in Figure 2 are the age and cohort profiles of both non-durable and durable consumption per household. Both age-consumption profiles show an important hump shape. The hump in ln(non-durable consumption) is approximately 0.84 and tops – like income – around age 45. Notice that this hump is slightly smaller than for household income. Interestingly, after age 50 nondurable consumption decreases at a slower pace than income. As we said before, our nondurable consumption measure includes rents and the imputed rental value of an owned dwelling. If we exclude these two items, we obtain an age profile which is very similar to that of income especially after age 50 and to the one obtained by Fernandez-Villaverde and Krueger (2007) (see Figure 2 of their paper). Figure 2 also shows that, ceteris paribus, younger cohorts consume more nondurable goods than the older ones. Non-durable consumption has increased from the 1905 cohort until the 1930 and stays approximately flat after.

The hump in durable consumption is about 0.5 but – in contrast to income and non-durable consumption – drops down much further after age 50.[7] We find a surprising decrease in durable expenditures per household over generations. We find that in real terms, and when holding all else equal, younger cohorts spend less on durable items than older cohorts.

The age-consumption profiles are hard to reconcile with basic specifications of the life cycle model. If households are aware of the hump shape in income, households would typically borrow for consumption when income is low and save when income is high. This in order to smooth the (expected)

5 In Figure 1, one should not interpret the reported values of ln(income) such 3.56 at age 45. The figure is only informative about the shape of the age income profile. The same caveat can be made for all other figures presented in this paper.

6 The complete set of estimation results are available from the authors upon request.

7 Fernandez-Villaverde and Krueger (2007) obtained a similar result.

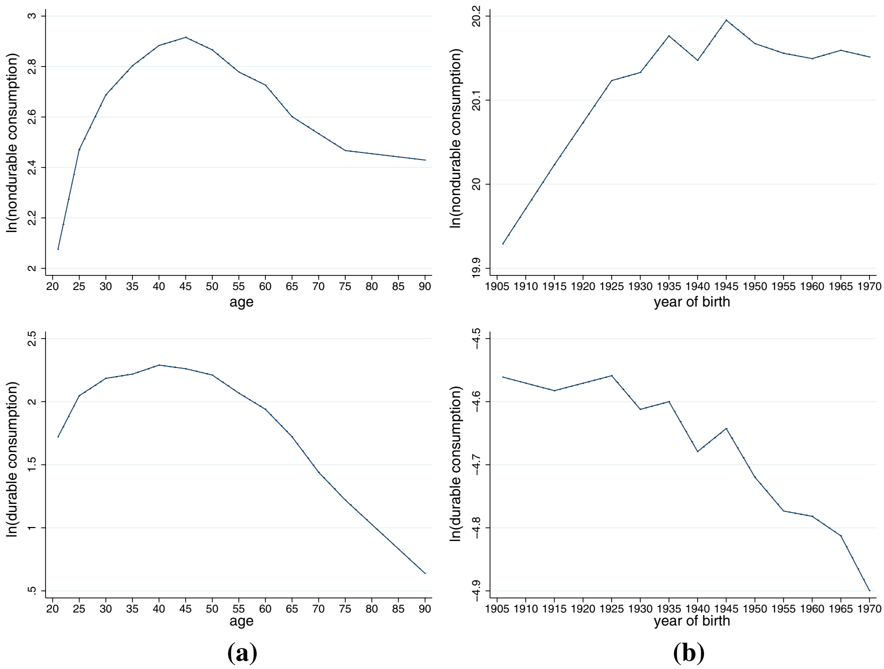

Figure 2 – Log consumption as a function of (**a**) age and (**b**) year of birth of the household head

marginal utility of consumption over the life cycle. The fact that consumption seemingly *tracks* income seems inconsistent with this argumentation. The evidence from Figures 1 and 2 therefore suggestively rejects the basic specifications of the life cycle model. The hump shape in consumption however, is not necessarily inconsistent with more elaborate versions of the life cycle model.

3.1 *Controlling for Household Composition*

There are many competing explanations for the hump shape in consumption. Life cycle theory predicts that the expected marginal rate of substitution between consumption now and in the future should be equal to a constant (that is a function of the discount rate and the interest rate). If – for example – non-separabilities between consumption, leisure and household composition are important however, the marginal rate of substitution between consumption now and in the future is a function of household composition and/or labor supply variables. It has been frequently argued that the hump in consumption should, at least for a part, be attributed to the hump in household size (e.g., Attanasio and Weber 1995).

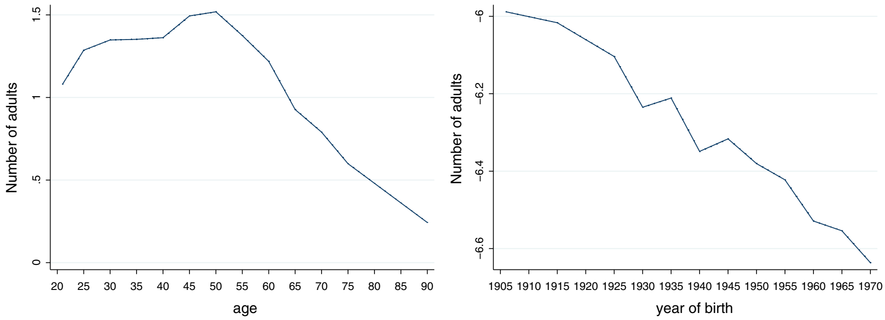

Figure 3 – Number of adults as function of age year of birth of the household head

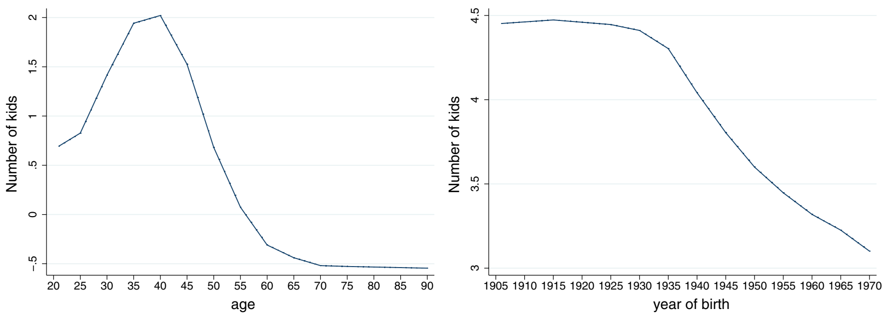

Figure 4 – Number of children as function of age and year of birth of the household head

In the Netherlands – and also elsewhere in the developed world – household size has decreased towards the end of the previous century. In part this is due to an increase in the number of single person households. In addition, we see that couples have less children now, than they had half a century ago. Figure 3 plots the number of adults within the household, as a function of age and year of birth respectively. The age profile is fairly flat until age 50 after which the probability of one of the household members dying becomes increasingly important. The decreasing cohort effects on the other hand, reflect the steady increase in the number of single headed households. The number of adults within a household has decreased by about 0.6 over generations.

Figure 4 documents the well-known hump shape in the number of children that peaks around age 35 to 40. After this age children start moving out of the household of their parents and start their own. The cohort pictures reveal another important – some would say alarming – feature of Dutch household data. Starting of with the 1930 cohort, younger cohorts start getting less and less children. We document a decrease of more than one child per household.

Figures 3 and 4 give helpful insights for interpreting the consumption profiles of Figure 2. For a given level of consumption increasing household size increases the marginal utility of consumption. Equating expected marginal utilities over time therefore, does not necessarily imply equating consumption levels over time.

We follow Fernandez-Villaverde and Krueger (2007) and allow for household size by constructing equivalent consumption levels. Equivalent consumption is constructed by dividing household consumption by the modified OECD equivalence scales as proposed by De Vos and Zaidi (1997).[8] The modified OECD scale is a household specific index that assigns a 1 to the first household member, 0.5 to every additional adult and 0.3 to each child. A couple with two children therefore gets assigned a equivalence scale of $1 + 0.5 + 0.3 + 0.3 = 2.1$. The idea is that households maximize expected life time utility by allocating *equivalent* consumption efficiently.

The age and cohort profiles of equivalent income, equivalent non-durable and equivalent durable consumption are shown in Figure 5. From comparing this figure with Figures 1 and 2 we immediately see that allowing for household size (in the way we do it here) matters quite a bit for the age and cohort profiles. The age profiles are much flatter and no longer peak around age 45, but much later at around 55 or 60, typically after the children have moved out of the household. Between age 60 and 65 we see that income per equivalent adult decreases with only 1.6% per year.[9] Early retirement has also a small effect on equivalized income. After age 65 drops a bit further but the rate of decline is still rather small.

The drop in income around retirement does not translate into a drop in non-durable consumption.[10] Hence, after correcting for household composition, nondurable consumption does not drop after retirement. These findings are quite different from Fernandez-Villaverde and Krueger (2007). Equivalizing income and nondurable consumption had, in their case, not a dramatic impact on the shape of the age profiles. According to their results, nondurable consumption per equivalent adult drops consideraby after age 50 (see Figure 5 of their paper). As compared with the US, the Netherlands has a rather generous pension system. Such institutional differences between the US and the Netherlands might affect consumption behavior differently. Although, on the

8 After a careful comparison of different scales, Fernandez-Villaverde and Krueger (2007) have decided to use an equivalence scale which is similar to ours.

9 Kalmijn and Alessie (2008) found a relationship between equivalized income and age which is very similar to the one presented in Figure 5. This is a comforting result because Kalmijn et al. use tax record data in their analysis. Contrary to survey data measurement error in administrative data is not so much an issue.

10 This is not true for a nondurable consumption measure which excludes housing. Even the drop in this consumption measure is rather small.

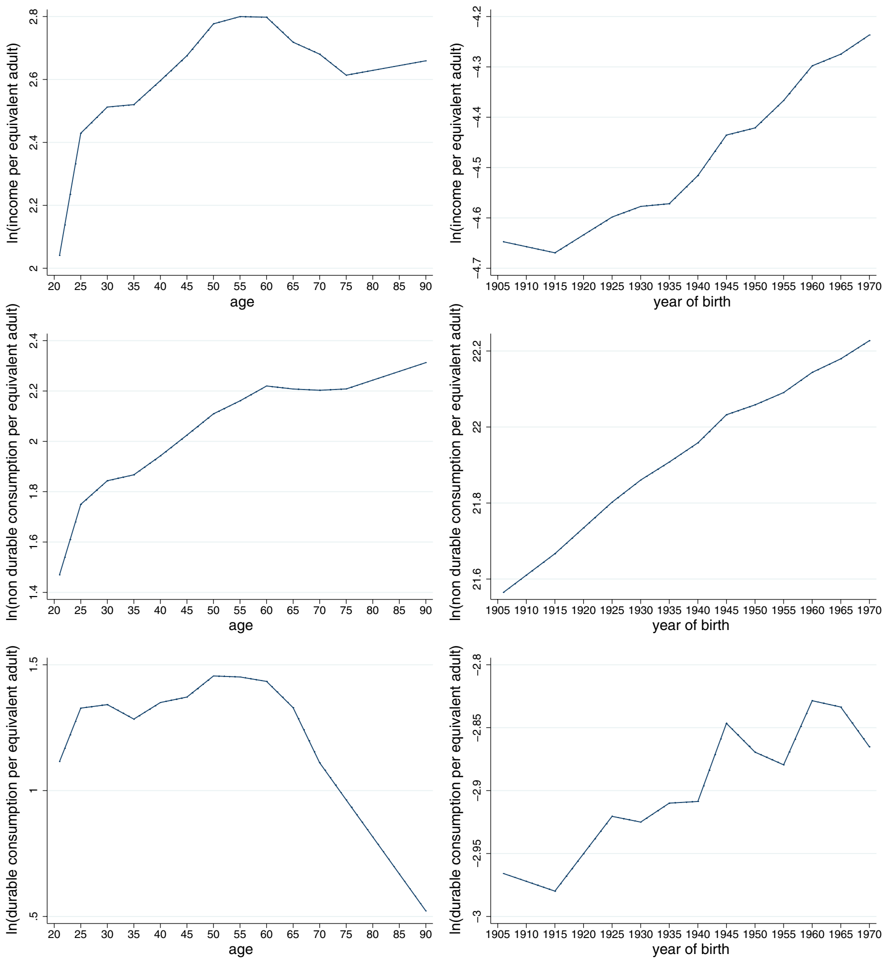

Figure 5 – Predicted *equivalent* income, non-durable consumption, and durable consumption as function of age and year of birth of the household head

basis of this evidence alone, we cannot exclude the possibility that other issues are at play here.

Very early in the life cycle (between age 21 and 25), durable consumption expenditures per equivalent adult rises sharply. This can possibly be attributed to binding liquidity constraints. From age 30 until 60 however, nondurable consumptions remains almost constant (it rises with a mere 10% over a period of thirty years). So, changes in household size are able to explain the hump in durable expenditures *up to* age 60. Yet, the drop in durable consumption *after* age 60 is striking. For as long as there is a consumption-retirement puzzle it seems to be related too consumer durables. Note however, that we do not observe the service flow of the stock of consumer durables, but merely expenditures.

Allowing for household composition above, also identifies an – intuitive – increase in the cohort profiles. Where we found negative cohort effects for durable expenditures per *household*, we find a positive cohort effect per *equivalent adult*. This is easily explained by the strong cohort effects in household size. Where, on average, household expenditures on durables decreased over generations, household size has decreased even quicker. The net effect is an increase of durable consumption per equivalent adult.[11]

4 EXPLAINING THE REST OF THE HUMP

Even after controlling for household demographics we still find that non-durable consumption seems to track income in the first phase of life, where durable expenditures stay constant. Then when income drops, durable expenditures drop as well. Yet, in this case non-durable expenditures remain unaffected. The next set of graphs show the participation rates (fulltime or part time) of the head of the household and the partner, respectively (Figure 6).

Here also we see a clear hump shape in both figures. (In addition we observe a slight dip around age 30 for the participation rate of the partner, perhaps reflecting the temporary decrease in participation rate to take care of young children at home.) We do not find cohort effects with the head of the household. For the partner (mostly women) we estimate that the participation rate picked up by about 0.2 (or 20% points) from the 1925 cohort to the 1965 cohort.

Not surprisingly the participation rate (for the head of the household) drops at about the age when income drops, i.e., around age 60. This indicates that at least part of the decline in durable expenditures is work related. It makes sense that after leaving the labor force, cars – an important durable item – are replaced less frequently. However, an equally valid explanation could be possible nonseparabilities between consumption and leisure. If durable consumption and leisure are substitutes an increase in leisure will lead to a decrease in consumption.

It is less straightforward to rationalize the fairly steep increase in non-durable consumption per equivalent adult. The usual suspects put forward in the literature are borrowing constraints, or intertemporal nonseparabilities (e.g., habit formation). Households are willing to borrow against future wealth, but banks would not lend them the money. However, fiercely binding

11 Note that we allow for household size in one specific way. If we allow for household size in a more flexible way we obtained similar results for non-durables and income (output available on request). A more flexible specification of household size eliminated the cohort effects for durables.

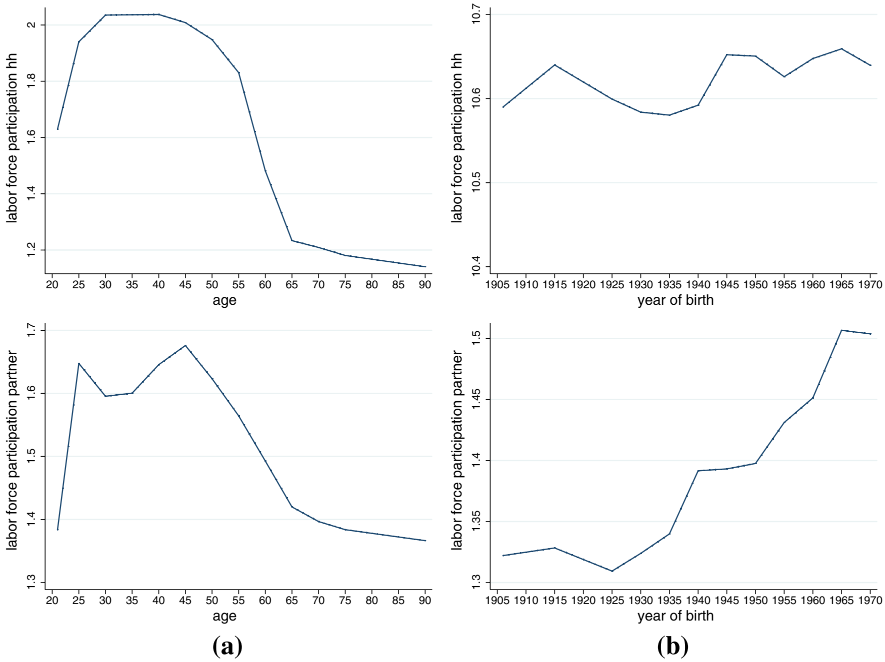

Figure 6 – Labor force participation rates as a function of (**a**) age (*left panels*) and (**b**) the year of birth (*right panels*). Household head (*top panels*), partner of household head (*bottom panels*)

liquidity constraints seems an incomplete explanation for this empirical phenomenon. A more intuitive explanation is that people form habits over the course of life. Consumption as a result, is worth less in marginal utility terms around age 50 than around age 20. In order to overcome this depreciation of consumption households find it optimal to slowly increase consumption over the life cycle. A third candidate is that young cohorts are simply too uncertain about how their income is going to develop. A precautionary mechanism induces households to *rationally* give up on the option to borrow against expected future income increases.

5 SUMMARY AND CONCLUSION

In this paper we have used Dutch data to document the age profiles of consumption, with special emphasis on the distinction between expenditures on durables and nondurables. We find that the relationship between (non)durable expenditures and age is clearly hump shaped with a top at age 45. The age profile of nondurable consumption changes dramatically when we account for changes in household demographics. Although after such a correction nondurable consumption does not decline after retirement, nondurable consumption seems to track income at the early stages of life cycle. These findings do not seem to be in line with the theoretical predictions of a standard life cycle model. In the previous section we have suggested some explanations for this finding but clearly more research is needed on this issue.

Like Fernandez-Villaverde and Krueger (2007) we find that durable consumption expenditures (per equivalent adult) drops sharply after retirement. In this paper we only provided some hints of how to explain this phenomenon. Over the last decade, several papers appeared interested in answering the question of why consumption expenditures drop at retirement. Those studies almost exclusively focus on nondurable consumption patterns. It seems worthwhile to extend this research by focussing on (the timing of) durable consumption (expenditures).

Finally it should be mentioned that our findings differ in some respects from those of Fernandez-Villaverde and Krueger (2007). Using US data, they report as one of their main results the similar timing and size in the humps for expenditures on nondurables and durables, even accounting for demographics. From Figure 5 it is abundantly clear that this is not the case in the Dutch context. An interesting research question is to what extent differences in the institutional environment, such as pension and health insurance systems, between the two countries could explain those differences.

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