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A Simple Model of Educated Hand-to-Mouth Consumers

Prosty model gospodarstw domowych typu *hand-to-mouth* z kapitałem ludzkim

Abstract

The main goal of this paper is to analyse the role of human capital in the incidence of *hand-to-mouth* (*HtM*) consumers: those who have no liquid resources. The proposed model is based on a two-asset model by **Kaplan, Violante and Weidner [2014]** with an extension to allow for endogenous accumulation of human capital and is confronted with empirical data on US households from the Survey of Consumer Finances (SCF). I show how the *HtM* status of consumers depends on their innate abilities, time preference and initial resources. *Wealthy HtM* households, i.e. households with illiquid resources but with little or no liquidity, are more able, more patient and initially richer than *poor HtM* households. As a consequence, they accumulate more human capital than *poor HtM* households. For both types of households, their status depends on having a steep income path, which is endogenous because of endogenous human capital accumulation. The correlation of observable characteristics with *HtM* behaviour may be of interest to economic policy makers: these consumers have a high marginal propensity to consume so that targeting them could increase the effectiveness of fiscal policy.

Keywords:
human capital, consumption, liquidity, hand-to-mouth, life cycle

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Streszczenie

Głównym celem niniejszego opracowania jest analiza wpływu kapitału ludzkiego na występowanie tzw. konsumentów typu *hand-to-mouth* (tj. konsumentów, którzy nie posiadają płynnych zasobów). Proponowany model oparty jest na modelu z dwoma aktywami, przedstawionym w pracy **Kaplan, Violante i Weidner [2014]**, z dodatkowym rozszerzeniem pozwalającym na endogeniczną akumulację kapitału ludzkiego i opiera się na danych Survey of Consumer Finances (SFC) dla gospodarstw domowych w USA. Pokazano, jak status konsumentów zależy od ich wrodzonych zdolności, preferencji czasowych i początkowych zasobów. Gospodarstwa domowe typu *wealthy HtM*, tj. gospodarstwa domowe z zasobami niepłynnymi, ale z niewielką płynnością lub zupełnie jej pozbawione, cechują się większymi wrodzonymi zdolnościami, większą cierpliwością i początkowo są one bogatsze niż gospodarstwa domowe typu *poor HtM*. W konsekwencji akumulują one więcej kapitału ludzkiego niż gospodarstwa domowe typu *poor HtM*. Dla obu typów gospodarstw domowych ich status zależy od posiadania stromej ścieżki dochodu, która jest endogeniczna z powodu endogenicznej akumulacji kapitału ludzkiego. Korelacja obserwowalnych cech z zachowaniem gospodarstw typu *HtM* może być interesująca dla polityki gospodarczej: konsumenci ci mają wysoką krań-

Słowa kluczowe:
kapitał ludzki, konsumpcja, płynność, *hand-to-mouth*, cykl życia gospodarstwa domowego

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cową skłonność do konsumpcji, więc ukierunkowanie na nie ekspansywnej polityki fiskalnej mogłoby zwiększyć jej efektywność.

Introduction

Consumption models in the spirit of Friedman, Modigliani and Hall have shaped the thinking about household consumption decisions at all possible time horizons (see **Browning and Crossley [2001]** for a survey on different aspects of life-cycle models). Nevertheless, the permanent income/life-cycle hypothesis is prone to some puzzles. One of them is "excess sensitivity" in the sense of an excessive response of consumption to expected changes in income in a situation where the theory predicts that the consumption response should be smoothed. Together with the fact that consumption/saving decisions do not react much to interest rate changes – see, e.g., **Campbell and Mankiw [1989]** – this suggests that many households do not satisfy their Euler equations because of liquidity constraints.

Standard incomplete market models, e.g. **Aiyagari [1994]** and **Huggett [1996]**, with ex-ante identical consumers that face uninsurable income shocks, can generate a fraction of the population that is liquidity constrained. Furthermore, there are saver-spender models, e.g. **Campbell and Mankiw [1989]** or **Gali et al. [2007]**, that assume two groups of consumers: one group that optimises in a forward-looking manner and another group that immediately consumes all income they earn. In both these types of models, a group of *hand-to-mouth* (*HtM*) households consumes everything they earn, yet both miss a significant fraction of *wealthy hand-to-mouth* households. These consumers are wealthy because they possess a positive stock of illiquid assets such as housing, often considerable in size, but at the same time they are constrained in terms of liquidity.

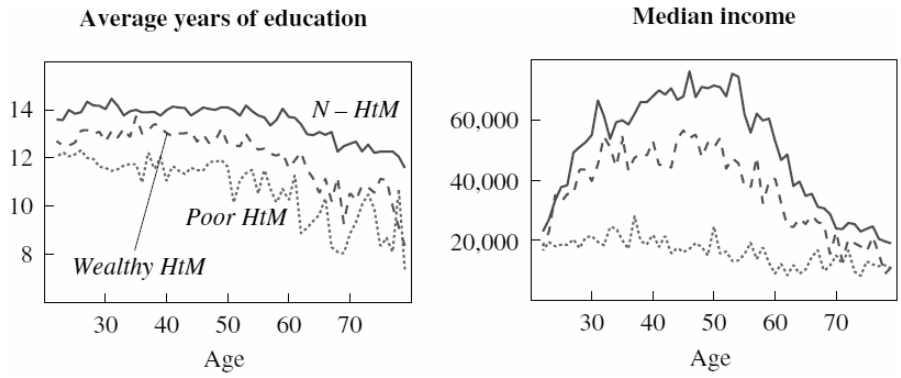
The existence of *wealthy hand-to-mouth* households (*wHtM*) is the main focus of **Kaplan and Violante [2014]** and **Kaplan, Violante and Weidner [2014]**. The authors suggest a model in which there are two types of assets: liquid ones, and illiquid ones with a higher rate of return. Based on a wide battery of robustness checks, the authors document that about a third of consumers in the United States are hand-to-mouth, out of which two-thirds are *wealthy HtM*, i.e. those that consume all their current income but at the same time have a strictly positive stock of illiquid assets such as housing. Ignoring such a group of consumers would lead to spurious conclusions on the effects of fiscal policy as *wealthy hand-to-mouth* households, in comparison with other households, exhibit a particularly high marginal propensity to consume (MPC). This group of households is crucial for fiscal policy, whose effectiveness for stimulating aggregate demand depends on correctly targeting transfers or tax rebates to groups with a high MPC.

A fundamental question from both a policy and theoretical perspective is the reason for the existence of *wealthy-hand-to-mouth* consumers. Possible explanations, mentioned in **Kaplan, Violante and Weidner [2014]**, include specific preferences or exogenous characteristics of buying some types of goods such as houses; idiosyncratic bad shocks such as health problems; job loss; and, finally, poor ability to plan expenses and foresee income. Another potential reason for the incidence of *wealthy hand-to-mouth* households is related to the accumulation of human capital over the life cycle. The idea of this paper is to analyse potential explanations, with a focus on the human capital channel so that the characteristics of *wealthy-hand-to-mouth* consumers can be precisely pinpointed.

Although *wealthy HtM* households share some important features with poor HtM households, such as similar fertility, besides being illiquid, they are also similar in some respects to *non-hand-to-mouth* (*nHtM*) households, for example in terms of the probability of having an unemployed member of the household or the probability of receiving social benefits. The most distinctive differences between *poor HtM*, *wealthy HtM* and *nHtM* households are their income and education, which are monotonically increasing between these groups (see Figure 1). Especially this last difference is interesting and its magnitude means that the seminal model in **Kaplan and Violante [2014]** is worth extending by endogenizing educational attainments and labour income, which is the main purpose of this paper.

The modelling of educational decisions in the style of **Ben Porath [1967]**, **Huggett et al. [2006]** and **Huggett et al. [2011]** in the two-asset Kaplan-Violante framework is expected to provide us with answers to the question about the differences in human capital across the different consumer types depicted in the left panel of Figure 1 and, together with the labour supply, about the differences in income depicted in the right panel of the figure. Altogether, this analysis of the endogenous current and expected income of a consumer should shed further light on the incidence of *hand-to-mouth* behaviour.

Figure 1. Education and income in various types of households (education is a value for heads of households)



Source: **Kaplan, Violante and Weidner [2014]**.

There are many potential channels of causality that are presumed to be involved in interdependencies between education and *HtM* status. The accumulation of large stocks of human capital increases the steepness of earnings over the life cycle and thus magnifies the incidence of liquidity constraints. Moreover, expenses on human capital may be affected by liquidity constraints. Lastly, educational expenditures can imply different timing of other expenditures, particularly those related to mortgages.

This analysis treats human capital as another type of asset with a given rate of return. An agent chooses a portfolio composition that consists of liquid and illiquid assets and also of human capital. Different characteristics of these three types of assets are relevant for the portfolio choice. Obviously, the relative rates of return on all these assets are important, but other features are also significant. Human capital is inalienable and yields a return only through exerting labour effort. Furthermore, human capital cannot be made liquid, while illiquid assets such as housing can be sold at a transaction cost. Finally, the use of human capital as collateral for credit is more limited than for illiquid assets such as housing.

Nevertheless, human capital can be analysed as an asset mainly because it earns a return that can be compared with returns on other assets. Furthermore, a decision to accumulate more education is also an economic decision that contains a cost-benefit analysis, similar to decisions about financial investments. Most recently, **Huggett and Kaplan [2015]** treated human capital as a financial asset.

It is interesting for several reasons to endogenize educational decisions and income while maintaining the general two-asset framework proposed by **Kaplan and Violante [2014]**. The main reason is that this makes it possible to capture the relevant dimension of consumer characteristics as documented in Figure 1. In view of the observed heterogeneity in the population (analysis of such heterogeneity in the context of macroeconomic modelling is discussed in **Heathcote et al. [2009]**, including comments about educational attainments), this additional dimension will help answer important theoretical and policy questions, especially because decisions about human capital formation affect a wide spectrum of socio-economic outcomes – see, e.g., **Card [1999]** and **Bhuller et al. [2014]**. Applications of the two-asset incomplete market model with endogenous human capital and income can be interesting from both the theoretical point of view and an economic policy perspective:

- Fiscal policy was the main motivation for **Kaplan and Violante [2014]** and **Kaplan, Violante and Weidner [2014]** as, according to their analysis, *wealthy HtM* households exhibit the highest MPC. These households are difficult to discern as they share socioeconomic characteristics with households showing lower MPC

values. The most unambiguous feature of *wealthy HtM* is the high probability of having a mortgage loan, yet it is politically difficult to target expansive fiscal policy on mortgage-indebted households. Investigating the role of human capital could potentially reveal other discernible characteristics of the group with a high MPC. Therefore, it could lead to policy implications that are more politically feasible.

- Life-cycle models offer a coherent framework for analysing life-time choices; see e.g. **Browning and Crossley [2001]**. The theory should not abstract from decisions on accumulating human capital and various types of physical assets as these choices are linked and shape consumption patterns over the life cycle.

The rest of this paper is organised as follows. Section 2 contains a descriptive statistical analysis of US households with respect to their *hand-to-mouth* status and their asset portfolio composition. Section 3 presents a stylised three-period model of *hand-to-mouth* behaviour with human capital accumulation. Section 4 shows a partial analytical solution to the model, while Section 5 describes numerical results of the consumer optimisation problem. Finally, Section 6 concludes.[1]

Analysis of survey data on US households

This section presents an analysis of Survey of Consumer Finances (SCF) data on US households and their asset portfolio composition. Special attention is given to the demographic and economic characteristics of different household types. The analysis builds on **Kaplan, Violante and Weidner [2014]**, but extends their paper in two dimensions. First, it uses the newest data from the 2010, 2013 and 2016 waves in order to establish the robust ness of the *hand-to-mouth* phenomenon across time in the post-crisis reality, while Kaplan, Violante and Weidner (KVW) use waves of the SCF from 1989 to 2010. Second, the analysis attaches more importance to human capital accumulation decisions by exploring student loans. In order to maintain the comparability of results, all definitions are identical as in KVW.

Defining *wHtM*, *pHtM* and *nHtM* households in the data

Methodology In order to define household types we need data on household income y, liquid assets m and illiquid assets a. The definitions are given as follows: *wHtM* households do not have liquid assets m but have a positive stock of illiquid assets a; *pHtM* households have neither liquid assets m nor illiquid assets a; and *nHtM* consumers have positive stocks of liquid assets m. More formally, *hand-to-mouth* status can show up at two kinks of the intertemporal budget constraint: at zero liquid assets or at the credit limit. The stock of liquid assets should be measured at the end of a pay period so that it is clear if a household can move liquid wealth between periods or it is at its kink. Unfortunately, the SCF reports balances at some random dates (dates of interview), which means that measuring household types needs further assumptions that may introduce a measurement error.

As KVW, we assume that households receive their income discretely and they consume continuously over the whole pay period at a constant rate. We abstract from discrete consumption commitments such as rent, mortgage, loan and alimony payments. Equivalently, we assume they are incurred in the middle of the pay period or are incurred smoothly. The liquid resources of a *hand-to-mouth* household peak at payday at the value of y and are depleted to zero (or to the credit limit) at the end of the pay period. Average liquid holdings within the pay period equal $y/2$ due to the constant rate of consumption. Then, hand-to-mouth households are those whose liquid wealth is positive and lower or equal to half their income (households at the zero kink) or whose liquid wealth is negative and lower or equal to half the income plus the credit limit (households at the credit constraint kink). Formally, *wHtM* and *pHtM* households are defined as follows:

- *wHtM* at the zero kink: $a > 0$ and $0 \leq m \leq y/2$
- *wHtM* at the credit constraint kink: $a > 0$ and $m \leq 0$ and $m \leq y/2 - \underline{m}$

[1] Moreover, the Appendix, which is available upon demand, contains formal derivations and details of the theoretical and empirical models presented in the paper.

- *pHtM* at the zero kink: $a \leq 0$ and $0 \leq m \leq y/2$
- *pHtM* at the credit constraint kink: $a \leq 0$ and $m \leq 0$ and $m \leq y/2 - \underline{m}$

Effectively, variable m depicts average liquid wealth. Variable m is the credit limit for a given household. The pay period is set to two weeks and the credit limit is equal to monthly income. As KVW point out, the criteria presented above are conservative and give a lower limit on *hand-to-mouth* incidence. The reason is that households that start a given period with any liquid wealth above the kink at zero or above the credit limit kink but end the period exhausting all possible liquid resources, carry average liquid holdings above the limits listed above. All other households are called *non-hand-to-mouth*.

Unlike KVW, who treat all *nHtM* consumers identically, we differentiate in our statistical analysis between *poor nHtM* (*pnHtM*), who have negative or zero illiquid assets, and *wealthy nHtM* (*wnHtM*) households, who have strictly positive illiquid assets. Both consumer types are not expected to differ in their MPC out of transitory income shocks as both have positive stocks of liquid assets implying that they are not at their budget/liquidity constraints. Nevertheless, they may differ systematically in their socioeconomic characteristics or in phases of the life cycle in which given household types typically occur. This last feature is fundamental in view of the analysis of human capital accumulation over the life cycle and it warrants differentiation.

Negative positions in illiquid assets a, both in the case of *HtM* and *non-HtM* households, are rare. These positions occur as a result of decreasing house prices, which push house values below the residual values of mortgage loans. Although these consumers own illiquid assets (houses and flats), they cannot use them to smooth consumption and, therefore, they resemble *poor HtM* or *poor nHtM* households and they are counted as such.

Income Income y is defined as the sum of all annual labour income and other income including self-employment income, pension income, government benefits (SSI, food stamps, unemployment benefits etc.), private transfers such as alimony and other sources of regular income other than investment income. The exclusion of interest, dividend and other capital income is dictated by its irregular character that may not be captured by SCF correctly.

Liquid wealth Liquid assets are the sum of checking, saving, money market and call accounts, mutual funds, stocks, corporate and government bonds. SCF data does not contain information on cash holdings. Therefore we have to use an imputation method, which is used by KVW and which is based on data from the Survey of Consumer Payment Choice (SCPC). We use the 2010, 2013 and 2015 editions to match them with the corresponding SCF waves (SCPC 2016 edition is not available). The imputation implies computation of the ratio of average cash holdings taken from the SCPC to the median holdings of checking, saving, money and call accounts from the SCF. Then, the aforementioned holdings of assets are inflated by the computed ratio. The cash holdings in 2016 dollars were 150, 236, 204 in 2010, 2013 and 2016 respectively, resulting in imputed cash ratios of about 1.05, 1.07 and 1.05 respectively.[2] Liquid wealth is equal to liquid assets minus liquid debt, which contains credit card and instalment debt.

Illiquid wealth Illiquid assets are defined as the sum of housing residential and non-residential real estate, private retirement accounts, life insurance, certificates of deposits and saving bonds. Illiquid wealth is the sum of illiquid assets net of mortgage debt. Similarly as in the baseline calculation method in KVW, illiquid wealth does not contain wealth in vehicles or student loans.

Sample selection All the graphs and statistics in the paper use a subsample of the SCF households in which the household head is between 22 and 79 years of age. In order to maintain comparability with KVW, we drop households with negative income and those whose income entirely comes from self-employment. Standard SCF weights, calculated to account for the over- sampling of certain households groups, non-responsiveness and hiding the identity of certain households, are applied to construct all statistics.

[2] The average cash holdings in SCPC are computed without taking into account the largest 2% of the holdings. This is motivated by the existence of a relatively limited number of households saving predominantly in cash. Their behaviour distorts the average values of cash holdings.

Results

Introduction This section provides descriptive statistics on the *hand-to-mouth* phenomenon. By comparing the results with KVW, we analyse the potential volatility of *HtM* households before and after the 2008 crisis. In all the graphs we depict weighted mean or median values that are calculated from pooled data combining the SCF 2010, 2013 and 2016 waves. All the financial variables are in 2016 US dollars and the age pertains to the head of the household. Graphs showing fractions of financial assets, net primary housing and retirement accounts to liquid and illiquid wealth are trimmed, eliminating the 0.1 percent of the largest and smallest values of a given variable to reduce sensitivity to outliers. All the fractions are (weighted) mean fractions. In order to smooth the graphs visually, a rolling mean is applied to all the raw statistics. The rolling mean is defined in the following way: $\beta_{age} = (b_{(age-1)} + b_{age} + b_{(age+1)})/3$, where b is the original raw value.[3] Finally, we compute statistics only if the sample is large enough to draw meaningful conclusions, which is relevant for older households in the analysis of mortgage and student debt.

Table 1. Household income, liquid and illiquid wealth holdings and portfolio composition in SCF 2010, 2013 and 2016 data. Cash accounts stand for cash, checking, saving, call & MM accounts. Bonds and stocks are directly held bonds and stocks

	median	SCF2010 mean	fraction positive	median	SCF 2013 mean	fraction positive	median	SCF 2016 mean	fraction positive
income	53,350	86,175	100%	51,154	86,037	100%	54,682	96,353	100%
net worth	68,565	387,935	87.8%	68,563	394,022	88.6%	82,066	469,024	89,7%
liquid wealth	1,860	101,151	73.0%	2,281	110,495	76.1%	2,628	147,719	74.7%
illiquid wealth	63,556	286,781	77.5%	61,609	283,527	76.0%	73,000	321,305	78.1%
net housing	26,528	109,410	61.0%	24,747	104,245	59.7%	33,000	119,021	61.6%
mortgage debt	0	83,963	49.4%	0	73,840	45.4%	0	69,519	43.6%
cash accounts	3,034	32,381	91.4%	3,639	34,589	91.9%	4,204	39,358	91.9%
credit card debt	0	3,267	41.3%	0	2,399	40.1%	0	2,653	46.0%
stocks	0	30,255	14.7%	0	36,089	13.9%	0	39,030	13.7%
bonds	0	9,031	1.5%	0	7,719	1.3%	0	7,745	1.1%
mutual funds	0	32,752	8.2%	0	34,497	8.0%	0	64,239	9.6%
retirement funds	1,990	97,752	52.9%	1,031	107,457	52%	2,000	120,277	53.7%
net car wealth	10,722	16,793	86.5%	10,105	10,105	85.2%	9,596	15,678	83.1%
life insurance	0	5,824	19.0%	0	7,010	18.7%	0	6,328	18.8%
student loan	0	5,783	20%	0	6,470	21.1%	0	8,133	23.5%

Source: Own calculations.

Aggregate portfolio composition Table 1 lists basic statistics on income and the portfolio composition of US households across the post-crisis years. The SCF data clearly shows the repercussions of the crisis: a stagnation, or even decrease, of mean and median income and net worth between 2010 and 2013. The latest wave in 2016 confirms recovery, but it was accompanied by slightly rising inequalities, as the mean to median ratios of income and net worth increased from 1.62 and 5.66 respectively in 2010 to 1.76 and 5.72 respectively in 2016. Another noticeable fact is a clear deleveraging of mortgage debt. The household portfolio composition has not changed significantly in comparison to the SCF 1989–2010 data presented by KVW. The largest component of the net wealth of the median household is housing, with all the financial assets except the retirement accounts being zero.[4] Finally, the increasing mean amount and incidence of student loans, already noted as a long-run trend in **Brown et al. [2014]**, are confirmed by the newest SCF data.

[3] For the first and last observation in a series we use directly their raw values: $\beta_{22} = b_{22}$ and $\beta_{79} = b_{79}$.

[4] The distribution of wealth is far from symmetric, with the mean values significantly surpassing the median values.

***HtM* and *nHtM* incidence** Using the definitions listed in the preceding section, we can compute the incidence of different household types, as shown in Table 2. The *hand- to-mouth* phenomenon is rather stable and robust across time. Despite being hit by a large economic crisis, the proportion of *HtM* households has not changed dramatically. It hovers around 30% of all households, which is similar to the pre-crisis levels reported by KVW. A small decline in the number of *HtM* consumers may be caused by the deleveraging of mortgage debt as debt is highly correlated with *HtM* status (see KVW for a discussion). The ratio of *wealthy* to *poor HtM* consumers is 1.5 to 1 and is stable in both the pre- and post-crisis periods.

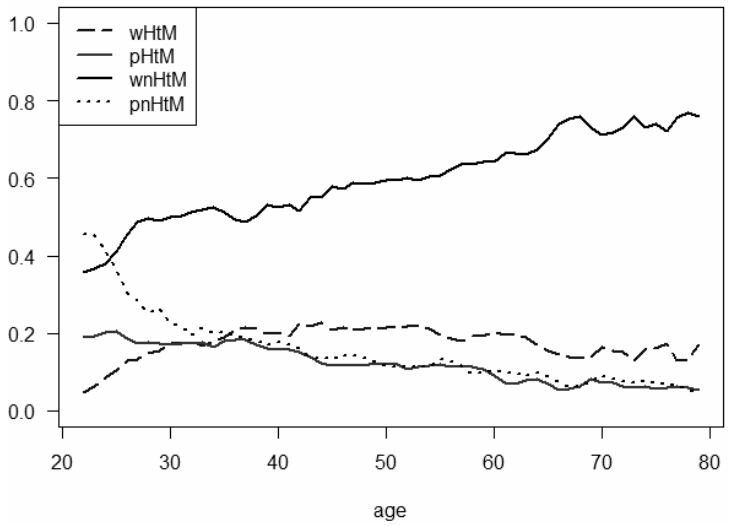
The table also contains additional groups of households: the *wealthy nHtM* and the *poor nHtM*. The *pnHtM* are those who have simultaneously liquid wealth with zero or negative illiquid wealth and the *wnHtM* are those who have both positive liquid and illiquid wealth stocks. The *poor nHtM* consumers form a small fraction of the *nHtM* households, about 15% of them.

Table 2. Incidence (fraction) of different household types in SCF 2010, 2013 and 2016 data

	SCF 2010	SCF 2013	SCF 2016
HtM	32.3%	30.2%	28.6%
wHtM	19.7%	17.3%	17.2%
pHtM	13.0%	12.9%	11.4%
nHtM	67.3%	69.8%	71.4%
wnHtM	57.7%	58.8%	60.9%
pnHtM	9.4%	11.0%	10.5%

Source: Own calculations.

Figure 2. Incidence (fraction) of different household types conditional on age. Pooled SCF 2010, 2013 and 2016 data



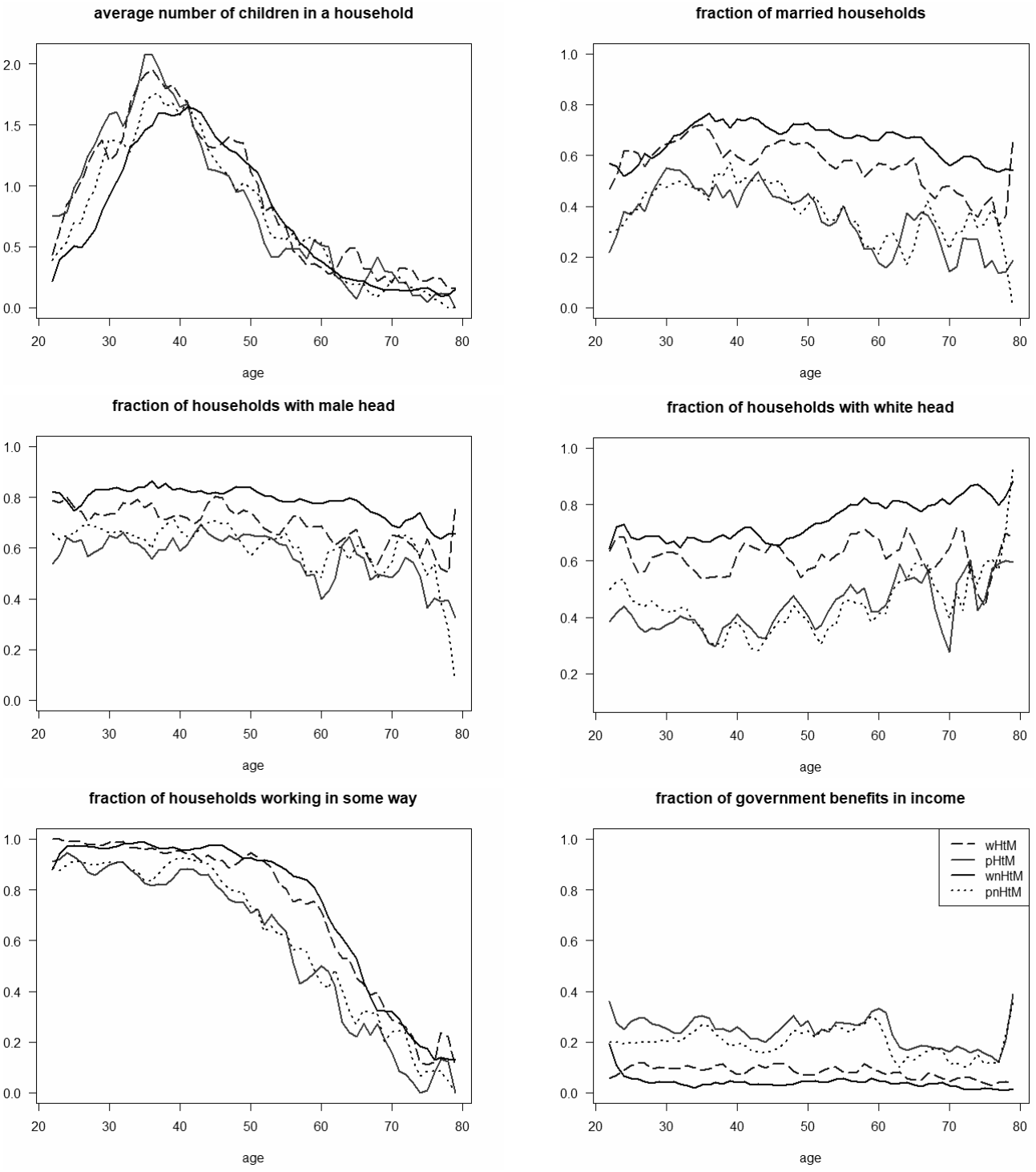
Source: Own calculations.

Figure 2 depicts the incidence of all household types conditional on age. The qualitative results regarding the *wHtM*, *pHtM* and *nHtM* incidence are nearly identical to those in KVW. The *poor HtM* status is monotonically decreasing with age, while the probability of having *wealthy HtM* status increases at the beginning of the life cycle and peaks at around 40 years of age only to decrease later. One difference between the post- and pre-crisis data is that both graphs are less steep, i.e. the *pHtM* starts at a level of around 20% instead of 30% and decreases at a slower pace. The same applies to the incidence of *wealthy HtM* households, which peaks at about 20%, about 5 pp lower than in KVW, but then decreases more slowly. The percentage of *wealthy nHtM* consumers increases monotonically through all age groups whereas the incidence of *poor nHtM* decreases

monotonically. The dynamics of *poor nHtM* status differs through age as it decreases much faster between 22 and 30–35 years of age and after that its dynamics resembles that of poor HtM consumers.

Demographic and social characteristics The most important sociodemographic indicators of all the household types are depicted in Figure 3.[5]

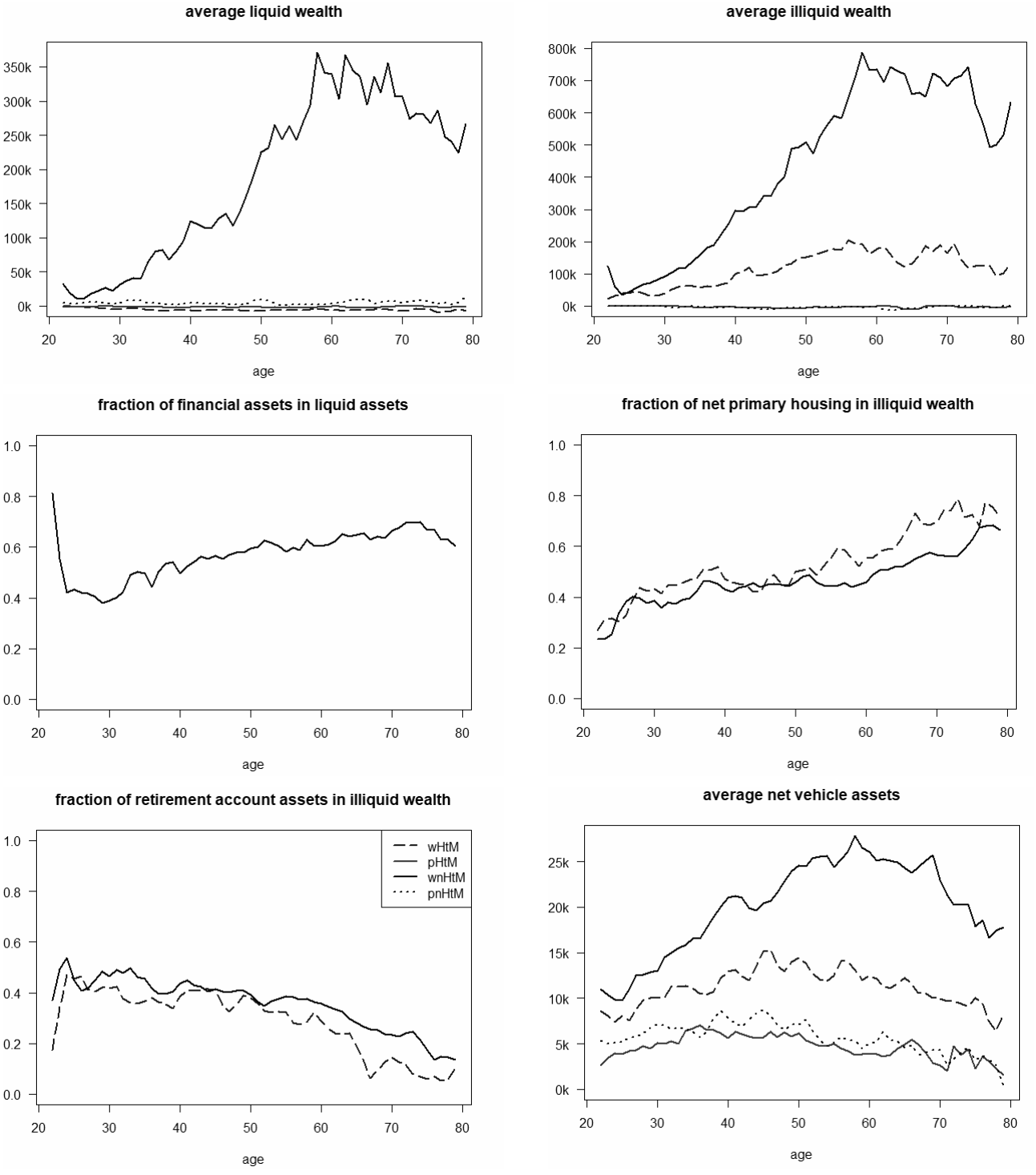
Figure 3. Demographic and social characteristics of different household types conditional on age. Pooled SCF 2010, 2013 and 2016 data



Source: Own calculations.

[5] "Working in some way" means working full-time, part-time or being self-employed. Government benefits do not contain pension benefits.

Figure 4. Wealth portfolio composition of different household types conditional on age. Pooled SCF 2010, 2013 and 2016 data



Source: Own calculations.

It is particularly noteworthy that in all the graphs, with the exception of the average number of children in a household, the *poor nHtM* and *poor HtM* are virtually identical across all age groups. The *wealthy nHtM* households differ considerably in all categories from the *poor HtM* /*nHtM* consumers. They have fewer children, are more often married, the head of the household is more often white and male, and they work more often, claiming less in benefits. The *wealthy HtM* represent intermediate positions in all categories but they resemble the *poor HtM* in terms of the average number of children. Moreover, they work with the same probability as the *wealthy nHtM*.

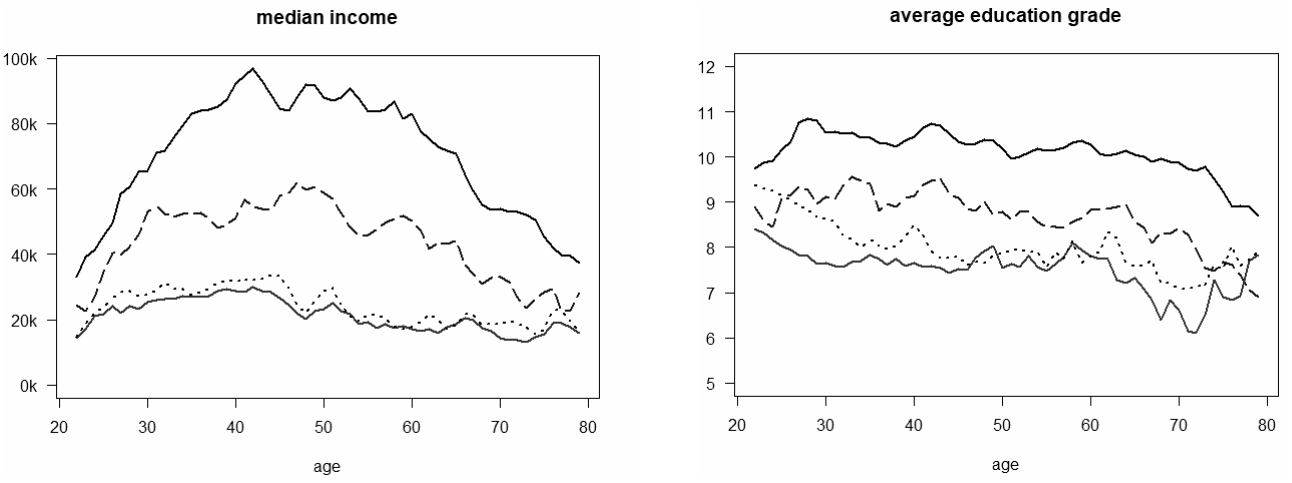
Portfolio characteristics The graphs in Figure 4 show various parts of the portfolio composition. Like in the other figures, qualitative differences between the post- and pre-crisis data are immaterial. It is particularly important to note that *poor nHtM* consumers own little liquid wealth although they fulfil the condition to be listed as *non-hand-to-mouth*. Obviously, as an immediate consequence of the definition, they do not have any positive illiquid wealth, thus resembling the *poor HtM*. A striking fact in the comparison with the pre-crisis data is the larger stock of mean liquid wealth, which is mainly due to an increase in the value of the stock of financial assets among the richest households. Simultaneously, median liquid asset wealth peaks at USD 20,000–25,000 and the median holdings of illiquid wealth reach maximally USD 300,000. The average values of net assets in vehicles point out the similarity between the poor HtM and poor nHtM and show that the portfolio position in net vehicles of the wealthy HtM is between these two groups and the wealthy nHtM.

Income, education and credits Figure 5 shows that the *poor nHtM* and *poor HtM* are similar in terms of their income and education grade[6] conditional on age. The only exception is the educational grade before 30–35 years of age, which is systematically larger for the *poor nHtM*. The shape of the income paths indicates that the *pHtM* and *pnHtM* are more likely to expect stagnating income in the future, conditional on staying in their current household type, whereas the *wHtM* and *wnHtM* have a much steeper income path. Qualitatively, Figure 5 does not exhibit any differences with Figure 1, which presents KVW results.

The right side of Figure 6 delves into the size and incidence of student loans. Contrary to the relationships depicted in the other figures, student loans are most relevant for young age groups. Although the *poor nHtM* resemble the *poor HtM* with respect to the probability of having a student loan, the average size of their loans is larger than for the *wHtM*. As with most other characteristics, the *wnHtM* are distant from other households, exceeding them in terms of both loan size and probability. The *wHtM* are nearly identical to the *wnHtM* with their probability of having educational debt, but its size is smaller on average.

The left side of Figure 6 presents statistics on mortgage credit. The revealed patterns suggest that there are two distinct groups of households when it comes to the probability of having a mortgage loan: the *poor HtM* and *poor nHtM* are much less likely to have such a liability than the *wealthy HtM* and *wealthy nHtM*. The difference between the *wealthy* types of households emerges in the average size of credit, which is larger for the *wealthy nHtM*. Due to the smaller sample size, it is difficult to draw conclusions from volatile data on average liabilities among indebted *poor* households.

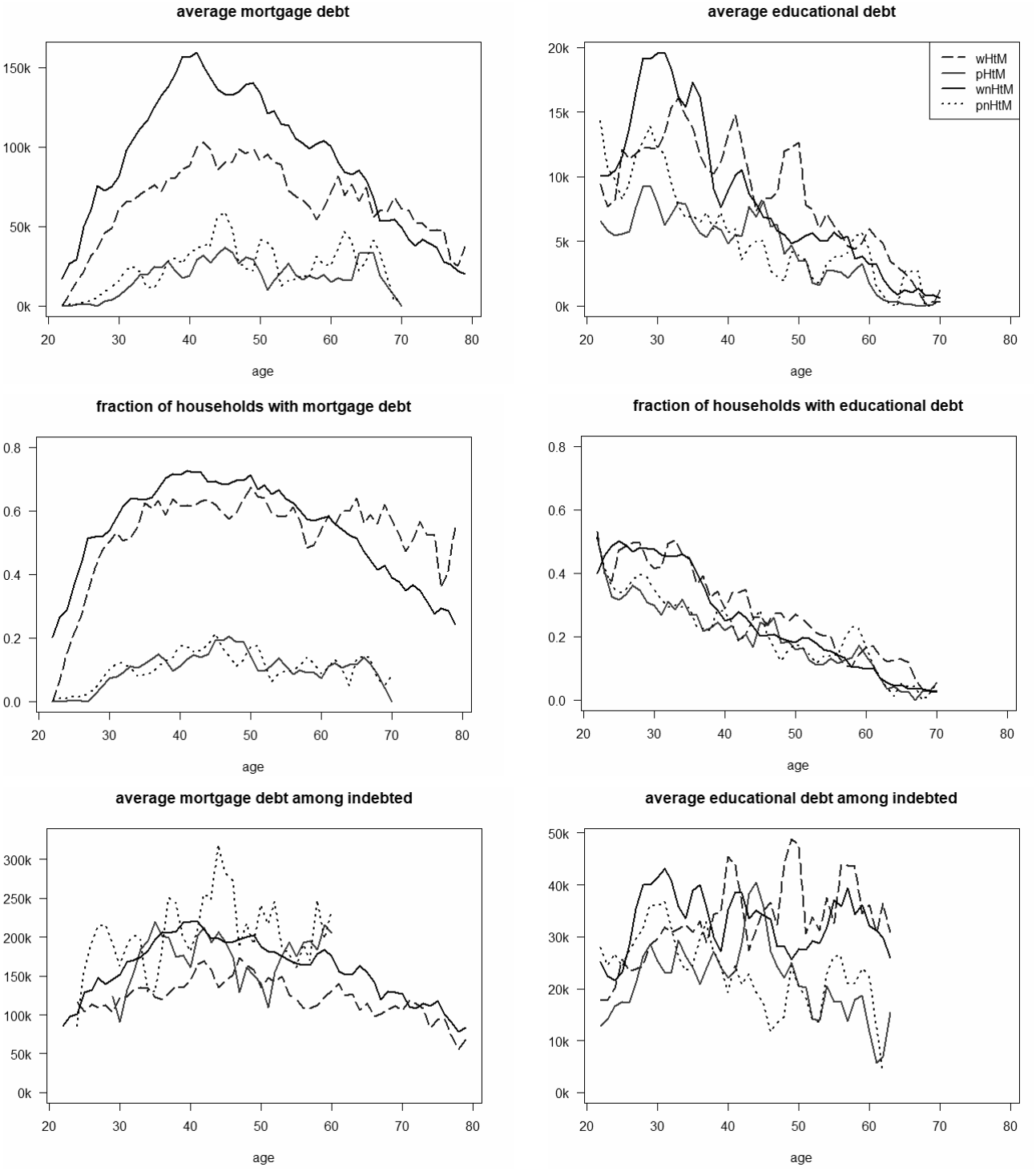
Figure 5. Income and education of different household types conditional on age. Pooled SCF 2010, 2013 and 2016 data



Source: Own calculations.

6 The education grade in the graph is a qualitative indicator of educational level. Values below 8 mean different years of completed primary or high school education; 8 means high school diploma; 9 is college without a degree; 10 and 11 are vocational or academic college programmes; 12 is a bachelor's degree; 13 is a master's degree; and 14 is a Ph.D. degree.

Figure 6. Mortgage and student debt characteristics of different household types conditional on age. Pooled SCF 2010, 2013 and 2016 data



Source: Own calculations.

Transitions between household groups The SCF data set is not a panel but a repeated cross-sectional survey. This makes it impossible to trace households over time and directly analyse the dynamic evolution of their *hand-to-mouth* status. KVW use the available SCF panel data between 2007 and 2009 to measure the probability of transition between the *pHtM*, *wHtM* and *nHtM*. Table 3 displays their results and shows that wHtM status is the most transitory, with about 45% of such households becoming *nHtM* after two years. The *pHtM* were less likely to change their type to *nHtM* (only a third underwent such a transition), and non-hand-to-mouth status was the most stable one.

Table 3. Transition matrix between household types for years 2007–2009 based on the Panel of the SCF. Each number is a fraction of a given row type in 2007 being a given column type in 2009.

07 → 09	*wHtM*	*pHtM*	*nHtM*
wHtM	45.5%	10.1%	44.4%
pHtM	12.7%	54.8%	32.6%
nHtM	12.9%	5.5%	81.6%

Source: **Kaplan, Violante and Weidner [2014]**.

Conclusions The statistical analysis of the empirical data leads to the following conclusions. First, *hand-to-mouth* behaviour is a stable and robust phenomenon. The latest, post-crisis data does not qualitatively change any results of KVW regarding the incidence, demographic characteristics or portfolio composition. Any existing differences are quantitative in nature, comprising the effects of housing deleveraging and an increased value of stocks of financial assets.

Second, the statistical analysis contributed to a better understanding of the interdependencies between student loans and human capital accumulation, on the one hand, and *hand-to-mouth* status, on the other. The analysis required a further division of households: *non-hand-to-mouth* consumers were divided into the *poor* and the *wealthy* ones. In groups above 35 years of age, the *poor nHtM* almost perfectly resemble the *poor HtM* (although in some sociodemographic statistics they resemble them even earlier), which is intuitive in view of the fact that the *hand-to-mouth* definition we use is rather liberal and some truly *poor HtM* households with no liquid or illiquid assets may be considered as *poor nHtM*. Moreover, a small fraction of the *poor nHtM* are those whose mortgage surpasses the value of housing, implying a negative stock of illiquid assets. Among the youngest households below 30 years of age, the *pnHtM* are consumers who have large student loans, comparable to those of *wealthy HtM* or even *wealthy nHtM*. It seems that over time *poor nHtM* consumers turn into *wealthy HtM* (possibly by taking out a mortgage loan) or straight into *wealthy nHtM* consumers. The group of *wealthy HtM* consumers is intermediate as it has a similar probability of having a student loan as the *wealthy nHtM* and the average size of a loan among the indebted is between the values represented by the *wnHtM* and *pHtM*.

Explaining the household problem: exposition of the model

In order to show that wealthy and poor educated consumers may exhibit *hand-to-mouth* behaviour and to track what consumer characteristics drive this kind of behaviour, it is useful to take a look at a simple three-period model with endogenous investment in human capital. The model is an extension of that developed by **Kaplan, Violante and Weidner [2014]**.

Let us consider a three-period model, $t \in \{0, 1, 2\}$, in which a consumer maximises his utility from consumption in the intermediate and final periods by making decisions about portfolio allocation (in the initial period) and consumption and the labour supply (in the intermediate and final periods). As in KVW, we assume that in the initial period the consumer does not consume and makes the decision only about the division of the initial resources ω (which are assumed to be strictly positive, $\omega > 0$). The consumer decides whether to invest resources in liquid assets m_1, which can be consumed in intermediate period 1, and illiquid assets a, which can be consumed only in final period 2. Illiquid assets such as housing and pension savings earn interest factor $R > 1$, while liquid assets have an interest factor that is normalised to 1. Moreover, illiquid assets, a considerable part of which is housing (see the empirical analysis in KVW), generate direct utility in both periods, as, for example, in **Kaplan and Violante [2014]**. A novelty in comparison to the KVW model is the possibility of investment in human capital h, which generates income in both periods through production function $A \cdot f(h, l_t)$. The human capital has the properties of an asset but it exhibits certain distinctive features: it is more difficult to use as collateral than an illiquid asset and it only generates resources if labour effort l_t is exerted, which generates disutility because of a loss of leisure. The parameter A is interpreted as the innate ability affecting the productivity of an individual.

Formally, the agent's maximisation problem is:

$$\max_{c_1,c_2,l_1,l_2,a} \quad u(c_1,l_1,a)+\beta\cdot u(c_2,l_2,a), \quad \beta>0$$

$$s.t.$$

$$c_1 = A\cdot f(h,l_1)+m_1-m_2$$

$$c_2 = g\cdot A\cdot f(h,l_2)+m_2+R\cdot a$$

$$\omega = m_1+a+h$$

with $c_1 \geq 0$, $c_2 \geq 0$, $l_1 \geq 0$, $l_2 \geq 0$, $m_1 \geq 0$, $m_2 \geq 0$, $a \geq 0$, $h \geq 0$, $\omega > 0$, $A > 0$. Households cannot take any debt.[7] The parameter $g \geq 0$ models the possibility of having an earnings path that is not constant over the life cycle – if $g > 1$, then the labour income path is increasing, ceteris paribus. β is the standard patience parameter. For simplicity, we assume that human capital and illiquid assets do not depreciate at all.

Schematically, the model can be depicted as follows:

	initial period	*intermediate period*	*final period*
	$t=0 \longrightarrow$	$t=1 \longrightarrow$	$t=2$
decisions :	$a,\ h,\ m_1$	$m_2,\ l_1$	l_2
production :		$A\cdot f(h,l_1)$	$g\cdot A\cdot f(h,l_2)$
utility :	$u(c_1,l_1,a)+\beta u(c_2,l_2,a)$	$u(c_1,l_1,a)+\beta u(c_2,l_2,a)$	$u(c_2,l_2,a)$
consumption :		$\underbrace{A\cdot f(h,l_1)+m_1-m_2}_{c_1}$	$\underbrace{g\cdot A\cdot f(h,l_2)+m_2+Ra}_{c_2}$

The utility and production functions are assumed to fulfil the following conditions[8] for $t \in \{1,2\}$ and for all combinations of $\{h, l_t\}$ with $h > 0$ and $l_t > 0$:

$$u_{c_t}(c_t,l_t,a)>0, \quad u_{c_tc_t}(c_t,l_t,a)<0,$$

$$u_{l_t}(c_t,l_t,a)<0, \quad u_{l_tl_t}(c_t,l_t,a)<0,$$

$$u_a(c_t,l_t,a)>0, \quad u_{aa}(c_t,l_t,a)<0$$

$$f_h(h,l_t)>0, \quad f_{hh}(h,l_t)<0,$$

$$f_{l_t}(h,l_t)>0, \quad f_{l_tl_t}(h,l_t)<0,$$

$$f_{l_th}(h,l_t)=f_{hl_t}(h,l_t)>0$$

---

7 This simplifying assumption can be obviously relaxed by introducing a borrowing limit, without changing the results qualitatively. Potentially, households could borrow against some of their future labour earnings or their illiquid assets. The empirical data shows negative positions not only of liquid but also illiquid assets. The latter arise because of negative shocks to house prices, which results in mortgage credit surpassing house values. The model abstracts from such phenomena and does not allow for negative stocks of illiquid assets.

8 Throughout the text partial derivatives are written like this: $\partial^2 f(x,y)/\partial x\partial x = f_{xx}(x, y)$. Sometimes, the arguments of a function are dropped to conserve space and make the text more readable, using the notation $f_{xx}(x, y) = f_{xx}$. Note also that, for example, u_{c1} pertains to $u_{c1}(c_1, l_1, a)$ and not to $u_{c1}(c_2, l_2, a)$.

Both production factors are necessary for production: $f(0, l_t) = f(h, 0) = f(0, 0) = 0$ and, therefore, $f_h(h, 0) = f_{lt}(0, l_t) = 0$.

Furthermore, the utility function is assumed to be separable:[9] $u(c_t, l_t) = U_U(c_t) - U_V(l_t) + U_W(a)$. Thus, the cross-derivatives are zero, in particular $u_{ct}l_t(c_t, l_t, a) = 0$. Moreover, both $u(c_t, l_t, a)$ and $f(h, l_t)$ fulfil the regularity conditions:

$$\lim_{h\to 0} f_h\left(h,l_t\right)=\infty,\quad \lim_{l_t\to 0} f_{l_t}\left(h,l_t\right)=\infty,\quad \lim_{l_t\to 0} u_{l_t}\left(c_t,l_t,a\right)=0$$

$$\lim_{c_t\to 0} u_{c_t}\left(c_t,l_t,a\right)=\infty,\quad \lim_{a\to 0} u_a\left(c_t,l_t,a\right)<\infty$$

The regularity conditions are crucial in ruling out corner solutions of zero labour supply and zero human capital as marginal productivity becomes infinite as $h \to 0$ or $l_t \to 0$ and marginal disutility of labour supply is zero as $l_t \to 0$. The utility function cannot exhibit infinite marginal utility of illiquid assets for $a \to 0$ as it would rule out the corner solution of zero illiquid asset holdings. The economic interpretation of this property indicates that illiquid assets (housing) are treated as luxury goods.

An example of such utility and production functions is the commonly used CRRA/CIES utility function with labour disutility entering the utility as in **King, Plosser and Rebelo [1988]**, with an additional term for the utility flow derived from the illiquid asset, and a standard Cobb-Douglas production function:

$$u\left(c_t,l_t,a\right)=\frac{c_t^{1-\sigma}-1}{1-\sigma}-\frac{\mu}{\alpha}l_t^{\alpha}+\frac{\psi}{\chi}\left(a+\varphi\right)^{\chi},\ \sigma\geq 0,\alpha>1,\mu>0,\psi>0,\varphi>0,\chi\in\left(0,1\right)$$

$$A\cdot f\left(h,l_t\right)=A\cdot h^{\gamma}l_t^{1-\gamma},\ A>0,\gamma\in\left(0,1\right)$$

Analytical solution of the model

The model can be solved using the method of backward induction. We begin with the final period 2, in which the labour supply l_2 is chosen. Then we proceed to the intermediate period 1, in which agents choose labour supply l_1 and liquid savings m_2. Finally, we get to the initial period 0, in which a decision about the composition of the portfolio consisting of a, m_1 and h is made (with $a + m_1 + h = \omega$). The model is fully deterministic; there is no uncertainty about any of the variables. There are no restrictions on the upper limit of the labour supply to avoid further complications, yet the presence of increasing disutility of labour ensures its finiteness. The *hand-to-mouth* (*HtM*) behaviour is defined in the same way as in the KVW model: if a consumer decides in the intermediate period to hold no liquid assets $m_2 = 0$ then he is called *HtM*, while if $m_2 > 0$ then he is called *non-hand-to-mouth* (*nHtM*). The decision in the initial period determines whether a consumer is *wealthy* (*n*) *HtM* or *poor* (*n*) *HtM*, which depends on whether the illiquid asset stock a is positive or zero. The backward induction solution is given as follows:[9]

Final period 2:

$$\max_{l_2} u\left(\underbrace{g\cdot A\cdot f\left(h,l_2\right)+m_2+R\cdot a}_{c_2},l_2,a\right)$$

s.t.

$$l_2\geq 0$$

[9] The formal analysis is presented in the Appendix, see Section A.1. A discussion on the sufficiency of first-order conditions is also given in the Appendix, see Section A.3.

The assumptions that the utility and production function satisfy the regularity conditions rule out zero labour supply[10] and because of that the analysis below focuses only on the choice of positive labour supply. Then, the optimality conditions imply $u_{c2} \cdot f_{l2} \cdot g \cdot A = -u_{l2}$. This is a standard intratemporal optimality condition, which equates the marginal rate of substitution $-u_l/u_c$ to the relative price of labour w, which is equal in the competitive labour market to the marginal product of labour $g \cdot A \cdot f_{l2}$. This condition determines labour supply l_2 for any amount of assets m_2 and a, which were chosen in the intermediate and initial periods and, together with labour supply l_2, determine consumption c_2.

Intermediate period 1:

$$\max_{m_2, l_1} u\left(\underbrace{A \cdot f\left(h, l_1\right) + m_1 - m_2}_{c_2}, l_1, a\right) + \beta \cdot u\left(\underbrace{g \cdot A \cdot f\left(h, l_2^{opt}\right) + m_2 + R \cdot a}_{c_2}, l_2^{opt}, a\right)$$

s.t.

$$l_1 \geq 0,\ m_2 \geq 0$$

The same assumptions as in the final period 2 rule out zero labour supply and lead to an analogous intratemporal optimality condition $u_{c1} \cdot A \cdot f_{l1} = -u_{l1}$. The optimality condition regarding m_2 leads, precisely as in the KVW model, to the so called "short-run Euler equation $u_{c1} \geq \beta u_{c2}$. If $m_2 > 0$, then $u_{c1} = \beta u_{c2}$: the consumer is unconstrained and the Euler equation is satisfied. If $\beta = 1$, this implies perfect consumption smoothing, i.e. $c_1 = c_2$. If $\beta < 1$, then $c_1 > c_2$ and if $\beta > 1$, then $c_1 < c_2$.

If $m_2 = 0$, then a consumer is constrained and cannot fully adjust consumption to the preferred level. The decision about m_2 is affected by the path of income in $t = 1$ and $t = 2$ and by preferences represented by parameter β. The more increasing (or "less decreasing") the path of income is the more likely it is that $m_2 = 0$ for a given β. If $m_2 = 0$ then the household is called *hand-to-mouth*, while households with positive m_2 are defined as *non-hand-to-mouth*.

Initial period 0:

$$\max_{a, h, m_1} u\left(\underbrace{A \cdot f\left(h, l_1^{opt}\right) + m_1 - m_2^{opt}}_{c_1}, l_1^{opt}, a\right) + \beta \cdot u\left(\underbrace{g \cdot A \cdot f\left(h, l_2^{opt}\right) + m_2^{opt} + R \cdot a}_{c_2}, l_2^{opt}, a\right)$$

s.t.

$$\omega = a + h + m_1$$

$$a \geq 0, \quad h \geq 0, \quad m_1 \geq 0$$

The analysis of the household problem in the initial period has to distinguish between two cases: $m_2 > 0$ and $m_2 = 0$ or, in other words, *nHtM* and *HtM* households respectively. Regularity conditions for the production function rule out zero human capital accumulation in the presence of a positive labour supply for both *HtM* and *nHtM* households, while the choice of zero human capital and zero labour supply is ruled out because of the regularity conditions. Therefore the analysis below[11] pertains only to the situation of a positive labour supply and positive human capital.

Ruling out the cases with no human capital for *HtM* households leaves us with four potential subcases: a combination of zero or positive liquid assets m_1 and illiquid assets a in the presence of positive human capital h. The model may thus generate both *wealthy* and *poor HtM* consumers. The *wealthy HtM* are those with positive illiquid assets in the final period, and their stock of liquid assets in the intermediate period might be

10 For a detailed analysis of this issue, see Section A.2 of the Appendix

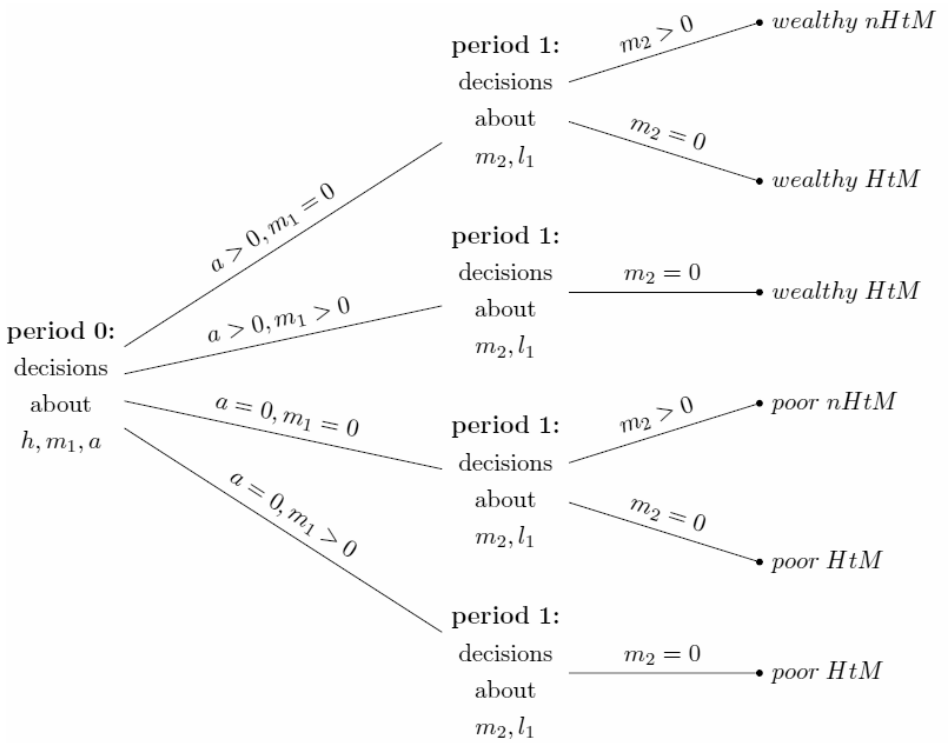
11 Details of the analysis are presented in Section A.2 of the Appendix.

either positive or zero. Similarly, the *poor HtM* may have no illiquid assets m_1 or a positive stock of them, but they have always no illiquid assets a.

The model rejects another two potential outcomes for *nHtM* households as it is not optimal to save in an asset that is return-dominated – we can rule out $m_1 > 0$ for these households. The *nHtM* households want to save some income in the intermediate period 1 in order to have higher consumption in the final 2nd period. For these households, $m_1 > 0$, and $m_2 > 0$ cannot be the optimal choice because illiquid assets have a higher return factor $R > 1$. Hence *nHtM* consumers choose their portfolio in the initial period so that it consists entirely of human capital or divide it between illiquid assets and human capital depending on the relation between the marginal return on education and on illiquid asset a. In the latter case, the optimal choice between illiquid asset a, earning the gross return after two periods and generating direct utility in both periods, and h, earning return of $f_h(h, l_i)$ in periods 1 and 2, is determined by $A \cdot u_{c1} \cdot [f_h(h, l_1) + g \cdot f_h(h, l_2)] = R \cdot u_{c1} + u_a \cdot (1 + \beta)$. The corner solution with $a = 0$ and $h > 0$ is possible if the allocation of all the initial wealth ω to human capital yields a higher return than for the illiquid asset. The return includes R and the additional utility flow u_a.

Figure 7 depicts the six potential outcomes that can be chosen by agents as solutions to their optimisation problem. Note that the graph depicts only solutions with $h > 0$, $l_1 > 0$, $l_2 > 0$ (in order to make the graphic more readable, decisions about the values of h, l_1 and l_2 are not given explicitly; solutions with combinations of $h = 0$ and $l_1 = l_2 = 0$ cannot occur given the assumptions made).

Figure 7. Potential solutions to the agent's decision problem. Note that all six solutions involve $h > 0$, $l_1 > 0$, $l_2 > 0$



Source: Own calculations.

Unfortunately, the model, although conceptually simple, is rich in nonlinearities and constraints and therefore does not give a tractable closed-form solution, even for simple utility and production functions and for a model with exogenous labour supply. Nevertheless, the possibility of the existence of *nHtM* (both *poor* and *wealthy*), *pHtM* and *wHtM* consumers is shown analytically. Their emergence depends on the slope of the endogenous income path, which means that the characteristics of consumers such as time preference β, innate ability A and initial endowment ω are crucial in making households'decisions about their (*n*) *HtM* status or decisions about accumulating illiquid assets a and human capital h.

Some of the results of the model are similar to those in KVW. First, both *HtM* and *nHtM* households emerge, where one of the determinants of their appearance is the slope of the income path. If the household has higher total income in the final period than in the intermediate one, $y_1 < y_2$, then it is more likely to be *HtM* as it is more likely to decide to save no liquid assets. If $y_1 > y_2$ instead, then the household is more likely to be *nHtM* because of holding a positive stock of liquid assets.

Second, the possibility of saving both in liquid assets m_1 and m_2 and, simultaneously, in illiquid assets is ruled out because the return factor of the liquid asset is lower than that of the illiquid one, $R > 1$, which is again in line with KVW. Furthermore, households may be willing to attach less value to consumption smoothing if they receive a sufficiently high return on illiquid assets, which gives rise to *HtM* households. A discussion of the empirical relevance of such behaviour can be found in **Browning and Crossley [2001]**.

A novelty in comparison with KVW is the introduction of endogenous labour income, which provides a motive to invest in human capital as part of the portfolio. Because of the assumptions on the production function, we can rule out zero human capital and zero labour supply, which is in accordance with empirics.

This makes it possible to have larger sets of *wealthy* and *poor hand-to-mouth* consumer types as, unlike in the KVW model, they can also be households with zero liquid wealth in the first period, i.e. $m_1 = 0$. This is because our assumptions preclude zero income so that consumers can get positive consumption in the intermediate period without the necessity of having positive liquid assets $m_1 > 0$. The assumptions on the production function imply that the set of *nHtM* consumer types is also larger as it consists of those dividing their initial endowment between the human capital and illiquid assets and those investing only in human capital while deciding to have no illiquid assets. In Section 2, these two groups of households were called the *wealthy nHtM* and the *poor nHtM* respectively.

Numerical solution of the model

The model is solved using numerical methods. The utility and production functions are parametrised as follows:

$$u\left(c_t, l_t, a\right) = \frac{c_t^{1-\sigma} - 1}{1-\sigma} - \frac{\mu}{\alpha} l_t^{\alpha} + \frac{\psi}{\chi}\left(a + \varphi\right)^{\chi}$$

$$A \cdot f\left(h, l_t\right) = A \cdot h^{\gamma} l_t^{1-\gamma}$$

The following parameter values are chosen for illustration purposes: $\sigma = 2$, $\alpha = 3$, $\mu = 1$, $\psi = 0.015$, $\varphi = 0.5$, $\chi = 0.3$, $\gamma = 0.5$, $R = 1.5$. The parameters β (time preference), A (innate ability), ω (initial endowment) and g (slope of the labour income path) are considered as those driving the *HtM* behaviour and the model is solved for a variety of their values. The considered values of A and ω are 25 equidistant points from the intervals [3, 5] and [1, 3] respectively. A and ω axes in the figures are depicted with ordinal values that place the parameters in the aforementioned vectors of these parameter values. Parameter g takes four values in the set {0.5, 0.75, 1, 1.25}.

For illustrative purposes a functional dependence is introduced between parameters β and A. The form of the dependence is $\beta = (\Gamma \cdot A)^{\Phi}$, with $\Gamma = 0.25$ and $\Phi = 2$, which generates values of β in the interval [9/16, 25/16]. First of all, the dependence reduces the degrees of freedom and makes it possible to depict the model graphically in a three-dimensional parameter space. Second, the direct positive relationship between β and A makes it possible to generate highly able (and therefore highly patient) *non-hand-to-mouth* consumers who invest in both human capital and illiquid assets. The economic reasoning behind such a relationship is that the time preference can be perceived as closely connected with working/learning productivity – see, e.g., **Cronqvist and Siegel (2015)**. Without delving into a discussion about what causes consumers to be more or less patient, it seems credible to assume that those who are more patient are more reliable and productive workers. Therefore both these characteristics are driven by the exogenously given innate ability, no matter if "exogenously given" means genetics or upbringing or if the dependence between A and β is a causal one or merely a correlation.

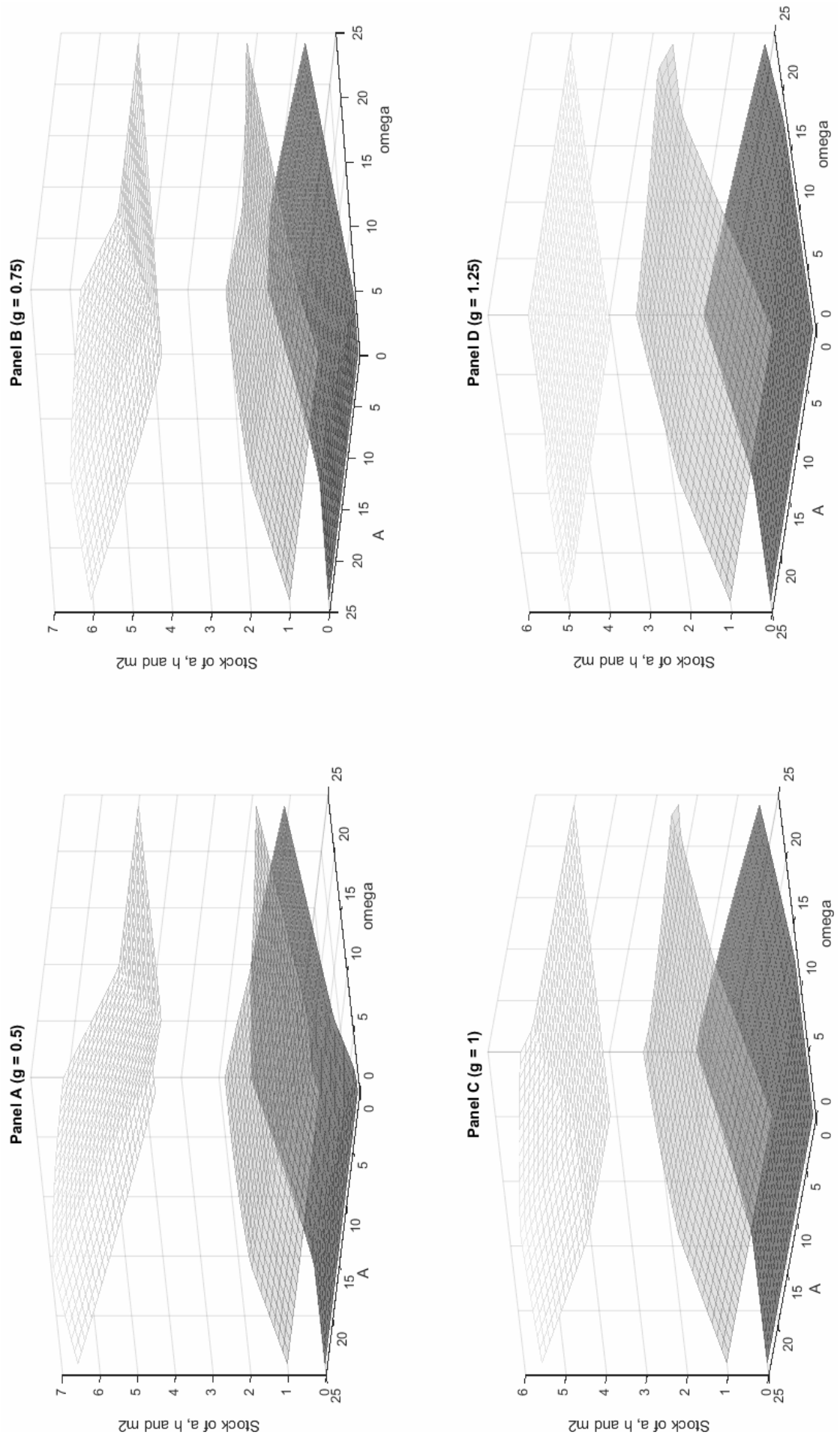


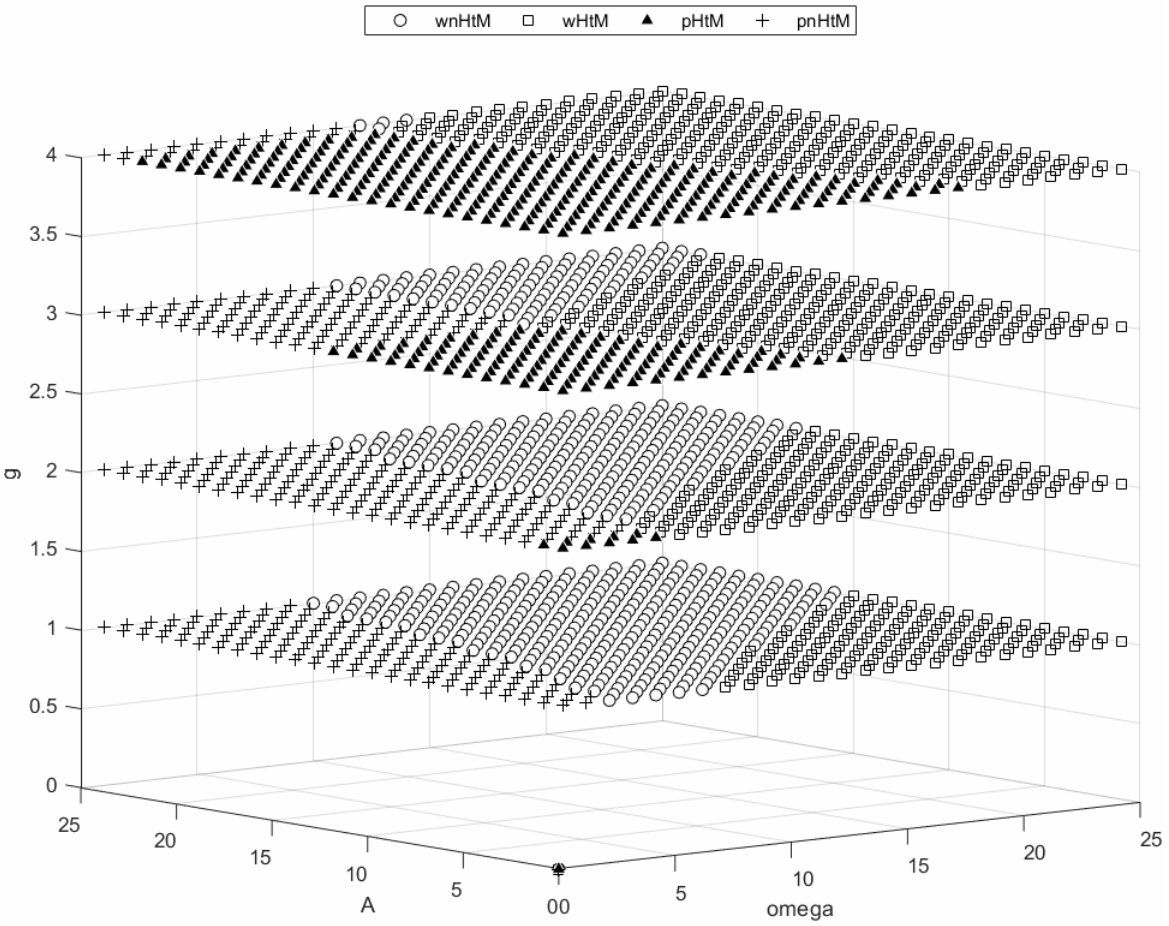
Figure 8. Stocks of illiquid assets a (**darkest surface**), human capital h (**medium-grey surface**) and liquid assets m_2 (**lightest surface**) for different values of g, ω and A. Note that the m_2 surface is moved up by 5 units to ensure graph readability (i.e. $m_2 = 5$ in the graph means that $m_2 = 0$ in the model)

Source: Own calculations.

The numerical solution of the consumer's problem is presented in Figure 8. The graphs show the values of the optimal allocation of resources between illiquid assets a (red surface), human capital h (blue surface) and liquid assets m_2 (yellow surface; to improve the readability of the graph, the m_2 surface is moved up by 5 units) for different values of the initial endowment ω and innate ability A. Each graph is computed for a different value of the relative productivity between periods g.

Figure 9 shows qualitatively the household's status for a given combination of initial endowment ω, innate ability A, and the relative productivity parameter g. Households that exhibit *wealthy non-hand-to-mouth* behaviour are depicted with rings, the *poor non-hand-to-mouth* are denoted by plus signs, while *wealthy hand-to-mouth* and *poor hand-to-mouth* are denoted by squares and triangles respectively.

Figure 9. Qualitative distribution of the wHtM (squares), pHtM (triangles), wnHtM (rings) and pnHtM (plus signs) statuses for different values of g (relative labour productivity between periods), ω (initial endowment) and A (innate ability)



Source: Own calculations.

The numerical solutions illustrate how the incidence of all four household types depends on the exogenous parameters of interest. It is difficult to match precisely the relative values of the stocks of liquid or illiquid assets and human capital created with a so stylised model to the empirical values presented in Section 2. Nevertheless, even in the simple framework, the results can match some important features of the data and give unambiguous predictions. The presented model can be interpreted as an analysis of a household's asset allocation problem over the life cycle, where the life cycle is split into three periods.

The most obvious conclusion is that the occurrence of *hand-to-mouth* status depends positively on the relation of income in the second period to that in the previous period (y_2/y_1), which means that the parameter g drives *HtM* behaviour by increasing the income in the final period of the model. Moreover, the higher

the initial endowment ω, the higher the stocks of human capital and illiquid assets as households have more resources to invest. However, higher ω lowers, *ceteris paribus*, the stock of liquid assets m_2 as households can invest more in a that gives a higher interest rate $R > 1$. Finally, higher innate ability increases the parameter β and therefore also the likelihood of being a *nHtM* household as consumers are more patient and more likely to save in the intermediate period in liquid assets m_2. The innate ability itself does not affect *HtM* behaviour in the same way it affects productivity in both periods.

The economic interpretation of the descriptive results presented in the preceding paragraphs gives the following answer on the incidence of the four household types:

- *Poor hand-to-mouth* households comprise those experiencing income growth (i.e. households with a high g) but also those who experience stagnating or even decreasing labour income. Both groups are dominated by initially poor and less able (less patient) consumers. It is noteworthy that the low human capital accumulation of these households equals their entire initial endowment. Households with the characteristics of these types are depicted in the panels "poor HtM A" and "poor HtM B"in Figure 10.[12]
- *Wealthy hand-to-mouth* households are initially rich and able (patient) with high labour income growth. These households have very large human capital stocks. The *hand-to- mouth* behaviour is caused by a high innate ability, patience and large g: they all make human capital productive and desirable as it yields a return also in the final period. Liquid assets m_2 are superseded by illiquid ones and by the liquidity created in the final period by labour income as investment in human capital yields higher returns. An example of the *wHtM* consumer is depicted in the panel "wealthy HtM" in Figure 10.
- *Wealthy and poor non-hand-to-mouth* consumers are a nonhomogeneous group with respect to their initial characteristics, yet they all exhibit stagnating or declining labour income.[13] They can be either initially rich and able with constant labour productivity or initially poorer and less able with declining labour income. The first group (see the "wealthy nHtM" panel in Figure 10) accumulates a lot of human capital and illiquid assets while the other one ("poor nHtM" panel) is more constrained because of a lower initial endowment. Both groups are patient enough to accumulate positive savings in the intermediate period and not to exhibit *HtM* behavior. Households depicted as "wealthy nHtM" have very large holdings of illiquid assets in comparison with other household types, and households described as "*poor nHtM*" match the empirical characteristics of their type relatively close.

Note that the liquid asset line m depicts m_1 and m_2 depending on the period and income y is labour income plus illiquid savings R a, without liquid savings m_2. The characteristics of the households are given in Table 4.

Table 4. Characteristics of the households in Figure 10

	Status	(A, ω)	g
1	*poor HtM* A	(2,2)	0.75
2	*poor HtM* B	(2,2)	1.25
3	*wealthy HtM*	(20,20)	1.25
4	*wealthy nHtM*	(23,20)	1
5	*poor nHtM*	(10,10)	0.75

Source: Own calculations.

12 It should be kept in mind that for poor HtM consumers the income graph is identical to the consumption graph, while the illiquid asset line is identical to the liquid asset one as they are both zero. The consumption graph overlaps with the income graph for the wealthy HtM as well.

13 Note that in Figure 10 income is defined as labour income plus interest on illiquid assets.

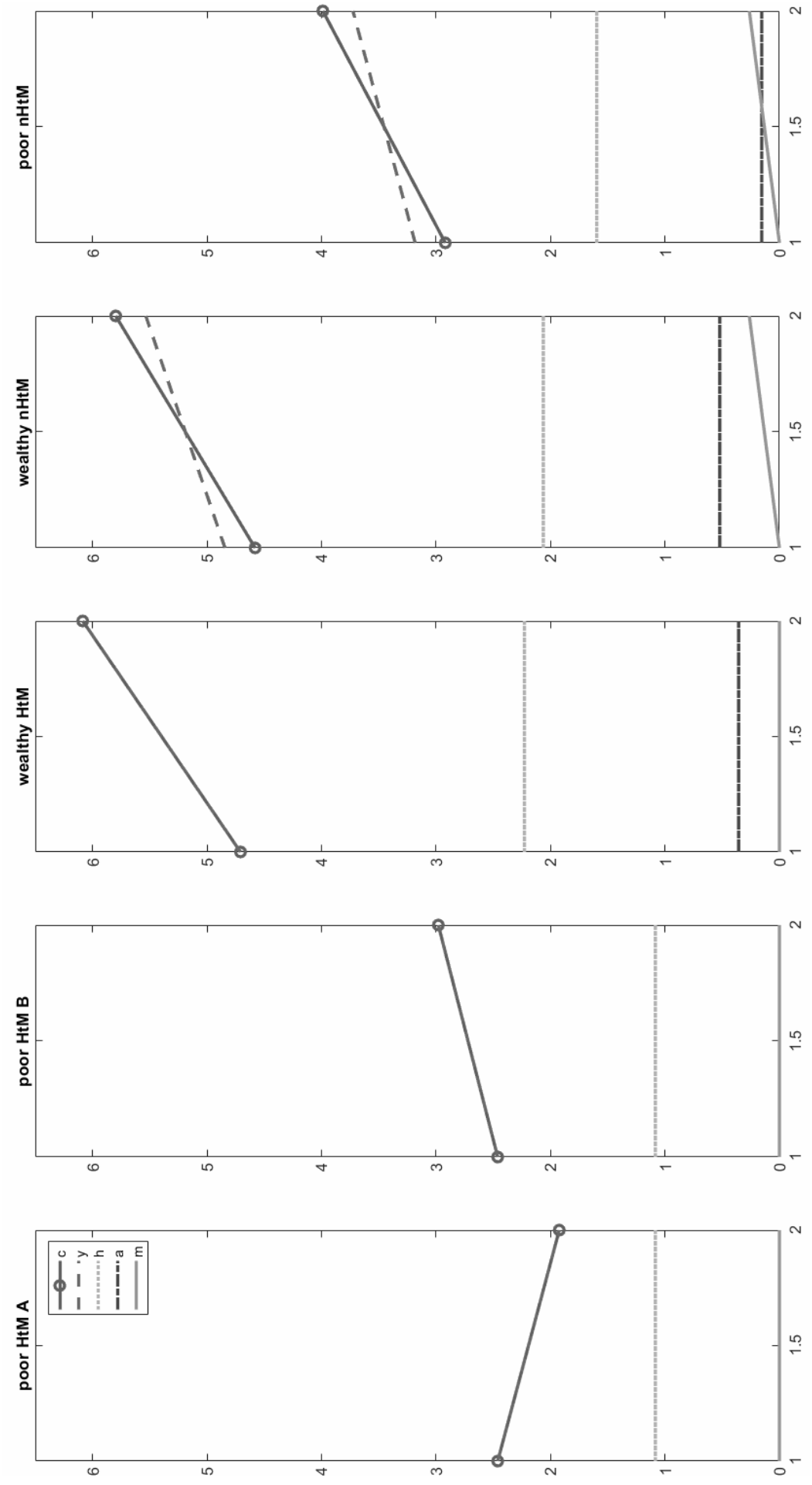


Figure 10. The values of asset holdings (a, h, m_1, m_2), consumption (c) and income (y) in the intermediate period 1 and in the final period 2 for 5 distinct households

Source: Own calculations.

A limitation of the model is the fact that it constrains the household optimisation problem to only three periods, which makes it impossible to generate a Ben-Porath hump-shaped, non- monotonic path of human capital investment/stock. Moreover, the model operates in a non- stochastic environment in which there are fewer incentives to save liquid assets that could smooth negative shocks. Thus, it does not allow for a full analysis of *hand-to-mouth* behaviour. *HtM* status is transitory and large flows between all four groups of consumers are observed empirically (see Table 3 and Figure 2). The existing empirical research, including Section 2 of this paper, does not shed much light on how persistent *pHtM*, *wHtM* and *nHtM* status is in the long run (i.e. if households change their type more than once or twice in the life cycle). Nevertheless, the aforementioned figures show that the analysis of *HtM* behaviour should allow for transitions.

Without a formal model allowing for more periods, such statements are only speculative, yet it could be presumed that in the very beginning of the life cycle households expect increasing income paths and they accumulate human capital as the *poor HtM*, *wealthy HtM* and *poor nHtM* types. Over time they transform gradually into *wealthy non-hand-to-mouth* households or *wealthy hand-to-mouth* by accumulating illiquid assets and expecting their income to stagnate. Such predictions are in line with the theoretical model and are confirmed by the empirical analysis with one caveat: *wealthy non-hand-to-mouth* consumers also experience increasing income. This feature could probably be captured by a model with stochastic shocks that would introduce precautionary saving motives.

Conclusions

The model presented in this paper is an extension of **Kaplan, Violante and Weidner [2014]** with the novelty of endogenizing income by introducing labour supply and human capital accumulation. This extended framework makes it possible to analyse the characteristics of *nHtM*, *wHtM* and *pHtM* households together with factors affecting the deliberate choices of these household types. Al though the model is too technically complex to obtain a tractable analytical solution, the effects of the exogenous parameters on the solutions can be analysed numerically.

The model predicts that *poor hand-to-mouth* consumers are initially poorer and less able while *wealthy hand-to-mouth* consumers are those with a higher initial endowment and higher abilities. Both groups experience income growth. *Non-hand-to-mouth* consumers experience a stagnating or decreasing labour income path and are more heterogeneous when it comes to their initial characteristics, which gives rise to different behaviour regarding accumulation of illiquid assets and human capital.

The major conclusion of the model is that *wealthy/poor hand-to-mouth* status is chosen endogenously. Households wish to optimise their utility, taking their characteristics for granted, and choose preferred values of asset and human capital stocks. In particular, it is worth pointing out the optimal educational decisions. They may imply deviations from full consumption smoothing by inducing decisions leading to being liquidity constrained.

I show the possibility of existence of *nHtM* (both *poor* and *wealthy*), *pHtM* and *wHtM* consumers. Their emergence depends on the slope of the endogenous income path, which means that the characteristics of consumers such as time preference β, innate ability A and initial endowment ω are crucial in making households' decisions about their (*n*)*HtM* status or decisions about accumulating illiquid assets a and human capital h.

Some of the results of the model are similar to those in KVW. First, both *HtM* and *nHtM* households emerge where one of the determinants of their appearance is the slope of the income path. If a household has higher total income in the final period than in the intermediate one, $y_1 < y_2$, then it is more likely to be *HtM* as it is more likely to decide to save no liquid assets. If $y_1 > y_2$ instead, then the household is more likely to be *nHtM* because of holding a positive stock of liquid assets.

Second, saving in both liquid and illiquid assets at the same time cannot be an optimal choice because the return factor of the liquid asset is lower than that of the illiquid one, $R > 1$, which is again in line with KVW. Furthermore, households may be willing to attach less value to consumption smoothing if they receive a sufficiently high return on illiquid assets, which gives rise to *HtM* households.

A novelty in comparison with KVW is the introduction of endogenous labour income, which provides a motive to invest in human capital as a part of the portfolio. Because of the assumptions on the production function, we can rule out zero human capital and also zero labour supply, which is in accordance with empirics.

This makes it possible to have larger sets of *wealthy* and *poor hand-to-mouth* consumer types as, unlike in the KVW model, they can also be households with zero liquid wealth in the first period, i.e. $m_1 = 0$. This is because our assumptions preclude zero income so that consumers can get positive consumption in the intermediate period without the necessity of having positive liquid assets $m_1 > 0$. The assumptions on the production function imply that the set of *nHtM* consumer types is also larger as it consists of those dividing their initial endowment between the human capital and illiquid assets and those investing only in human capital, deciding to have no illiquid assets. In Section 2, these two groups of households were called *wealthy nHtM* and *poor nHtM* respectively.

The model should be perceived with caution because of its stylised nature. A 3-period (effectively, a 2-period) optimisation makes it impossible to obtain the empirically observed non-monotonic relationships of assets or human capital stocks over the life cycle. Furthermore, the model abstracts from the stochastic shocks and revisions of expectations. Therefore, the next step in the analysis of *wealthy* and *poor hand-to-mouth* households should be the extension of the life-cycle horizon of consumers to many annual periods, for example, and the introduction of risk. Although such a model, in view of multiple periods, assets and decisions, must be expected to be numerically complicated, it could explain the dynamic nature of *hand-to-mouth* behaviour.

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