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Abstract

This paper examines the responsiveness of German hand-to-mouth (HtM) households to hypothetical, transitory income shocks, aiming to facilitate effective fiscal policy targeting. Drawing on a two-asset life-cycle model by Kaplan et al. (2014), German households are classified based on their holdings of liquid and illiquid assets. Three household types emerge: poor, wealthy, and non HtM. Spending responses of each type are derived by evaluating a Household Finance and Consumption Survey (HFCS) question. Contrasting the underlying model, poor HtM households (0.57) are found to exhibit a spending response considerably higher than that of wealthy HtM (0.49) and non HtM (0.48) households. The discrepancy between theoretical predictions and empirical findings can be partially attributed to log income being a significant, independent driver of German spending responses, which contrasts the model's homothetic notion of income. The paper identifies a distinct portfolio composition and unique demographic characteristics of German poor HtM households, which may inform future targeting efforts.

Zusammenfassung

Diese Arbeit untersucht die Konsumreaktion deutscher hand-to-mouth (HtM) Haushalte auf hypothetische, transitorische Einkommensschocks, um eine zielgerichtete Fiskalpolitik zu erleichtern. Auf der Grundlage eines Zwei-Vermögensgüter-Lebenszyklusmodells von Kaplan et al. (2014) werden Haushalte anhand ihrer liquiden und illiquiden Vermögenswerte klassifiziert. Drei Haushaltstypen entstehen: poor, wealthy und non HtM Haushalte. Die Konsumreaktion jeder Gruppe wird durch die Auswertung einer Household Finance and Consumption Survey (HFCS)-Frage abgeleitet. Entgegen den Prognosen des zugrunde liegenden Modells zeigen poor HtM Haushalte (0,57) eine deutlich höhere Konsumreaktion als wealthy HtM (0,49) und non HtM Haushalte (0,48). Die Diskrepanz zwischen theoretischen Annahmen und empirischen Befunden wird in Teilen darauf zurückgeführt, dass entgegen der homothetischen Einkommensdarstellung des zugrunde liegenden Modells Log-Einkommen ein signifikanter und unabhängiger Treiber deutscher Konsumreaktionen ist. Die Arbeit identifiziert verschiedene demografische und portfoliobezogene Merkmale deutscher poor HtM Haushalte, die eine entsprechende fiskalpolitische Ausrichtung unterstützen können.

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1 Introduction

While the life-cycle/permanent income hypothesis (LC/PIH), as described by Friedman (1957); Hall (1978), posits that the consumption response to a transitory income shock is negligible, a growing body of empirical research suggests that households demonstrate a considerable spending response to such shocks (Kaplan et al., 2014)[1]. Recent German fiscal policy appears to be informed by these findings, as policies designed to stimulate aggregate spending have taken a central role in Germany during recent crises. Prominent examples include a €130 billion economic stimulus package introduced during the COVID-19 pandemic and multiple relief packages introduced during the energy crisis. Alongside making key structural changes, a main objective of these measures was to stabilise and stimulate consumer spending (Feld et al., 2020; Grimm et al., 2022).

However, while some measures of these stimulus packages were targeted at specific household groups, others remained broad in scope. For example, one policy of the COVID-19 stimulus package aimed at stimulating consumer spending by temporarily reducing value added tax (VAT) rates for all consumers. Similarly, the energy crisis relief packages aimed to stimulate aggregate consumer spending by, among other measures, raising the basic tax-free allowance and allocating a €300 lump-sum payment to all income taxpayers. The German Federal Ministry of Finance has since stated that, when drafting these policies, speed and impact took priority over differentiation and targeting (Federal Ministry of Finance, 2023). While this may be considered reasonable in light of prevailing circumstances at the time, it is a commonly held view among economists that broad, untargeted stimuli are ineffective in maximising the spending response to transitory income shocks (Kaplan et al., 2014). This thesis therefore sets out to examine how fiscal stimulus payments should be targeted at German households in order to maximise the spending response to transitory income shocks.

To achieve this, the study draws on a two-asset life-cycle model by Kaplan and Violante (2014); Kaplan et al. (2014). A key argument of the model is that a considerable share of all households are constrained, spending all their available resources in every pay period. These so-called *hand-to-mouth* (HtM) households are expected to demonstrate a considerable spending response to transitory income shocks. Kaplan et al. (2014) argue, that the majority of equilibrium macroeconomic models with heterogeneous agents underestimate this true share of constrained households, because they often rely on net worth data to determine a household's level of constraint. By contrast, Kaplan et al. (2014) distinguish between liquid assets (e.g. cash holdings) and illiquid assets (e.g. life insurance, retirement accounts or housing), and assume that both assets differ in their accessibility and return. Specifically, liquid assets are expected to yield a low return but can be accessed easily, while illiquid assets yield a higher return but are assumed to be inaccessible in the short-term and can only be accessed by paying a transaction cost (Kaplan et al., 2014). Therefore, a household's short-term level of constraint is expected to depend on its liquid asset holdings alone (Kaplan et al., 2014). In other words, by the end of a pay period, a household is considered to be constrained not when it has exhausted its entire net worth but when it has exhausted its liquid asset holdings (Kaplan et al., 2014).

[1]For instance, Shapiro and Slemrod (2009) find that when examining the 2008 US stimulus payments, average MPCs are roughly equal to one third. Kaplan and Violante (2014) find that households spend approximately 25% of rebates on non-durable goods within the quarter they are received. Parker et al. (2013); Broda and Parker (2014) find that MPCs for tax rebates average between 12-30% for non-durable consumption and between 50-90% if durable consumption is accounted for. Fagereng et al. (2021) observe MPCs ranging from 35-71% when observing lottery winners in Norway and Boehm et al. (2025) observe MPCs ranging from 23-61% when handing out prepaid debit cards to French households as part of a randomised controlled trial.

Based on these underlying assumptions, the model derives three types of hand-to-mouth (HtM) households. The first are the so-called *poor hand-to-mouth* (P-HtM) households, who are characterised by holding little or no liquid assets and no illiquid assets (Kaplan et al., 2014). The second are the *wealthy hand-to-mouth* (W-HtM). These households are characterised by holding little or no liquid assets, but considerable illiquid wealth (Kaplan et al., 2014). Note that the net worth of these households is well above zero, meaning that a traditional heterogeneous-agent macroeconomic equilibrium model relying on overall net worth would not classify them as being constrained (Kaplan et al., 2014). However, as the model assumes illiquid assets to be inaccessible in the short-term, a household's level of constraint is determined by its holdings of liquid assets alone (Kaplan et al., 2014). Therefore, even though they hold considerable illiquid wealth, W-HtM households are assumed to be constrained (Kaplan et al., 2014). Finally, *non hand-to-mouth* (N-HtM) households are expected to be unconstrained, as they are characterised by holding considerable liquid (and illiquid) wealth (Kaplan et al., 2014).

This study relies on said two-asset life-cycle model by Kaplan et al. (2014) in order to classify German households. Afterwards, it aims to determine their respective marginal propensity for expenditure (MPX). Kaplan et al. (2014) derive a household's spending response by relying on the econometric identification strategy of Blundell et al. (2008). This strategy isolates the spending response to transitory income shocks by exploiting long-term fluctuations in income and consumption data (Kaplan et al., 2014). Unfortunately, this strategy is very data demanding, making it difficult to apply it to households outside the U.S. (Cherchye et al., 2024). Specifically, while Kaplan et al. (2014) are able to meet these data requirements by relying on the extensive Panel Study of Income Dynamics (PSID), this study relies on the the less comprehensive Household Finance and Consumption Survey (HFCS). However, the HFCS has recently added a survey question that asks households to report their spending response to a hypothetical, transitory income shock. This study utilises this survey question to directly infer the MPX of each household group. In doing so, the particular question this study sets out to examine is:

How should fiscal stimulus payments be targeted at German hand-to-mouth households in order to maximise the spending response to transitory income shocks?

The remainder of the study is structured as follows. Section (2) reviews the theoretical and empirical literature related to this study. Section (3) introduces the baseline model and its main mechanisms. Section (4) discusses the corresponding empirical identification strategy and the parameter choices made for German HFCS data. Section (5) presents the German hand-to-mouth shares and discusses accompanying sensitivity tests. Additionally, it examines the portfolio composition and other demographic characteristics of German hand-to-mouth (HtM) households. Section (6) discusses the respective marginal propensity for expenditure (MPX) of HtM groups, compares the findings with the model's theoretical predictions and examines the drivers of MPX heterogeneity between groups. Finally, the section discusses sensitivity tests for MPX estimates and considers the limitations of the findings. Section (7) concludes.

2 Literature Review

Traditional equilibrium macroeconomic models with heterogeneous agents often feature only a single asset. Prominent examples of such one-asset environments are the incomplete market models by Aiyagari (1994); Huggett (1996); Carroll (1997), which rely on a household's net wealth when deriving its consumption response to an unexpected transitory income shock (Kaplan et al., 2014). By contrast, the two-asset life-cycle model by Kaplan and Violante (2014); Kaplan et al. (2014) considers heterogeneous agents while distinguishing between liquid and illiquid assets. The closest connection between this two-asset life-cycle model and traditional heterogeneous agent single-asset models are the so-called "spender-saver" models in tradition of Campbell and Mankiw (1989) (Kaplan et al., 2014)[2]. These models differentiate between two types of consumers, a forward-looking saver, who smooths consumption based on their permanent income, and a "rule-of-thumb" spender, who consumes all their income in each period (Kaplan et al., 2014). The two-asset life-cycle model relates to this concept in that it examines "hand-to-mouth" households, which, similar to "rule-of-thumb" households, spend a majority of their current income in every pay period (Kaplan et al., 2014). However, spender-saver models typically impose a household's spender or saver status exogenously, whereas in the two-asset life-cycle model, a household's hand-to-mouth status arises endogenously (Kaplan et al., 2014). For example, a W-HtM household's status is derived based on their conscious decision to allocate their endowment to illiquid rather than liquid assets. Notably, the classification framework of Kaplan and Violante (2014); Kaplan et al. (2014) has since been applied to New Keynesian models in order to examine the transmission mechanisms of monetary policy. Specifically, the so-called Heterogeneous-Agent New-Keynesian (HANK) model by Kaplan et al. (2018) builds on the hand-to-mouth classification in order to examine the direct and indirect channels, through which monetary policy may affect aggregate consumption[3].

Applying the two-asset life-cycle model to empirical data yields three distinct household groups (P-HtM, W-HtM, N-HtM). This thesis aims at deriving their corresponding marginal propensity for expenditure (MPX) by examining a particular HFCS survey question that asks households to report the percentage they would spend out of an unexpected transitory income shock. To situate this approach within the extensive literature on consumption and spending responses to unexpected windfall gains, this study draws on Parker and Souleles (2019), who categorise said literature into two distinct groups. The first group infers a household's spending response based on actual expenditure data, e.g. by examining natural or randomised experiments. Parker and Souleles (2019) refer to this strategy as the "revealed-preferences" approach. Contributions to this strand of literature include Parker et al. (2013); Broda and Parker (2014), who observe real spending responses of U.S. households to economic stimulus payments in 2008, Kueng (2018), who examines the effect of predetermined payments by the Alaska Permanent Fund, Fagereng et al. (2021), who assess the spending behaviour of Norwegian lottery winners or Boehm et al. (2025), who observe the effect of one-off monetary transfers that are paid out to French households.

The second strand of literature derives a household's spending response based on their reported preferences (Parker and Souleles, 2019). Specifically, this literature exploits survey questions that ask households to report their spending response to a hypothetical,

[2]More recently, this strand of models has been extended by the work of Eggertsson and Krugman (2012); Justiniano et al. (2013) (Kaplan et al., 2014).

[3]On the other hand, authors such as Galí et al. (2007); Bilbiie (2008) employ so-called Two-Agent New-Keynesian (TANK) models, which build on Campbell and Mankiw (1989) and their classification of households into spenders and savers (Kaplan et al., 2018).

transitory income shock. Earlier contributions to this strand of literature have relied on examining qualitative spending responses (Fuster et al., 2021). For example, Shapiro and Slemrod (2003a,b, 2009) examine the spending response to tax rebates by asking individuals to report whether they would (i) mostly spend it, (ii) mostly save it, or would use it to (iii) mostly pay of existing debt (Fuster et al., 2021). However, several surveys have since added questions that infer a respondent's quantitative spending response by asking them to report the percentage they would spend out of a transitory income shock. Examples include the Survey of Household Income and Wealth (SHIW), the Survey of Consumer Expectations (SCE), the Bank of England/NGM Household Survey or the Household Finance and Consumption Survey (HFCS). A growing body of empirical literature has therefore shifted towards examining quantitative spending responses (Fuster et al., 2021)[4]. By utilising a HFCS survey question, this study follows said "reported-preferences" approach and is particularly related to the the contributions examining quantitative spending responses.

The work closest to this study is that of Cherchye et al. (2024), as they utilise a quantitative HFCS survey question to derive the marginal propensity to consume of hand-to-mouth households in Belgium. Besides focusing on the distinct wealth distribution patterns and demographic peculiarities of German households, this paper builds upon their work in two key areas. First, it aims at overcoming the data limitations of Cherchye et al. (2024) by examining new HFCS data, allowing for further volatility and sensitivity tests. Second, it aims to extend the scope of Cherchye et al. (2024) by examining the underlying drivers of MPX heterogeneity, thereby hoping to provide additional insight into how and why empirical evidence may diverge from the theoretical predictions of Kaplan et al. (2014).

3 Baseline Model

Unless stated otherwise, all theoretical assumptions and corresponding solutions presented in this section have been adopted from the two-asset life-cycle model of Kaplan et al. (2014) and therefore do not represent my own work. First, the model depicts a household that lives for three periods ($t = 0, 1, 2$), and consumes during the last two ($t = 1, 2$). Preferences over consumption across these two periods are defined as:

$$v_0 = u(c_1) + u(c_2), \tag{1}$$

with no discounting between periods and diminishing marginal utility ($u' > 0$ and $u'' < 0$) (Kaplan et al., 2014). The model is deterministic, i.e. a household at $t = 0$ is aware of its future income path (y_1, y_2). A household faces two key allocation decisions during its life cycle. The first one is the so-called "portfolio allocation decision" at $t = 0$, where a household allocates their initial endowment ($\omega = a + m_1$) between illiquid assets (a) and liquid assets (m_1) (Kaplan et al., 2014). As mentioned above, both asset types are assumed to have specific characteristics. Illiquid assets cannot be accessed at the consumption/saving decision at $t = 1$ and yield a return R at period $t = 2$. Liquid assets m_1 are accessible before the consumption/saving decision at $t = 1$ (and liquid assets m_2 before the corresponding consumption decision at $t = 2$), but yield a lower return than illiquid assets ($1 < R$) (Kaplan et al., 2014).

The second allocation decision is the so-called "consumption/saving decision" at $t = 1$. At this point, the household holds a predetermined amount of liquid and illiquid assets

[4]See Jappelli and Pistaferri (2014, 2020); Olafsson and Pagel (2018); Bunn et al. (2018); Christelis et al. (2019); Fuster et al. (2021); Cherchye et al. (2024).

$(a \geq 0,\ m_1 > 0)$ and receives income y_1. Now, the household chooses to either consume all its liquidity and income, or to carry a positive amount of liquid assets to the next period $(m_2 > 0)$ (Kaplan et al., 2014). Finally, at $t = 2$, the household faces its final consumption decision, where it receives income y_2 and consumes this income together with any savings in liquid assets (m_1), illiquid assets (a), and the corresponding return on illiquid assets (R) (Kaplan et al., 2014). As households at $t = 2$ merely consume all remaining resources, the two key allocation decisions to analyse are the initial portfolio allocation decision at $t = 0$ and the consumption/saving decision at $t = 1$ (Kaplan et al., 2014).

Kaplan et al. (2014) derive a household's HtM-status based on its asset position at the consumption/saving decision at $t = 1$. Specifically, a household is classified as *non hand-to-mouth* (N-HtM), if, at the consumption/saving decision at $t = 1$, it holds a positive amount of liquid assets and a non-negative amount of illiquid assets $(m_2 > 0,\ a \geq 0)$ (Kaplan et al., 2014). Conversely, a household that holds neither liquid nor illiquid assets at the consumption/saving decision $(m_2 = 0,\ a = 0)$ is classified as a *poor hand-to-mouth* (P-HtM) household (Kaplan et al., 2014). Finally, a household that holds no liquid assets but holds a positive amount of illiquid assets $(m_2 = 0,\ a > 0)$ is classified as a *wealthy hand-to-mouth* (W-HtM) household (Kaplan et al., 2014).

The allocation decision of a W-HtM household merits further elaboration. First, note that as preferences over consumption are given by (1), and the model assumes diminishing marginal utility, a household will desire to smooth consumption across periods $t = 1$ and $t = 2$ in order to maximise overall utility (Kaplan et al., 2014)[5]. In the baseline model without borrowing, a household at $t = 1$ must maintain large positive balances of liquid rather than illiquid assets to smooth consumption. This is because illiquid assets are assumed to be inaccessible in the short-term (at $t = 1$). In other words, any investment in illiquid assets will limit the household in its ability to smooth consumption across periods (Kaplan et al., 2014). Given these preconditions, one might think that a household at risk of being liquidity constrained would seek to compensate for this by allocating their entire initial endowment to liquid assets. Instead, a W-HtM household willingly allocates a positive amount of its endowment to illiquid assets. Kaplan et al. (2014) argue, that this allocation decision can indeed maximise a household's lifetime utility, given that illiquid assets are assumed to yield a higher return than liquid assets $(R > 1)$. Specifically, section 3.2 will show that if the particular condition (5) is met, the return on illiquid assets is sufficiently high so that holding a positive amount of illiquid assets yields an increase in lifetime consumption that compensates for the welfare loss caused by not being able to smooth consumption across $t = 1$ and $t = 2$ (Kaplan et al., 2014). In other words, if condition (5) is met, a liquidity constrained household will still allocate a positive amount of its initial endowment to illiquid assets. Such a household that willingly bears the welfare loss from not smoothing consumption in order to hold illiquid assets, is classified as a W-HtM household (Kaplan et al., 2014)[6].

Several assumptions are made by Kaplan et al. (2014) to solve the baseline model. Period utility u is modeled as CES, with an intertemporal elasticity of substitution $\sigma > 0$. The initial endowment ω is set to 1, with $\omega = a + m_1$. Income in period $t = 1$, denoted as y_1, can either be high or low $\{y_L, y_H\}$, where $y_H > R + y_2$ and $0 < y_L < y_2 - 1$. Income in $t = 2$ is defined as $y_2 > 1$. The interest rate on illiquid assets is R and the interest rate for liquid assets is 1 with $1 < R$ (Kaplan et al., 2014).

[5] Any additional unit of consumption increases utility $(u' > 0)$ but at a decreasing rate $(u'' < 0)$. A household is therefore incentivised to smooth consumption across periods to maximise overall utility.

[6] Note that condition (5) may hold for some households but not for others, allowing P-HtM and W-HtM households to co-exist in the same environment.

3.1 Consumption/Saving Decision ($t = 1$)

In line with Kaplan et al. (2014), the model is solved backwards, starting with the consumption/saving decision at $t = 1$. This decision determines, whether a household at $t = 1$ will consume all its liquidity or carry a positive amount into period $t = 2$. The corresponding outcome is what distinguishes a non hand-to-mouth household (N-HtM) from a hand-to-mouth household (HtM). Specifically, a N-HtM household is able to meet its desired level of consumption at $t = 1$ and is able to carry over a positive amount of liquid assets into the next period ($m_2 > 0$) (Kaplan et al., 2014). Conversely, a HtM household will consume all available income (y_1) and liquid assets (m_1) without being able to meet its desired level of consumption. Without borrowing, the household is constrained at the zero kink and unable not carry any liquid assets into the next period ($m_2 = 0$) (Kaplan et al., 2014).

Formally, given the predetermined amount of liquid assets $m_1 = \omega - a$, the utility maximisation problem for the consumption/saving decision at $t = 1$ is given by:

$$\begin{aligned} v_1(a) &= \max_{c_1, m_2} u(c_1) + u(c_2) \\ &\text{s.t.} \\ c_1 + m_2 &= y_1 + \omega - a \\ c_2 &= m_2 + Ra + y_2 \\ m_2 &\geq 0. \end{aligned}$$

The first and second lines of the constraint represent the budget constraints at $t = 1$ and $t = 2$. The last condition implies that liquid asset holdings cannot be negative, as borrowing is not yet allowed in the baseline model. Given these conditions, the utility maximisation problem has the following solution for liquid asset holdings m_2[7]:

$$m_2 = \max \left\{ \frac{y_1 + \omega - y_2 - (1 + R)a}{2}, 0 \right\}. \tag{2}$$

The solution illustrates, that a household's holdings of m_2 depend on its income path: A low income path with $y_1 = y_L$ is defined as $0 < y_L < y_2 - 1$. With $\omega = 1$ and $a \geq 0$, this implies $y_L < y_2 - 1 \leq y_2 - \omega + (1 + R)a$ for any feasible consumption pair (a, m_1) (Kaplan et al., 2014). Given this relation of variables, solution (2) shows that a household under a low income path faces a negative interior solution for m_2, i.e. the household would ideally like to borrow. However, as borrowing is not yet considered, such a household will be constrained at the corner solution $m_2 = 0$ instead (Kaplan et al., 2014). In other words, income $y_1 = y_L$ is sufficiently low relative to y_2 that a household would ideally like to borrow ($m_2 < 0$) but is constrained at the zero-kink with $m_2 = 0$. Holding zero liquid assets after the consumption/saving decision ($m_2 = 0$) and having no access to credit, a household with such an income path is characterised as hand-to-mouth (HtM) (Kaplan et al., 2014). Its corresponding consumption path is $c_1 = y_1 + \omega - a$ and $c_2 = y_2 + Ra$. Whether this HtM household is poor HtM or wealthy HtM depends on its illiquid asset

[7] See Appendix A.1.1 for a thorough derivation of the solution.

holdings. These are determined at the initial portfolio allocation decision at $t = 0$, which will be discussed in the next section.

Next, consider a high income path ($y_1 = y_H$) such as $y_H > R + y_2$. A household on such a high income path faces the condition $y_H > R + y_2 \geq y_2 - w + (1 + R)a$ for any feasible consumption pair (a, m_1) (Kaplan et al., 2014). Solution (2) demonstrates that if this condition holds, the interior solution will be positive ($m_2 > 0$). In other words, income $y_1 = y_H$ is high enough relative to y_2 that a household will carry a positive amount of liquid assets into the next period ($m_2 > 0$) (Kaplan et al., 2014). Such a household is able to smooth consumption across $t = 1$ and $t = 2$ with a corresponding consumption path of $c_1 = c_2 = (y_1 + \omega + y_2 - a(1 - R))/2$. Therefore, a household facing such a high income path is classified as a non hand-to-mouth household (N-HtM) (Kaplan et al., 2014).

3.2 Initial Portfolio Allocation Decision ($t = 0$)

The initial portfolio allocation decision at period $t = 0$ determines the allocation of a household's initial endowment (ω) between liquid assets (m_1) and illiquid assets (a) (Kaplan et al., 2014). To understand how this decision affects a household's HtM classification, recall the key differences between the three household groups. At the consumption/saving decision at $t = 1$, a N-HtM household is characterised by holding a non-negative amount of illiquid assets and a positive amount of liquid assets ($a \geq 0,\ m_2 > 0$). On the other hand, a P-HtM household is characterised by holding neither liquid nor illiquid assets ($a = 0,\ m_2 = 0$). Finally, a W-HtM household is characterised by holding no liquid assets but a positive amount of illiquid assets ($a > 0,\ m_2 = 0$) (Kaplan et al., 2014).

According to this definition, the defining feature of an N-HtM household is that it holds a positive amount of liquid assets m_2. Therefore, whether a household is N-HtM is determined by the consumption/saving decision at $t = 1$ (Kaplan et al., 2014). The initial portfolio allocation decision at $t = 0$, on the other hand, specifies whether a HtM household is classified as P-HtM or W-HtM. This is because, while all HtM households are liquidity constrained, P-HtM and W-HtM households differ in their illiquid asset holdings. Specifically, P-HtM households hold zero illiquid assets, whereas W-HtM households hold positive levels of illiquid assets (Kaplan et al., 2014). The following subsection formally depicts the initial portfolio allocation decision at $t = 0$. Note, that the model is deterministic, meaning a household has perfect foresight. Therefore, the utility maximisation problem at $t = 0$ depends on a household's future income path (Kaplan et al., 2014).

High income path: As illustrated in section 3.1, a household on a high income path ($y_H > y_2 + R$) will hold a positive amount of liquid assets ($m_2 > 0$) at the consumption/saving decision at $t = 1$ and is therefore classified as N-HtM household (Kaplan et al., 2014). Its corresponding consumption path is smooth, with $c_1 = c_2 = (y_1 + y_2 + m_1 + aR)/2$. At $t = 0$, the household anticipates this and maximises its utility accordingly. The utility maximisation problem at $t = 0$ is then given by:

$$
\begin{aligned}
v_0 = \max_{a, m_1} \; & u\left(\frac{y_1 + y_2 + m_1 + Ra}{2}\right) \\
\text{s.t.} \quad & \\
\omega &= a + m_1 \\
m_1 &\geq 0,\ a \geq 0.
\end{aligned}
$$

With $R > 1$, a household under a high income path maximises utility by investing all its initial endowment into illiquid assets with $a = 1$ (Kaplan et al., 2014). This is because a household on a high income path knows it will be able to smooth consumption across periods $t = 1$ and $t = 2$, regardless of its allocation decision at $t = 0$. It therefore chooses to allocate its initial endowment to the asset with the highest overall return (a), even though it will not be accessible at $t = 1$. As a result, a household on a high income path holds $m_2 > 0, a > 0$ and is classified as N-HtM (Kaplan et al., 2014)[8]. The corresponding consumption path is smooth with $c_1 = c_2 = (y_H + y_2 + R)/2$.

Low income path: Section 3.1 shows that without borrowing, a household on a low income path ($y_L < y_2 - 1$) is unable to smooth consumption across periods $t = 1$ and $t = 2$. At the consumption/saving decision at $t = 1$, it would like to borrow but is constrained at the zero kink ($m_2 = 0$) (Kaplan et al., 2014). At the initial portfolio allocation decision at $t = 0$, the household anticipates this and maximises utility at $t = 0$ accordingly. The utility maximisation problem at $t = 0$ becomes:

$$\begin{aligned} v_0 &= \max_{a,m_1} u(c_1) + u(c_2) \\ &\text{s.t.} \\ a + m_1 &= \omega \\ c_1 &= m_1 + y_1 \\ c_2 &= Ra + y_2 \\ m_1 &\geq 0, \ a \geq 0. \end{aligned}$$

The first line of the constraint depicts the resource constraint at $t = 0$. The second and third lines of the constraint represent the budget constraints at $t = 1$ and $t = 2$. Liquid and illiquid asset holdings (m_1, a) are assumed to be non-negative. Given these conditions, the utility maximisation problem holds the following solution for illiquid asset holdings a[9]:

$$a = \max \left\{ \frac{R^\sigma (y_1 + \omega) - y_2}{R + R^\sigma}, 0 \right\}. \tag{3}$$

Solution (3) illustrates, that when facing a low income path, a household's holdings of illiquid assets depend on the return R, income y_1 and y_2, the initial endowment ω and the elasticity of intertemporal substitution σ (Kaplan et al., 2014). We see that if a particular condition (4) holds, the interior solution of (3) becomes negative. The household is then constrained at the corner solution $a = 0$, as illiquid asset holdings are assumed to be non-negative. Intuitively, this means that if the return on illiquid assets is sufficiently low, the household chooses to allocate its entire endowment to liquid assets $(m_1 = 1, a = 0)$.

[8] A household is classified as N-HtM if $m_2 > 0, a \geq 0$. Therefore, holding a positive amount of illiquid assets is not a necessary prerequisite for N-HtM households. Instead, the consumption pair $m_2 > 0, a > 0$ represents optimal N-HtM behaviour if the return on illiquid assets is $R > 1$. If conditions were different (e.g. if the return on illiquid assets would be lower), the household might choose not to invest into illiquid assets ($a = 0$). However, it would still be classified as N-HtM, as long as it holds sufficient liquidity to carry over a positive amount of liquid assets to the next period ($m_2 > 0$) (Kaplan et al., 2014).

[9] See Appendix A.1.2 for a thorough derivation of the solution.

The corresponding consumption path is $c_1 = y_1 + m_1$ and $c_2 = y_2$. With a corresponding consumption pair of $(a = 0,\ m_2 = 0)$, such a household is characterised as P-HtM (Kaplan et al., 2014).

$$R \leq \left(\frac{y_2}{y_1 + \omega}\right)^{1/\sigma} \tag{4}$$

Conversely, if condition (5) holds, the interior solution of equation (3) is positive (Kaplan et al., 2014). Note that the household still faces a low income path. As demonstrated in section 3.1, this means it will not possess sufficient liquid assets to meet its desired level of consumption at $t = 1$, even when, as is done by a P-HtM household, allocating its entire endowment to liquid assets (Kaplan et al., 2014). Regardless, if condition (5) is satisfied, the return on illiquid assets is sufficiently high for a household to allocate a positive amount of its initial endowment to illiquid assets $(a > 0, m_1 < 1)$. Such a household is characterised as W-HtM (Kaplan et al., 2014). The allocation decision may appear counter-intuitive, as any investment in illiquid assets further constrains the household in its ability to smooth consumption across periods. Indeed, Kaplan et al. (2014) argue that, at period $t = 1$, such a W-HtM household will be even more liquidity constrained than a P-HtM household[10]. Nevertheless, allocating a positive amount of its endowment to illiquid assets maximises the W-HtM household's lifetime utility, as the overall rise of lifetime consumption more than compensates the welfare loss from a consumption gap between $t = 1$ and $t = 2$ (Kaplan et al., 2014).

$$R > \left(\frac{y_2}{y_1 + \omega}\right)^{1/\sigma} \tag{5}$$

Several parameters determine whether a household faces conditions (4) or (5). A high relative return on illiquid assets (R) increases the attractiveness of illiquid assets as a saving instrument, ceteris paribus. Next, if a household can expect steep income growth $(y_2 > y_1)$, it will expect an already high consumption level at $t = 2$, which, all other factors constant, will reduce the appeal of illiquid assets as a saving instrument. Last, a higher elasticity of intertemporal substitution suggests that a household is more willing to tolerate fluctuations in consumption across periods, making it more likely for a household to invest in illiquid assets, ceteris paribus (Kaplan et al., 2014).

3.3 Unexpected Governmental Transfer τ

After discussing the classification of HtM households, the effect of an unexpected governmental transfer τ is examined next. The transfer is paid after the initial portfolio allocation at $t = 0$ but before the consumption/saving decision at $t = 1$ (Kaplan et al., 2014). First, to examine the effect of τ on N-HtM households, recall that N-HtM households face a high income path (Kaplan et al., 2014). Consequently, they are unconstrained with regard to liquidity and are expected to smooth consumption across periods, as this maximises their overall utility. Therefore, any unexpected governmental transfer τ will be smoothed across periods $t = 1$ and $t = 2$ as well. The corresponding marginal propensity

[10]This can also be illustrated by examining the shadow value λ of an additional unit of income at $t = 1$. Given a diminishing marginal utility $u' > 0$ and $u'' < 0$, the λ for a W-HtM agent, $\lambda = u'(y_1 + \omega - a) - u'(y_2 + Ra)$, is larger than λ for a P-HtM agent, $\lambda = u'(y_1 + \omega) - u'(y_2)$ (Kaplan et al., 2014).

to consume (MPC) out of a governmental transfer τ is therefore equal to 0.5 for N-HtM households (Kaplan et al., 2014).

The effect of τ on P-HtM households is examined next. Recall that, at the portfolio allocation decision at $t = 0$, a P-HtM household allocates all of its endowment to liquid assets ($a = 0, m_1 = 1$) (Kaplan et al., 2014). Formally, with a low income path ($y_1 = y_L$) and an unexpected governmental transfer τ, its utility maximisation problem at the consumption/saving decision at $t = 1$ becomes:

$$\begin{aligned} v_1(m_1, a) &= \max_{c_1, m_2} u(c_1) + u(c_2) \\ &\text{s.t.} \\ c_1 + m_2 &= \tau + \omega + y_1 \\ c_2 &= m_2 + y_2 \\ m_2 &\geq 0, \end{aligned}$$

which holds the solution for m_2:

$$m_2 = \max \left\{ \frac{\tau + \omega + y_1 - y_2}{2}, 0 \right\}. \tag{6}$$

We observe that if τ is sufficiently low relative to y_1, y_2 and ω (specifically, if $0 < \tau \leq y_2 - \omega - y_1$), the interior solution of (6) will be either negative or equal to zero (Kaplan et al., 2014). Therefore, similar to a scenario without a governmental transfer, the P-HtM household will remain liquidity constrained at the consumption/saving decision ($m_2 = 0$). Consequently, it will consume the entire transfer τ with a corresponding $MPC = 1$ (Kaplan et al., 2014). Note, that if the transfer is sufficiently high relative to y_1, y_2 and ω ($\tau > y_2 - \omega - y_1$), a household at the consumption/saving decision will become unconstrained and will be able to carry a positive amount of liquid assets over to the next period ($m_2 > 0$). Then, it is able to smooth consumption across periods with $c_1 = c_2 = (\tau + \omega + y_1 + y_2)/2$. Consequently, the household will smooth the transfer τ equally across periods as well, with a $MPC = 0.5$ (Kaplan et al., 2014)[11]. In other words, if the unexpected governmental transfer τ is sufficiently high, it can alter a household's HtM status from P-HtM to N-HtM (Kaplan et al., 2014).

The effect of τ on W-HtM households is examined next. Similar to a P-HtM household, a W-HtM household faces a low income path. However, unlike a P-HtM household, it faces a sufficiently high return on illiquid assets (condition (5)) in order to allocate a positive amount of its endowment to illiquid assets at the portfolio allocation decision at period $t = 0$ ($a > 0, m_1 < 1$) (Kaplan et al., 2014). Formally, with an unexpected governmental transfer τ, the utility maximisation problem of a W-HtM household at the consumption/saving decision at $t = 1$ becomes:

[11] Kaplan et al. (2014) describe the transition mechanism from constrained to unconstrained consumption behaviour as follows: $MPC = (\tau + y_2 - \omega - y_1)/2\tau$. As the size of the transfer τ increases, we see that the MPC gradually approaches 0.5.

$$
\begin{aligned}
v_1(m_1, a) &= \max_{c_1, m_2} u(c_1) + u(c_2) \\
&\text{s.t.} \\
c_1 + m_2 &= \tau + (\omega - a) + y_1 \\
c_2 &= m_2 + y_2 + Ra \\
m_2 &\geq 0,
\end{aligned}
$$

which holds the solution for m_2:

$$
m_2 = \max \left\{ \frac{\tau + \omega + y_1 - y_2 - a(1+R)}{2}, 0 \right\}. \tag{7}
$$

We observe that if the transfer is sufficiently low relative to other parameters (specifically, if $\tau \leq y_2 - (y_1 + \omega) + a(1+R)$), the interior solution of (7) will be negative or equal to zero (Kaplan et al., 2014). This means that at the consumption/saving decision, a W-HtM household will remain liquidity constrained with $m_2 = 0$. Consequently, it will consume the entire transfer τ with a corresponding $MPC = 1$ (Kaplan et al., 2014). However, if the transfer is sufficiently high relative to other parameters ($\tau > y_2 - (y_1 + \omega) + a(1+R)$), the household becomes unconstrained with regard to liquidity and will be able to carry a positive amount of liquid assets over to the next period ($m_2 > 0$) (Kaplan et al., 2014). Then, it is able to smooth consumption across periods with $c_1 = c_2 = (\tau + \omega + y_1 + y_2 + a(R-1))/2$. In this case, the household will smooth the consumption of τ equally across periods $t = 1$ and $t = 2$ as well, with a corresponding $MPC = 0.5$ (Kaplan et al., 2014). Importantly, due to their portfolio allocation decision at $t = 0$, W-HtM households are more liquidity constrained than P-HtM households (Kaplan et al., 2014). Consequently, a W-HtM household requires a larger governmental transfer τ to become unconstrained. Formally, this is reflected by the fact that the condition for a W-HtM household to remain liquidity constrained when receiving the transfer ($\tau \leq y_2 - y_1 - \omega + a(1+R)$) is weaker than that for a P-HtM household ($\tau \leq y_2 - y_1 - \omega$) (Kaplan et al., 2014).

4 Identification Strategy

Having established the formal classification approach of the underlying model for hand-to-mouth (HtM) households, this section will discuss the strategy for identifying HtM households in empirical data. To do so, this work relies on the identification strategy and corresponding parameter definitions proposed by Kaplan et al. (2014). Therefore, unless stated otherwise, all theoretical assumptions and definitions have been adopted from Kaplan et al. (2014) and do not represent my own work.

In their empirical identification strategy, Kaplan et al. (2014) extend the baseline model to account for unsecured credit (i.e. credit granted without the requirement of providing collateral, such as personal loans or credit cards)[12]. Recall that in the baseline model, a household is classified as hand-to-mouth, if it consumes all its liquid assets in period $t = 1$ and carries none into the next period $t = 2$. However, in the extended model, a household is able to borrow. Consequently, a household is classified as HtM not if it holds zero liquid

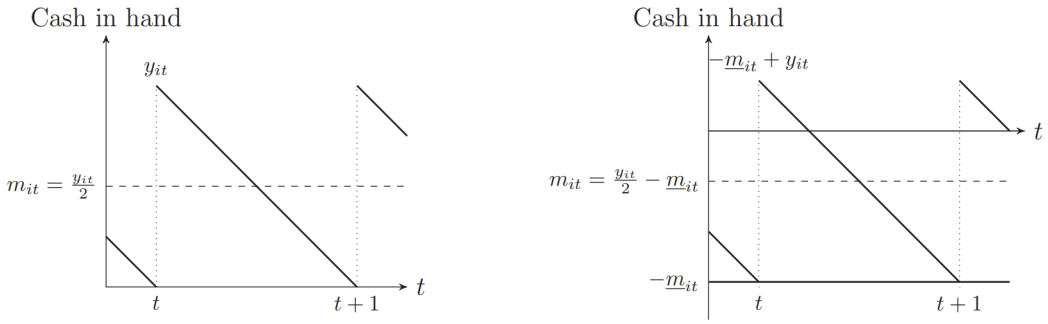
[12] See Appendix A.2 for a detailed discussion of the extended model with unsecured credit.

assets but if, at the consumption/saving decision at $t = 1$, it borrows up to the credit limit (Kaplan et al., 2014). The difference between both concepts is illustrated in Figure 1. Panel (a) depicts a baseline model environment, where households are constrained at the zero kink. In contrast, panel (b) presents an extended framework, where households can borrow until they reach the credit limit ($-\underline{m}_{it} < 0$). Following Kaplan et al. (2014), I employ the latter framework with unsecured credit to identify hand-to-mouth households in HFCS data.

Kaplan et al. (2014) put forward several methods to identify hand-to-mouth households in empirical data. The baseline approach involves the examination of a household's average balances of liquid assets. Alternative identification strategies include assessing the overall net worth, incorporating pre-committed consumption expenditures or deriving the HtM share via direct survey questions (Kaplan et al., 2014). Fortunately, HFCS data allows for the adoption of both the baseline identification strategy and all aforementioned alternate strategies. The following section will commence by introducing the baseline identification strategy. The alternative identification strategies will be introduced later and will be utilised to evaluate the sensitivity of the baseline HtM shares (see Table 2)[13].

4.1 Average Liquid Balances

Following the theoretical framework of Kaplan et al. (2014), one would ideally determine a household's HtM status by examining its liquid asset holdings at the end of a pay period. The timing of the observation matters here, as a household is only considered to be HtM, if it has depleted all its liquid assets and available credit *at the end* of a pay period (Kaplan et al., 2014)[14]. Unfortunately, many datasets, including the HFCS, only report a household's average liquid balances. To classify households under such data limitations, the empirical identification strategy must be adjusted accordingly (Kaplan et al., 2014).



(a) HtM at the zero kink

(b) HtM at the credit limit

Figure 1: HtM classification. Source: Kaplan et al. (2014, p. 89).

Figure 1, panel (b) illustrates the problem of aligning average liquid balances with the theoretical framework of Kaplan et al. (2014). The panel depicts the extended model with borrowing, in which income is paid discretely (e.g. once a month), and consumption occurs continuously and at a constant rate. y_{it} represents the income of household i in period t, the household's credit limit is denoted as $-\underline{m}_{it} < 0$, and m_{it} represents the household's

[13] See Appendix A.3 for a detailed discussion of all alternative identification strategies.

[14] Illiquid asset holdings, on the other hand, are assumed to be inaccessible in the short term, meaning that a household's illiquid wealth is assumed to remain constant throughout the observed pay period. Therefore, the point at which a household's illiquid wealth is observed within a pay period is considered to be negligible (Kaplan et al., 2014).

average liquid balances over the pay period (Kaplan et al., 2014). A hand-to-mouth household receives its income y_{it} at the beginning of period t and consumes it at a constant rate until its liquid assets and credit are fully depleted by the end of the period. Naturally, the household's average liquid balances over the period are likely to exceed the amount of liquid assets it holds at the very end of the pay period. Therefore, relying on average liquid balances without adjusting the identification strategy may result in portraying a constrained household as unconstrained, i.e. poses a danger of misclassifying HtM households as non HtM (Kaplan et al., 2014).

In order to account for this mechanism, Kaplan et al. (2014) determine a household's HtM status based on whether its average liquid balances exceed or fall below the threshold of half a household's income ($y_{it}/2$) minus its credit limit. The term "half a household's income" is derived based on the assumption that resources are consumed at a constant rate throughout the pay period (Kaplan et al., 2014). The credit limit is considered in order to adhere to the extended model in which a household is classified as HtM only if, at the end of period t, it has exhausted all its liquid assets and has borrowed up to the credit limit $-\underline{m}_{it}$. A household with average liquid assets at or below the threshold of $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$ (represented by the dotted line in Figure 1, panel (b)) is then classified as a hand-to-mouth household (Kaplan et al., 2014). A household with average liquid balances at or below this threshold that also holds zero or negative illiquid assets is further classified as poor HtM (Kaplan et al., 2014)[15]. In contrast, a household with average liquid balances below the threshold that also holds a positive amount of illiquid assets is classified as wealthy HtM (Kaplan et al., 2014).

Formally, a household is classified as P-HtM if:

$$a_{it} \leq 0, \quad m_{it} \leq 0 \quad \text{and} \quad m_{it} \leq \frac{y_{it}}{2} - \underline{m}_{it}, \tag{8}$$

and as W-HtM if:

$$a_{it} > 0, \quad m_{it} \leq 0 \quad \text{and} \quad m_{it} \leq \frac{y_{it}}{2} - \underline{m}_{it}. \tag{9}$$

Classifying households based on whether their average liquid balances exceed or fall below the threshold of $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$ may lead to both over- and underestimation of the true HtM share. Kaplan et al. (2014) argue, that the proposed identification strategy provides a conservative lower bound, as it does not account for a household's liquid savings and may therefore underestimate the true share of HtM households[16]. However, if a household does not consume at a constant rate but faces bulk expenditures at the beginning of the period (e.g. rent or mortgage payments), the baseline identification strategy may instead overestimate the share of HtM households (Kaplan et al., 2014)[17]. In line with

[15] Kaplan et al. (2014) classify households with negative illiquid assets as P-HtM households, e.g, households with negative housing equity. This is due to the fact that even though these household technically hold illiquid assets, they cannot utilise them to smooth consumption, therefore resembling P-HtM rather than W-HtM households.

[16] Consider a household that ends the pay period having fully depleted its liquid assets, thereby being HtM according to the theoretical framework. If, at the beginning of the period, this household had liquid savings in addition to its income, its average liquid balances over the pay period may exceed the threshold for being HtM and the empirical identification strategy would misclassify it as N-HtM.

[17] Consider a household that does not borrow up to the credit limit, therefore being N-HtM according to the theoretical framework. If this household faces bulk expenditures at the beginning of the period, its average liquid balances over the period may fall below the critical benchmark, meaning the empirical identification strategy would misclassify it as HtM.

Kaplan et al. (2014), this issue of potential overestimation is addressed by accounting for the timing of "pre-committed consumption expenditures". Specifically, this paper adopts this adjustment to the baseline identification strategy as a sensitivity test. A detailed discussion of this and other alternative identification strategies can be found in Section 5.1 and Appendix A.3.

4.2 Parameter Choices and HFCS Data

In order to adhere closely to the baseline identification strategy of average liquid balances and formal definitions (8) and (9), this paper adopts the parameter definitions proposed by Kaplan et al. (2014). The particular definitions are discussed below and do not represent my own work.

Net Liquid Assets. In line with Kaplan et al. (2014), this paper considers net liquid assets, i.e. liquid assets minus liquid debt. For HFCS data, liquid assets are defined as a household's holdings of cash, current accounts, mutual fund holdings, corporate or government bond holdings and shares in publicly traded companies (Kaplan et al., 2014). Liquid debts are defined as a household's remaining balance on credit cards after the latest payment, as well as balances on credit lines and any outstanding bank overdrafts that accrue interest (Kaplan et al., 2014). To assess the sensitivity of HtM shares to this parameter definition, Kaplan et al. (2014) expand upon this baseline definition by including home-equity lines of credit (HELOC). This sensitivity test is adopted and discussed in section 5.1.

Net Illiquid Assets. In line with Kaplan et al. (2014), this paper considers net illiquid assets, i.e. illiquid assets minus illiquid debt. For HFCS data, illiquid assets are defined as a household's holdings of occupational and voluntary pension plans, the cash value of its life insurance policies, its holdings of certificates of deposits and saving bonds, as well as the value of a household's main residence and other properties (Kaplan et al., 2014). Illiquid debt is defined as mortgages and unsecured loans taken out to finance a household's properties (Kaplan et al., 2014). To examine the sensitivity of HtM shares to this parameter definition, this work will later expand upon this baseline definition by considering the resale value of vehicles and other illiquid assets such as antiques, artwork or gold (see section 5.1).

Income. In line with Kaplan et al. (2014), income is not only defined as labour income but also includes the regular governmental transfers a household relies on. Specifically, for HFCS data, income is defined as a household's gross income from wages, salaries, and self-employment, unemployment benefits, regular private transfers (such as child support and alimony) and regular public transfers (Kaplan et al., 2014). Infrequent financial gains such as interests, dividends and other capital income are excluded.

Credit Limit. Unfortunately, the HFCS does not report a household's unsecured credit limit. Therefore, when evaluating HFCS data, Kaplan et al. (2014) propose using a benchmark based on data from the U.S. Survey of Consumer Finances (SCF). Specifically, they derive the (self-reported) median credit limit-to-income ratio[18]. They find that for 2010 U.S. households, this median ratio is equivalent to 1.2 months of income and set the benchmark credit limit to one month of a household's income (Kaplan et al., 2014)[19].

[18]The corresponding survey question X414(#1) in the 2010 SCF codebook asks: "What is the maximum amount you could borrow on (this account/all of these accounts); that is, what is your total credit limit?" The reported amount is then compared to the household's reported income.

[19]Note that this credit limit refers to unsecured credit (e.g. private loans, credit cards) and not to credit

Due to a lack of HFCS data, this paper adopts the same benchmark, setting the unsecured credit limit for German households to one month of their income. This benchmark value allows for household-specific variation, as each household is assigned an individual credit limit depending on their reported income. However, other limitations persist. First, by considering only unsecured credit, credit granted by putting up collateral (e.g. housing) is ignored. This might paint an incomplete picture of a household's short-term constraint. Specifically, one may argue that a household is not truly constrained if it has exhausted all its unsecured credit but can gain still gain short-term credit by putting up their illiquid assets as collateral. Second, credit conditions in the U.S. and Germany may differ, potentially affecting the appropriateness of the benchmark for German households. To assess the sensitivity of HtM shares to this parameter choice, the credit limit is later extended by considering home equity lines of credit (HELOC), which are loans granted for putting up ones property as collateral (Kaplan et al., 2014). In line with Kaplan et al. (2014), another sensitivity test extends the credit limit to 12 months and zero months of income, for both the overall share of German HtM households and the corresponding MPX values (see Table 2, Table 7).

Pay Period. Based on data from the U.S. Bureau of Labor Statistics, Kaplan et al. (2014) adopt a bi-weekly pay period as this is the most common pay period for U.S. households. Intuitively, a monthly pay period may seem more appropriate for German households. However, to the best of my knowledge, no data set tracks the length of German pay periods. Without clear evidence to justify a deviation from Kaplan et al. (2014), the bi-weekly pay period is therefore adopted as a baseline parameter. A monthly pay period is later adopted as a sensitivity test (see Table 2).

HFCS Sample. Table 1 depicts all HFCS waves that are used for this household analysis. In line with Kaplan et al. (2014), certain household groups are excluded. Specifically, households with a main respondent younger than 22 or older than 79 are dropped. Households with negative income are dropped to avoid reporting and data entry errors. Households with income from self-employment are excluded, as this income tends to be more volatile and inconsistent than regular wage income (Kaplan et al., 2014). HFCS survey weights are applied to all households in the final sample to address imperfections such as unit non-response and coverage problems[20].

	HFCS 2010	HFCS 2014	HFCS 2017	HFCS 2021
Initial sample size	3565	4461	4942	4119
Exclusions				
Not age 22-79	246	270	371	472
Negative income	0	0	0	0
All inc. from self empl.	228	252	258	178
Final sample size	3091	3939	4313	3469

Table 1: HFCS sample size for German households before and after exclusions, HFCS 2010-2021.

granted for putting up collateral (e.g. home equity lines of credit).

[20]See Appendix A.4 for a discussion of HFCS survey weights and the HFCS sample design.

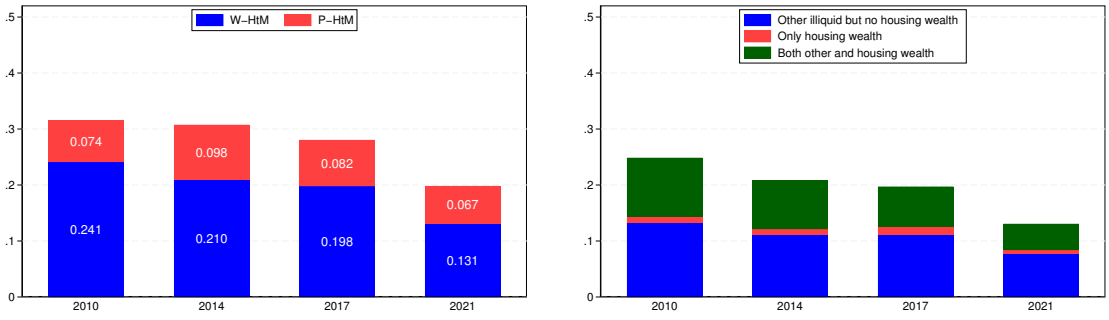
5 German Hand-to-Mouth Households

The following section utilises the parameter definitions of the previous section in order to determine the hand-to-mouth (HtM) status of German households. Afterwards, the sensitivity of the corresponding baseline estimates is tested by examining several alternative parameter choices and identification strategies. The section concludes by exploring the demographic characteristics of individual HtM groups.

5.1 HtM Shares

Table 2 presents a pooled analysis across all four data waves (HFCS 2010-2021). The table shows that under the baseline identification strategy, 27.7 percent of German households are classified as hand-to-mouth. The majority of these HtM households are wealthy HtM, who make up 19.7 percent of all households, while 8.0 percent of all households are classified as poor HtM. Figure 2, panel (a) depicts the baseline hand-to-mouth shares for each of the four data waves. When comparing these individual data waves, it is evident that HtM shares decline consistently over time. The decline appears to be driven by a continuous reduction of wealthy HtM households over time, while the share of poor HtM households appears to be less volatile.

Figure 2, panel (b) provides an initial overview of the illiquid asset portfolio composition of German W-HtM households. Specifically, it depicts the respective shares of W-HtM households whose portfolios consist out of either housing wealth only (red bars), other illiquid assets only (blue bars), or a combination of the two (green bars) (Kaplan et al., 2014). The blue bars in Figure 2, panel (b) indicate that approximately half of all W-HtM households do not possess any housing wealth. Instead, their portfolios consist out of "other illiquid assets", which are defined as a household's pension plans, life insurance policies, certificates of deposit and savings bonds (Kaplan et al., 2014). Section 5.3 will expand upon these findings by providing a more detailed examination of the portfolio composition of German HtM households.



(a) Baseline HtM shares

(b) W-HtM portfolio composition

Figure 2: Baseline HtM shares and W-HtM portfolios. HFCS 2010-2021.

However, before doing so, it is important to acknowledge the limitations of the baseline parameters and identification strategy. First, parameters such as a household's unsecured credit limit and pay period are not reported in HFCS data. Consequently, this study is forced to adopt the corresponding parameter choices from Kaplan et al. (2014), which are primarily geared towards U.S. households. Second, the baseline identification strategy may not adequately capture a household's rate of consumption. This is because it assumes

a constant rate of consumption and does not account for certain bulk expenditures that might accrue at a certain point in time (so-called "pre-committed consumption expenditures"), such as rent or mortgages (Kaplan et al., 2014). Third, the baseline definitions of liquid and illiquid assets may be incomplete and thus require additional extensions to ensure comprehensiveness. In an attempt to address these issues, this paper conducts a sensitivity analysis of the baseline HtM estimates. All tests and their corresponding results are presented in Table 2 and discussed below.

Alternative Parameter Choices: Credit Limit. In line with Kaplan et al. (2014), the unsecured credit limit is set to one month of income. However, if the true credit limit of German households is higher, the baseline identification strategy could overestimate the share of HtM households. This is because households with a higher credit limit would be classified as liquidity constrained for every borrowed amount larger than one month's income, even though their credit limit may not be fully exhausted. If, on the other hand, the true unsecured credit limit of German households is lower than one month's income, the baseline identification strategy may underestimate the true HtM share. This is because households with an unsecured credit limit lower than a month's income could be classified as unconstrained, even if they fully exhaust their credit limit. To assess the extent of this potential misclassification, a first sensitivity test extends (and lowers) the unsecured credit limit to 12 (and zero) months of income, in line with Kaplan et al. (2014). Table 2 shows, that an extended credit limit of 12 months lowers the average HtM share by 2.9 percentage points compared to baseline shares. By contrast, setting the unsecured credit limit to zero months raises the average HtM share by 5.9 percentage points.

A second limitation of the baseline credit limit is that it only refers to unsecured credit. However, households may also use secured credit to obtain short-term liquidity, for example by putting up their illiquid assets as collateral. In this case, the baseline identification strategy might overestimate the true share of constrained HtM households, as it does not take into account households gaining liquidity through this type of credit (Kaplan et al., 2014). In an attempt to account for secured credit, this paper follows Kaplan et al. (2014) in considering so-called "home equity lines of credit" (HELOC), where households are granted liquidity for putting up their home as collateral[21]. Table 2 shows that accounting for liquidity gained from HELOCs does not alter the German P-HtM share. This is not surprising, given that these households are assumed to hold no positive illiquid assets and therefore should not be able to offer home equity as collateral. On the other hand, considering HELOCs lowers the German W-HtM share by 1.1 percentage points compared to baseline estimates.

Finally, so-called "cc puzzle households" carry revolving credit card debt while at the same time holding positive liquid balances (instead of paying off their debt) (Kaplan et al., 2014). The existence of these households is a well-documented phenomenon in finance literature, with up to 27 percent of U.S. households displaying such behaviour (Telyukova, 2013). Even though these households still have slack in both credit and liquid wealth, the net liquid wealth of many of these households may be close to zero. Therefore, the baseline identification strategy might classify these household as HtM, even though they are not truly liquidity constrained (Kaplan et al., 2014). To assess the extent of this potential overestimation, such households are excluded from the sample. As shown in Table 2, this reduces the HtM share by only 0.2 percentage points compared to baseline estimates.

[21] In line with Kaplan et al. (2014), HELOCs are incorporated as liquid debt while the credit limit is extended by the total line of available credit.

	P-HtM	W-HtM	N-HtM	HtM	HtM-NW
Baseline	0.080	0.197	0.723	0.277	0.102
Credit limit 12 months income	0.074	0.174	0.752	0.248	0.089
Credit limit set to 0	0.090	0.245	0.664	0.336	0.119
HELOCs as liquid debt	0.080	0.186	0.734	0.266	0.102
Excludes cc puzzle households	0.084	0.191	0.725	0.275	0.106
Comm. cons. - beg.	0.070	0.174	0.755	0.245	0.090
Comm. cons. - end	0.097	0.272	0.631	0.369	0.134
Financially fragile households	0.121	0.435	0.444	0.556	0.198
Higher illiquid wealth cutoff	0.107	0.170	0.723	0.277	0.102
In past year, c > y	0.100	0.366	0.534	0.466	—
Monthly pay period	0.095	0.308	0.597	0.403	0.132
Vehicles as illiquid asset	0.052	0.225	0.723	0.277	0.069
Ret. acc. as liquid for 60+	0.080	0.189	0.731	0.269	0.102
Businesses as illiquid assets	0.079	0.203	0.718	0.282	0.101
Direct as illiquid assets	0.080	0.231	0.689	0.311	0.102
Other valuables as illiquid assets	0.077	0.201	0.723	0.277	0.099

Table 2: Sensitivity tests for baseline HtM shares with HFCS data from 2010-2021, pooled. *"In past year, $c > y$"* considers households whose spending exceeded their income to be HtM. *"Financially fragile households"* considers households up to €2000 above the baseline threshold as HtM. *"Higher illiquid wealth cutoff"* considers households as W-HtM only if they hold more than €1000 in illiquid assets. *"Credit limit 12 months income"* considers annual income instead of monthly income as the unsecured credit limit. *"Credit limit set to 0"* estimates HtM shares without allowing for borrowing. *"Ret. acc. as liquid for 60+"* considers retirement accounts for households aged 60+ to be liquid assets. *"Business as illiquid assets"* considers income from self-employment to be income and adds business assets to illiquid wealth. *"Direct as illiquid assets"* considers stocks, bonds, and mutual funds to be illiquid assets. *"Other valuables as illiquid assets"* considers additional valuables to be illiquid assets such as gold, artwork and antiques. *"HELOCs as liquid debt"* extends the definition of liquid debt to include home equity lines of credit. *"Excludes cc puzzle households"* drops households that have both positive liquid assets and revolving credit card debt. *"Weighted by income"* weighs HtM shares by income in addition to the already applied HFCS household weights. *"Comm. cons. - beg. of period"* (*"Comm. cons. - end of period"*) estimates HtM shares when a household's committed consumption takes place at the beginning (the end) of a period.

Alternative Parameter Choices: Others. Baseline HtM estimates may also be sensitive to alternative pay periods as well as extended definitions of liquid assets, illiquid assets and income (Kaplan et al., 2014). To examine the extent of this sensitivity, the baseline parameter of a bi-weekly pay period is replaced with a monthly pay period. While this may seem like a more intuitive choice to begin with, to the best of my knowledge, no empirical evaluation of the length of German pay periods exist. Without clear evidence to justify deviating from the baseline parameter, a monthly pay period is therefore only employed as a sensitivity test. Table 2 shows that assuming a monthly pay period increases German HtM share significantly from 27.7 percent to 40.3 percent. Next, baseline definitions of liquid assets, illiquid assets and income are expanded in line with Kaplan et al. (2014). Specifically, one test broadens the baseline definition of illiquid assets by including vehicles (Kaplan et al., 2014)[22]. Another test classifies the retirement accounts of households aged 60+ as liquid instead of illiquid assets, as these households may no longer use retirement accounts as a long-term investments, but rather like saving-accounts (Kaplan et al., 2014). Another test extends the definition of illiquid assets to include other valuables such as gold, artwork, and antiques (Kaplan et al., 2014). Another test classifies former liquid assets such as stocks, bonds and mutual funds as illiquid assets (Kaplan

[22]In line with Kaplan et al. (2014), this study considers the resale value of the vehicle, minus the loans taken out to purchase it.

et al., 2014). Finally, another test extends the definition of income to include income from self-employment (which was previously excluded due to volatility concerns), and considers business assets to be illiquid assets (Kaplan et al., 2014). Table 2 shows, that HtM shares across all tests deviate by no more than 3.4 percentage points from baseline estimates.

Alternative Identification Strategies. The baseline model determines a household's HtM status based on its liquidity at the end of a pay period. However, as discussed in section 4.1, the HFCS only provides a household's average liquidity. Consequently, the baseline empirical identification strategy determines a household's HtM status depending on whether its average liquid balances are above, at, or below a certain threshold. This threshold is defined as half a household's income minus its credit limit, or: $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$ (Kaplan et al., 2014). The term "half a household's income" represents the assumption that a household consumes resources at a constant rate throughout the pay period. However, assuming a constant rate of consumption does not take into account so-called "pre-committed consumption expenditures" (Kaplan et al., 2014). These are predetermined bulk expenditures that a household might have to pay every pay period, such as rent, mortgage and loan payments and alimony (Kaplan et al., 2014). If these expenditures are not smoothed across the pay period but incur at a specific point in time (e.g. the beginning or the end of a pay period), the baseline identification strategy determines a household's HtM status with measurement error (Kaplan et al., 2014)[23]. Table 2 shows that HtM shares are indeed sensitive to the existence and timing of bulk-expenditures. If they are assumed to incur at the beginning of the pay period, the baseline identification strategy would overestimate the true HtM share by 3.2 percentage points. If they are assumed to incur at the end of a pay period, the baseline strategy would underestimate the true HtM share by 9.2 percentage points compared to baseline estimates.

Next, recall that the baseline identification strategy classifies households as HtM only once they have depleted their liquid assets and exhausted their entire credit limit. As noted by Kaplan et al. (2014), this definition is rather rigid. Consequently, another sensitivity test extends this definition by also classifying "financially fragile" households as hand-to-mouth. Following Lusardi et al. (2011), a household is considered to be financially fragile, if it is unable to come up with €2000 in 30 days. In line with Kaplan et al. (2014), the concept is implemented by raising the HtM threshold. Specifically, households with an income up to €2000 above the baseline threshold are now classified as HtM (Kaplan et al., 2014). Table 2 shows that considering financially fragile households raises the overall HtM share considerably from 27.7 to 55.6 percent. Another underlying assumption of the baseline identification strategy is that HtM households with any net illiquid assets above zero are classified as wealthy HtM (Kaplan et al., 2014). However, differences in P-HtM and W-HtM spending behaviour may not be as pronounced, if the W-HtM households hold only a small amount of illiquid wealth. Another sensitivity test therefore increases the illiquid wealth cut-off, classifying all HtM households with illiquid assets below €1000 as P-HtM (Kaplan et al., 2014). Table 2 shows that this lowers the share of W-HtM households from 19.7 to 17.0 percent and increases the share of P-HtM households from 8.0 to 10.7 percent.

Next, households are classified directly via survey questions. To do so, this study utilises an HFCS survey question, which asks respondents to report whether in the past year their spending was lower, exceeded, or was about the same as their income. This approach follows Kaplan et al. (2014), who, using a similar survey question for U.S. households, consider all households whose spending exceeds their income to be HtM[24]. Table 2 shows,

[23] For a detailed description of this mechanism, see Appendix A.3.

[24] See Appendix A.3 for the specific wording and a detailed discussion of how HFCS survey questions

that when following this alternative identification strategy, the HtM share rises considerably from 27.7 to 46.6 percent. However, Kaplan et al. (2014) note that this test should be interpreted as an upper bound for HtM classification, as it classifies households as HtM even if their high spending stems from dissaving or borrowing. Finally, a net worth identification strategy is employed. Unlike the baseline identification strategy, it does not differentiate between liquid and illiquid assets (Kaplan et al., 2014). Consequently, the key distinction between P-HtM and W-HtM households (different levels of illiquid wealth) is not observed. As a result, only two household groups emerge, namely hand-to-mouth-net-worth (HtM-NW) and non hand-to-mouth-net-worth (N-HtM-NW) households (Kaplan et al., 2014)[25]. Table 2 shows that the HtM-NW share is 10.2 percent, thereby sitting between baseline P-HtM and W-HtM estimates.

Overall, Table 2 shows that the alternative parameter choices and identification strategies employed here typically yield HtM estimates that are similar to or larger than baseline estimates. While some tests yield lower HtM estimates compared to the baseline (e.g. credit limit set to 12 months of income, considering HELOCs, considering pre-committed consumption expenditures), they lower the overall German HtM share by no more than 3.2 percentage points. Conversely, a number of alternative parameter choices have been demonstrated to raise German HtM shares considerably (e.g. considering a monthly pay period, a direct survey question, a credit limit of zero months of income). The most considerable increase occurs when classifying "financially fragile" households as hand-to-mouth, which raises the HtM share from 27.7 to 55.6 percent. In light of these findings, the baseline identification strategy is interpreted as providing a conservative lower-bound on the fraction of German HtM households.

5.2 HtM Portfolio Composition and Demographics

In order to examine the portfolio composition of German HtM households, Table 3 first presents some general descriptive statistics in line with Kaplan et al. (2014). Using the Harmonized Index of Consumer Prices (HICP), all monetary variables are adjusted to €2021. Asset holdings are depicted with mean and median values. "Frac. Pos." depicts the fraction of households holding a positive quantity of a given asset. When turning to the interpretation, we see means being consistently larger than median values across all asset categories, indicating that the data is skewed to the right. Differences between mean and median values are more pronounced for net worth than for income, suggesting a more pronounced right tail in the wealth distribution than the income distribution. Moreover, German households appear to hold their wealth predominantly in illiquid assets, with the average median net illiquid asset position (55 963€) being considerably larger than the average median net liquid position (2 114€). Bank accounts (see cash/checking/savings/MM) are the most common channel through which liquid assets are held. Specifically, 87.9 percent of all German households hold positive liquid balances through this channel, whereas the fractions of households with positive stock and bond holdings are much smaller (11.7 and 3.7 percent, respectively). When turning to illiquid assets, we see that housing is the most dominant channel. Nevertheless, only 48 percent of all German households hold positive housing equity (the median for housing wealth is zero), indicating that the distribution of housing wealth is concentrated. This is a well-documented phenomenon, as German households are known to have one of the lowest homeownership rates in Europe (Kaas et al., 2019).

are utilised to classify HtM households.

[25] See Appendix A.3 for a through discussion of the net worth categorisation.

	Mean	Median	Frac. Pos.
Income (age 22-59)	54094	44122	0.993
Net Worth	227494	67225	0.939
Net liquid assets	19471	2114	0.853
Cash, checking, saving, MM accounts	7307	1820	0.879
Directly held stocks	4775	0	0.117
Directly held bonds	1720	0	0.037
Revolving credit card debt	546	0	0.167
Net illiquid assets	208023	55963	0.854
Housing net of mortgages	162610	0	0.480
Retirement accounts	8167	0	0.363
Life insurance	16271	0	0.478

Table 3: Descriptive statistics for German households on income, net worth, liquid and illiquid Wealth. Monetary variables are adjusted to €2021 using the Harmonized Index of Consumer Prices (HICP). HFCS 2010-2021, pooled.

Due to its significance for German portfolios, the housing channel is investigated further. To do so, Figure 3 examines the distribution of housing debt among homeowners in line with Kaplan et al. (2014). Specifically, it depicts the housing leverage ratio, i.e. the ratio of housing debt to housing value[26]. We see that out of all homeowners with a leverage ratio of zero (i.e. homeowners with no housing debt), less than 15 percent are HtM households. Put differently, only few hand-to-mouth homeowners have no housing debt and none of them are poor HtM. Another finding is that the share of HtM households among homeowners appears to increase as the leverage ratio rises. As noted by Kaplan et al. (2014), this is consistent with the intuition that a higher leverage ratio implies higher mortgage payments, which absorb more of a homeowner's disposable income. Homeowners facing these higher mortgage payments are therefore more likely to be constrained and, in turn, more likely to be classified as hand-to-mouth (HtM) (Kaplan et al., 2014). Finally, we see that between poor and wealthy HtM households, only the latter display leverage ratios equal to or smaller than one. Therefore, only wealthy HtM homeowners hold housing value greater than or equal to their housing debt. By contrast, all poor HtM homeowners are found to display leverage ratios larger than one, meaning they hold more housing debt than positive housing value. This is in line with the models assumption that poor HtM households do not hold positive net illiquid assets (Kaplan et al., 2014).

To gain a better understanding of German HtM households, Figure 4 aims at providing a more detailed examination of their portfolio composition and demographic characteristics. First, Figure 4, panel (a) depicts the median net liquid wealth held across all HtM groups. We see that German N-HtM households hold considerable net liquid wealth across their life-cycle. By contrast, P-HtM households are found to hold virtually no net liquid assets. W-HtM households appear to hold positive, albeit little liquid wealth across the majority of their life-cycle. Next, Figure 4, panel (b) compares the median net illiquid wealth held by N-HtM and W-HtM households. German N-HtM households are found to hold a significant amount of illiquid assets (peaking at over €300 000), which appear to be distributed in a hump-shaped manner throughout their life-cycle. While German W-HtM

[26] In line with Kaplan et al. (2014), housing debt is defined as the sum of all mortgages. Housing value is defined as the value of the households main residence and other properties it holds at the time of the interview.

households hold substantial net illiquid wealth as well (peaking at under €200 000), their illiquid asset holdings are considerably lower than those of German N-HtM households throughout their life-cycle.

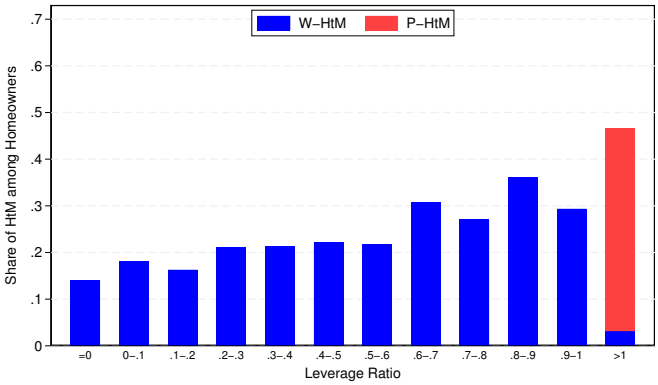


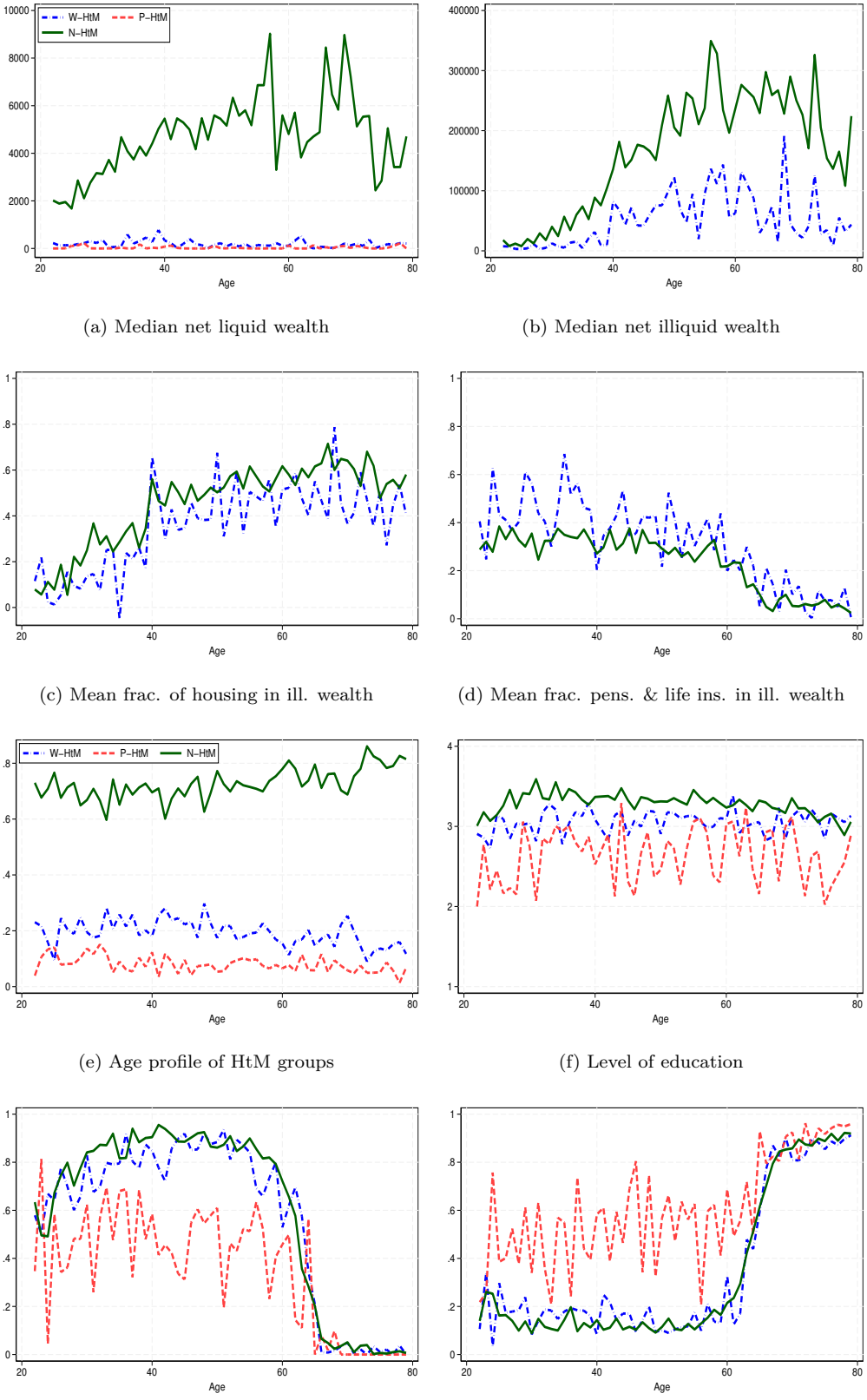
Figure 3: Leverage ratios of German HtM homeowners. HFCS 2010-2021, pooled.

Figure 4, panels (c) and (d) examine the fraction of illiquid wealth held through either housing or pensions and life insurance. Panel (c) shows that the fraction housing makes up in a N-HtM household's illiquid wealth portfolio increases as the household grows older. Specifically, at age 22, housing makes up less than 10 percent of a N-HtM household's illiquid wealth portfolio, while it makes up close to 60 percent of their illiquid wealth portfolio at age 79. By contrast, panel (d) shows that the fraction of pensions and life insurance in a N-HtM household's illiquid wealth portfolio decreases from roughly 30 percent at age 22 to almost zero at age 79. This suggests that German N-HtM households start to deplete these assets during the later stages of their life-cycle. Compared to N-HtM households, German W-HtM households appear to hold a smaller fraction of their illiquid wealth in housing and a higher fraction in pensions and life insurance. However, as lines from both HtM groups often overlap across their life-cycle, the overall investment patterns of both groups appear to closely resemble each other.

Figure 4, panel (e) depicts HtM shares across age. The share of German P-HtM households appears to decrease only slightly over age, fluctuating around the 10 percent mark throughout the entire life-cycle. W-HtM shares appear to be more volatile, with shares decreasing from roughly 30 percent at around age 50 to about 10 percent at age 79. We see that as shares of HtM households decrease with age, the share of N-HtM households rises. This suggests that in the later stages of their life-cycle, some households transition from being poor or wealthy hand-to-mouth to being non hand-to-mouth households. Figure 4, panel (f) depicts a household's educational level, where level 1 corresponds to primary education or lower and level 4 to a master's degree or higher. We see that German N-HtM households display the highest level of education, with the average educational level being only slightly lower for W-HtM households. Although the data is noisy, the educational level of German P-HtM households appears to be considerably lower than that of N-HtM households throughout their life-cycle.

Figure 4, panel (g) depicts the fraction of working individuals per household[27]. The fraction of workers per N-HtM household remains above 80 percent between the ages of 40

[27]A household member is classified as "working" if they are either doing regular work for pay, are self-employed or work in a family business (Household Finance and Consumption Network, 2023). See Appendix A.4, HFCS Sample Design for a more detailed description of the HFCS data collection process.



(a) Median net liquid wealth

(b) Median net illiquid wealth

(c) Mean frac. of housing in ill. wealth

(d) Mean frac. pens. & life ins. in ill. wealth

(e) Age profile of HtM groups

(f) Level of education

(g) Frac. of working household members

(h) Frac. of income from gov. benefits

Figure 4: Portfolio composition (panel (a)-(d)), and demographics (panel (e)-(h)) of German HtM households. All monetary variables are adjusted to €2021 using the Harmonized Index of Consumer Prices (HICP). HFCS 2010-2021, pooled.

and 60. Afterwards, the fraction of workers drops considerably, with the majority of individuals belonging to such households having seemingly stopped working by the age of 70. While the data is noisy, we see that the fraction of workers per poor HtM household is considerably lower across age as it remains below 80 percent for households aged 22 to 65, and drops to zero for households aged 70 and over. The fraction of workers per wealthy HtM household resembles the fraction of workers per non HtM household. Both groups show a similar hump shape throughout the life-cycle and a similar drop in workers per household between the ages of 60 and 70. Next, Figure 4, panel (h) examines the fraction of income stemming from from government benefits (defined as all social transfers including public pensions). Again, we see striking similarities between N-HtM and W-HtM households, for whom governmental benefits make out less than 20 percent between age 25 to 60. Afterwards, the fraction of income from governmental benefits increases considerably for both household groups, indicating that at this point in time, W-HtM and N-HtM households start receiving public pensions. While the data is noisy, we see that P-HtM households differ from these two household groups in that governmental benefits already make out a considerable part of their income before age 60.

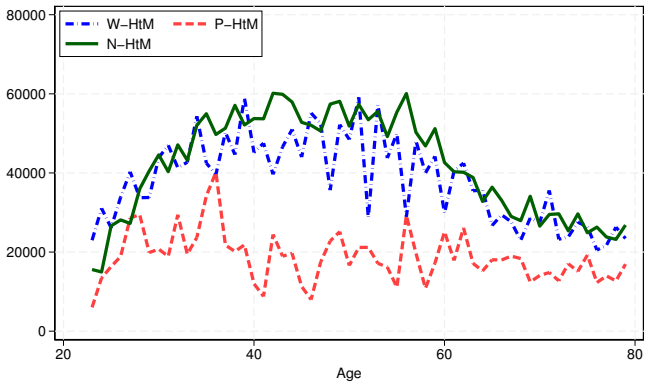


Figure 5: Median income of HtM groups. HFCS 2010-2021, pooled.

Finally, Figure 5 depicts the annual median income of all three HtM groups. While data is noisy for P-HtM households, we see that their annual median income is the lowest of all household groups across their entire life-cycle. The corresponding income slope is not hump-shaped, with the annual median income fluctuating around the €20000 mark. By contrast, the annual median income of N-HtM households is considerably higher, with their life-cycle income slope showing a more traditional hump shape. Specifically, the N-HtM annual median income rises between age 22 to 40, peaks at around age 45 and then declines until it levels off at age 79. Finally, the W-HtM life-cycle income slope shows striking similarities to the slope of N-HtM households. Although absolute median income is reported to be lower on average for W-HtM households aged 40 to 60, the income paths of W-HtM and N-HtM households have a similar hump shape and often overlap each other throughout their life-cycle[28].

Overall, this section finds that across a range of portfolio characteristics and demographics, German W-HtM households resemble N-HtM households rather than P-HtM households. Both W-HtM and N-HtM households hold considerable illiquid wealth and share a similar life-cycle income slope. Both groups also exhibit similar investment patterns throughout their life-cycle, holding similar fractions of their illiquid wealth in life insurance, pensions

[28]Appendix A.5, Table 8 shows that the similarities between W-HtM and N-HtM incomes persist when the analysis is restricted to working-age households (aged 22-59).

and housing. Moreover, the two groups are comparable in terms of their levels of education, the fraction of working individuals per household and the fraction of income stemming from government benefits. By contrast, German P-HtM households can often be clearly distinguished from the other two groups. Specifically, they hold no illiquid wealth and a considerably lower annual median income throughout their life-cycle. They display lower levels of education than other household groups, a smaller fraction of working household members, and a larger fraction of their income stems from government benefits.

6 Marginal Propensity for Expenditure

This thesis deviates from Kaplan et al. (2014) in how it derives the spending response to a transitory income shock. Specifically, the authors use an econometric methodology by Blundell et al. (2008) that exploits long-term fluctuations in income and consumption data. Unfortunately, this approach is very data demanding. Other authors such as Cherchye et al. (2024), who apply the two-asset life-cycle model of Kaplan et al. (2014) to Belgian households, therefore argue that adopting this methodology is not feasible for most datasets, including the HFCS. For this reason, this paper aims at deriving the marginal propensity for expenditure through a more direct approach. Specifically, it utilises a survey question that was added to the Household Finance and Consumption Survey in 2017 and is available for the two latest waves (HFCS 2017-2021). The exact wording of the survey question is:

"Imagine you unexpectedly receive money from a lottery, equal to the amount of income your household receives in a month. What percent would you spend over the next 12 months on goods and services, as opposed to any amount you would save for later or use to repay loans?"

A number of factors must be borne in mind when utilising this type of question. First, the question is concerned with consumption expenditures rather than consumption. Consequently, it allows to derive the marginal propensity for expenditure (MPX) as opposed to the marginal propensity to consume (MPC). This distinction is non-trivial and particularly important, as the question above does not differentiate between durable and non-durable goods. To illustrate this issue, consider a scenario where a household buys a durable good such as a car. When doing so, consumption *expenditures* accrue immediately while *consuming* a car is a process that occurs slowly over time (Laibson et al., 2022). Buying such a durable good then generates a one-time burst of expenditure, whereas the utility generated from consumption is lower and longer-lasting (Laibson et al., 2022). Consequently, at the time of the purchase, the household's marginal propensity for expenditure (MPX) will be larger than its marginal propensity to consume (Laibson et al., 2022)[29]. To acknowledge and highlight this distinction, this thesis chooses the acronym of MPX instead of MPC to describe any estimates derived from this survey question.

Another potential caveat of the survey questions above may be that it refers to *hypothetical* transitory income shocks. Therefore, an important question is whether a households' self-reported spending response to a hypothetical, transitory income shock actually reflects their real spending behaviour. A prominent standpoint against this assumption is provided by Friedman and Wallis (1942, p. 179–80), who argue that: *"Questionnaires*

[29] On the other hand, MPC and MPX are equivalent when purchasing non-durable goods. This is because when buying a non-durable good (e.g. a lettuce), both the utility generating consumption and consumption expenditure accrue immediately and are short-lived (Laibson et al., 2022).

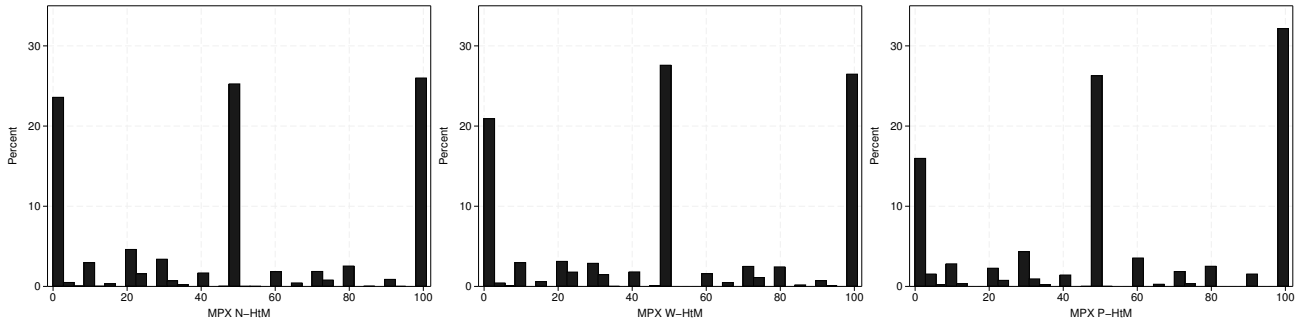
or other devices based on conjectural responses to hypothetical stimuli [...] are valueless because the subject cannot know how he would react". Contrasting this statement, recent literature found evidence of an informative relation between a household's reported preferences and actual spending behaviour. For example, Parker et al. (2013) found that when U.S. households reported they would mostly spend their 2008 fiscal stimulus payment, this claim indeed matched their subsequent spending behaviour. Since then, Parker and Souleles (2019) have added to this by comparing survey data containing a household's reported preferences to data that reports actual spending behaviour. In doing so, they found that reported preferences are highly informative of actual spending behaviour (Parker and Souleles, 2019). Building on this evidence, this paper assumes that hypothetical survey questions, such as the one above, are indeed a valid proxy for a households actual spending behaviour.

6.1 Baseline Results

Before discussing particular results and their implications, it is important to examine the underlying response pattern of German households. Figure 6 depicts the distribution of survey responses for each HtM group. We see that reported preferences of all HtM households cluster around three values: zero percent (spending none of the hypothetical, transitory income shock), 50 percent (spending half of it) or 100 percent (spending all of it). The respective data is therefore biased towards rounding and/or focal points. Such heaping is not unique to German household data or the Household Finance and Consumption Survey. Instead, similar tendencies have been found when examining the same HFCS survey question for other European countries (Drescher et al., 2020; Cherchye et al., 2024). Moreover, other surveys that include similar survey questions have produced strong heaping patterns as well. Specifically, publications examining survey questions on transitory income shocks that are included in the England/NMG Consulting Survey, the Dutch CentER Internet Panel or the Italian Survey of Household Income and Wealth have reported similar heaping patterns (Bunn et al., 2018; Christelis et al., 2019; Jappelli and Pistaferri, 2014, 2020). While theoretical models have been developed to address this issue in specific environments[30], none of them have been, to the best of my knowledge, successfully applied to survey data on consumption expenditures. Attempting to do so would therefore exceed the scope of this paper. Consequently, the reported preferences will be examined without adjusting for heaping. This will, of course, affect the robustness of the results, an issue that will be revisited below.

Table 4 depicts the average marginal propensities for expenditure (MPX) for baseline and net worth (NW) classifications. Among the baseline groups, N-HtM households (0.48) report the lowest marginal propensity for expenditure. For W-HtM households (0.49), the MPX is only slightly higher, whereas P-HtM households (0.57) report an MPX that is considerably higher, with a point estimate that lies above the others and a 95% confidence interval that is largely distinct. These results partially align with Kaplan et al. (2014) in that N-HtM households report the lowest spending response out of all baseline classifications. However, the results in Table 4 are not in accordance with the model's prediction that, when facing a transitory income shock, W-HtM households should display a similar spending response to that of P-HtM households. Instead, the MPX of P-HtM households is considerably higher than that of W-HtM households, who, in turn, report an MPX resembling that of N-HtM households. For comparison, the marginal propensity for

[30] For example, Kleinjans and Soest (2014) develop a model to account for rounding, focal point answers and item non-response which is specifically tailored to survey questions in the U.S. Health and Retirement Study (HRS).



(a) N-HtM (b) W-HtM (c) P-HtM

Figure 6: Survey responses for N-HtM, W-HtM, and P-HtM households. HFCS 2017–2021, pooled.

expenditure is also reported for net worth (NW) classifications, which do not distinguish between liquid and illiquid assets (see Appendix A.3). Here, the so-called N-HtM-NW households (0.48) report a MPX that resembles that of baseline N-HtM households (0.48). On the other hand, HtM-NW households (0.56) report a marginal propensity for expenditure that is positioned between that of P-HtM and W-HtM households.

Before examining the underlying drivers of this MPX heterogeneity, it is important to briefly address the scale of the reported values. Specifically, Table 4 reports spending responses ranging from 0.48 to 0.57, whereas Kaplan et al. (2014) report spending responses ranging from only 0.12 to 0.30. To understand this difference in range, note that Kaplan et al. (2014) consider only non-durable goods when examining a household's spending response to a transitory income shock. By contrast, the HFCS survey question examined here does not differentiate between durable and non-durable goods, which typically yields higher MPX estimates. Authors such as Parker et al. (2013); Broda and Parker (2014) compare both approaches of deriving the spending response to a transitory income shock. When considering only non-durable goods, they report estimates in line with Kaplan et al. (2014). Conversely, when analysing the same transitory income shock and the same households while considering spending on non-durables *and* durables, they report estimates that are in line with the results of Table 4[31]. Therefore, the range of spending responses presented here is interpreted as being consistent with existing research, once the underlying characteristics of the survey question have been taken into account.

However, the finding that German W-HtM households report a spending response similar to that of N-HtM households is at odds with Kaplan et al. (2014) and requires further elaboration. Therefore, the following section sets out to examine the underlying drivers of German MPX heterogeneity. Notably, the two-asset life-cycle model by Kaplan et al. (2014) identifies a households liquidity as the sole driver of spending responses. However, German W-HtM and P-HtM households appear to hold roughly similar levels of liquidity (see Figure 4, panel a), while displaying considerable differences in their marginal propensity for expenditure. This raises the question of whether other factors, such as illiquid assets or income, may affect the heterogeneity of German spending responses as well.

[31]When only considering expenditures on non-durables, Parker et al. (2013) report spending responses to range from 0.12 to 0.31 and Broda and Parker (2014) report spending responses ranging from 0.14 to 0.21. When considering both durables *and* non-durables, Parker et al. (2013) report spending responses ranging from 0.52 to 0.91 and Broda and Parker (2014) report spending responses ranging from 0.51 to 0.75.

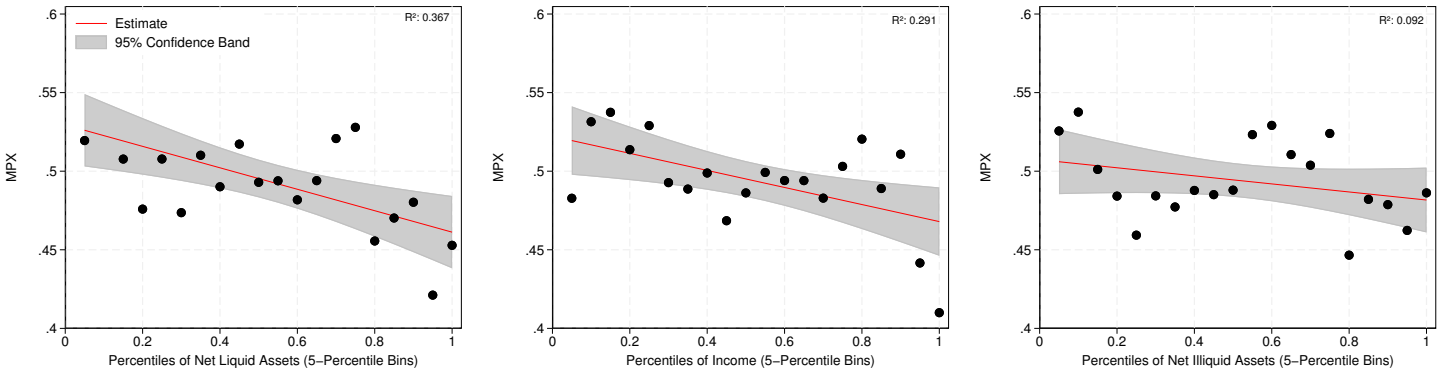
	N	MPX	Std. Err.	Std. Dev.	[95% Conf. Interval]
P-HtM	581	0.571	0.0245	0.380	[0.522-0.618]
W-HtM	1283	0.492	0.0177	0.363	[0.458-0.527]
N-HtM	5918	0.481	0.0078	0.371	[0.466-0.497]
HtM-NW	742	0.559	0.0210	0.383	[0.518-0.600]
N-HtM-NW	7040	0.483	0.0073	0.369	[0.468-0.497]

Table 4: Baseline MPX out of hypothetical, transitory income shocks for different HtM groups. HFCS 2017-2021, pooled.

6.2 Drivers of German MPX Heterogeneity

For a first visual examination of the drivers of German spending responses, Figure 7 presents three binned scatterplots that illustrate the relationship between average MPX responses and potentially significant variables (net liquid assets, income, and net illiquid assets). The percentiles of the respective wealth category are depicted on the x-axis, household data is grouped into 5-percentile bins, and average survey responses for each bin are plotted on the y-axis. The red line depicts a linear OLS fit across the binned data, capturing the direction and approximate strength of the relationship.

Panel (a) depicts a negative association between net liquid asset bins and average MPX responses. Similarly, panel (c) shows a negative association between illiquid asset bins and average MPX responses. Notably, upon initial observation, the relationship in panel (c) appears to be less pronounced in comparison, indicating a less robust association. These findings are consistent with the model's intuition of liquid assets being a key driver of a household's spending response to a transitory income shock, whereas illiquid assets are assumed to be less predictive (Kaplan et al., 2014). However, panel (b) also reveals a negative association between income bins and average spending responses. This finding stands in contrast to the model's assumption that spending responses do not vary systematically with income levels (an assumption that will be discussed further below) (Kaplan et al., 2014). It is important to note that Figure 7 can only provide preliminary visual evidence and does not allow for causal inferences. However, the findings necessitate a more thorough examination of income and its association with German MPX heterogeneity.



(a) Net liquid assets (b) Income (c) Net illiquid assets

Figure 7: Average MPX survey responses across liquid assets, income, and illiquid assets. HFCS 2017–2021, pooled.

In an attempt to provide a more detailed examination of the drivers of MPX heterogeneity, a regression analysis is conducted. Table 5, columns (1)-(4) depict pooled OLS models, with columns (1)-(3) either considering log net liquid assets, log income, or log net illiquid assets. Column (4) considers all three covariates. Column (5) depicts a random effects model for the same set of variables[32]. Turning to the results, columns (1) and (2) report coefficients on log net liquid assets and log income that are negative and statistically significant at the 1% level ($p < 0.01$). A similarly negative coefficient is found in column (3) on log net illiquid assets, albeit weaker in magnitude and statistical significance ($p < 0.05$). Next, column (4) examines the three wealth measures jointly. The coefficients on log net liquid assets and log income remain negative and statistically significant at the 1% level ($p < 0.01$). However, the coefficient on log net illiquid assets flips positive and is only significant at the 10% level ($p < 0.10$). Finally, the random effects model in column (5) once again reports negative and significant coefficients on log net liquid assets ($p < 0.01$) and log income ($p < 0.05$). However, the coefficient on log illiquid assets is now found to be statistically insignificant. Therefore, the relationship between log net illiquid assets and MPX is not robust when accounting for unobserved, individual-level heterogeneity.

To summarise, Table 5 holds three key findings. First, an increase in log net liquidity is consistently associated with a significantly lower MPX across all models. Second, the association between log net illiquid assets and MPX is not robust when accounting for unobserved, individual-specific heterogeneity. These two findings are consistent with the prediction of the two-asset life-cycle model that liquid assets are a key driver of spending responses, whereas the effect of illiquid assets is expected to be less predictive (Kaplan et al., 2014). However, the third finding is that log income is negatively associated with spending responses across all models, even when controlling for liquid and illiquid wealth. This suggests that absolute income levels may contribute independently to German MPX heterogeneity.

If substantiated, this finding would stand in contrast to Kaplan et al. (2014). Specifically, their two-asset life-cycle model has a homothetic notion of income, meaning that scaling income proportionally is assumed to have no effect on a household's spending response and HtM status, as long as their income path remains constant (Kaplan et al., 2014). The authors explicitly state this for W-HtM households: *" [...] a high-income household is as likely to be wealthy HtM as a low-income one, as long as the life-cycle slope of their income profiles is the same."* (Kaplan et al., 2014, p. 85). Therefore, it is a household's income *path* across periods, not their income *level* at time of the data collection that affects a household's HtM status[33]. As the HtM status is invariant to income levels, so is the corresponding spending response of a household (Kaplan et al., 2014). By contrast, Table 5 indicates that log income levels are significantly associated with a German household's spending response to a transitory income shock. Specifically, a one-unit increase in log income is associated with a 0.65-0.95 percentage point decline in the MPX, depending on the underlying model (corresponding p-values range from $p < 0.01$ to $p < 0.05$). This means that while the underlying two-asset life-cycle model assumes homothetic preferences and predicts that spending responses should be invariant to income levels (conditional on the

[32] A random effects model allows to control for unobserved heterogeneity *and* time constant variables such as gender or region (which would be dropped in a fixed effects regression). However, this comes at the cost of relying on the strong assumption that $Cov(\alpha_i, x_{it}) = 0$.

[33] For example, a household's holdings of liquid assets m_2 (one determinant of a household's HtM status), depend on the relation of y_1 to y_2 (i.e. the slope of the income path). This is because the household's overarching goal is to smooth consumption. If a household faces a low income path ($y_1 < y_2$), it is expected to borrow in order to do smooth consumption, regardless of its absolute income level y_1 (Kaplan et al., 2014).

income path), the empirical results presented here point to deviations from that theoretical benchmark. Instead, Table 5 suggests that income levels could have a more direct, non-homothetic impact on the spending responses of German households.

	OLS				RE
	(1)	(2)	(3)	(4)	(5)
Log Net Liquid Assets	-0.596***			-0.570***	-0.551***
	(0.127)			(0.146)	(0.152)
Log Income		-0.915***		-0.879***	-0.651**
		(0.259)		(0.324)	(0.329)
Log Net Illiquid Assets			-0.222**	0.232*	0.177
			(0.113)	(0.140)	(0.142)
Ph2m	1.564	6.300***	7.922***	4.694**	5.721***
	(1.419)	(0.991)	(1.524)	(2.080)	(2.048)
Wh2m	0.574	1.478**	1.602***	1.008	1.153
	(0.780)	(0.578)	(0.585)	(0.813)	(0.824)
Age	0.219***	0.219***	0.240***	0.248***	0.242***
	(0.0172)	(0.0167)	(0.0182)	(0.0192)	(0.0196)
Level of Education	0.0144	-0.301	-0.428**	0.0400	0.0935
	(0.204)	(0.192)	(0.195)	(0.212)	(0.220)
Number of Children	0.505*	0.850***	0.645**	0.546*	0.504*
	(0.283)	(0.270)	(0.273)	(0.294)	(0.305)
Working	-0.643	0.359	0.297	0.160	-0.231
	(0.506)	(0.504)	(0.505)	(0.551)	(0.562)
Female	3.017***	2.924***	2.914***	2.945***	2.891***
	(0.415)	(0.395)	(0.404)	(0.425)	(0.444)
Dummy for 2021	-4.507***	-4.729***	-4.919***	-4.567***	-4.432***
	(0.402)	(0.384)	(0.392)	(0.412)	(0.387)
East Germany	0.383	1.145**	1.024**	-0.102	-0.167
	(0.515)	(0.493)	(0.515)	(0.542)	(0.565)
Constant	42.75***	48.06***	40.13***	47.28***	45.53***
	(1.639)	(2.719)	(1.623)	(3.005)	(3.082)
R^2	0.139	0.137	0.140	0.154	0.189
N	6737	6737	6737	6737	6737

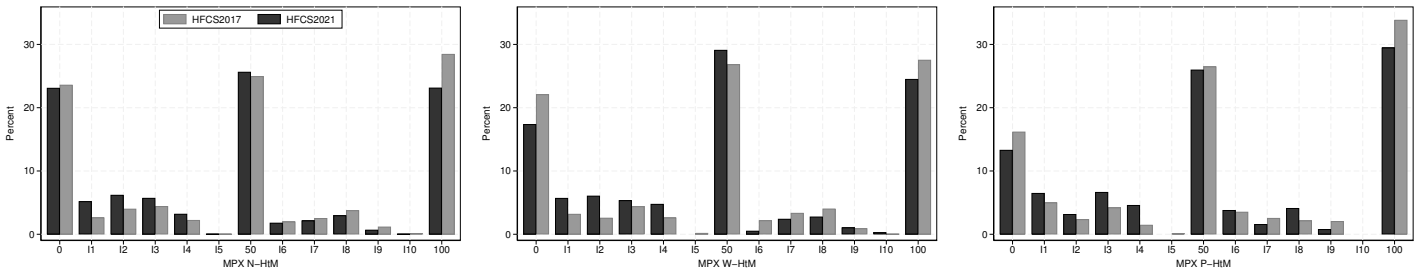
Table 5: Drivers of MPX heterogeneity. Columns (1) - (4) show pooled OLS models, column (5) a random effects model. Standard errors in parentheses. Statistical significance displayed with * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. HFCS 2017-2021.

A non-homothetic income channel would offer a potential explanation for the observed differences in MPX estimates between German W-HtM and P-HtM households. Specifically, when considering the income distribution illustrated in Figure 5 (and Table 8), we see that the median income of German W-HtM households closely resembles that of unconstrained N-HtM households, whereas the median income of P-HtM households is considerably lower. Given the significant negative association of income levels and German spending responses, these differences may help account for why German W-HtM households report a lower MPX than P-HtM households.

6.3 Reliability of MPX Estimates

Before summarising and discussing the results in section 7, two robustness concerns are addressed. First, there are only two data waves to draw from. If reported survey responses vary significantly between these two waves, confidence in the reported results is reduced. Second, reported spending responses may be susceptible to selection bias due to the model's underlying parameter choices.

First, the volatility of survey responses *across waves* is examined. Figure 8 presents a first visual comparison of the 2017 and 2021 wave, which indicates that marginal propensities for expenditure are broadly similar across waves, including comparable heaping patterns. For a more formal assessment of whether the underlying distributions differ, a two-sample Kolmogorov–Smirnov test is applied to individual-level MPX responses, in line with Fuster et al. (2021). The maximum absolute difference (D-value) between the empirical cumulative distribution functions of HFCS 2021 and HFCS 2017 is moderate but statistically significant for the full sample ($D = 0.063, p < 0.01$) (see Appendix, Table 6). This means that the null hypothesis of identical distributions is rejected and that there is a moderate but significant shift in the distribution of responses over time.



(a) N-HtM (b) W-HtM (c) P-HtM

Figure 8: Survey responses for N-HtM, W-HtM, and P-HtM households. HFCS 2017–2021, pooled.

In line with Fuster et al. (2021), Figure 9 examines the volatility of *within-individual* responses. The binned scatter plot compares survey answers of households that have participated in both waves. Responses for the 2017 wave are placed on the x-axis, responses for the 2021 wave on the y-axis[34]. A 45°-line is added for comparison. The circle size reflects the weight of households in each respective bin, i.e. how many households have chosen this survey answer. As expected, the bins at 0, 50 and 100 are substantially larger than others, reflecting the previously established heaping pattern around these values. Figure 9 shows that while the relationship between both waves is positive, it is unstable over time (it would be perfectly stable if bins align with the 45°-line). This means that there is substantial variation of within-individual responses over time. As noted by Fuster et al. (2021), this may reflect either a measurement error at the survey implementation level or genuine changes in (financial) circumstances or preferences. The former appears to be less likely, as the HFCS pays close attention to consistency, for example by training interviewers before conducting the survey and by using a highly standardised questionnaire (Household Finance and Consumption Network, 2023).

[34]The total number of German households participating in both survey waves is $N = 3106$, which is roughly 40 percent of the pooled sample size of both waves ($N = 7782$).

Figure 9 is therefore interpreted as an indicator of changes in circumstances or preferences of German households over time. In terms of fiscal policy targeting, this implies that having shown a high willingness to spend a transitory income shock in the past does not constitute a sufficient prerequisite for being targeted again.

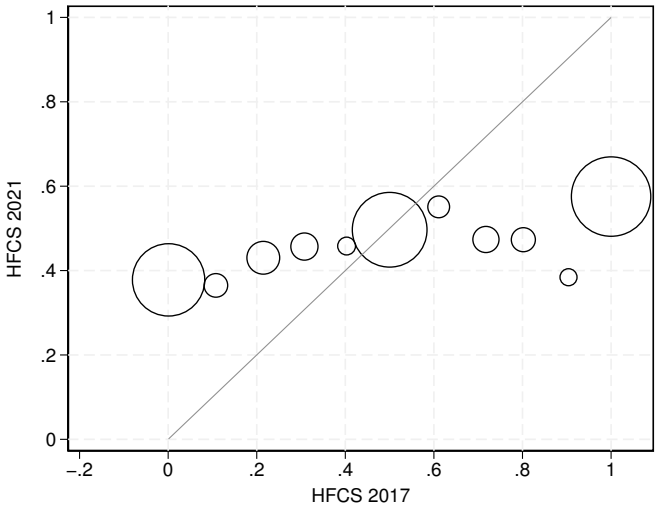


Figure 9: Within-individual response stability across waves. HFCS 2017-2021.

A potential selection bias due to particular parameter choices or the general sample composition is examined next. First, marginal propensities for expenditure are re-computed for alternative credit limit and pay period assumptions. Recall that due to a lack of information, this paper assumes a bi-weekly pay period and a credit limit of one month of income. Both parameter choices are adopted from Kaplan et al. (2014) and were initially chosen to examine U.S. households (see Section 4.2). To assess the sensitivity of baseline estimates with regard to these parameter choices, mean MPX estimates are re-computed by imposing (1) a credit limit of either 12 or zero months of income and (2) either a weekly or a monthly pay period. Selection bias may arise not only from specific parameter choices, but also from other general sample characteristics. One issue that has been highlighted in Figure 6 is the heaping of survey responses (e.g. around 50% answers), a phenomenon acknowledged and examined by various researchers[35]. To assess the sensitivity of baseline MPX estimates to such heaping, another test excludes all 50% answers. Last, the underlying data was in part collected during the COVID-19 pandemic. A major macroeconomic shock such as this may distort MPX estimates by affecting a household's income and expenses. To examine the extent to which financial instability might bias the baseline MPX estimates, another sensitivity tests restricts the sample to households that report stable income and expenditure levels over the past 12 months. All test results are summarised in Appendix, Table 7. MPX estimates do not differ by more than ±3.0 percentage points from baseline estimates across all tests. The subgroup ranking among HtM groups remains unchanged across all tests. Specifically, P-HtM households always report the highest, W-HtM households the second highest and N-HtM households the lowest marginal propensity for expenditure. This increases confidence that this ranking is not driven by the particular parameter choices or sample composition issues tested here.

[35]For example, Giustinelli et al. (2022) find that when surveys elicited respondent's expectations for future events on a 0-100 scale, the corresponding data was subject to substantial heaping. While the reasons for such heaping are incompletely understood, researchers such as Manski and Molinari (2010) have suggested that respondents may round their answers to simplify communication and/or to convey partial knowledge.

It is important to stress that the findings discussed here are subject to crucial limitations. First, the considerable volatility of the data both across waves and within individuals means that caution should be exercised when interpreting and generalising the results. This is especially true given that the relevant survey question is only included in the two most recent HFCS data waves. Therefore, the results presented in this paper should be understood as applying narrowly to German households over the specified survey wave period from 2017 to 2021. Second, the data exhibits strong heaping patterns around the values of 0, 50 and 100. As previously mentioned, these patterns likely reflect a focal point or rounding bias rather than a household's true preferences. This bias remains uncorrected in the current analysis, meaning that MPX estimates presented here are still subject to focal point and rounding distortions.

7 Conclusion

This study sets out to examine how fiscal stimulus payments should be targeted at German households in order to maximise the spending response to transitory income shocks. The objective is approached using a two-asset life-cycle model by Kaplan et al. (2014), which classifies households based on their liquid and illiquid asset holdings. Three household types emerge: *poor hand-to-mouth* (P-HtM) households, characterised by holding little or no liquid assets and no illiquid assets; *wealthy hand-to-mouth* (W-HtM) households, characterised by holding little or no liquid assets but substantial illiquid assets; and *non hand-to-mouth* (N-HtM) households, characterised by holding substantial liquid (and illiquid) assets (Kaplan et al., 2014). Following the model, German households are classified into these distinct groups. The corresponding marginal propensity for expenditure (MPX) is determined next. To do so, an HFCS survey question is exploited in which respondents are asked to report what percentage they would spend out of an unexpected, transitory income shock. Finally, a regression analysis is conducted in order to explore the underlying drivers of the MPX heterogeneity between groups.

In line with a substantial body of empirical literature, this study finds the spending responses to a hypothetical, transitory income shock to be considerable, ranging from 0.48 to 0.57. When comparing the empirical findings to theoretical predictions of the underlying model, the results of this paper align with Kaplan et al. (2014) in that hand-to-mouth (HtM) households report a higher marginal propensity for expenditure than non hand-to-mouth (N-HtM) households. Moreover, the regression analysis confirms the model's assumption that liquid assets are a significant driver of spending responses, whereas illiquid assets are less predictive. However, a key prediction of Kaplan et al. (2014) is that when faced with an unexpected transitory income shock, W-HtM households should report a spending response that mirrors or even exceeds that of P-HtM households. This is not supported by the findings of this paper, which report an $MPX = 0.49$ for German W-HtM households. This figure is more closely aligned with the MPX of N-HtM households (0.48) than with the MPX of P-HtM households (0.57). One potential explanation for the discrepancy between theoretical predictions and this paper's empirical findings lies in different notions of income. On the one hand, the underlying two-asset life-cycle model operates under a homothetic notion of income, meaning that a household's MPX is expected to be invariant to income levels, given that its life-cycle income slope remains the same (Kaplan et al., 2014). On the other hand, this paper finds a significant negative association between log income and the MPX of German households. Specifically, a one-unit increase in log income is associated with a 0.65-0.95 percentage point decline in the

marginal propensity for expenditure, depending on the underlying model (p-values range from $p < 0.01$ to $p < 0.05$). This points toward a non-homothetic relation in which higher income levels are associated with a lower marginal propensity for expenditure of German households. This relationship might help explain why the MPX of German W-HtM households is lower than that of German P-HtM households, as median income levels of W-HtM households are found to be considerably higher than those of P-HtM households (see Figure 5, Table 8).

When interpreting these findings in the context of fiscal policy design, it is important to emphasise that with a range of 0.48 to 0.57, all three groups exhibit non-trivial spending responses to a hypothetical, transitory income shock. Consequently, neither German N-HtM nor W-HtM households should be excluded when allocating fiscal policy payments, especially considering the seizable population shares of these groups. However, as German P-HtM households consistently report the highest marginal propensity for expenditure across all tested model calibrations, this paper concludes that they are the most responsive to hypothetical, transitory income shocks. For this reason, this paper argues that directing additional attention to this group, e.g. in the form of targeted top-ups, can help maximise the overall spending response to transitory income shocks. The effectiveness of such measures is conditional on the ability to target German P-HtM households effectively. Therefore, who are the German P-HtM households? This paper finds that depending on the underlying model calibration, P-HtM households make up 8–12 percent of German households. They hold very little to no net liquid wealth, no net illiquid wealth (including no positive housing wealth), and face the lowest median income levels out of all household groups examined. A considerable fraction of their income stems from government benefits, and their education level and fraction of working household members are lower than that of any other group examined. Notably, and contrary to the U.S. counterpart described by Kaplan et al. (2014), German P-HtM households are not primarily made up out of young individuals. Instead, their share remains largely constant across age, suggesting that only few German P-HtM households are able to transition to a different HtM status as they grow older. Taken together, these characteristics may serve as an initial guide to identify German P-HtM households in applied settings. However, it is important to note that they remain imperfect proxies and identifying P-HtM households based on these characteristics will likely involve measurement error, overlap with other groups and other classification noise. Future research may therefore refine these indicators and improve the process of identifying and targeting German P-HtM households.

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A Appendix

A.1 Baseline Model: Derivations

Subsection A.1.1 will present the derivation of solution (2), which describes a household's liquid asset holdings m_2 at the consumption/saving decision at $t = 1$. Subsection A.1.2 will present the derivation of solution (3), which describes a household's illiquid asset holdings a at the initial portfolio allocation decision at $t = 0$. Other solutions for a household's liquid and illiquid asset holdings, i.e. in the face of an unexpected governmental transfer τ or under the extended model with unsecured credit, are derived in a similar way and are not explicitly modelled here. All following utility maximisation problems and their solutions are adopted from Kaplan et al. (2014), while the derivations represent my own work.

A.1.1 Consumption/Saving Decision: Solution for Liquid Assets (m_2)

Kaplan et al. (2014) describe the utility maximisation problem for households at the consumption/saving decision at $t = 1$ as given by:

$$\begin{aligned} v_1(a) &= \max_{c_1, m_2} u(c_1) + u(c_2) \\ s.t. \quad c_1 + m_2 &= y_1 + \omega - a \\ c_2 &= m_2 + Ra + y_2 \\ m_2 &\geq 0. \end{aligned}$$

With no discounting between periods and the assumption of diminishing marginal utility ($u' > 0,\ u'' < 0$), households want to smooth consumption equally across periods $t = 1$ and $t = 2$. Kaplan et al. (2014) also assume that a substitution parameter ρ is related to the intertemporal elasticity of substitution σ by $\rho = \frac{\sigma - 1}{\sigma}$. The corresponding CES utility function is described as:

$$u(c_1, c_2) = \left(c_1^\rho + c_2^\rho\right)^{\frac{1}{\rho}}. \tag{10}$$

1) The Lagrangian for the problem is:

$$\mathcal{L} = \left(c_1^\rho + c_2^\rho\right)^{\frac{1}{\rho}} + \lambda_1 \left(y_1 + \omega - a - m_2 - c_1\right) + \lambda_2 \left(m_2 + Ra + y_2 - c_2\right) + \mu m_2. \tag{11}$$

2) First-Order Conditions:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial c_1} &= \frac{1}{\rho} \left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_1^{\rho - 1} - \lambda_1 = 0, \\ \frac{\partial \mathcal{L}}{\partial c_2} &= \frac{1}{\rho} \left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_2^{\rho - 1} - \lambda_2 = 0, \\ \frac{\partial \mathcal{L}}{\partial m_2} &= -\lambda_1 + \lambda_2 + \mu = 0. \end{aligned}$$

3) Solving for m_2:
The first order condition $\frac{\partial \mathcal{L}}{\partial m_2}$ implies $\lambda_1 = \lambda_2 + \mu$. For any interior solution ($m_2 > 0$) it holds that $\mu = 0$, which implies that $\lambda_1 = \lambda_2$. Therefore:

$$\begin{aligned} & \frac{1}{\rho} \left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_1^{\rho - 1} = \frac{1}{\rho} \left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_2^{\rho - 1} \\ (=) \quad & c_1 = c_2 \\ (=) \quad & y_1 + \omega - a - m_2 = m_2 + Ra + y_2 \\ (=) \quad & m_2 = \frac{y_1 + \omega - a - Ra - y_2}{2}. \end{aligned}$$

This interior solution holds for any $m_2 > 0$. Due to the non-negativity constraint of the baseline model ($m_2 \geq 0$), the corner solution is given by $m_2 = 0$. Therefore, the solution for liquid asset holdings m_2 at the consumption/saving decision at $t = 1$ is:

$$m_2 = \max\left\{\frac{y_1 + \omega - y_2 - a(1+R)}{2}, 0\right\}. \tag{12}$$

A.1.2 Initial Portfolio Allocation Decision: Solution for Illiquid Assets (a)

Kaplan et al. (2014) argue that in the baseline model without borrowing, a low income path ($y_1 = y_L$) implies $m_2 = 0$. For a household on such a low income path, the utility maximisation problem at the initial portfolio allocation decision at $t = 0$ is given by:

$$\begin{aligned} & v_0 = \max_{a,m_1} u(c_1) + u(c_2) \\ s.t. \quad & c_1 = m_1 + y_1 \\ & c_2 = Ra + y_2 \\ & \omega = a + m_1 \\ & m_1 \geq 0, \quad a \geq 0. \end{aligned}$$

With no discounting between periods and the assumption of diminishing marginal utility ($u' > 0,\ u'' < 0$), households want to smooth consumption equally across periods $t = 1$ and $t = 2$. Kaplan et al. (2014) also assume that a substitution parameter ρ is related to the intertemporal elasticity of substitution σ by $\rho = \frac{\sigma - 1}{\sigma}$. The corresponding CES utility function is described as:

$$u(c_1, c_2) = \left(c_1^\rho + c_2^\rho\right)^{\frac{1}{\rho}}. \tag{13}$$

1) The Lagrangian for the problem is:

$$\mathcal{L} = \left(c_1^\rho + c_2^\rho\right)^{\frac{1}{\rho}} + \lambda_1\left(m_1 + y_1 - c_1\right) + \lambda_2\left(Ra + y_2 - c_2\right) + \lambda_3\left(\omega - a - m_1\right) + \mu_1 m_1 + \mu_2 a. \tag{14}$$

2) First-Order Conditions:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial c_1} &= \frac{1}{\rho}\left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_1^{\rho-1} - \lambda_1 = 0, \\ \frac{\partial \mathcal{L}}{\partial c_2} &= \frac{1}{\rho}\left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_2^{\rho-1} - \lambda_2 = 0, \\ \frac{\partial \mathcal{L}}{\partial m_1} &= \lambda_1 - \lambda_3 + \mu_1 = 0, \\ \frac{\partial \mathcal{L}}{\partial a} &= -\lambda_3 + R\lambda_2 + \mu_2 = 0. \end{aligned}$$

3) Solving for a:
For an interior solution ($m_1 > 0$ and $a > 0$), it holds that $\mu_1 = 0$ and $\mu_2 = 0$[36]. Then, the first order conditions $\frac{\partial \mathcal{L}}{\partial m_1}$ and $\frac{\partial \mathcal{L}}{\partial a}$ imply that $\lambda_1 = \lambda_3$ and $\lambda_3 = R\lambda_2$, which, in turn, implies $\lambda_1 = R\lambda_2$. This can be expressed as:

$$\left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_1^{\rho-1} = \left(\left(c_1^\rho + c_2^\rho\right)^{\frac{1-\rho}{\rho}} \rho c_2^{\rho-1}\right) R$$

[36] Kaplan et al. (2014) assume that a household on a low income path will always choose to allocate a positive amount of its endowment to liquid assets at the initial portfolio allocation decision ($m_1 > 0$), as households are expected to be in need of some liquidity at $t = 1$.

$$
\begin{aligned}
(=) \quad & c_1^{\rho-1} = R c_2^{\rho-1} \\
(=) \quad & c_1 = R^{\frac{1}{\rho-1}} c_2 \\
(=) \quad & c_1 = R^{-\sigma} c_2 \\
(=) \quad & \omega - a + y_1 = R^{-\sigma}(Ra + y_2).
\end{aligned}
$$

The solution for a is:

$$
a = \frac{\omega + y_1 - R^{-\sigma} y_2}{R^{-\sigma} R + 1}.
$$

Expanding with $\frac{R^\sigma}{R^\sigma}$ gives:

$$
a = \frac{R^\sigma(\omega + y_1) - y_2}{R + R^\sigma}.
$$

This interior solution holds for any $a > 0$, $m_1 > 0$. Due to the non-negativity constraint of the baseline model, the corner solution for illiquid asset holdings is $a = 0$. Therefore, the solution for illiquid assets at the initial portfolio allocation decision at $t = 0$ is:

$$
a = \max\left\{\frac{R^\sigma(y_1 + \omega) - y_2}{R + R^\sigma}, 0\right\}. \tag{15}
$$

A.2 Extended Model with Unsecured Credit

Unless stated otherwise, all theoretical assumptions and corresponding solutions of section A.2 are adopted from Kaplan et al. (2014) and do not represent my own work. The authors argue, that if a households current income y_1 is low enough relative to its future income y_2, it would ideally like to borrow in order to smooth consumption across periods ($m_2 < 0$) (Kaplan et al., 2014)[37]. In the baseline model, this is not possible and households are constrained at the zero kink with $m_2 = 0$. In this extended version of the model, households are now able to access credit in order to finance consumption at $t = 1$. Specifically, at $t = 1$, a household can now borrow a fraction ϕ of its future income y_2 with a corresponding interest rate of $R^b > 1$ (Kaplan et al., 2014). As a result, a household's holdings of liquid assets at $t = 1$ are no longer constrained by the zero kink but by a credit limit defined as $\underline{m} = \phi y_2 / R^b$. For the analysis of HtM behaviour, Kaplan et al. (2014) also assume that $R^b < y_2$. Solution (16) shows, that this condition is necessary in order for households on a low income path to borrow. If borrowing is possible but $R^b \geq y_2$, then accessing credit is too expensive and the household will not make use of this instrument (Kaplan et al., 2014). In this case, there would be no difference between household behaviour in the extended model with borrowing and the baseline model without borrowing. To further simplify the analysis, the authors assume logarithmic utility with $\sigma = 1$ and define a low income path as $y_1 = y_L = 0$ (Kaplan et al., 2014).

With the credit limit as a new liquidity constraint, Kaplan et al. (2014) classify a household as P-HtM if, at the consumption/saving decision at $t = 1$, it holds zero illiquid assets

[37] This is due to preferences over consumption (1) and the assumption of diminishing marginal utility ($u' > 0, u'' < 0$). Under these conditions, a household maximises utility by smoothing consumption equally across periods $t = 1$ and $t = 2$, rather than consuming more in one period and less in the other (Kaplan et al., 2014).

and borrows up to the credit limit ($a = 0,\ m_2 = -\phi y_2/R^b$)[38]. Similarly, a household is considered to be W-HtM, if it borrows up to the credit limit and holds a positive amount of illiquid assets ($a > 0,\ m_2 = -\phi y_2/R^b$) (Kaplan et al., 2014). A N-HtM household holds a non-negative amount of illiquid assets and is unconstrained with regard to its holdings of liquid assets such as $a \geq 0,\ m_2 > -\phi y_2/R^b$ (Kaplan et al., 2014). Note that in the extended model, a household is considered to be unconstrained with regard to liquid asset holdings as long as it does not exhaust its credit limit. Sections A.2.1 - A.2.3 depict the formal solution of the extended model with unsecured credit. Similar to the solution of the baseline model in section 3, the respective model is solved backwards, starting with the consumption/saving decision at $t = 1$. All theoretical assumptions and corresponding solutions of section A.2.1 - A.2.3 are adopted from Kaplan et al. (2014).

A.2.1 Consumption/Saving Decision at $t = 1$

High income path: Similar to the baseline model, a household under a high income path is expected to have a sufficient amount of liquid assets at the consumption/saving decision at $t = 1$ in order to carry a positive amount of liquid assets into the upcoming period to smooth consumption ($m_2 > 0$) (Kaplan et al., 2014). Therefore, compared to the baseline model, this household's allocation decision remains unchanged. It does not engage in borrowing and remains unconstrained. Similar to the baseline model, a household on such a high income path is therefore classified as N-HtM (Kaplan et al., 2014).

Low income path: In the baseline model, a household on a low income path would ideally like to borrow but is constrained at the zero kink ($m_2 = 0$). Given these restrictions, such a household is then always classified as HtM (Kaplan et al., 2014). Contrary to the baseline model however, households can now engage in borrowing to smooth consumption across periods. Therefore, for a household on a low income path, the utility maximisation problem at the consumption/saving decision at $t = 1$ becomes:

$$\begin{aligned} v_1(m_1, a) &= \max_{c_1, m_2} \log(c_1) + \log(c_2) \\ &s.t. \\ c_1 + m_2 &= +m_1 \\ c_2 &= R^b m_2 + Ra + y_2 \\ m_2 &\geq -\frac{\phi y_2}{R^b}. \end{aligned}$$

Here, Kaplan et al. (2014) establish the credit limit ($m_2 = -\phi y_2/R^b$) as the new constraint for liquid asset holdings. The solution to this utility maximisation problem with respect to liquid assets m_2 becomes:

$$m_2 = \max \left\{ \frac{R^b m_1 - y_2 - Ra}{2R^b}, -\frac{\phi y_2}{R^b} \right\}. \tag{16}$$

[38]The model does not consider negative positions of illiquid assets ($a < 0$). However, Kaplan et al. (2014) note that negative illiquid asset positions, for example negative housing equity, may occur in survey data. In their identification strategy, these households are included among P-HtM households (see section 3.1). This is because, it is assumed that households cannot use these assets to smooth consumption.

Given that Kaplan et al. (2014) assume $R^b < y_2$, the interior solution of solution (16) is negative[39]. In other words, with an interest rate on borrowing such as $R^b < y_2$, a household under a low income path will always engage in borrowing ($m_2 < 0$) (Kaplan et al., 2014). However, whether such a household borrows up to the credit limit or not depends on the specific relation of R^b to future income y_2 and the household's shares of liquid assets m_1 and illiquid assets a. Specifically, if the following condition holds:

$$R^b < \frac{y_2(1-2\phi) + Ra}{m_1}, \tag{17}$$

the interest rate on borrowing R^b is sufficiently cheap (relative to parameters y_2, ϕ, R, a, m_1) that a household will borrow up to the credit limit ($m_2 = -\phi y_2/R^b$) (Kaplan et al., 2014). Put differently, if condition (17) holds, then (16) will provide a corner solution. As a result, the household is unable to smooth consumption and forced to face an increasing consumption path of $c_1 = m_1 + (\phi y_2/R^b)$ and $c_2 = y_2(1-\phi) + Ra$ (Kaplan et al., 2014). Having exhausted its borrowing limit, this household is characterised as hand-to-mouth (HtM) (Kaplan et al., 2014). On the other hand, if the following condition holds:

$$y_2 > R^b \geq \frac{y_2(1-2\phi) + Ra}{m_1}, \tag{18}$$

the interest rate on borrowing is sufficiently expensive (relative to parameters y_2, ϕ, R, a, m_1) that the household will not borrow up to the credit limit (Kaplan et al., 2014). Due to the condition $R^b < y_2$, the corresponding solution for (16) is negative but interior. The household is able to smooth consumption equally across periods with $c_1 = c_2 = (R^b m_1 + y_2 + Ra)/2$ (Kaplan et al., 2014). Therefore, while the household engages in borrowing, it is still considered to be unconstrained and is classified as non hand-to-mouth (N-HtM) (Kaplan et al., 2014)[40].

Several parameters determine, whether condition (17) or (18) holds. First, a lower interest rate R^b increases the attractiveness of borrowing, ceteris paribus. Second, a higher relative income y_2 increases the attractiveness of borrowing, as more resources need to be transferred from period $t = 2$ to $t = 1$ in order to smooth consumption. Third, recall that allocating a larger amount of a household's initial endowment ω to its illiquid asset holdings a implies that the household holds fewer liquid assets m_1[41]. Therefore, all other factors constant, holding a larger amount of illiquid assets a implies that a household is more constrained with regard to its liquidity, which in turn increases the attractiveness of borrowing (Kaplan et al., 2014).

A.2.2 Initial Portfolio Allocation Decision at $t = 0$

The initial portfolio allocation decision at $t = 0$ determines a household's holdings of illiquid assets a and liquid assets m_1. This allocation decision does not affect the status of a

[39] Kaplan et al. (2014) assume $0 \leq m_1 \leq 1$ and $0 \leq a \leq 1$.

[40] Recall that in the baseline model, a household is only unconstrained, if it holds a positive amount of liquid assets after the consumption/saving decision at $t = 1$ ($m_2 > 0$). This assumption is now relaxed. With unsecured credit, a household is unconstrained even if it engages in borrowing, as long as it does not reach the credit limit ($m_2 > -\phi y_2/R^b$) (Kaplan et al., 2014).

[41] With $\omega = 1$ and $\omega = a + m_1$, allocating a larger amount of ω to a household's illiquid asset holdings a implies a decrease of its liquid asset holdings m_1.

N-HtM household, who is classified based on its liquid asset holdings of m_2 at the consumption/saving decision at $t = 1$. Specifically, such a N-HtM household is characterised by a consumption pair of $a \geq 0,\ m_2 > -\phi y_2/R^b$ (Kaplan et al., 2014). However, the initial portfolio allocation decision is essential to distinguish between poor and wealthy HtM households, as they only differ with regard to their illiquid asset holdings a. Specifically, a P-HtM household is characterised by a consumption pair of $a = 0,\ m_2 = -\phi y_2/R^b$, while a W-HtM household is characterised by a consumption pair of $a > 0,\ m_2 = -\phi y_2/R^b$ (Kaplan et al., 2014). Therefore, the following solution focuses on the initial portfolio allocation of poor and wealthy HtM households.

In the extended model with unsecured credit, Kaplan et al. (2014) classify a household as HtM if it faces a low income path and sufficiently cheap borrowing (i.e. if condition (17) holds). As discussed in section A.2.1, a household under these conditions borrows up to the credit limit ($m_2 = -\phi y_2/R^b$) and faces a consumption path of $c_1 = m_1 + (\phi y_2/R^b)$ and $c_2 = y_2(1-\phi) + Ra$ (Kaplan et al., 2014). As the model is deterministic, a HtM household at the initial portfolio allocation at $t = 0$ is aware of this future consumption path and maximises its utility accordingly. The corresponding utility maximisation problem is given by:

$$\begin{aligned} v_0 &= \max_{a,m_1} u(c_1) + u(c_2) \\ &\quad s.t. \\ c_1 &= m_1 + (\phi y_2/R^b) \\ c_2 &= Ra + y_2(1-\phi) \\ \omega &= a + m_1 \\ m_1 &\geq 0,\ a \geq 0. \end{aligned}$$

The first and second line of the constraint represent the budget constraints at $t = 1$, $t = 2$. The third line of the constraint represents the initial resource constraint at $t = 0$. Holdings of a and m_1 are assumed to be non-negative. The solution to this utility maximisation problem with respect to illiquid assets a is:

$$a = \max\left\{\frac{R + [(1 + R/R^b)\phi - 1]y_2}{2R}, 0\right\}. \tag{19}$$

Whether (19) has an interior or a corner solution depends on the return on illiquid assets R and its relationship to the interest rate on borrowing R^b, to future income y_2 and to the borrowed fraction of income y_2, ϕ (Kaplan et al., 2014). Specifically, a household will choose not to invest in illiquid assets ($a = 0$) if:

$$R \leq y_2 \frac{(1-\phi)}{(1+\phi)}. \tag{20}$$

In this case, the household will face a corer solution. It is constrained at the credit limit and holds zero illiquid assets ($a = 0,\ m_2 = -\phi y_2/R^b$). Such a household is characterised as P-HtM (Kaplan et al., 2014). If on the other hand:

$$R > y_2 \frac{(1-\phi)}{(1+\phi)}, \tag{21}$$

the solution in (19) is interior, as the household will choose to invest a positive amount of its initial endowment ω in illiquid assets ($a > 0$) (Kaplan et al., 2014). In this case, a household will hold a positive amount of illiquid assets while simultaneously being constrained at the credit limit ($a > 0,\ m_2 = -\phi y_2/R^b$). Such a household is characterised as W-HtM (Kaplan et al., 2014). Several parameters determine, whether conditions (20) or (21) hold. A high relative return R increases the attractiveness of illiquid assets as a saving instrument, ceteris paribus. A high relative income y_2 guarantees a high consumption level at $t = 2$. Therefore, all other factors constant, it reduces the appeal of investing in illiquid assets. A higher borrowed fraction ϕ of income y_2 implies a lower guaranteed level of consumption at $t = 2$, ceteris paribus. Borrowing therefore increases the appeal of illiquid assets as a saving instrument (Kaplan et al., 2014).

A.2.3 Unexpected Governmental Transfer

According to Kaplan et al. (2014), a household receives the unexpected governmental transfer τ after the initial portfolio allocation decision at $t = 0$ but before the consumption/saving decision at $t = 1$. Recall that a N-HtM household is unconstrained and smooths consumption equally across $t = 1$ and $t = 2$. Therefore, any unexpected governmental transfer will be smoothed equally across periods $t = 1$ and $t = 2$ as well. The corresponding marginal propensity to consume for a N-HtM household is $MPC = 0.5$ (Kaplan et al., 2014). On the other hand, P-HtM and W-HtM households are constrained at the consumption/saving decision at $t = 1$. If τ is small enough for these households to remain constrained, the unexpected governmental transfer will be consumed in its entirety. In this case, the $MPC = 1$ for both P-HtM and W-HtM households (Kaplan et al., 2014).

Importantly, while both poor and wealthy HtM households display the same marginal propensity to consume for a sufficiently low τ, a W-HtM household requires a larger governmental transfer to become unconstrained (Kaplan et al., 2014). To illustrate this, recall that a P-HtM household faces a low income path ($y_1 = y_L = 0$), sufficiently cheap borrowing (i.e. condition (17) holds) and a return on illiquid assets sufficiently low that the household chooses not to invest in illiquid assets (i.e. condition (20) holds) (Kaplan et al., 2014). At the initial portfolio allocation decision at $t = 0$, it therefore allocates its entire initial endowment ω to liquid assets with $a = 0, m_1 = 1$. Still, its holdings of m_1 are not sufficient to smooth consumption across $t = 1$ and $t = 2$, meaning the household still desires to engage in borrowing. With borrowing being sufficiently cheap, the household borrows up to the credit limit, facing a corresponding consumption pair of $a = 0,\ m_2 = -\phi y_2/R^b$ (Kaplan et al., 2014).

A W-HtM household, similar to a P-HtM household, faces a low income path ($y_1 = y_L = 0$) and sufficiently cheap borrowing (Kaplan et al., 2014). However, a W-HtM household also faces a return on illiquid assets R that is sufficiently high in order to allocate some of its initial endowment ω to illiquid assets (i.e. condition (21) holds). With the initial endowment being defined as $\omega = a + m_1$, any investment in illiquid assets will reduce the household's liquid asset holdings m_1, all other factors constant[42]. Consequently, at $t = 1$, a W-HtM household will hold fewer liquid assets m_1 than a P-HtM household, therefore requiring a larger governmental transfer to become unconstrained (Kaplan et al., 2014).

[42] However, Kaplan et al. (2014) assume that a household on a low income path will always choose to allocate some positive amount of its endowment to liquid assets at the initial portfolio allocation decision ($m_1 > 0$), as households are expected to be in need of some liquidity at $t = 1$.

A.3 Alternative Identification Strategies

Following Kaplan et al. (2014), this paper examines average liquid balances in order to identify a household's HtM status in empirical data (see section 4.1). However, the authors also propose several alternative identification strategies in order to examine the sensitivity of the baseline results. Those that can be performed on HFCS data are adopted and described below, with the corresponding results being depicted in Table 2.

Net Worth. The first alternative to the baseline identification strategy is to determine a household's HtM status based on its overall net worth. Kaplan et al. (2014) define net worth in period t as $n_{it} = a_{it} + m_{it}$. As there is no longer a distinction between liquid and illiquid assets, only two types of household emerge, namely *non HtM-net-worth* (N-HtM-NW) and *HtM-net-worth* (HtM-NW) households (Kaplan et al., 2014). Under the extended model with unsecured credit, a household is considered to be HtM-NW if:

$$n_{it} \leq 0 \quad \text{and} \quad n_{it} \leq \frac{y_{it}}{2} - \underline{m}_{it}. \tag{22}$$

This net worth identification strategy is based on the same reasoning as the baseline identification strategy of average liquid balances (see Figure 1). Specifically, Kaplan et al. (2014) still assume that income is paid discretely (e.g. once a month), that resources are consumed at a constant rate throughout the pay period and that households can borrow up to the credit limit $\underline{m}_{it}$. A household is considered to be HtM-NW, if its average net worth balances n_{it} are equal to or below the threshold of half its income ($y_{it}/2$) minus its credit limit ($\underline{m}_{it}$) (Kaplan et al., 2014).

Pre-Committed Consumption Expenditures. As discussed in section 4.1, Kaplan et al. (2014) assume that consumption occurs at a constant rate throughout the pay period. Based on this assumption, the term "half of a household's income" is used to derive a household's HtM status[43]. However, a household might face "pre-committed consumption expenditures", which are bulk expenditures it has to pay each pay period (e.g. rent, mortgage payments or alimony) (Kaplan et al., 2014). Consumption would then no longer be constant throughout the pay period. Therefore, depending on when these expenditures occur, the baseline identification strategy could either over- or underestimate the true HtM share (Kaplan et al., 2014).

To illustrate this, consider a household that, at the end of a pay period, is able to carry some of its liquid asset holdings into the next period. Following the model's theoretical dynamics, this household's true HtM status would be that of a non hand-to-mouth household (N-HtM) (Kaplan et al., 2014). However, if this household faces pre-committed consumption expenditures $\bar{c}_{it}$ at the beginning of the period, its liquid balances will experience a sharp decline right after it receives its income. As a result, its average liquid balances over the pay period could fall below the threshold of $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$. Consequently, the baseline identification strategy would misclassify the household as hand-to-mouth (HtM), thereby overestimating the true share of HtM households (Kaplan et al., 2014). On the other hand, consider a household that has exhausted its credit limit at the end of the pay period, therefore being HtM according to the model's theoretical dynamics (Kaplan et al., 2014). If this household faces pre-committed consumption expenditures $\bar{c}_{it}$ at the end of the pay period, its liquid balances will remain stable over the majority of the pay

[43] In the baseline model, the threshold is defined as $m_{it} = \frac{y_{it}}{2}$. In the extended model with unsecured credit, the threshold becomes $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$ (Kaplan et al., 2014).

period and only experience a sharp decline at the end. As a result, the household's average liquid balances over the pay period could exceed the threshold of $m_{it} = \frac{y_{it}}{2} - \underline{m}_{it}$, meaning the baseline identification strategy would misclassify the household as non hand-to-mouth (N-HtM). In this case, the baseline identification strategy would underestimate the true HtM share (Kaplan et al., 2014).

To account for pre-committed consumption expenditures, Kaplan et al. (2014) adjust the threshold with which they identify HtM households. First, if pre-committed consumption expenditures occur at the beginning of the period, the threshold (for the extended model with unsecured credit) becomes $m_{it} \leq ((y_{it} - \bar{c}_{it})/2) - \underline{m}_{it}$ (Kaplan et al., 2014). Second, if the committed consumption expenditures occur at the end of the period, the threshold becomes $m_{it} - \bar{c}_{it} \leq (y_{it}/2) - \underline{m}_{it}$ (Kaplan et al., 2014). Finally, if pre-committed consumption expenditures are smoothed across the pay period, the threshold becomes $m_{it} - (\bar{c}_{it}/2) \leq ((y_{it} - \bar{c}_{it})/2) - \underline{m}_{it}$, which is equal to the baseline identification threshold (Kaplan et al., 2014). Following Kaplan et al. (2014), this study defines pre-committed consumption expenditures $\bar{c}_{it}$ as rent and mortgage payments, as well as HMR-, property- and non-collateralised loans, leasing and alimony payments.

Direct Survey Questions. Kaplan et al. (2014) also use survey questions to directly infer a household's HtM status. Specifically, they classify a household as HtM if the household reports that, on average, it spends more than its income (excluding purchases of large durable goods such as cars or housing). As the HFCS contains a similar question to the one used by Kaplan et al. (2014), this question is incorporated as an additional sensitivity test (see Table 2, $c > y$)[44].

A.4 HFCS Sample Design

HFCS Households: In HFCS data, a household is defined as a person living alone or a group of people living together in the same private dwelling who share expenditures, including the common provision of living essentials (Household Finance and Consumption Network, 2023). When a household is interviewed, data is collected at both the household and the individual level. Specifically, information on real and financial assets, consumption, credit constraints, intergenerational transfers and gifts is collected by questioning a single household member who is identified as the main respondent (Household Finance and Consumption Network, 2023). On the other hand, information regarding demographics, employment, pensions and insurance policies is collected from all household members aged 16 and over (Household Finance and Consumption Network, 2023). For income, some information is collected at the household level (e.g. income from financial investments), while other information is collected at the individual level (e.g. employment-related income and pension income) (Household Finance and Consumption Network, 2023).

HFCS Survey Weights: The Household Finance and Consumption Survey selects German households based on a stratified sampling design, where sample units are chosen based on region and municipality size (Household Finance and Consumption Network, 2023). However, a sample design based on these factors alone would likely result in an inefficient estimate of the wealth distribution. This is because the distribution of wealth in Germany is known to be skewed and certain assets are held by only a small propor-

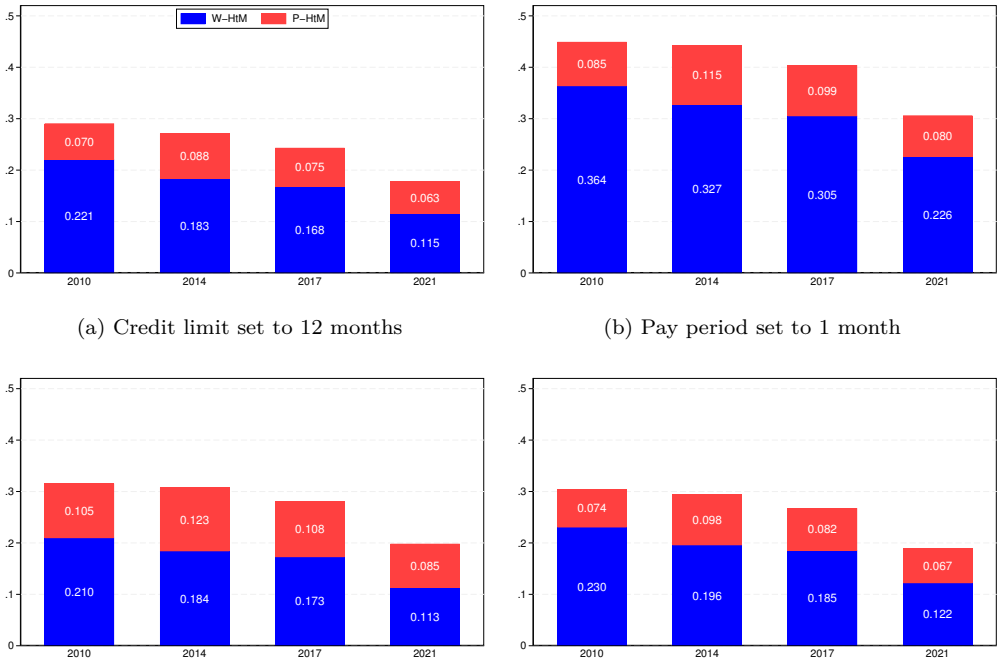
[44]The wording of the respective HFCS survey question (hi0600) is: "Again aside from any purchases of assets, over the last 12 months would you say that your (household's) regular expenses were higher than your (household's) income, just about the same as your (household's) income or that (you/your household) spent less than (your/its) income?"

tion of households (Household Finance and Consumption Network, 2023). Such a small population share might not be adequately captured in a sample based only on region and municipality size. In addition, wealthier households are known to have a higher non-response rate to surveys (Household Finance and Consumption Network, 2023). The HFCS therefore oversamples wealthy households. For German households, this is achieved by oversampling wealthy street sections (in cities with more than 100 000 inhabitants) and municipalities with a taxable income above a certain threshold (Household Finance and Consumption Network, 2023). To avoid a corresponding over-representation of wealthy households, and to control for unit non-response and other coverage problems, this study applies HFCS survey weights whenever examining households. These survey weights are constructed by the HFCS in order to account for the practice of oversampling and to minimise the overall bias of the sample (Household Finance and Consumption Network, 2023).

A.5 Graphs and Tables

	D-value	P-value
Total HFCS	0.063	<.001
N-HtM	.0724	<.001
W-HtM	.0655	<.001
P-HtM	.0585	.069

Table 6: Two-sample Kolmogorov-Smirnov test of the equality of survey response distributions. *D-value* indicates the maximum absolute difference of the HFCS 2021 survey responses compared to HFCS 2017.



(a) Credit limit set to 12 months

(b) Pay period set to 1 month

(c) Higher illiquid wealth cutoff

(d) Credit limit extended with HELOC's

Figure 10: HtM shares for German households, based on various alternative parameter choices compared to baseline parameters. HFCS 2010-2021.

	N-HtM	W-HtM	P-HtM	N-HtM-NW	HtM-NW
Baseline	0.481	0.492	0.571	0.483	0.559
	(0.0079)	(0.0177)	(0.0245)	(0.0073)	(0.0210)
Credit limit 12 months income	0.482	0.494	0.577	0.484	0.570
	(0.0074)	(0.0162)	(0.0251)	(0.0070)	(0.0220)
Credit limit set to 0	0.475	0.504	0.595	0.481	0.567
	(0.0077)	(0.0154)	(0.0240)	(0.0070)	(0.0203)
Pay period 1 month	0.482	0.486	0.563	0.481	0.556
	(0.0079)	(0.0124)	(0.0223)	(0.0070)	(0.0182)
Pay Period weekly	0.483	0.490	0.594	0.482	0.589
	(0.0071)	(0.207)	(0.0265)	(0.0068)	(0.0229)
Low level of education	0.481	0.496	0.596	0.484	0.564
	(0.0080)	(0.0190)	(0.0295)	(0.0078)	(0.0245)
Risky investment attitudes	0.481	0.492	0.566	0.482	0.560
	(0.0080)	(0.0181)	(0.0249)	(0.0074)	(0.0211)
Unstable income & expenses	0.494	0.496	0.561	0.494	0.559
	(0.0119)	(0.0250)	(0.0359)	(0.0111)	(0.0340)
Drop 50% answers	0.478	0.477	0.58	0.4759	0.5652
	(0.1043)	(0.178)	(0.282)	(0.0095)	(0.234)

Table 7: Sensitivity tests for baseline MPX estimates. *"Credit limit 12 months income"* considers annual income instead of monthly income as the credit limit. *"Credit limit set to 0"* considers HtM shares at the zero kink.*"Low level of education"* drops households with an education level of 2 or lower on the ISCED-2011 scale. *"Risky investment attitudes"* drops households with a willingness to take above-average financial risks. *"Unstable income & expenses"* retains only households with stable income and expenses over the last 12 months. Standard errors in parenthesis, HFCS 2017-2021, pooled.

	N-HtM			W-HtM			P-HtM		
	Mean	Median	Frac. Pos.	Mean	Median	Frac. Pos.	Mean	Median	Frac. Pos.
Income (age 22-59)	58050	48251	0.993	52694	43191	0.996	25375	19908	0.990
Net Worth	279195	114434	0.976	129694	32137	0.966	−2135	3	0.540
Net liquid assets	27077	4560	0.920	−702	180	0.721	−247	6	0.567
Cash, checking, saving, MM accounts	9857	3167	0.940	717	282	0.773	276	8	0.584
Directly held stocks	6585	0	0.158	9	0	0.009	0	0	0.000
Directly held bonds	2372	0	0.051	2	0	0.002	0	0	0.000
Revolving credit card debt	294	0	0.148	1492	0	0.254	526	0	0.120
Net illiquid assets	252118	99357	0.909	130396	32921	1.000	−1888	0	0.000
Housing net of mortgages	197143	44510	0.543	102147	0	0.446	−2581	0	0.000
Retirement accounts	9613	0	0.390	6096	0	0.400	128	0	0.022
Life insurance	19084	393	0.512	12413	578	0.543	218	0	0.017

Table 8: Descriptive statistics for German HtM groups on income, net worth, liquid and illiquid wealth. Monetary variables are adjusted to €2021 using the Harmonized Index of Consumer Prices (HICP). HFCS 2010-2021, pooled.