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ESTIMATING CONSUMPTION RESPONSES TO INCOME SHOCKS OF DIFFERENT PERSISTENCE USING SELF-REPORTED INCOME MEASURES

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Models of intertemporal consumption choice posit that consumption reacts more strongly to income shocks with persistent effects than to shocks with temporary effects. This prediction is tested using data from the Estonian Household Budget Surveys for 2002–07. Questions in the survey make it possible to distinguish between two income components of different persistence, using the individual households' subjective income classification. Estimations confirm that households distinguish income components of different persistence and react to these differently; the consumption response to income shocks with persistent effects is significantly higher than the response to shocks with only temporary effects. Further analysis reveals, however, that consumption also reacts to lagged shocks to temporary income even when the households are not liquidity constrained, suggesting that their behavior is not fully consistent with the standard forward-looking unconstrained consumption models.

JEL Codes: D12, D91, E21, R22

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> [A]lthough the agent may be able to discriminate between a transitory and a permanent shock, the econometrician is not. As a result, econometric identification of separate income shock components is difficult in the extreme. (Pistaferri, 2001, p. 465)

1. INTRODUCTION

This paper studies the response of household consumption to shocks in income processes with different persistence, using data from a panel of Estonian

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households for the period 2002–07. The dataset makes possible a decomposition of household income into a process that households assess as persistent and a process that is assessed as exhibiting little or no persistence. Unlike most previous studies, this identification of income processes of different persistence is based on the reporting of the households and does not rely on the theory-based restrictions that are otherwise required.

Following the seminal contribution of the Permanent Income Hypothesis (PIH) by Friedman (1957), models of intertemporal consumption choice typically predict that households respond differently to shocks of different persistence. Households respond one-to-one to income shocks that are expected to have a permanent impact on future income, while the consumption response to shocks with transitory effect is negligible. Numerous studies have sought to provide estimates of consumption responses to different types of income shock in order to gain a better understanding of the factors that affect consumption.

It is challenging to devise empirical tests of the intertemporal consumption model, particularly tests that can estimate the consumption response to shocks in income processes of different persistence. The main reason for this is that when an income change is observed for a household, the amount of supplementary information available on the persistence of the income change is usually limited. The decomposition of income into a persistent and a transitory component is needed not only for investigation of the consumption choices of households, but also for other purposes like analysis of earnings inequality, as in Gustavsson (2008). Three different ways to decompose income shocks into components of different persistence have been devised in the literature.

One approach is to use quasi-experimental data in which specific episodes of income changes can be classified according to their expected impact on the income path of the households. Another approach relies on model-based or statistical decomposition of observed income shocks into permanent and transitory components. Such econometric identification requires either very long time series or additional restrictive assumptions about the co-movement of consumption and income (cf. also the citation above from Pistaferri, 2001). Finally, it might be possible to deduce the degree of income shock persistence directly from information provided by the individual household. The use of subjective or self-reported income measures to identify the persistence of income shocks is very rare in the literature as the required information is typically not available in household surveys.

This paper uses the latter approach as the Estonian Household Budget Survey (HBS) uniquely permits a decomposition of household income into two distinct components: one for which the household expects changes to have long-lasting effects, and one for which the household expects changes to be transitory. Using supplementary statistical evidence, we find that Estonian households do indeed split their income according to this classification as the dynamics of the two income processes are markedly different. The decomposition enables us to study the consumption response of Estonian households to income shocks of different persistence.

The paper also offers a view on intertemporal consumption choice at the household level in an environment characterized by a high degree of macroeco-

nomic uncertainty. The Estonian households in this study experienced a rapid increase in their income throughout the period 2002–07, while high inflation, booming real estate prices, and increased foreign indebtedness contributed to increased uncertainty (Brixiova *et al*., 2010). This macroeconomic environment offers an exciting setting for testing the predictions of consumption models built on a forward-looking optimizing behavior of rational agents.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the theoretical and empirical literature on consumption response to income changes. Section 3 introduces the Estonian HBS data and examines the properties of the income shocks that are identified using the ancillary survey information. Section 4 presents the results of the consumption estimation using the income shocks identified in Section 3. Finally, Section 5 summarizes the empirical findings.

2. Consumption Response to Income Changes: A Brief Literature Overview

Theories of intertemporal consumption assume that the household plans its consumption choices over present and future periods simultaneously, while seeking to maximize expected aggregate utility. Such models typically predict that a forward-looking rational household will smooth consumption over time given its expected future income stream (Jappelli and Pistaferri, 2010a). The reaction of consumption to income shocks will therefore depend on the impact of the shocks on the sum of current and expected future income. The consumption of an individual household does not depend directly on its current income, but on the information contents of the current income for the future income stream.

The current income provides information that allows the household to update its expectation of future income, and the household consequently adapts its consumption profile to the new information. One example is the Permanent Income Hypothesis which asserts that if an unanticipated change in income is deemed to be fully persistent, the household will alter consumption one-to-one. On the other hand, a transitory shock depicting an unanticipated one-period shift in the income stream implies a limited effect on lifetime earnings; the household will absorb most of the income change through saving or dissaving and the effect on current consumption will be limited, depending on the remaining lifespan.

It is clear that many factors affect the response of consumption to income shocks or, phrased differently, the degree of insurance of consumption against income shocks (Blundell *et al*., 2008). Besides the persistence of the shock and whether or not it is anticipated, factors such as the household's time and risk preferences, liquidity constraints, and information constraints will be of importance (see the long list in Blundell *et al*., 2008, including footnote 3).

The theoretical effects of the persistence of the income shock have been examined in a number of studies. Kaplan and Violante (2010) and Hryshko (2013) compute the theoretical consumption response to an unanticipated income shock

given different assumptions about the model of intertemporal consumption choice and the persistence of the shocks. They show that the consumption response decreases fast when persistence falls below 1. Kaplan and Violante (2010) present that the consumption response is expected to be below 0.5 when the persistence is 0.93. Kukk *et al*. (2012) tabulate the consumption response to income shocks in the baseline PIH model for a wider range of persistence. They show that when the persistence coefficient is 0.8, the theoretical consumption response is below 0.2. However, theoretical models of rational forward-looking choice predict a stronger consumption response to persistent or permanent unanticipated income shocks than to temporary or transitory unanticipated income shocks.

Empirical testing of the intertemporal consumption model is typically based on a classification of unanticipated income shocks into different components according to their impact on the household's expected discounted income. Jappelli and Pistaferri (2010a) provide a comprehensive review of the empirical literature using a range of approaches to disentangle observed income shocks into anticipated and unanticipated changes. To test the hypotheses of the intertemporal consumption model, the unanticipated income shocks are further divided into permanent and transitory shocks (Chao, 2003).

Studies investigating income dynamics typically decompose the income into a highly persistent component and a transitory or less persistent component (Heathcote *et al*., 2009). We use the term highly persistent (superscript H) and less persistent (superscript L) to differentiate the two income processes:

$$\begin{aligned} \log Y_{it}^{H} &= \rho^{H} \log Y_{it-1}^{H} + \xi_{it}^{H} \\ \log Y_{it}^{L} &= \rho^{L} \log Y_{it-1}^{L} + \xi_{it}^{L} \end{aligned}. \tag{1}$$

Subscript i indexes the household and t the time. The highly persistent income component $\log Y_{it}^{H}$ is described by its autoregressive coefficient $\rho^{H} \in [0, 1]$ and a white noise shock ξ_{it}^{H}. Under the widely used assumption that $\rho^{H} = 1$, the highly persistent component is a martingale, implying that shocks have permanent effects. The less persistent income component $\log Y_{it}^{L}$ is described by its autoregressive coefficient $\rho^{L} \in [0, 1]$ and the white noise shock ξ_{it}^{L}. Under the widely used assumption that $\rho^{L} = 0$, income shocks only affect the income in the period in which the shock occurs. The labeling of the two different income components implies that $\rho^{H} > \rho^{L}$.

The standard empirical model for estimating the consumption response to shocks in the two income processes in equation (1) takes the form:

$$\Delta \log C_{it} = Z_{it}'\gamma + \beta_1 \xi_{it}^{H} + \beta_2 \xi_{it}^{L} + \varepsilon_{it}. \tag{2}$$

The dependent variable $\Delta \log C_{it}$ is the change in log consumption. The variables in the column vector Z_{it} are preference shifters that affect consumption and γ is a vector of corresponding coefficients. The coefficients β_1 and β_2 capture the response of consumption to shocks to the highly and less persistent income components, cf. equation (1). Finally, ε_{it} is an error term. The model is used in numerous empirical studies (cf. Blundell *et al*., 2008; Jappelli and Pistaferri, 2010a; Hryshko, 2013).

In *quasi-experimental* data the reaction of households to specific episodes of income changes is used to disentangle the effect of shocks with permanent and transitory effects (see, e.g., Hryshko *et al*., 2010; Sahm *et al*., 2010; Aguila *et al*., 2011). In some episodes the observed income changes are regarded as transitory, such as temporary unemployment, one-off tax refunds, or weather shocks, while in other episodes they are viewed as long-lasting, such as major health problems or retirement. A drawback of quasi-experiments is that they tend to focus on one specific income change, whereas households are likely to be subjected to several shocks at the same time and their reactions to a particular episode may be affected by other income innovations of a potentially different kind.

A model-based *econometric decomposition* of the observed income changes into permanent and transitory components was pioneered in the seminal paper of Hall and Mishkin (1982). They derive from the Permanent Income Hypothesis a set of variance–covariance restrictions between changes in consumption and changes in income across different time periods, and furthermore they impose the assumption that the household's income consists of two parts: a difference-stationary component with innovations that persist indefinitely; and a covariance-stationary component whose innovations dissipate over time. Hall and Mishkin (1982) use data from the U.S. Panel Study of Income Dynamics (PSID) and a derived set of restrictions to estimate the response of household consumption to these two types of innovations. They find that 80 percent of the households consume a constant share of their expected discounted current and future income streams, while the remaining 20 percent follow the *rule-of-thumb* proportional consumption model.

Quah (1990) uses the same model-based decomposition of the income process to derive testable implications about the *aggregate* income and consumption processes. In particular, he relies on the spectral density properties of income changes under the assumption of one difference-stationary component and one covariance-stationary component to argue that smoothness of the observed aggregate consumption process is not inconsistent with considerably more volatile aggregate income, as previously claimed in *Deaton's paradox* by Deaton (1987).

The model-based decomposition of income shocks, and its implied links with consumption changes, has also been used by Blundell *et al*. (2008) to study the evolution of income and consumption inequality using the PSID and the Consumer Expenditure Survey (CEX) for the period 1978–92. They document the consumption response to permanent and transitory income shocks across different education and age cohort groups; the estimated coefficients of the permanent shock vary between 0.4 and 0.95, while those of the transitory shock remain statistically indistinguishable from 0. They also conclude that the degree of insurance of the U.S. households against the two types of shocks remained unchanged over the sample period, while the relative *volatility* of the shocks has increased more for the insurable kind of income variation.

Applying a similar methodology, Jappelli and Pistaferri (2010b) use the Bank of Italy Survey of Household Income and Wealth (SHIW) for the period 1987–2006 to examine the benefits of the financial integration within the EMU in terms of potential improvements in the ability of households to smooth their consumption in the face of unanticipated income fluctuations. They find that household

consumption responses are not statistically different in the pre-EMU and post-EMU sub-samples, with the estimated consumption elasticity in the range of 0.7 to 1.0 for shocks to permanent income, and from 0 to 0.3 for shocks to transitory income.

We have found two consumption papers that use self-reported or *subjective assessments* of the persistence of household income, both applying methodologies other than that in the present study. Pistaferri (2001) uses data from the Italian SHIW for 1989–91 in which households reported their income in the survey year and their expectation of income in the following year. From this subjective information *and* additional assumptions on the development of household income across the life-cycle, income was decomposed into its temporary and persistent components. Pistaferri (2001) found no sensitivity to shocks with a transitory effect on income, while the estimated elasticity of shocks with a permanent effect is 0.57.[1]

Concurrently with the publication of the working paper version of this study (Kukk *et al*., 2012), Sabelhaus and Ackerman (2012) published a study in which they derive the transitory income shock from self-reported income measures in the U.S. Survey of Consumer Finances (SCF). They investigate the extent to which the response to self-reported transitory income shocks contributed to the slowdown in the growth of food spending between 2004 and 2010. They estimate an Engel curve and find that a self-reported transitory income shock has a statistically significant effect on spending on food away from home. As the SCF makes it possible to derive the transitory income shock only for the relatively small fraction of households who report *unusually high* deviations of their current income from actual income, households with relatively small income deviations are left out of the study.

3. Dataset and Identification of Income Shocks

3.1. *The Estonian Household Budget Survey*

The Estonian HBS was conducted from 2002 to 2007 by Statistics Estonia, using a unified statistical methodology, which is outlined below and described in detail in ES (2012).[2] The rolling panel part of the Estonian HBS, used for empirical consumption modeling in this paper, consists of pairs of household observations on durable and non-durable consumption, different types of income, and various additional characteristics. The cross-sectional part of the Estonian HBS has previously been used by Kulikov *et al*. (2009) in an exploratory study of the saving behavior of Estonian households.

Each wave of the Estonian HBS comprises a representative cross-section of Estonian households based on regional stratification. The data are collected using a rolling panel structure: one half of the households are newly drawn from the

[1]Jappelli and Pistaferri (2000) also use subjective income expectations from the same survey, but test for excess sensitivity to *predicted* income innovations.

[2]The survey was discontinued in 2008–09 due to funding constraints and restarted in 2010 using a different sampling methodology. More information on the survey, including the list of official publications and methodology notes on both the pre-2008 and post-2009 samples, can be found on the website of Statistics Estonia (http://www.stat.ee/households).

population registry, while the second half is made up by re-interviewing the households that entered the survey the previous year. The data collection takes place in a sequence of 12 consecutive rounds, each corresponding to one calendar month and covering one-twelfth of the full annual sample. As a result of this survey design, the available time dimension of our panel is limited to two observations per household, spaced apart by exactly one calendar year. Due to the sample attrition and changes in response rates across different survey waves, the number of re-interviewed and newly drawn households displays some variations from year to year.

The panel contains observations on 2351 individual household units, each one observed at two time periods separated by one calendar year, for a total of 4,702 panel observations. This is the dataset resulting after some trimming of the original survey data. All households classified as self-employed have been excluded; this happens when the share of their business-related income in the total monthly income exceeds the threshold of 20 percent. The income of self-employed households is very volatile and subject to potentially large measurement errors.[3] Following the same argument a few observations with property income exceeding 20 percent of total income have also been excluded.[4] Finally, all observations where the head of the household is classified as inactive in the labor market in either of the time periods have been removed from the sample.[5]

The Estonian HBS contains a detailed breakdown of the *monthly* income and consumption figures of each household. The after-tax household income is composed of wage income, business-related income, property income, transfers, and other income sub-categories reported for the month of the interview. The total spending on household consumption is the sum of spending reported for the month of the interview on 12 different consumption expenditure groups; cf. the COICOP/HICP categories (Eurostat, 2014a).

We use two distinct monthly measures of after-tax household income which are available in the Estonian HBS: the *current* monthly income, and the *regular* income. The interviewed household is first asked to provide its current (or realized) income for the month of the interview. This information is based on detailed listings of different income sources to enhance the reliability of the data provided. The household is subsequently asked to provide an estimate of the regular income. The question is the following: "What is the usual amount of money at the disposal of your household during one month from all sources of income?" This question was asked *after* the household had stated its current monthly income.

The sequencing of the two questions should ensure that the household is aware of the differences between the two income concepts. This is confirmed by the fact that only 6 percent of the interviewed households report the same current and

[3]Kukk and Staehr (2014) refer to income under-reporting of self-employed households in the Estonian HBS. Krueger and Perri (2010) document substantial differences in the observed labor income volatility between self-employed and non-self-employed households in the PSID and SHIW datasets.

[4]This income category includes rents from owned land and real estate, interest income on deposits and investments, and intellectual property income. For the rest of the observations, property income comprises on average less than 0.2 percent of households' total income and therefore should not markedly affect the estimations.

[5]This partly addresses issues related to the possible non-separability of consumption and leisure in the utility of the representative household (see Attanasio and Weber, 2010).

regular income. In total 76 percent of the households report current income to be higher than regular income and 18 percent report current income to be lower than regular income. It cannot be ruled out that some households will equate regular income with the income from their main employment so that current income typically will be larger than regular income. The frequency of cases where current income is lower than regular income suggests, however, that this is not a very prevalent problem.

In any case, there is no means to ensure that parts of the different income components are correctly reported. The possibility of erroneous reporting compels us to examine the properties of the two income components in detail in the next subsection. It must be emphasized, however, that the purpose of this study is to investigate the consumption decision of households when the income shocks are derived from *subjective* measures of different income measures.

The two separate income measures make it possible to disentangle shocks with a long-term effect on income and shocks with a short-term effect based on the subjective assessment of the households. The methodology used for identifying household income shocks is discussed in Section 3.2. Although we are able to distinguish income shocks with different persistence, the survey does not provide any information on whether or not the income changes are expected. We discuss the implications for our results in the next subsection when the income shocks are computed.

On the consumption side, this paper takes advantage of two household consumption figures provided by the survey: full monthly household consumption, which covers all 12 COICOP/HICP sub-groups; and non-durable monthly household consumption, which is the sum of expenditures on food, non-alcoholic and alcoholic beverages, tobacco, clothing and footwear, housing (excluding regular maintenance and repair), transport services and fuel, newspapers, books and magazines, pet food, hotels, and eating out. Most of our results are based on the non-durable consumption measure, which is standard practice in the empirical consumption literature, but we also carry out robustness checks using the total monthly household consumption figure.[6]

In line with the theoretical model and the empirical literature, we convert all nominal income and consumption variables to real values. To this end, the monthly HICP price index for 2002–07 is used as a deflator (Eurostat 2014b; variable name: *prc_hicp_midx*, index 2005 = 1). We follow the convention in the empirical consumption literature and express the consumption and income variables in logarithms.

Table 1 shows summary statistics of the main consumption and income variables. Here and henceforth we use the subscripts in the following way: the index i refers to an individual household in the panel; the index $t \in \{1, 2\}$ refers to different observations of each individual household, where $t = 1$ denotes the first time the household is surveyed and $t = 2$ the second time the household is surveyed.

[6]The dynamics of durable consumption are in general different from those of non-durable consumption (cf. Bertola and Caballero, 1990). Since durable consumption goods deliver a stream of services lasting for many time periods, the correct way to account for them is to impute these service streams using an empirical procedure. We do not pursue this route, opting instead for a simpler way of separating the two kinds of consumption expenditures in our empirical models.

TABLE 1

Main Variables in the Dataset, Household-Specific Data

Variable	Definition	Mean	S.D.
$\log C_{it}^{tot}$	Logarithm of real monthly total consumption expenditures	8.952	0.680
$\log C_{it}^{nd}$	Logarithm of real monthly non-durable consumption expenditures[a]	8.494	0.595
$\log Y_{it}$	Logarithm of real monthly after-tax income	9.151	0.636
$\log Y_{it}^{reg}$	Logarithm of real regular monthly after-tax income	9.018	0.558
$\log Y_{it}^{temp}$	Logarithm of real temporary monthly after-tax income, $\log Y_{it}^{temp} \equiv \log Y_{it} - \log Y_{it}^{reg}$	0.133	0.361

Notes: The real variables are in 2005 prices. In the sample period, the *kroon* (isocode EEK) was the currency in Estonia; the exchange rate was fixed at 15.65 EEK for 1 EUR.

[a]Expenditures on non-durable consumption include expenditures on food, alcohol, clothes and footwear, non-durable housing expenses, public transport and fuels, journals and magazines, pet food, eating out, travel and tourism expenses.

The calendar times of the interviews are not explicitly indexed, but a set of annual dummies is included in the empirical consumption models in Section 4 as a way of capturing business-cycle effects.

Beyond the variables directly stemming from the Estonian HBS, the last row of Table 1 also includes a measure of the *temporary income* of the household. The log temporary income, $\log Y_{it}^{temp}$, is defined as the difference between the household's log current income and its log regular income, that is, $\log Y_{it}^{temp} = \log Y_{it}^{cur} - \log Y_{it}^{reg}$.

The average real after-tax income Y_{it} amounts to 9424 EEK (602 EUR) per month, while the average real *regular* after-tax income Y_{it}^{reg} amounts to 8259 EEK (527 EUR) per month within the sample period. This means that the current income realized in the month on average exceeds the regular income by 14.1 percent.[7]

The discrepancy between the averages of the current and regular income measures is substantial, but it must be recalled that these measures are derived directly from the households' *subjective* assessments. The temporary income measure is equally a subjective measure computed without any constraints or statistical filtering. The fact that the realized income outpaced the regular income is likely the result of the very fast growth in real and nominal incomes during the sample period. Real GDP grew on average by 8.1 percent per year from 2002 to 2007 (Eurostat 2014b, code: *nama_gdp_k*). Nominal wages grew by 14.9 percent per year and real wages by 9.6 percent per year during the same period (Statistics Estonia 2014, code: *WS5311*; Eurostat 2014b, code: *prc_hicp_aind*).[8]

Apart from income and consumption data, the Estonian HBS contains a wealth of information about different household characteristics, including socio-demographic attributes (age of the head of the household and family size), variables for consumption characteristics (dummies for above-average or

[7]This also follows from the approximation afforded by the average of the log real *temporary* monthly after-tax income, which takes the value 0.133 or 13.3 percent.

[8]The fact that the average of the log real temporary income is substantially above 0 will not affect the results of the consumption estimations in Section 4 since the temporary income shocks entering the estimations are in all cases demeaned (cf. Section 3.2). The interpretation of the results may however depend on whether or not households correctly separate the temporary and persistent components.

below-average level) and indicators of economic affluence (participation in the labor market, property ownership flags, and liquidity position). A brief summary of these ancillary variables, which are mainly used as control variables in the empirical models in Section 4, is provided in Table A.1 in Appendix A.

3.2. *Identification of Income Shocks*

The feature of the Estonian HBS which sets it apart from most other micro-econometric datasets is the availability of two different income measures, which are assessed by the household as exhibiting different persistence. The empirical strategy used in Section 4 to estimate consumption sensitivities relies on the identification of shocks to the two income processes, cf. equations (1) and (2).

In our dataset the current income comprises two income measures which are available for computing the shocks: the regular income, $\log Y_{it}^{reg}$, which is assessed by the household as being relatively persistent, and the temporary income, $\log Y_{it}^{temp}$, which is assessed as exhibiting little persistence.

The shocks to the two income processes are computed in the following way:

$$\begin{aligned} \log Y_{it}^{reg} &= \alpha^{reg} + \rho^{reg} \log Y_{it-1}^{reg} + v_{it}^{reg} \\ \log Y_{it}^{temp} &= \alpha^{temp} + \rho^{temp} \log Y_{it-1}^{temp} + v_{it}^{temp}, \end{aligned} \tag{3}$$

The index i depicts the household, while the index t indicates whether the specific variable refers to the first or the second interview round ($t = 1$ or 2). The terms ρ^{reg} and ρ^{temp} are autoregressive coefficients and v_{it}^{reg} and v_{it}^{temp} are the shocks of the corresponding income processes. Depending on the autoregressive coefficients, the two income shocks are expected to have different impacts on the household consumption change between the two time periods; cf. equations (1) and (2).

The regular income variable conveys a perception of households' average income over a certain time span, possibly taking into account income expectations in the near future. The precise formulation of the question, however, leaves some open ends, as different respondents are likely to have different time horizons in mind when reporting their regular income. This makes it difficult to attain a clear picture of the persistence of the regular income measure implied by the survey responses.

At the same time, temporary income is defined as a residual of the current income left after subtraction of the regular income component; by construction it represents a highly idiosyncratic part of the household income. However, because this income measure is a linear combination of the current income $\log Y_{it}^{cur}$ and the regular income $\log Y_{it}^{reg}$, its persistence remains unknown: it is linked to the underlying persistence of the current and regular income variables.

In order to ascertain the empirical properties of regular and temporary household income, and to compute the shocks to the two processes, we estimate the coefficients in (3) using first micro data and then aggregated data. The results are shown in Table 2.

First, we employ a pooled OLS estimation to obtain estimates of the two persistence coefficients ρ^{reg} and ρ^{temp}. As noted, the time dimension of our panel is limited to two observations per household, making it impossible to control fully

TABLE 2

Coefficient Estimates of Persistence of Regular and Temporary Income

	(1) Regular Income	(2) Temporary Income	(3) Regular Income	(4) Temporary Income
$\hat{\rho}^{reg}$	0.815***	..	0.818***	..
	(0.015)		(0.072)	
$\hat{\alpha}^{reg}$	1.768***	..	1.645**	..
	(0.132)		(0.647)	
$\hat{\rho}^{temp}$	..	0.253***	..	–0.026
		(0.038)		(0.125)
$\hat{\alpha}^{temp}$	..	0.087***	..	0.139***
		(0.009)		(0.021)
Wald test (*F*-stat)	159.0	..	6.40	..
	[0.000]		[0.014]	
R^2	0.634	0.065	0.678	0.001
No. of obs.	2351	2351	71	71

Notes: OLS estimation of equation (3) with $\log Y_{it}^{reg}$ or $\log Y_{it}^{temp}$ as dependent variable. The coefficient $\hat{\rho}^{reg}$ is the estimated persistence for regular income and $\hat{\rho}^{temp}$ is the estimated persistence for temporary income, while $\hat{\alpha}^{reg}$ and $\hat{\alpha}^{temp}$ denote the respective constants. Robust standard errors are reported in parentheses below the coefficient estimates. Superscripts ***, **, and * indicate that the coefficient is statistically different from 0 at the 1%, 5%, and 10% level, respectively. The Wald test shows the *F*-statistic and in square brackets below the *p*-value of the null hypothesis that the coefficient of the regular income is equal to one.

for time-invariant household heterogeneity by employing the fixed effects estimator. We make use of additional control variables to examine the issue in some detail.

Second, acknowledging the risk of biased results from the pooled OLS estimator, we depart from household-specific data and use aggregated data series. We average out household heterogeneity in our dataset by taking means of $\log Y_{it}^{reg}$ and $\log Y_{it}^{temp}$ across all households interviewed in each survey month from 2002 to 2007, obtaining two time series with 72 monthly observations each. An OLS estimation is then used to estimate the coefficients ρ^{reg} and ρ^{temp} from the averaged data.

Columns (1) and (2) in Table 2 show the estimated coefficients of the two income processes in (3) using the pooled OLS estimation. There are indeed substantial differences in the persistence of the two income variables: the estimate of ρ^{reg} in Column (1) is 0.81, while the estimate of ρ^{temp} in Column (2) is 0.25. Figure B.1 in Appendix B shows estimates of the two coefficients based on estimations undertaken for each month across the sample period. Although the confidence intervals of the rolling estimates are wider because the samples are smaller, on average they remain close to their full sample levels.

As mentioned previously, the results in Columns (1) and (2) of Table 2 are susceptible to unobserved household heterogeneity. While unable to take this heterogeneity into account fully with the fixed effects estimator, we examine the extent of the problem by adding control variables to our baseline regression in Table 2. The results are shown in Tables C.1 and C.2 in Appendix C. The estimate of ρ^{reg} is somewhat sensitive to the set of controls, but it remains in the interval of

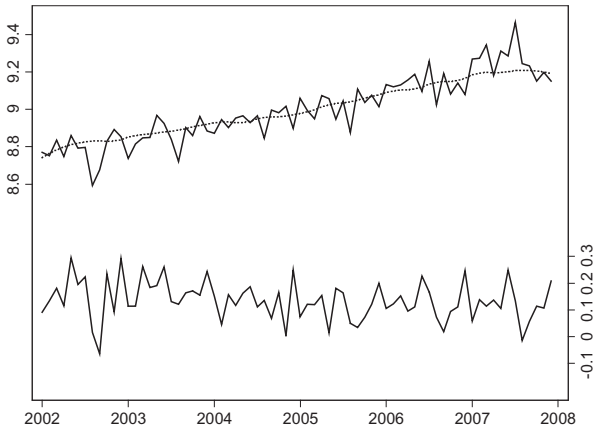

Figure 1. Variables $\log Y_{it}^{reg}$ (Left Scale) and $\log Y_{it}^{temp}$ (Right Scale) Averaged Across Households and the Real Gross Domestic Product (Dotted Line)

Notes: Monthly data. The real gross domestic product is from Eurostat (2014b, variable name: *namq_gdp_k*). Monthly data are obtained by interpolation from quarterly series using flexible polynomials, rescaled to match the average regular income level.

0.7–0.8 across various specifications in Table C.1. The estimate of ρ^{temp} remains broadly unchanged around the value of 0.25 for all model specifications in Table C.2.

We also implemented estimations for different sub-samples separately, for example for households with high and low education level of the household head, and for households with income below or above the median. The estimation results are provided in Tables C.3 and C.4 in Appendix C. The results remain very similar across the samples, lending support to our conjecture that the unobserved household heterogeneity does not have a substantial impact on the estimations of income persistence.

Columns (3) and (4) in Table 2 provide estimates of ρ^{reg} and ρ^{temp} obtained from the aggregated $\log Y_{it}^{reg}$ and $\log Y_{it}^{temp}$ series. The two series are displayed in Figure 1, showing the overall development of the two household income streams across the sample period from 2002 to 2007. The regular income appears to be closely following the trend of real gross domestic product, while the temporary income variable lacks any trend and exhibits no apparent dynamic structure. The estimate of ρ^{reg} in Column (3) confirms the persistence of the regular income stream obtained using the pooled data in Column (1). On the other hand, the temporary income persistence coefficient ρ^{temp} in Column (4) is now not statistically different from 0, suggesting that the corresponding pooled data result may be biased due to the omitted household heterogeneity term in the presence of a lagged dependent variable.[9]

[9]The autoregressive coefficients in columns (3) and (4) of Table 2 are likely to be underestimated due to a well-known downward small-sample bias of the least-squares estimator in the linear dynamic models with lags (see Shaman and Stine, 1988).

In summary, our results in Table 2 suggest that the regular income process is quite persistent, with the coefficient ρ^{reg} lying in the interval 0.7–0.8. By contrast, the temporary income process exhibits little or no persistence, with ρ^{temp} falling in the interval of 0–0.25. The estimated range of ρ^{temp} implies that the shock to temporary income, v_{it}^{temp}, is likely to have little effect on the household's consumption plans.

The lack of household-specific estimates for the persistence of regular and temporary income streams calls for a judicious approach to the estimation of the corresponding income shocks. Therefore, we consider several different assumptions regarding the persistence of the two income streams. For each assumption, we compute residuals from equation (3) and use these shocks when estimating the consumption responses.

The baseline assumption is that $\rho^{reg} = 1$ and $\rho^{temp} = 0$. Under this assumption, the shock to regular income, v_{it}^{reg}, has a permanent effect on income, that is, $\log Y_{it}^{reg}$ is a unit root process, while the shock to temporary income, v_{it}^{temp}, affects income for just a single time period, that is, $\log Y_{it}^{temp}$ is a white noise process. This choice of baseline is also a direct reflection of the households' own assessment of the persistence of the two income components.

We also consider three alternative assumptions regarding the persistence of the income processes, cf. the estimations in Table 2. The first alternative assumes that $\rho^{reg} = 0.9$ and $\rho^{temp} = 0$; the second alternative that $\rho^{reg} = 0.8$ and $\rho^{temp} = 0$; and the third alternative that $\rho^{reg} = 0.8$ and $\rho^{temp} = 0.25$. These sets of assumptions broadly cover the different estimates of the two persistence coefficients. They are used to examine the impact on the estimated consumption responses of different assumptions regarding the persistence of the income shocks.

Table 3 provides the statistics for the shocks v_{it}^{reg} and v_{it}^{temp}, which are computed using the four alternative assumptions about the persistence of the shocks. The means of the empirical income shocks are 0 in all cases due to the way the shocks are computed. The standard deviations are very similar across the different persistence assumptions in Columns (1)–(4), but are substantially higher than those found in most other studies; see the overview of Meghir and Pistaferri (2011). The high standard deviations may reflect the rapid changes in household income during the economic boom as discussed in Section 3.1. This might lead to higher variability in both income shocks.

TABLE 3

Descriptive Statistics of Shocks to Regular and Temporary Income, Different Assumptions about Their Persistence

	(1) $\rho^{reg} = 1$ $\rho^{temp} = 0$		(2) $\rho^{reg} = 0.9$ $\rho^{temp} = 0$		(3) $\rho^{reg} = 0.8$ $\rho^{temp} = 0$		(4) $\rho^{reg} = 0.8$ $\rho^{temp} = 0.25$	
	v_{it}^{reg}	v_{it}^{temp}	v_{it}^{reg}	v_{it}^{temp}	v_{it}^{reg}	v_{it}^{temp}	v_{it}^{reg}	v_{it}^{temp}
S.D.	0.355	0.360	0.343	0.360	0.340	0.360	0.340	0.348
Correlation	–0.185		–0.188		–0.186		–0.240	

Notes: The empirical income shocks v_{it}^{reg} and v_{it}^{temp} are computed by inserting the persistence assumptions in the column headings into equation (3).

It is notable that the standard deviations of temporary and regular shocks are of the same magnitude, which may be at odds with the understanding that more persistent income shocks would have smaller variances. The reason may again be related to the rapid increase in average incomes during the sample period which are likely to have led to substantial changes in the assessment of regular income levels. In addition, as we are using survey data the large standard deviations of the derived shocks may also indicate the presence of the measurement errors.

The shocks to regular and temporary income are negatively, but weakly, correlated. A negative correlation is also found in Hryshko (2013), who estimates the correlation coefficient between permanent and transitory shocks to be –0.5 in data from the SHIW.

The theoretical model of intertemporal consumption choice in equation (1) assumes that the shocks to the income processes are unanticipated. There is no information in the survey on this issue, but the empirical equivalents v_{it}^{reg} and v_{it}^{temp} were constructed so as to make it probable that this assumption also holds in the empirical model. Furthermore, we investigated the descriptive power of the socio-demographic and economic variables for the shocks. The adjusted R^2 is below 0.02 for both income shocks and the value of the F-statistic is below 5, indicating a very modest explanatory power of the variables (not shown). This suggests that the derived shocks are to a large extent unexplainable by observed variables.

4. Consumption Estimations

4.1. *Estimations of the Standard Consumption Model*

The empirical model originates from equation (2) where control variables are added in the form of preference shifters and time fixed effects (to capture aggregate economic developments). The following equation is used for estimating consumption sensitivities to shocks to different income components:

$$\Delta \log C_{it} = Z_{it}'\gamma + \beta_1 v_{it}^{reg} + \beta_2 v_{it}^{temp} + \varepsilon_{it}. \tag{4}$$

The dependent variable $\Delta \log C_{it}$ is the change in the logarithm of consumption between two time periods. The dependent variable is taken to be non-durable consumption in most cases, but it is total consumption in some robustness analyses. The control variables in the column vector Z_{it} are annual time dummies and preference shifters in the form of the change in household size and the logarithm of the age of the head of the household (cf. Attanasio, 1999). The annual time dummies seek to capture aggregate effects on household consumption.[10] (Given the inclusion of time dummies for each period, no constant is included.) The vector γ contains the coefficients of the control variables. The coefficient of the shock to regular income is β_1 and the coefficient of the shock to temporary income is β_2. Finally, ε_{it} is an error term.

[10]We also tested the inclusion of monthly dummies for seasonal effects, but found that the dummies were typically statistically insignificant, while the other estimation results remained essentially unchanged. The reason for the absence of seasonality effects is likely to be that the regressions include changes in consumption and income from the *same month* the previous year.

TABLE 4

RESPONSE OF NON-DURABLE CONSUMPTION TO INCOME SHOCKS, DIFFERENT ASSUMPTIONS REGARDING THE PERSISTENCE OF THE INCOME PROCESSES

	(1) $\rho^{reg} = 1$ $\rho^{temp} = 0$	(2) $\rho^{reg} = 0.9$ $\rho^{temp} = 0$	(3) $\rho^{reg} = 0.8$ $\rho^{temp} = 0$	(4) $\rho^{reg} = 0.8$ $\rho^{temp} = 0.25$
v_{it}^{reg}	0.260***	0.259***	0.243***	0.266***
	(0.033)	(0.034)	(0.033)	(0.034)
v_{it}^{temp}	0.121***	0.120***	0.116***	0.176***
	(0.029)	(0.028)	(0.028)	(0.034)
Wald test (F-stat)	11.81	11.61	9.86	4.59
	[0.001]	[0.001]	[0.002]	[0.032]
No. of obs.	2351	2351	2351	2351
R^2	0.076	0.073	0.069	0.077

Notes: OLS estimation of equation (4) with $\Delta \log C_{it}$ as dependent variable. The variable v_{it}^{reg} is the regular income shock and v_{it}^{temp} is the temporary income shock derived from equation (3). Household size, log of age of household head, and year dummies are included in the estimations but are not shown in the table. Robust standard errors are reported in parentheses below the coefficient estimates. Superscripts ***, **, and * indicate that the coefficient is statistically different from 0 at the 1%, 5%, and 10% level, respectively. The Wald test shows the F-statistic and in square brackets below the p-value of the null hypothesis that the coefficients of the shocks to regular and temporary income are identical.

Table 4 shows the first set of estimation results in which changes in non-durable consumption are explained by shocks to income of different persistence and the set of control variables. Column (1) provides the results of the baseline estimation in which the shocks to regular income are assumed to be fully persistent ($\rho^{reg} = 1$) and the shocks to temporary income to be without persistence ($\rho^{temp} = 0$). A shock to regular income of 10 percent induces a consumption increase of 2.6 percent in the same period. The results are lower than those obtained in the studies that use econometric identification of the shocks, listed in Section 2. According to these studies, the elasticity of consumption to a permanent income shock is between 0.6 and 1. In our study, the self-reported regular income is not fully persistent and the estimated coefficient should therefore be lower.

It also follows from Column (1) in Table 4 that a shock to temporary income of 10 percent leads to a 1.2 percent increase in consumption. Although studies that use statistical decomposition typically report a negligible consumption response, studies based on quasi-experiments find a consumption response to transitory income of a magnitude comparable to our estimate, cf. the comprehensive review by Jappelli and Pistaferri (2010a).

Nevertheless, among households in Estonia, non-durable consumption is more sensitive to a shock to the highly persistent income component than to a shock to the less persistent income component. The difference between the two coefficients is statistically significant at the 1 percent level. The results reflect the fact that households distinguish between shocks to income processes that contain different levels of persistence.

Columns (2)–(3) in Table 4 show the estimation results when different assumptions about the persistence of the regular income process are used. The results are qualitatively similar to those of the baseline estimation, indicating that

the results are rather insensitive to the persistence of the permanent income variable. Column (4) shows the results when temporary income is assumed to exhibit some persistence. Overall the results in Columns (2)–(4) suggest that an inability to identify the true income process of the households does not affect the results of the consumption estimations. The results in Table 4 are robust to a large number of specification changes and to the inclusion of different control variables.[11]

The estimated coefficient of a shock to temporary income (0.12) is comparable to the results in Jappelli and Pistaferri (2010b), based on econometric decomposition of different income processes, as they estimated the coefficient to be in the range of 0 to 0.3. Blundell *et al.* (2008) and Pistaferri (2001) found no response of consumption to a shock with transitory effect on income. The estimated coefficient of a shock to regular income (0.26) is smaller than that estimated in studies where the coefficient for the full sample is estimated to be around 0.6. As the latter are estimated for shocks with a permanent effect on income, while the regular income used in this paper exhibits persistence that is lower than 1, the estimation results should be different. The consumption response is expected to decrease fast when the persistence coefficient falls below 1 (cf. Kaplan and Violante, 2010; Hryshko, 2013).

As discussed in Section 3.1, the decomposition of income into regular and temporary components relies on the households' own assessments, and we can therefore not rule out the possibility of measurement errors due to the households mixing up the two income components. If the households include part of their temporary income in the regular income measure, then we would expect the consumption response to the derived regular income shock to be relatively low. If, on the other hand, households do not include all of their persistent income in the regular income measure, we would expect a positive consumption response to a temporary income shock. The sequencing of the income questions should, however, diminish the risk that the households mix up the two income concepts when being interviewed. Moreover, possible measurement errors are arguably of less concern in the present analysis since the aim is to uncover the consumption response to income shocks derived from the subjective income measures of households.

Moreover, if the income shocks contain an anticipated component, the consumption response is expected to be lower as households have already adjusted to the anticipated income changes (see discussion in Jappelli and Pistaferri, 2010a). On top of that, if households are insured against some of their income shocks, the consumption response to regular shocks is smoothed, as noted by Blundell *et al.* (2008).

In conclusion, given the lower persistence of the regular income than in many other studies, potential measurement errors in the income components, possible anticipated income changes, and partial insurance, the estimation results in this paper using self-reported income measures are comparable with those in studies that use statistical decomposition.

[11]The robustness tests are available from the authors upon request.

4.2. *The Response of Consumption to Lagged Shock to Temporary Income*

The consumption response to a temporary income shock found in Section 4.1 cannot be explained by the presence of persistence in the temporary income process. Even if the persistence is 0.25, the upper limit in Table 2, the shock still dies out fast and has very little effect on lifetime earnings. Moreover, although it cannot be completely ruled out that some of the temporary income shock is anticipated, this cannot explain the significant response of consumption. An anticipated temporary income shock should, in line with an unanticipated temporary income shock, have a negligible impact on consumption (Jappelli and Pistaferri, 2010a).

One possibility is that households use short time horizons in their consumption decisions, that is, they divide the windfall income between a limited number of future time periods. The shorter than life-time horizon is also mentioned by Friedman (1957) and can still be considered to be forward-looking behavior. Another possibility is that households react to a shock to temporary income only in the time period in which the shock occurs, that is, they do not fully smooth consumption in this case. This type of behavior is considered to be either myopic or induced by some constraints on forward-looking behavior such as liquidity constraints (Attanasio and Weber, 2010).

The consumption specification in equation (4) does not allow us to shed light on the reasons for the consumption response to the temporary income shock. In an attempt to shed further light on the issue, we include the lagged temporary income shock. In case the consumption response to temporary income shocks is due to a short time horizon of households, the coefficient of the lagged temporary income variable is expected to be statistically insignificant as the temporary income is divided proportionally across time periods. If the consumption follows current income, the sign of the significant coefficient is expected to be negative.

The consumption specification when the lagged temporary income shock v_{it-1}^{temp} is included takes the form:

$$\Delta \log C_{it} = Z_{it}\gamma + \beta_1 v_{it}^{reg} + \beta_2 v_{it}^{temp} + \beta_3 v_{it-1}^{temp} + \varepsilon_{it}. \tag{5}$$

As there are only two observations per household, we have to restrict the persistence of the shock to temporary income to 0 in order to include the lagged temporary income variable.

Table 5 shows the results of estimations of equation (5). The estimated coefficient of the lagged shock to temporary income is negative and statistically significant. Moreover, inclusion of the lagged shock changes the estimated coefficients for current regular and temporary shocks.

The coefficient of the lagged shock to temporary income is negative and, in numerical terms, close to the coefficient of the current shock to temporary income. This holds irrespective of the assumption of persistence in the shock to regular income. The result suggests that consumption reacts positively to a shock to positive temporary income only in the same period when the shock appears. In the following period the consumption has to retreat by the same magnitude as it responded to the shock during the previous period.

TABLE 5

ESTIMATIONS WHEN LAGGED SHOCK TO TEMPORARY INCOME IS INCLUDED

	(1) $\rho^{reg} = 1$ $\rho^{temp} = 0$	(2) $\rho^{reg} = 0.9$ $\rho^{temp} = 0$	(3) $\rho^{reg} = 0.8$ $\rho^{temp} = 0$
v_{it}^{reg}	0.329***	0.328***	0.308***
	(0.034)	(0.035)	(0.034)
v_{it}^{temp}	0.196***	0.194***	0.186***
	(0.036)	(0.035)	(0.035)
v_{it-1}^{temp}	–0.247***	–0.242***	–0.233***
	(0.030)	(0.030)	(0.030)
Wald test (F-stat)	9.96	11.11	8.38
	[0.002]	[0.002]	[0.004]
R^2	0.106	0.102	0.096
No. of obs.	2351	2351	2351

Notes: OLS estimation of equation (5) with $\Delta \log C_{it}$ as dependent variable. The variable v_{it}^{reg} is the regular income shock, v_{it}^{temp} is temporary income shock and v_{it-1}^{temp} is lagged temporary income shock derived from equation (3). Household size, log of age of household head, and year dummies are included in the estimations but not shown in the table. Robust standard errors are reported in parentheses below the coefficient estimates. Superscripts ***, **, and * indicate that the coefficient is statistically different from 0 at the 1%, 5%, and 10% level, respectively. The Wald test shows the F-statistic and in square brackets below the p-value of the null hypothesis that the coefficients of the shocks to regular and temporary income are identical.

When the effect of a lagged shock to temporary income is taken into account, the coefficients of the current period income shocks increase relative to the results in Table 4. A shock that increases regular income by 10 percent increases consumption by 3.3 percent in the same month. A current period shock to temporary income of the same magnitude increases consumption by 2 percent. The coefficients of the regular and temporary income shocks of the same period are still significantly different, suggesting that households do indeed distinguish between income shocks to different income components and they incorporate this information into their consumption decisions.

The findings in Table 5 are robust to different assumptions about the identification of the income shocks, as illustrated by the estimations in Columns (2) and (3). Estimations with total consumption instead of non-durable consumption also produce qualitatively similar results; cf. Table D.1 in Appendix D. The response of total consumption to income shocks is larger than that of non-durable consumption and the lagged shock to temporary income is significant with a negative sign.

The results are robust to the inclusion of additional control variables that capture changes in the economic situation and the behavior of the household; see Table D.2 in Appendix D. These robustness tests are important as the dataset has only two observation points per household, which implies that the differenced specification in (5) has only one observation per household, ruling out any fixed effects estimation. The inclusion of variables capturing peculiarities in consumption, changes in employment status, household wealth or liquidity constraints do

not change the coefficients of the income shocks in substantial ways. The coefficients of consumption response are not affected by omitted variables bias with the notable exception of the lagged shock to temporary income.

The statistical and economic significance of the lagged shock to temporary income might relate to numerous explanations, such as myopic behavior of households or partial consumption insurance, for instance due to liquidity constraints. Previous studies have found evidence for both explanations (see the overview of Attanasio and Weber, 2010).

In standard models of intertemporal consumption choice, households react to the current and lagged negative transitory shock if they are liquidity constrained. As noted by Jappelli and Pistaferri (2010a), constrained households are not able to smooth declines in transitory income through borrowing.

In order to understand the impact of liquidity constraints on our results, we estimated equation (5) on two different sub-samples. We split the households into two sub-samples based on their *liquidity score*. The liquidity score is derived from subsets of questions about the ability of the household to finance consumption expenditures of various nominal values instantly by borrowing or by drawing down savings.[12] The score ranges from 0 to 6 and larger values indicate easier access to liquidity. We pooled the scores of 0–2, which correspond to tight constraints on consumption, as these households are not able to finance consumption expenditure of 15,000 EEK (959 EUR) instantly from either savings or credit. The second sub-sample consists of households with liquidity scores between 3 and 6, which indicate that a sufficient amount of savings or credit is available to finance consumption expenditures of values above 15,000 EEK. We label the sub-samples as households with low liquidity and high liquidity.

Table 6 presents the estimation results for the two sub-samples. It shows a higher consumption response to a transitory income shock among households with low liquidity, although the difference is not significant in statistical terms. Households with low liquidity exhibit a significantly higher response to an income shock to regular income than do households with high liquidity; the point estimates are 0.45 and 0.26, respectively. In the framework of partial insurance models, these results can be explained by constraints on self-insurance; consequently, households are not able to smooth their regular income. There might be other explanations for the results, such as differences in the persistence of regular income or the presence of anticipated income shocks, but a deeper analysis is beyond the scope of this paper. The overall result is that liquidity constraints do not explain the consumption response to the temporary shock and other explanations, including myopic behavior of households, may therefore be considered.

The results in this subsection are important for several reasons. First, most studies investigating the response of consumption to transitory income use only current variables, as lagged variables are seldom available. Our results show that omitting the lagged temporary income may bias the estimated coefficients of current income shocks downwards. This may be important when the estimated

[12]The survey asked about the ability to finance instant consumption expenditures for three values—1000 EEK (64 EUR), 5000 EEK (320 EUR), and 15,000 EEK (959 EUR)—and specifies the source of financing.

TABLE 6

Sensitivity of Non-Durable Consumption to Shocks by Different Subsamples

	(1) Low Liquidity	(2) High Liquidity
v_{it}^{reg}	0.451***	0.261***
	(0.063)	(0.040)
v_{it}^{temp}	0.222***	0.183***
	(0.052)	(0.045)
v_{it-1}^{temp}	–0.270***	–0.222***
	(0.042)	(0.043)
Wald test (F-stat)	8.17	2.83
	[0.004]	[0.093]
R^2	0.122	0.106
No. of obs.	863	1488

Notes: OLS estimation of equation (5) with $\Delta \log C_{it}$ as dependent variable. The variable v_{it}^{reg} is the regular income shock, v_{it}^{temp} is temporary income shock and v_{it-1}^{temp} is lagged temporary income shock derived from equation (3). Household size, log of age of household head, and year dummies are included in the estimations but are not shown in the table. Robust standard errors are reported in parentheses below the coefficient estimates. Superscripts ***, **, and * indicate that the coefficient is statistically different from 0 at the 1%, 5%, and 10% level, respectively. The Wald test tests the null hypothesis that the difference between the coefficients of shocks to regular and temporary income is not statistically significant. The values in the square brackets are p-values.

coefficients of the standard intertemporal consumption model without a lagged temporary income variable are interpreted.

Second, the significant negative coefficient of the lagged temporary income shock in the sub-sample of households without liquidity constraints is not consistent with standard consumption models of forward-looking unconstrained households. Our results show that households tend to react to contemporaneous temporary income shocks during the same time period. The study of Hall and Mishkin (1982) is among the few that estimate the responses to both current and lagged transitory shocks. They obtain a negative sign for the lagged variable and explain it by alluding to the rule-of-thumb consumption.

5. Conclusion

A detailed understanding of the determinants of household consumption is important for an analysis of microeconomic welfare and for macroeconomic policy prescriptions. This paper analyzes how household consumption in Estonia reacts to different income shocks.

The main innovation of the analysis is the identification of income shocks of different persistence using information provided by the individual households. The identification of income persistence based on self-reported income measures is uniquely made possible by data in the Estonian HBS. This eliminates the need for

restrictive statistical decomposition, which typically utilizes additional assumptions about the co-movements of consumption and income.

The data sample consists of 2351 households interviewed twice during the period 2002–07, a period of rapid economic growth and increasing household income in Estonia. The two income measures are regular income and temporary income, where the latter is defined as the difference between the current and regular incomes reported by the households. In order to assess the properties of the income measures, different empirical methods are used to produce approximate estimates of their persistence. The analyses show that the households diligently assess the persistence of the two income measures. Shocks or innovations to the two different income processes can be calculated.

The starting point for the consumption estimations is a model with a shock to regular and temporary income. The consumption response to a shock affecting regular income is significantly higher than the response to a shock affecting temporary income. This result entails a different degree of consumption smoothing depending on the persistence of the income shocks, and this is consistent with standard models of intertemporal consumption choice. The estimations are robust to different consumption measures, to different degrees of persistence of the income processes, and to the inclusion of additional control variables.

Further estimations reveal, however, that consumption also reacts to the lagged shock in temporary income, which is not consistent with standard models of forward-looking households. The coefficient of the lagged shock to temporary income is negative and, in numerical terms, close to the coefficient of the contemporaneous shock to temporary income. Exploratory investigations rule out liquidity constraints as an important factor for the results, suggesting that other explanations such as myopic behavior should be considered. The upshot is in any case that the consumption choice is in part affected by factors that cannot be ascribed to intertemporal smoothing of consumption.

The identification of income shocks based on self-reported income measures is novel. This study contributes to the empirical literature on consumption behavior by estimating consumption responses to income shocks of different persistence given the subjective assessment of households. In spite of the unique shock identification and sample, the results are broadly in line with findings in earlier studies, namely that households react differently to shocks to income of different persistence. Nevertheless, as households respond to transitory income changes, the study presents new evidence that consumption also adjusts to the transitory income of the previous period. The finding helps to improve the understanding about the co-movement of consumption and income.

An important direction for future research is the estimation of different consumption responses to positive and negative shocks to income. Some empirical evidence suggests that households perceive changes in their financial situation asymmetrically, as found by Mastrogiacomo (2010) among others. Tests of asymmetry for consumption response can provide additional information on the extent of forward-looking behavior, and also on reasons for deviations from the standard model of intertemporal consumption choice. The challenges of implementing such tests are considerable and can be left for future research.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix A: Variable definitions
Table A.1: Definitions of additional variables used in the empirical models of household consumption behaviour
Appendix B: Identification of income shocks in the Estonian HBS
Figure B.1: Rolling monthly estimates of ρ^{reg} (left scale) and ρ^{temp} (right scale) together with their 95 percent confidence intervals (dotted line) and estimates using the full sample (dashed lines)
Appendix C: Robustness checks of income persistence estimations
Table C.1: Regular income persistence coefficient with control variables
Table C.2: Temporary income persistence coefficient with controls
Table C.3: Income persistence coefficients for different sub-samples
Table C.4: Income persistence coefficients for different sub-samples
Appendix D: Robustness tests of estimations with lagged shock to temporary income
Table D.1: Sensitivity of total consumption to shocks to income processes of different persistence
Table D.2: Robustness test of the baseline regression to different sets of control variables