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Causality in the link between income and satisfaction. IV estimation with internal instruments [1]

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Abstract

Usually, it is expected that income increases life satisfaction. In recent years tough, research emerged that shows how subjective well-being, including satisfaction, influences objective measures, as for example income. This would then require explicit identification strategies for estimating effects of income on life satisfaction.

I address this issue using German SOEP data and Lewbel's (2012) method, which generates instruments from heteroscedasticity. This allows identification of two separate causal effects in the link between income and life satisfaction: (1) income affecting satisfaction and (2) satisfaction affecting income. This analysis focuses on life satisfaction and equivalized income, because this is the income measure most welfare analyses use to assess utility of income.

Results show no significant effects of income on life satisfaction, but effects of satisfaction on income. This suggest that the effect of income on life satisfaction may be overstated in standard approaches that do not account for this reverse causality – possibly due to reverse causality, which is likely rooted in response behavior, rather than income generation.

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Keywords: life satisfaction, income, utility of income, reverse causality.

[1] The main idea, general set up and most results of this study are part of my thesis (Elsas 2021), but not Section 5.3 and the conclusion related to it.

1 Introduction

In economic theory, the concept of utility is used to explain human behavior. It is standardly assumed that higher incomes generate higher levels of utility. Since utility is a theoretical concept, which is not directly observable, welfare and happiness economists equate utility with happiness and analyze self-reported data on satisfaction to test this assumption empirically (i.e. Easterlin 1995, Vendrik and Woltjer 2007, Layard et al. 2008, Carver and Grimes 2019). Typically the only causal pathway considered is that running from income to happiness. The reverse pathway, i.e. happiness causing income, is often neglected.

More recently however, evidence emerged that happiness promotes health, sociability, careers and productivity (De Neve et al. 2013) - all of which are causes and sources of earned income. Earned incomes, in turn, are one of the primary elements of a household's overall income (alongside e.g. government transfers or incomes from capital). These positive effects of happiness could transmit to overall household income, which means that overall household income could therefore potentially be influenced by happiness. Additionally, happiness may also increase equivalized household incomes via increasing the probability of household formation with a partner, which generates economies of scale compared to single households. It is thus likely that household income is also positively affected by happiness.

Since most people refer to equivalized household income when evaluating their income satisfaction (Schwarze 2003), it is reasonable that many studies use measures of equivalized household income when estimating the hedonic effects of income (e.g., Stutzer 2004, Boyce et al. 2010, Vendrik and Woltjer 2007, Jäntti et al. 2014). But, if greater happiness is a cause for greater household incomes, then estimates that do not account for this causal path will be biased upward. One aim of this study is therefore to explore the probable size of such a bias. I thus provide here the first (to my knowledge) simultaneous estimations of the bi-directional causal effects between equivalized income and happiness.

Estimating the causal effect of happiness on equivalized household income is another substantive contribution which adds to the wider debate on the effects of happiness on socio-economic outcomes.

Data for the analysis come from the German SOEP[2] for the years 1985 to 2017 (273768 person-year-observations of 38,134 individuals). Self-reports on life satisfaction serve as measure for happiness, but estimations using financial satisfaction are provided too, since financial satisfaction is also a commonly used proxy for utility of income. Income is measured as annual equivalized household income. Identification relies on Lewbel instruments (Lewbel 2012), a method that exploits heteroscedasticity in the endogenous regressors to identify causal effects.

Results indicate that income has no significant causal effect on life satisfaction, whereas satisfaction has an effect on income. Standard estimates of the effect of income on satisfaction appear to be biased upwards.

In the next section some related literature is discussed. The economic model, the identification strategy and the econometric model are explained in the third section. The fourth section describes the data. Since this is crucial for identification, that section also describes the patterns of heteroscedasticity in the endogenous variables of interest. Results are presented in the fifth section. Two further sections present robustness checks and further estimations using financial satisfaction. A final section concludes.

2 Related literature

In economic theory and in the general public it is expected that income, ceteris paribus, generates utility and thereby raises satisfaction. Although this hypothesis has received general empirical support, the much debated Easterlin Paradox (Easterlin 1974, Stevenson and Wolfers 2008, Easterlin 2017, Kaiser and Vendrik 2019), which notes that as countries grow richer over time, they do not grow happier, raises doubts about the utility of income hypothesis.

The debate about the importance of own income for life satisfaction never stopped completely (Hagerty and Veenhoven 2003, Easterlin 2005, Clark et al. 2008, Kahneman and Deaton 2010, Boyce et al. 2010), but the majority agrees that income does matter, though perhaps only to a limited extent (Easterlin 1995, Oswald 1997, Diener and Oishi 2000, Frey and Stutzer 2002, Boyce et al. 2017).

[2] The German Socio-Economic Panel Study is an ongoing longitudinal study of German households. The SOEP began in 1984 with a sample of adult members from randomly selected households in West Germany. Since 1984, the SOEP has expanded to include East Germany and also added various subsamples to maintain a representative sample of the entire German population and to allow analyses of special groups in society, e.g affluent households, the migrant population or income-poor families.

Very few previous studies, though, use methods that are explicitly able to identify causal effects of income on life satisfaction. Most of these studies find support for the hypothesis that income matters. At first, in a very innovative approach a significantly positive effect of income on life satisfaction was estimated exploiting exogenous income increases that occurred with the German reunification (Frijters et al. 2004). Yet, orderd logit estimations that account for individual-specific correlated unobserved heterogeneity were lateron found to be inconsistent estimators (Baetschmann et al. 2015). Some instrumental variable approaches yielded positive estimates, yet relevance and exogeneity of the instruments for income are not always straightforwardly established. This is, for example, the case if instruments are constructed from the share of respondents in the household showing their payslip to the interviewer[3] and also when the parents' or spouse's education is used as an instrument.[4] Exogeneity and relevance of industry- and occupation-wide variation in earnings, in contrast, are very well-established for instrumenting income in life satisfaction estimations, and are hence repeatedly used for this purpose: Luttmer (2005) analyzes the effect of spatial reference income, i.e. the mean income in the neigborhood, using US data. Vendrik (2013) and Kaiser (2018) use the same instruments, but German and British Data, and analyze if people adapt to income. All three studies did not focus the effect of own current income on life satisfaction, but all found strongly significant, positive and large effects of current income on life satisfaction. Vendrik (2013), though, mentions that the instruments they use are specially suitable to predict permanent income, rather than income of shorter periods.

In contrast to the aforementioned studies, Lachowska (2017) found large, significantly positive and robust effects of income on affect, but no statistically significant, nor robust effects on life satisfaction. She uses an instrument that she constructed from the economic stimulus tax

[3] Powdthavee (2010) used the share of respondents who showed their payslip to the interviewer, to predict household income. "The idea is that there is a direct correlation between the proportion of household members showing and not showing their payslip to the interviewer and that of household income as household income is bound to have been measured more accurately where the proportion of household member who showed payslip is high." (Powdthavee 2010, p. 81). This however explains precision of the income measure, but is no argument for a monotone effect on the amount of income, which would be needed for an instrumental variable estimation.

[4] Knight et al. (2009) also estimate significantly positive effects of income on life satisfaction in China. They used fathers and spouses education to instrument income in the life satisfaction equation. The usual statistical test are convincing, but only a weak argument is given that supports the generally untestable exogeneity assumption for the instrument: it is said that it was not likely that spouses or fathers education influences life satisfaction (except through income), because even own education is only weakly associated to life satisfaction in their OLS estimations with all covariates (Knight et al. 2009, p. 646). Findings for Germany indicate the contrary, i.e. that "[...] overall, family background and individual factors are of approximately equal importance for permanent life satisfaction." (Schnitzlein and Wunder 2016, p. 146)

rebate that was implemented in the US in 2008, where timing of the payment was randomly assigned. This randomly assigned timing is the exogenous variation that she uses to identify the causal effect of a one-shot increase in income on life satisfaction.

A further study that analyzes the effects of short-run income shocks and long-term income changes bridges the gap between those who found large positive effects of income on life satisfaction (Luttmer 2005, Vendrik 2013, Kaiser 2018) and the result of Lachowska (2017), who found no effect: Using also German SOEP data Bayer and Juessen (2015) found that long-term changes in income have significant and sizable positive effects on life satisfaction, while short-term shocks have none. The authors identify the causal effects from lags and leads of the endogenous regressor.[5]

Psychologists, economists and common sense suspect that satisfaction or happiness also impact on income. Several recent studies in behavioral economics analyze (affective and evaluative) subjective well-being as a cause of various outcomes such as risk avoidance or delay gratification (for an overview, see: Lane 2017, De Neve et al. 2013), saving (Guven 2012), absenteeism (Bubonya et al. 2017), (un-)employment (Krause 2013, Kesavayuth and Zikos 2018), career progression (for an overview see: Walsh et al. 2018) or productivity (Oswald et al. 2015, Tenney et al. 2016, Bryson et al. 2017, Böckerman and Ilmakunnas 2012). All these outcomes predict income. Nevertheless, studies of the effect of satisfaction on income are rare and most often focus on earned income rather than equivalized household income. The first study on the effect of satisfaction on income appears to be by Graham et al. (2004). Using Russian panel data, they find that positive expectations and residual happiness are positively associated to future incomes. However, time lags can only identify unidirectional causal effects if no individual-specific unobserved heterogeneity is present that affects both dependent and any explanatory variable. De Neve and Oswald (2012) address this problem with siblings fixed effects; they estimate the effect of happiness at age 22 on future income at age 29 and find a positive effect. One other study investigates the causal effect of happiness on earnings (Mishra and Smyth 2014) using a relatively new method, the Lewbel (2012) instruments. They find a

[5] To pass the exogeneity requirement, the instruments must meet two conditions: The "No Foresight" condition which assumes that all deterministic components of income are captured in the exogenous controls that enter the first-stage regression. It holds whenever the individual has no better information on income growth in the next period than the econometrician. The second condition for the instrument to be exogenous is the "Short Memory" condition, which requires that, narrowly understood, change in assets neither responds to persistent shocks in the year before, nor to transitory shocks two years before (Bayer and Juessen 2015, pp. 166).

positive effect of happiness on earnings for men. All these three, however, analyze earned income. This is the main income source for many people. However, these results cannot answer the question about effects of satisfaction on equivalized income. It could be that the effect of satisfaction on earnings attenuates when earnings are shared among household members. On the other hand, it is possible that household formation accelerates the effect of satisfaction on equivalized household income, which would not be picked up by estimation for earned income.

This would be a minor problem if many studies focusing the utility or welfare effect of income did not analyze the potential effect of equivalised household income (e.g., Stutzer 2004, Boyce et al. 2010, Vendrik and Woltjer 2007, Jäntti et al. 2014). For the purpose of welfare analyses and due to economies of scale, whereby incomes may be used more efficiently in larger households, it is appropriate in these settings to equivalize household incomes. And it is hence necessary to know if estimates of the hedonic effect of income are potentially overstated due to reverse causality that runs from happiness to equivalized household income.

3 Model and identification

To identify causal effects, researchers often exploit time lags, based on the idea that causes precede results. However, if individual-specific time-invariant unobservable or unobserved characteristics influence income and happiness, the time-lag method could falsely indicate a causal relation due to confounding. Such problems may be partially cured with fixed effects, like individual or family fixed effects. Nevertheless estimates still suffer from time-varying unobserved heterogeneity, and only the limited variation around fixed effects can be used for identification.

An arguably more elaborate approach applies external instruments, which affect only one of income or happiness directly, while the second is only indirectly affected via the first. Convincing instruments, especially for satisfaction, are usually hard to find. Guven (2012), who analyzed the effect of happiness on savings and consumption behavior found a convincing instrument for happiness: unexpected sunshine. Sunshine sufficiently influences happiness, so that the instrument is strong enough to identify sizable effects of happiness on savings behavior. Yet these might be be restricted to those whose satisfaction answers are driven to a larger extent by moods, affect and sunshine. As for income, an unforeseen tax rebate as used by Lachowska (2017) may be a particularly clean instrument, but is not available in the German case.

Lewbel (2012) shows that it may be an alternative approach to construct internal instruments from the model's data. This method can be applied when no valid external instruments are available and is already used in empirical economics. In the following it will be explained how Lewbel's (2012) method can be applied to identify causal effects in the income happiness link.

3.1 Model

It is well-established that utility - measured in levels of stated satisfaction - depends positively on personal incomes. Nevertheless, there remains a long-standing controversy over the degree to which satisfaction depends on income. I join this debate with the question:

RQ1: Does satisfaction depend on income?

One might approach answering **RQ1** by estimating a regression of the form:

$$s_{it} = \gamma_1 \ln(y_{it}) + X'_{it}\beta_1 + \alpha_i + \varepsilon_{1it} \tag{1}$$

Here, s_{it} denotes satisfaction of individual i at time t. X is a vector of controls, α_i is an individual fixed effect, and ε_{1it} is an ideosyncratic error. I avoid estimating α_{1i}, by demeaning[6] (1):

$$\dot{s}_{it} = \gamma_1 \dot{\ln}(y_{it}) + \dot{X}'_{it}\beta_1 + \varepsilon_{1it} \tag{2}$$

Here, $\dot{s}_{it} = s_{it} - \bar{s}_i$, and similar for $\dot{\ln}(y_{it})$ and each jth variable $\dot{x}_{jit}$ of the J variables in $\dot{X}_{it}$.

Although demeaning captures all time-invariant unobserved determinants that might confound the relationship between s_{it} and $\ln(y_{it})$, there are further issues which could cause inaccuracies in answers obtained from estimating (2): First, respondents might find it difficult to accurately report their incomes. There may therefore be measurement error in income, causing estimates from (2) to be biased towards zero. Second, there may be further unobserved time-varying determinants of stated satisfaction that could act as confounders. Third, incomes may depend on satisfaction. Although this third possibility has been considered, most previous studies purely focused on earned income. Focusing earned income serves more to understand how satisfaction causes income. This study however attempts to explore if equivalized income

[6] I do not manually demean, but use Stata's xtreg and ivreg2h commands, each with the fe option.

is also influenced by satisfaction. To the best of my knowledge this possibility has until now not been evaluated in a joint analysis with **RQ1**. Therefore, the second research question is:

RQ2: Does equivalized income depend on satisfaction?

A natural approach to answering this question is to estimate a regression that is analogous in form to (2):

$$\dot{ln}(y_{it}) = \gamma_2 \dot{s}_{it} + \dot{X}'_{it}\beta_2 + \varepsilon_{2it} \tag{3}$$

However, if the true values of γ_1 and γ_2 are indeed different from zero, OLS estimates of (2) and (3) will be biased due to simultaneity of γ_1 and γ_2. One aim of this study is to gauge how large the impact of such simultaneity is.

3.2 Identification

A standard approach to circumvent these problems would be to find suitable instruments for both satisfaction and income. Although such instruments potentially exist (see Section 2), I here explore the use of an alternative strategy where instruments are constructed from a readily available subset of the observed exogenous variables in $\dot{X}$. This approach, developed by Lewbel (2012), can be summarized as follows.

To construct instruments for $\dot{\ln}(y_{it})$ in equation (2), the following auxiliary regression are run in the first step:[7]

$$\dot{ln}(y)_{it} = \dot{Z}'_{it}\delta_1 + \nu_{1it} \tag{4}$$

Where $\dot{Z}$ is a subset of K variables in $\dot{X}$ with each variable in $\dot{Z}$ satisfying the exogeneity assumption. One can then use the residuals $\hat{\nu}_{1it}$ and sample-centered values of each variable $\dot{z}_k$ in $\dot{Z}$ to calculate K instruments for $\ln(y_{it})$ in the second step:

$$yinst_{kit} = (\dot{z}_{kit} - \bar{\dot{z}}_k)\hat{\nu}_{1it} \tag{5}$$

[7] Actually I did not conduct the estimation step by step, I use the Stata-ado 'ivreg2h' by Baum and Schaffer (2012).

Instruments for $\dot{s}_{it}$ to be used in equation (3) are constructed analogously:

$$\dot{s}_{it} = \dot{Z'}_{it}\delta_2 + \nu_{2it} \tag{6}$$

is estimated to calculate the K instruments for $\dot{s}_{it}$ as given by

$$sinst_{kit} = (\dot{z}_{kit} - \bar{\dot{z}}_k)\hat{\nu}_{2it}. \tag{7}$$

These instruments are then - as in conventional instrumental variable estimations - used to predict the endogenous regressors in the structural equations, (2) and (3).

The intuition of this identification strategy follows from linear regression mechanics: Residuals are by construction exogenous to the the right-hand-side variables. If satisfaction, the outcome of Eq. (2), is independent of the residuals of the auxiliary income regression given in Eq. (4), and if the variables in Z are exogenous in the structural equation, then the instruments are exogenous. In that case, the instruments affect the outcome only via the endogenous regressor. To be relevant, the instrument must affect the endogenous regressor. If residuals are heteroscedastic, they contain (information about) the variation of the outcome variable, which makes the instruments relevant.

The instruments here are hence constructed from observed variables, which are assumed to be exogenous. Since identification heavily relies on these variables, I use only those that can be considered exogenous to the best of my knowledge. Z thus includes *age*, age^2, $wave^2$, and $wave^3$. In the baseline estimations $Z = X$, meaning that no further controls are considered in the estimations.

However, as this is a very unusual specification, I run robustness checks in which I augment the set of variables in X to also include more standard demographic controls. See Section 4 for a list and description. I then compare two specifications for each research question: The baseline specification that only includes age and wave (and powers thereof) as controls, with instruments for income (satisfaction) that are constructed from these controls. The robustness specification then contains demographic variables as further controls, but instruments are again constructed solely from the exogenous controls in Z. Next to the informal comparison of these specifications, results from Hansen's J test on over-identifying restrictions are reported to evaluate exogeneity of all instruments, i.e. the constructed and all controls.

Lewbel (2012) and Baum and Lewbel (2019) show that each instrument $yinst_k$ must satisfy $\text{Cov}(z_k, \varepsilon_1\varepsilon_2) = 0$ and $\text{Cov}(z_k, \varepsilon_1^2) \neq 0$. [8] The former assumption is satisfied if the errors ε_1 and ε_2 are independent of each other. This is the case when income and satisfaction are endogenous in each other because of a common factor. Such a common factor may be aspirations or well-being, or both. The latter requirement simply implies heteroscedasticity in the auxiliary regression of (4) and (6). Breusch-Pagan heteroscedasticity test statistics are therefore presented in Table A1.5.

The relevance of an instrument constructed from a particular variable z_k depends on the strength of heteroscedasticity with respect to z_k. The next section therefore inspects observed heteroscedasticity patterns with estimates and statistical tests, and with residual plots that indicate how locally restricted the estimates are.

Estimations are run with the Stata-ado ivreg2h, which was written by Baum and Schaffer (2012), calling the GMM estimator and estimating clustered standard errors, since multiple observations per person are used.

4 Data

Data come from the German Socio-Economic Panel Study (SOEP)[9], which is described in Goebel et al. (2019). I restrict the sample to individuals of age 18 to 60 who live in private households. Each individual's first observation is dropped, because Frick et al. (2006) found that the quality of income information is significantly lower in these observations. Observations with extreme values for equivalized household income (outer 2% of the distribution in each survey year) are also excluded because these are prone to measurement error (Layard et al. 2008).

The first endogenous variable is the annual post government household income in the year before the survey. Incomes are deflated to the baseline year 2005 and equivalized with the square root of the household size, which is very close to the OECD equivalence scale from Hagenaars et al. (1994) and used in recent OECD publications (OECD 2008, 2011).[10]

[8] Similarly, each instrument $sinst_k$ must satisfy $\text{Cov}(x_k, \varepsilon_1\varepsilon_2) = 0$ and $\text{Cov}(x_k, \varepsilon_2^2) \neq 0$.

[9] I use version 34 (doi:10.5684/soep.v34)

[10] I also ran all estimations with the unequivalized household income. This slightly changed the size of the coefficients but not the interpretation. Results are reported in the appendix A1.3.

The second endogenous variable is life satisfaction, measured on a 11-point Lickert-type scale, with higher values indicating higher satisfaction. Analogue analyses are run with financial satisfaction. Since I use income in the year before the survey, I also use satisfaction in the year before the survey, because with satisfaction data collected a few months later than the income measure, RQ2 could not be analyzed properly.

Exogenous controls are age, age squared, survey wave squared and cubed.[11] The baseline specification uses less controls than studies on life satisfaction usually use. To ease comparison with other known estimates, I add specifications with commonly used controls; these are: reference income[12] education, marital status, children in the household (yes/no), region of residence (East/West Germany), being unemployed at the time of the interview, home ownership and health, approximated with hospital overnight stays (yes/no) in the previous year. Since most women give birth in a hospital, hospital overnight stays for women do not necessarily indicate health problems. To account for this, I include an interaction term for women who answered that they stayed in hospital overnight in the year before and who live in a household with children not older than one year.[13] Sample descriptives are presented in Table 1.

Since identification relies on heteroscedasticity related to the exogenous control variables, estimates of the association between exogenous controls and the squared residuals of (4) and (6) are presented in Table A1.5, together with statistics on the Breusch-Pagan test for heteroscedasticity.

The last two rows in Table A1.5 show the χ^2 test statistics and corresponding p-values for the Breusch-Pagan-Test, indicating that heteroscedasticity is present in all endogenous variables.

Figure 1 and Figure 2 are plots of the distribution of residuals that are used to construct the instruments for income and life satisfaction.[14] The plots underline the message of the Breusch-Pagan test in Table A1.5. The distribution of the residuals of income narrows over the survey years and respondents' age. The distribution of the residuals of life satisfaction also narrows

[11] For convenience age and squared survey wave are divided by 10, squared age and cubed wave are divided by 100, to avoid significant zeroes.

[12] Reference income is the mean income of all individuals within an moving age range of 5 years younger and 5 years older, living in the same state (Bundesland), in households of the same size (top-coded at 5 persons per household), and with similar highest level of education

[13] Hospital overnight stay is not measured in the years 1990 and 1993. To avoid large data losses, I inserted random numbers, generated from a binomial distribution with the the same success probability as the observed variable.

[14] Demeanded income and life satisfaction were regressed on demeaned exogenous controls, i.e. age, age^2, wave^2 and wave^3.

Table 1: Sample descriptives

	Mean	Std. Dev.	Min	Max
Life satisfaction	7.009	1.733	0	10
Income	37587	18686	120	802920
Financial satisfaction	6.335	2.209	0	10
Age	41.641	10.812	20	60
Female	0.523	0.499	0	1
Years of education	12.047	2.680	7	18
Hospital overnight stay	0.102	0.303	0	1
Gave birth	0.015	0.121	0	1
Married	0.476	0.499	0	1
Children in household	0.662	0.473	0	1
Living in East Germany	0.199	0.399	0	1
Unemployed	0.067	0.250	0	1
Home owner	0.484	0.500	0	1

Source: SOEP v34, own calculations. 273,768 person year observations of 38134 individuals.
Notes: Hospital overnight stay for 261,782 person year observations, and 11986 imputed random numbers. Income is post-government household income, not equivalized.

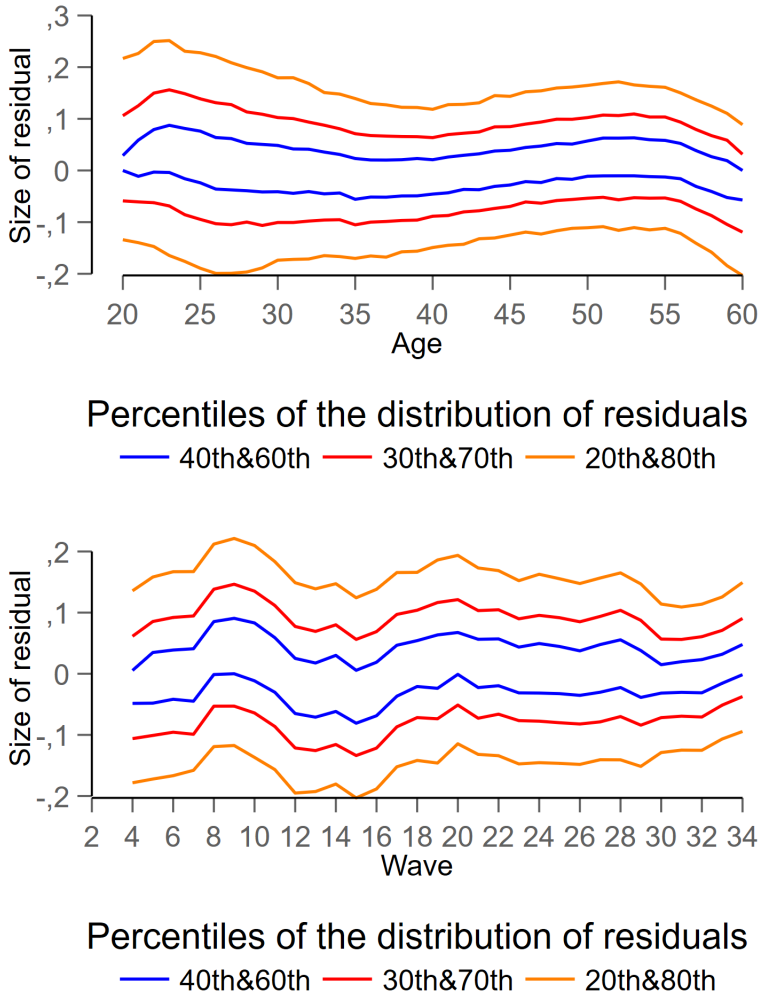

Figure 1: Age- and wave-related heteroscedasticity in income

Source: SOEP v34, own calculations. 337031 person year observations of 46945 individuals.
Notes: Residuals from fixed effects regressions of income on age, age^2, wave^2 and wave^3

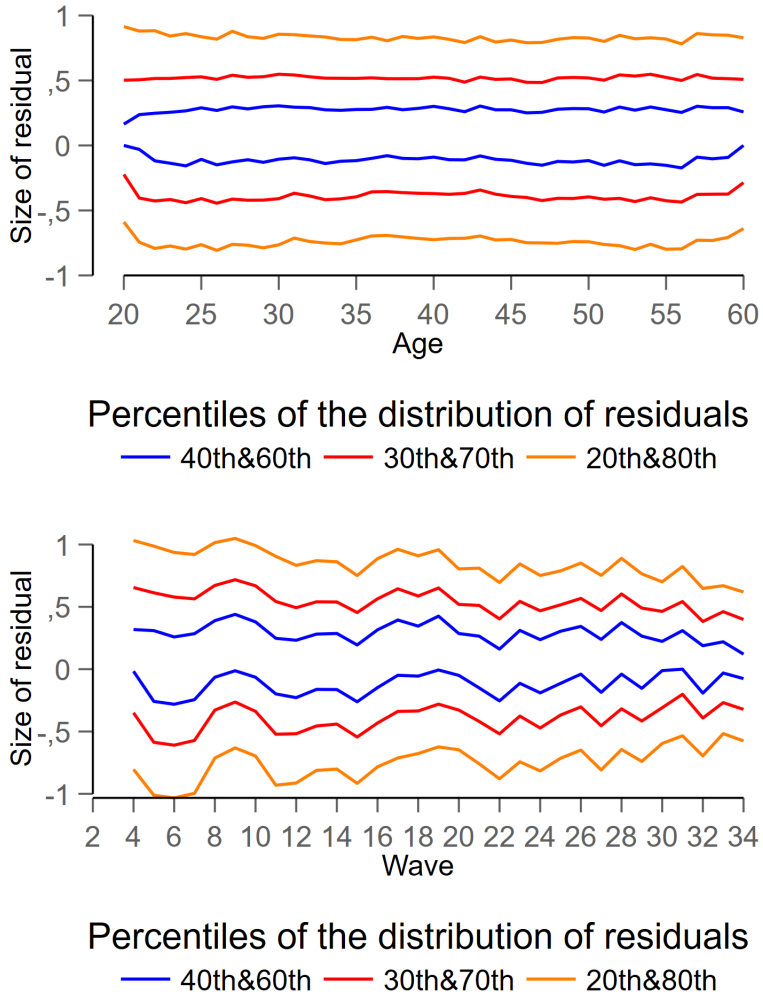

Figure 2: Age- and wave-related heteroscedasticity in life satisfaction

Source: SOEP v34, own calculations. 337031 person year observations of 46945 individuals.
Notes: Residuals from fixed effects regressions of life satisfaction on age, age^2, wave^2 and wave^3

Table 2: Squared residuals of endogenous regressors and exogenous controls

	ν_{1it}^2 (Equiv. income)	ν_{2it}^2 (Life satisfaction)
Age	–0.017***	–0.169***
	(0.000)	(0.007)
Age, sq.	0.010***	0.099***
	(0.000)	(0.008)
Wave, sq.	–0.005***	–0.083***
	(0.000)	(0.004)
Wave, cub.	0.001***	0.016***
	(0.000)	(0.001)
Constant	0.135***	2.783***
	(0.001)	(0.028)
Chi squared	4630	2087
Prob> Chi squared	0.000	0.000

Source: SOEP v34, own calculations. 337031 person year observations of 46945 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. Dependent variables are squared residuals from fixed effects regressions, exogenous variables are within transformed.

over the survey years and reveals a slight tendency to narrow in the respondents' middle ages. Heteroskedasticity in financial satisfaction follows a similar pattern, the plots thereon are presented in the appendix in Figure A1.3. It thus appears as though the exogenous controls and squared residuals are sufficiently associated to allow for identification based on Lewbel's instruments.

5 Results

Results are presented in the same order as the model equations are discussed. Some notes apply to all results: To avoid problems of weak instruments, I follow Baum et al. (2007), who suggest the rule of thumb of Staiger and Stock (1997). This means that only estimates with F-statistics > 10 should be trusted. Since the estimations rely on multiple observations per person, the Wald F- statistics based on the reduced rank test of Kleibergen and Paap (2006) are valid test statistics, because they are robust to non-i.i.d. errors. These F values are displayed as "K-P F-Statistic" for each IV estimation in the bottom of the tables. Test statistics for the Hansen J

test of overidentifying restrictions, which tests the null that the instruments are exogeous, are reported under each IV estimation.[15] In the bottom line of most estimation tables a z-score is reported, which, when it's absolute value exceeds 1.96, indicates that the estimates from the IV procedure significantly differ from the conventional fixed effects estimates.

The complete estimation results are to be found in the appendix A1.1.

5.1 RQ1: Income causing satisfaction

The answer to RQ1 is provided in Table 3, and it obviously depends on the method. The conventional fixed effects estimation confirms that increasing incomes are associated with increased life satisfaction with a reasonable effect size. The estimates from the IV approach, however, show no effect of income on life satisfaction.

Table 3: FE-IV and FE estimations of RQ1: Utility of equivalized household income

	I		II	
	IV-FE	FE	IV-FE	FE
Income, log.	0.051	0.355***	–0.006	0.367***
	(0.073)	(0.013)	(0.108)	(0.015)
Demographic controls	no	no	yes	yes
K-P F-Statistic	267		172	
Hansen J	5.545		5.983	
Prob>Chi sq.	0.1360		0.1125	
Z-score	–4.102		–3.408	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

The most standard fixed effects regression result is presented in the last column of Table 3. This is a fixed effects estimation of the association between income and life satisfaction, when adding a large set of demographic controls (including health and marital status, education, (un-)employment, region of residence, children, home ownership and reference income). This specification is thus closer to previous studies. The penultimate column shows results from the comparable estimation, where the same demographic control variables are included, but the internal

[15] For the Hansen J test, it is thus a successfull result if χ^2 indicates that the null is not rejected.

instrumental variables approach is used. The instruments are exclusively constructed from the exogenous controls (age, age squared and survey wave squared and cubed), but not from the demographic controls. First and second column present results from the most sparse models, with only age and wave (and its powers); where in the first column identification comes from the internal instruments and in the second column the corresponding straightforward fixed effects estimates are presented.

In general, the patterns in the estimations with and without further controls are similar: The effects found through IV-estimations are zero while the FE-estimates are significantly positive. The z-sores indicate that the estimates from the two identification strategies differ significantly. Including further demographic controls does not meaningfully change the estimates: even though the sign reverses, the IV estimates are statistically insignificant with and without further demographic controls, the z-score to compare these coefficients is 0.437 (not given in the table), indicating that the difference between the estimates is not statistically significant. The conventional fixed effects estimates with and without further demographic controls are also not significantly different from each other. This similarity in the patterns suggests that the exogeneity assumption (i.e. that the product of first and second stage errors is uncorrelated to the exogenous controls) is not seriously violated due to omitted variables - at least not due to omitting the demographic controls that were considered here. The Hansen J test, which is associated with a p-value of more than 0.1 underlines this by also suggesting no violations to exogeneity.

5.2 RQ2: Satisfaction causing income

The preceding results showed that usual fixed effects estimations may overstate the effect of income on life satisfaction. One possible reason for this finding could be reverse causality: life satisfaction might cause income, as asked in RQ2.

Estimates in Table 4 support this hypothesis only weakly. Higher life satisfaction might cause higher equivalized income, but significance is only weak and disappears when further control variables are included in the estimation. Again, the coefficients of the conventional fixed effects estimations are significantly positive. These, however, may be biased due to any of the reasons mentioned in Section 3.1.

Table 4: FE-IV and FE estimations of RQ2: Life satisfaction causing household income

	I		II	
	IV-FE	FE	IV-FE	FE
Life satisfaction	0.011*	0.016***	0.010	0.014***
	(0.006)	(0.001)	(0.006)	(0.001)
Demographic controls	no	no	yes	yes
K-P F-Statistic	158		158	
Hansen J	2.663		0.745	
Prob>Chi sq.	0.4466		0.8626	
Z-score	–0.741		–0.723	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

Covariates[16] again, do not significantly change the results for the conventional fixed effects estimates, and change only the significance test for the IV-FE estimation. According to the test statistics, the IV estimation is trustworthy; Instruments are not weak and the model is not misspecified, which could be interpreted as all instruments being exogenous.

The weak indication for a causal effect from life satisfaction on income matches the results for RQ1 that higher incomes do not cause greater life satisfaction although the association is significantly positive. The conventional fixed effects estimator could overstate the hedonic effect of income due to reverse causality.

5.3 Re-estimation with satisfaction and income reported in the same survey year

When thinking about mechanisms, it is reasonable to require that the effect should not precede the cause; in the case of simultaneous causality between income and life satisfaction, this means that both should refer to the same period. Thus, the analysis so far has focused on reported

[16] The set of demographic covariates in the estimations for RQ2 is the same as for RQ1 except for giving birth and reference income, these are not included in the estimations for Table 4.

income, which refers to the year before the survey, and satisfaction from the previous survey year.

In most estimates of the link between income and satisfaction, however, the income measure very often refers to the year prior to data collection and satisfaction statement. Although effects of satisfaction on previous year's income seem nonsensical at first glance, simultaneous causality in this temporal order (of income and satisfaction data) is of particular interest because it would limit the interpretation of most estimates. At second glance, and taking into account that income is reported rather than measured, it seems possible that satisfaction at the time of the survey could influence reported income in the year before the survey, e.g., through response behavior.

Therefore, I re-estimate the models with satisfaction in the year of the survey and income in the year before the survey.

Table 5: FE-IV and FE estimations of RQ1: Income in t-1 causing life satisfaction in t

	I		II	
	IV-FE	FE	IV-FE	FE
Income, log.	0,104	0,373***	–0,015	0,342***
	(0,074)	(0,013)	(0,109)	(0,015)
Demographic controls	no	no	yes	yes
K-P F-Statistic	267		172	
Hansen J	18,22		18,12	
Prob>Chi sq.	0,0004		0,0004	
Z-score	-3,5871		-3,242	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

Table 6: FE-IV and FE estimations of RQ2: life satisfaction in t causing income in t-1

	I		II	
	IV-FE	FE	IV-FE	FE
Life satisfaction	0,027***	0,017***	0,023***	0,015***
	(0,007)	(0,001)	(0,007)	(0,001)
Demographic controls	no	no	yes	yes
K-P F-Statistic	112		113	
Hansen J	7,061		3,797	
Prob>Chi sq.	0,0700		0,2842	
Z-score	1,4198		1,1228	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

Results in Table 5 again do not indicate a causal effect of income on life satisfaction. Here, income refers to the year before the survey and satisfaction at the time of the survey. Since Hansen's J is significantly above zero, the null of exogeneity of all included variables must be rejected, i.e. the exogenous variables or the instruments or both do not meet the exogeneity assumption. Estimates on RQ2, however, indicate a causal effect of satisfaction on income. The IV estimates are similar in size and significance to the standard FE estimates. Together with the previous results, this suggests that satisfaction could influence how respondents report their income. Effects of satisfaction on equivalized income itself, whether through earning income or sharing income, cannot appear in the temporal order analyzed in this estimation and would likely be more pronounced after a period of more than one year.

This interpretation is supported by results from estimates in a third temporal order, where again satisfaction and income are not reported in the same survey, but refer to the same year. Satisfaction reported in the survey year t and income reported for the same year, but reported in survey year t+1. The results are very similar to the main models with no significant effect of income on life satisfaction and weak effects of life satisfaction on income. Results are presented in the appendix in Tables A1.3 and A1.4

5.4 Robustness check with simulated data

One objection against the presented estimates might result from the fact that three of four IV estimations reveal only small or zero and insignificant effects, while the corresponding conventional fixed effects estimator found larger and significant effects. One might therefore suspect that the Lewbel IV estimator is not suitable for either the discrete scale of the satisfaction data or not capable of detecting small significant effects due to the reduced power which is common in IV estimations and even more so when only within variation of the data is used. To address this concern the same regressions are rerun on simulated data. On top of the SOEP data, I simulated a random variable with panel data structure and a similar distribution as reported income.[17]

Table 7: Re-estimations of H1 and H2: For simulated random income and manipulated satisfaction depending on simulated income

	RQ1		RQ2	
	IV FE	FE	IV FE	FE
Sim.Income	0.218***	0.238***		
	(0.076)	(0.026)		
Sim.Satisf.			0.004	0.003***
			(0.004)	(0.000)
K-P F-Statistic	266		158	
Hansen J	1.4		8.8	
Prob>Chi sq.	0.7132		0.0325	
Z-score	–0.252		0.279	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

I then manipulated the satisfaction data such that it depended on the simulated income data, but preserved its scaling and distribution. This yields a simulated income measure, which is completely exogenous, but correlated within individuals over time. I then manipulated the satisfaction data such that it depends on the simulated income data, but preserves its scaling and distribution. [18]

[17] Stata program code for the simulated income data is given in appendix A1.4.
[18] Stata program code for the manipulated satisfaction data is given in appendix A1.4.

This procedure results in a simulated income measure, which is completely exogenous, uncorrelated between individuals but correlated within, and satisfaction data that to some extent depend on this exogenous simulated income. Hence in a re-estimation of RQ1 and RQ2 one would expect that the conventional fixed effects estimator finds positive effects in both directions and that the IV-FE estimator finds only a positive effect for RQ1, i.e. the effect of simulated income on manipulated satisfaction.

Results of re-estimations of H1 and H2 in Table 7 show the expected pattern, supported by statistical tests. This may increase confidence that the zero effects presented in Sections 5 indeed represent the nonexistence of causal effects in the link between income and satisfaction in the underlying population.

6 Conclusion

This study intended to explore simultaneity in the income-happiness link and to what extent this might bias standard estimates of the hedonic effect of income. In that sense this study is methodological, since it does not focus the precise mechanisms that could generate the simultaneity. Conclusions are both promising and disappointing.

They are disappointing because using Lewbel instruments, no significant causal effect from income on life satisfaction is found, but instead indication for a causal effect of life satisfaction on income. The zero effect of equivalized income on life satisfaction is unexpected and in contradiction to most findings in this area of research. Nevertheless, one can be cautiously optimistic that the zero effects are not a problem due to the estimator or its application, for two reasons: First, most studies in this field do not properly identify causal effects, but estimate merely associations under consideration of covariates and individual level fixed effects. Among those studies that use convincing methods, results indicate that long-term changes in income have significant and sizable effects on life satisfaction (Vendrik 2013, Bayer and Juessen 2015) while short-term shocks do not influence life satisfaction (Bayer and Juessen 2015, Lachowska 2017). Second, in a simulation, where satisfaction data was manipulated so that it depends on a simulated random, but income-like variable, the estimator found the simulated effect.

Results on the second research question indicate that life satisfaction indeed influences the measure for equivalized household income. This effect is statistically significant when income

and satisfaction data are collected in the same survey year, but only weakly significant when income data is reported in another survey year but refers to the same year as the satisfaction data. This pattern of reverse causality is likely due to response behavior rather than income generation. In conclusion, it must be considered that the effect of income on life satisfaction is probably overstated in conventional fixed effects estimations.

The present analysis is promising because Lewbel's (2012) internal instruments passed the tests for weak instruments in each specification. This is encouraging news for empirical satisfaction research, as this method might be able to solve the problem focused on here and fill a gap that still exists in empirical happiness research: Identifying causal effects between life satisfaction and its correlates.

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A Appendix

A1.1 Complete estimations results for the tables in the paper

Table A1.1: Estimates for RQ1: Equivalized income causing life satisfaction

	Equiv.Income		Life satisfaction			
	First stage	First stage	IV-FE	FE	IV-FE	FE
Instr.Age	–1.175***	–0.841***				
	(0.113)	(0.092)				
Instr.Age2	0.151***	0.103***				
	(0.006)	(0.005)				
Instr.Wave2	–0.018***	–0.010**				
	(0.006)	(0.005)				
Instr.Wave3	0.004***	0.003***				
	(0.001)	(0.001)				
Age	0.362***	0.358***	0.257***	0.148*	0.022	–0.112
	(0.021)	(0.020)	(0.092)	(0.088)	(0.097)	(0.090)
Age, sq.	–0.006***	–0.021***	–0.015***	–0.013**	0.012*	0.020***
	(0.001)	(0.001)	(0.006)	(0.005)	(0.006)	(0.006)
Survey wave, sq.	–0.012***	–0.016***	–0.035***	–0.031***	–0.035***	–0.029***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.005)	(0.004)
Survey wave, cub.	0.002***	0.003***	0.008***	0.007***	0.008***	0.007***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Years of educ.		0.019***			0.014**	0.007
		(0.002)			(0.007)	(0.006)
Hospital stay		–0.010***			–0.126***	–0.122***
		(0.002)			(0.011)	(0.011)
Gave birth		0.012**			0.353***	0.349***
		(0.005)			(0.024)	(0.024)
Married		0.077***			0.274***	0.247***
		(0.005)			(0.020)	(0.019)
Kids		–0.121***			0.019	0.064***
		(0.003)			(0.018)	(0.013)
East Germany		0.075***			–0.254***	–0.279***
		(0.017)			(0.059)	(0.058)
Unemployed		–0.070***			–0.284***	–0.257***
		(0.004)			(0.019)	(0.018)
Home owner		0.128***			0.098***	0.049***
		(0.004)			(0.020)	(0.015)
Reference income		0.775***			0.127	–0.167***
		(0.006)			(0.088)	(0.024)
Equiv. Income			0.051	0.355***	–0.006	0.367***
			(0.073)	(0.013)	(0.108)	(0.015)
Constant				3.734***		5.518***
				(0.246)		(0.301)
K-P F-Statistic			267		172	
Z-score			–4.102		–3.405	
Hansen J			5.5		5.9	
Prob>Chi squared			0.1360		0.1164	

Source: SOEP v34, own calculations. 273768 person-year observations of 38,134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses.

Table A1.2: Estimates for RQ2: Life satisfaction causing equivalized income

	IV-FE	FE	IV-FE	FE
Age	0.352***	0.350***	0.377***	0.377***
	(0.023)	(0.023)	(0.022)	(0.022)
Age, sq.	–0.006***	–0.006***	–0.011***	–0.011***
	(0.002)	(0.002)	(0.002)	(0.002)
Survey wave, sq.	–0.012***	–0.011***	–0.013***	–0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
Survey wave, cub.	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Years of education			0.017***	0.017***
			(0.002)	(0.002)
Hospital stay			0.003	0.003*
			(0.002)	(0.002)
East Germany			–0.034	–0.033
			(0.022)	(0.022)
Married			0.113***	0.111***
			(0.006)	(0.005)
Kids			–0.132***	–0.132***
			(0.003)	(0.003)
Unemployed			–0.072***	–0.071***
			(0.004)	(0.004)
Home owner			0.157***	0.156***
			(0.005)	(0.005)
Life satisf.	0.011*	0.016***	0.010	0.014***
	(0.006)	(0.001)	(0.006)	(0.001)
Constant		8.748***		8.513***
		(0.056)		(0.056)
K-P F-Statistic	158		158	
Z-score	–0.741		–0.723	
Hansen J	2.7		0.7	
Prob>Chi squared	0.4466		0.8626	

Source: SOEP v34, own calculations. 273768 person year observations of 38134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses. Income is annual net household income, equivalized to household size with the square root rule.

A1.2 Re-estimation with satisfaction and income reported in different surveys

Table A1.3: FE-IV and FE estimations of RQ1: Income in t causing life satisfaction in t

	I		II	
	IV-FE	FE	IV-FE	FE
Income, log.	0,051	0,355***	0,002	0,308***
	(0,073)	(0,013)	(0,075)	(0,013)
Demographic controls	no	no	yes	yes
K-P F-Statistic	267		267	
Hansen J	5,545		8,239	
Prob>Chi sq.	0,1360		0,0413	
Z-score	-4,1022		-4,003	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

Table A1.4: FE-IV and FE estimations of RQ2: life satisfaction in t causing income in t

	I		II	
	IV-FE	FE	IV-FE	FE
Life satisfaction	0,011*	0,016***	0,008	0,013***
	(0,006)	(0,001)	(0,006)	(0,001)
Demographic controls	no	no	yes	yes
K-P F-Statistic	158		159	
Hansen J	2,663		2,243	
Prob>Chi sq.	0,4466		0,5235	
Z-score	-,741		-,887	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

A1.3 Estimates for RQ1 and RQ2 with unequivalized household income

FE and FE-IV estimations of H1 for net household income, unequiv.

	Life satisfaction		Financial satisfaction	
	FE-IV	FE	FE-IV	FE
Household income	–0.037	0.330***	0.670***	0.898***
	(0.058)	(0.013)	(0.074)	(0.017)
K-P F-Statistic	374		374	
Hansen J	7.4		17.4	
Prob>Chi squared	0.0599		0.0006	
Z-score	–6.139		–3.007	

Source: SOEP v34, own calculations. 273,768 person-year observations of 38,134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses. All estimations include age, age^2, wave^2 and wave^3.

FE-IV and FE estimations of H2 for net household income, unequiv.

	Household Income		Household Income	
	FE-IV	FE	FE-IV	FE
Life satisfaction	0.009	0.017***		
	(0.007)	(0.001)		
Financial satisfaction			0.039***	0.030***
			(0.005)	(0.001)
K-P F-Statistic	158		266	
Z-score	–1.132		1.780	
Hansen J	6.0		24.6	
Prob>Chi sq.	0.1103		0.0000	

Source: SOEP v34, own calculations. 273,768 person-year observations of 38,134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses. All estimations include age, age^2, wave^2 and wave^3.

A1.4 Robustness check with simulated data

Simulated Income data

```
sort hid year pid
capture drop n
by hid: gen n = _n
gen synthinc = .
set seed 2
replace synthinc = 10000 + rgamma(2.6 , 11000) if n==1
sort hid year pid
by hid: egen sinc = max(synthinc )
replace sinc = sinc + rnormal(0, 2400) if n>1
gen lsinc = log(sinc)
```

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
postginc overall |  37586.51   18686.23   120.0281   802919.9 |     N =  273768
         between |             19161.24   1833.962   802919.9 |     n =   38134
         within  |             9784.383  -101426.2   427230.3 | T-bar = 7.17911
                 |                                            |
sinc     overall |  38581.24   18008.28   2675.273   190952.5 |     N =  273768
         between |             17611.64   6545.122   189555.7 |     n =   38134
         within  |             4936.261  -51482.71   129222.4 | T-bar = 7.17911
```

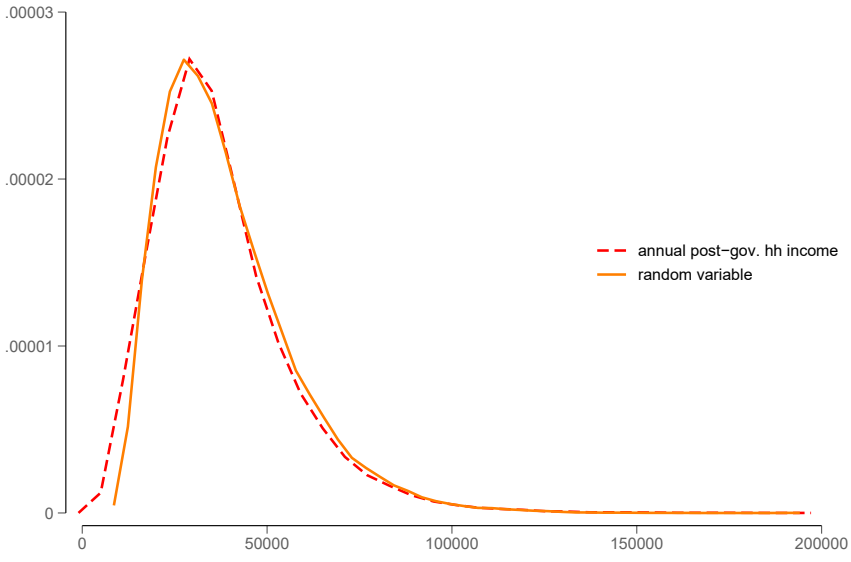

Figure A1.1: Kernel density estimation for observed income and random income-like variable

Source: SOEP v34, own calculations.
Notes: Income is post government household income, simulated income comes from a random number gamma distribution.

Manipulated satisfaction data

```
foreach sat of varlist ls {
gen  simsat  = 'sat' + 0.5*lsinc -5.23
replace simsat = round(simsat)
xtsum simsat 'sat'
}
```

```
Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
simsat    overall |  7.032776   1.738057         -1         11 |     N =  273768
          between |             1.426768          0         11 |     n =   38134
          within  |              1.17114  -2.050557   14.74706 | T-bar = 7.17911
                  |                                          |
ls        overall |    7.0369    1.73096          0         10 |     N =  273768
          between |             1.421368          0         10 |     n =   38134
          within  |             1.167018  -2.046433   14.39404 | T-bar = 7.17911
```

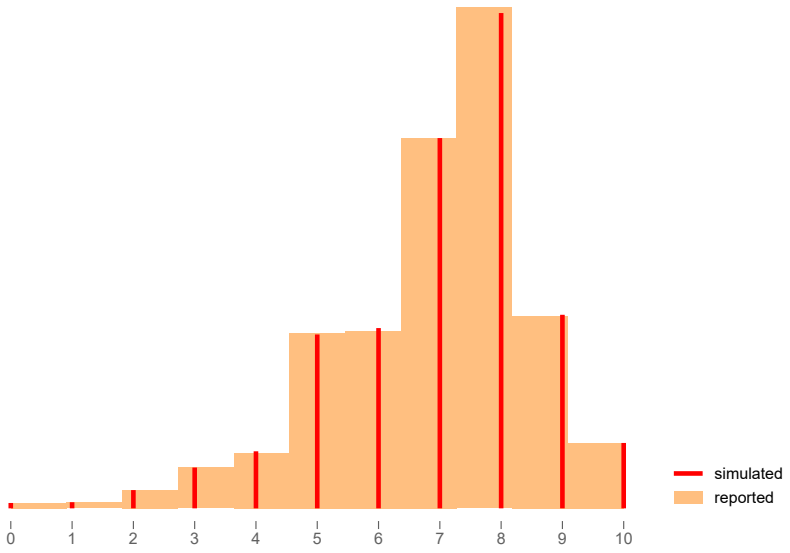

Figure A1.2: Frequencies for reported and manipulated satisfaction levels

Source: SOEP v34, own calculations.

A1.5 Re-estimation of H1 and H2 for financial satisfaction

One may believe that financial satisfaction (instead of overall life satisfaction) is a better proxy for economic welfare. Studies that investigate the link between financial satisfaction and income are e.g. Schwarze (2003), D'Ambrosio and Frick (2012), Ng and Diener (2014), Frijters et al. (2015), Guardiola and Guillen-Royo (2015), Elsas (2016), Brown and Gray (2016), Bütikofer and Gerfin (2017). To connect to this strand of the literature the main estimations are rerun using financial satisfaction.

Table A1.5: Squared residuals of financial satisfaction regressed on exogenous controls

Age	–0.017***
	(0.000)
Age, sq.	0.010***
	(0.000)
Wave, sq.	–0.005***
	(0.000)
Wave, cub.	0.001***
	(0.000)
Constant	0.135***
	(0.001)
Chi squared	4630
Prob> Chi squared	0.000

Source: SOEP v34, own calculations. 337031 person year observations of 46945 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. Dependent variables are squared residuals from fixed effects regressions, exogenous variables are within transformed.

Heteroskedasticity in financial satifaction

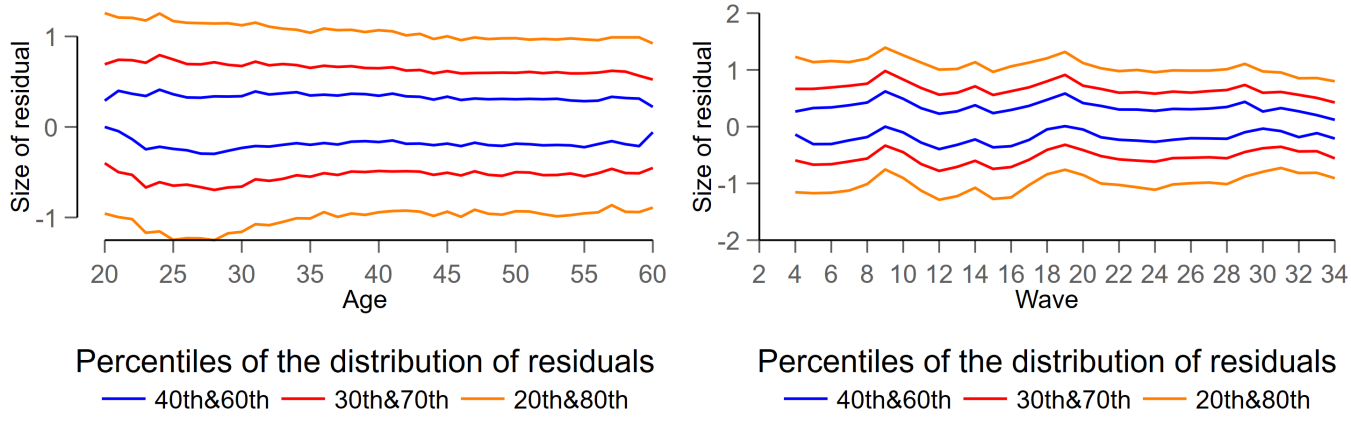

Figure A1.3: Age- and wave-related heteroscedasticity in financial satisfaction

Source: SOEP v34, own calculations. 337031 person year observations of 46945 individuals.
Notes: Residuals from fixed effects regressions of financial satisfaction on age, age^2, wave^2 and wave^3

Table A1.6: FE-IV and FE estimations of RQ1: Income causing financial satisfaction

	I		II	
	IV-FE	FE	IV-FE	FE
Income, log.	0.917***	0.949***	1.167***	1.122***
	(0.096)	(0.018)	(0.138)	(0.020)
Demographic controls	no	no	yes	yes
K-P F-Statistic	267		172	
Hansen J	17.311		22.534	
Prob>Chi sq.	0.0006		0.0001	
Z-score	–0.327		0.321	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3.

According to the results in Table A1.6 one cannot conclude that the effect of income on financial satisfaction is overstated with conventional FE estimation, because the z-score does not exceed 1.96. The p-value of the Hansen J test, however, indicates specification problems, either with the instruments or the exogenous controls. Future analyses should address this problem.

The estimated effect of financial satisfaction on income is shown in Table A1.7. This effect is larger than the effect of life satisfaction on income. Again, though, the Hansen J test indicates specification issues, either with the instruments or the exogenous controls.

Table A1.7: FE-IV and FE estimations of RQ2: Financial satisfaction causing equivalized income

	I		II	
	IV-FE	FE	IV-FE	FE
Fin. satisfaction	0.035***	0.028***	0.031***	0.026***
	(0.004)	(0.001)	(0.004)	(0.001)
Demographic controls	no	no	yes	yes
K-P F-Statistic	266		265	
Hansen J	32.585		32.727	
Prob>Chi sq.	0.0000		0.0000	

Source: SOEP v34, own calculations. 273,768 person year observations of 38,134 individuals.

Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parentheses. All estimations include age, age^2, survey wave ^{2} and survey wave^3. Dependent variable is net equivalized household income.

Table A1.8: Estimations for RQ1 and financial satisfaction

	First stage	IV-FE	FE	IV-FE	FE
Income, log.		0.917***	0.949***	1.167***	1.122***
		(0.096)	(0.018)	(0.138)	(0.020)
Age	0.362***	0.790***	0.765***	0.460***	0.459***
	(0.021)	(0.116)	(0.111)	(0.123)	(0.112)
Age, sq.	–0.006***	–0.051***	–0.049***	–0.007	–0.007
	(0.001)	(0.007)	(0.007)	(0.008)	(0.007)
S.wave, sq.	–0.012***	–0.056***	–0.055***	–0.049***	–0.049***
	(0.001)	(0.005)	(0.005)	(0.006)	(0.005)
S.wave, cub.	0.002***	0.014***	0.013***	0.012***	0.012***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Years of edu				0.011	0.012
				(0.009)	(0.009)
Hospital				–0.034***	–0.035***
				(0.012)	(0.012)
Gave birth				0.130***	0.130***
				(0.030)	(0.030)
Married				0.222***	0.227***
				(0.025)	(0.024)
Kids				0.087***	0.080***
				(0.023)	(0.016)
East				–0.361***	–0.354***
				(0.079)	(0.079)
Unemployed				–0.263***	–0.265***
				(0.023)	(0.021)
Home owner				0.055**	0.063***
				(0.026)	(0.019)
Ref.Income				–0.815***	–0.773***
				(0.112)	(0.031)
Constant			–4.354***		1.777***
			(0.314)		(0.377)
Instr.Age	–1.175***				
	(0.113)				
Instr.Age2	0.151***				
	(0.006)				
Instr.Wave2	–0.018***				
	(0.006)				
Instr.Wave3	0.004***				
	(0.001)				
K-P F-Statistic		267		172	
Z-Score		–0.327		0.321	
Hansen J		17.3		22.5	
Prob>Chi squared		0.0006		0.0001	

Source: SOEP v34, own calculations. 273768 person-year observations of 38134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses.

Table A1.9: Estimations for RQ2 and financial satisfaction

	First stage	IV-FE	FE	IV-FE	FE
Financial satisfaction		0.035***	0.028***	0.031***	0.026***
		(0.004)	(0.001)	(0.004)	(0.001)
Age	1.069***	0.312***	0.323***	0.347***	0.355***
	(0.106)	(0.023)	(0.023)	(0.022)	(0.022)
Age, sq.	–0.054***	–0.004**	–0.004***	–0.010***	–0.010***
	(0.007)	(0.002)	(0.002)	(0.001)	(0.002)
S.wave, sq.	–0.065***	–0.010***	–0.010***	–0.012***	–0.012***
	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
S.wave, cub.	0.015***	0.001***	0.002***	0.002***	0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Years of edu				0.017***	0.017***
				(0.002)	(0.002)
Hospital				0.003*	0.003
				(0.002)	(0.002)
East				–0.029	–0.029
				(0.021)	(0.021)
Married				0.105***	0.107***
				(0.005)	(0.005)
Kids				–0.129***	–0.130***
				(0.003)	(0.003)
Unemployed				–0.063***	–0.066***
				(0.004)	(0.004)
Home owner				0.152***	0.152***
				(0.005)	(0.005)
Constant			8.744***		8.509***
			(0.054)		(0.055)
Instr.Age	–1.075***				
	(0.082)				
Instr.Age2	0.057***				
	(0.005)				
Instr.Wave2	0.019***				
	(0.004)				
Instr.Wave3	–0.002***				
	(0.001)				
K-P F-Statistic		266		265	
Z-score		1.788		1.382	
Hansen J		32.6		32.7	
Prob>Chi squared		0.0000		0.0000	

Source: SOEP v34, own calculations. 273768 person year observations of 38134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses. Dependent variable is net household income, equivalized to household size with square root rule.

Table A1.10: Estimations for RQ1 and financial satisfaction

	First stage	IV-FE	FE	IV-FE	FE
Income, log.		0.917***	0.949***	1.167***	1.122***
		(0.096)	(0.018)	(0.138)	(0.020)
Age	0.362***	0.790***	0.765***	0.460***	0.459***
	(0.021)	(0.116)	(0.111)	(0.123)	(0.112)
Age, sq.	–0.006***	–0.051***	–0.049***	–0.007	–0.007
	(0.001)	(0.007)	(0.007)	(0.008)	(0.007)
S.wave, sq.	–0.012***	–0.056***	–0.055***	–0.049***	–0.049***
	(0.001)	(0.005)	(0.005)	(0.006)	(0.005)
S.wave, cub.	0.002***	0.014***	0.013***	0.012***	0.012***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Years of edu				0.011	0.012
				(0.009)	(0.009)
Hospital				–0.034***	–0.035***
				(0.012)	(0.012)
Gave birth				0.130***	0.130***
				(0.030)	(0.030)
Married				0.222***	0.227***
				(0.025)	(0.024)
Kids				0.087***	0.080***
				(0.023)	(0.016)
East				–0.361***	–0.354***
				(0.079)	(0.079)
Unemployed				–0.263***	–0.265***
				(0.023)	(0.021)
Home owner				0.055**	0.063***
				(0.026)	(0.019)
Ref.Income				–0.815***	–0.773***
				(0.112)	(0.031)
Constant			–4.354***		1.777***
			(0.314)		(0.377)
Instr.Age	–1.175***				
	(0.113)				
Instr.Age2	0.151***				
	(0.006)				
Instr.Wave2	–0.018***				
	(0.006)				
Instr.Wave3	0.004***				
	(0.001)				
K-P F-Statistic		267		172	
Z-Score		–0.327		0.321	
Hansen J		17.3		22.5	
Prob>Chi squared		0.0006		0.0001	

Source: SOEP v34, own calculations. 273768 person-year observations of 38134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses.

Table A1.11: Estimations for RQ2 and financial satisfaction

	First stage	IV-FE	FE	IV-FE	FE
Financial satisfaction		0.035***	0.028***	0.031***	0.026***
		(0.004)	(0.001)	(0.004)	(0.001)
Age	1.069***	0.312***	0.323***	0.347***	0.355***
	(0.106)	(0.023)	(0.023)	(0.022)	(0.022)
Age, sq.	–0.054***	–0.004**	–0.004***	–0.010***	–0.010***
	(0.007)	(0.002)	(0.002)	(0.001)	(0.002)
S.wave, sq.	–0.065***	–0.010***	–0.010***	–0.012***	–0.012***
	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
S.wave, cub.	0.015***	0.001***	0.002***	0.002***	0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Years of edu				0.017***	0.017***
				(0.002)	(0.002)
Hospital				0.003*	0.003
				(0.002)	(0.002)
East				–0.029	–0.029
				(0.021)	(0.021)
Married				0.105***	0.107***
				(0.005)	(0.005)
Kids				–0.129***	–0.130***
				(0.003)	(0.003)
Unemployed				–0.063***	–0.066***
				(0.004)	(0.004)
Home owner				0.152***	0.152***
				(0.005)	(0.005)
Constant			8.744***		8.509***
			(0.054)		(0.055)
Instr.Age	–1.075***				
	(0.082)				
Instr.Age2	0.057***				
	(0.005)				
Instr.Wave2	0.019***				
	(0.004)				
Instr.Wave3	–0.002***				
	(0.001)				
K-P F-Statistic		266		265	
Z-score		1.788		1.382	
Hansen J		32.6		32.7	
Prob>Chi squared		0.0000		0.0000	

Source: SOEP v34, own calculations. 273768 person year observations of 38134 individuals.
Notes: Significance levels * 0.10 ** 0.05 *** 0.01. Cluster-robust standard errors in parantheses. Dependent variable is net household income, equivalized to household size with square root rule.