Household economies of scale for wealth: The benefits of sharing with wealth-in-utility

Severin Rapp

September 21, 2023

Measures of private wealth are often available only at the household or tax-unit level. But how does household wealth map into individual welfare? Analogous to household economies of scale for consumption, I argue that there are economies of scale to household wealth. This paper is the first to offer a methodology and empirical results to account for household wealth scale effects based on wealth-in-utility preferences. I propose economies of scale that differ by accumulation purpose – funding consumption as opposed to holding wealth for status or bequest motives (non-consumption). Presenting estimates of scale effects derived from stated preference data in the German Socio-Economic Panel (SOEP), I find that non-consumption economies of scale are almost perfect. In addition, the paper offers an empirical application to inequality measurement. Since non-consumption wealth matters primarily among wealthy households, adjusting household wealth for size primarily affects less affluent households, feeding into higher estimates of inequality. For example, the Palma ratio for Germany increases by up to 18% once scale effects are taken into account, and the Gini index by 3%. Beyond providing parameter estimates for a wealth-in-utility model with household size, the results have relevant applications in the measurement of inequality and optimal taxation.

Severin Rapp: Vienna University of Economics and Business, Department of Economics. Helpful comments from Max Kasy, Francisco Ferreira, Salvatore Morelli, Josef Falkinger, Pirmin Fessler, Emanuel List, H. Xavier Jara, Alyssa Schneebaum, Sofie Waltl, Wilfried Altzinger, Jesús Crespo Cuaresma, Stefan Humer and the participants of the 10^{th} ECINEC Meeting, the RISIng Winter School, the Vienna Workshop on Wealth Inequality and Intergenerational Mobility, and the Austrian Chamber of Labour's Young Economists Conference are gratefully acknowledged.

1. Introduction

Introducing his study on consumption and household size of Belgian worker-families, Engel (1985) argues that "everything humans do happens for the sake of consumption". Ever since, the concept of household economies of scale has focused on consumption. If individuals live together in households, they can share consumer goods. Sharing gives rise to economies of scale, such that the level of per-capita expenditure necessary for a given standard of living falls as household size increases. Consumption scale effects are vital for analysing household expenditure. However, it is not clear whether the traditional notion of scale effects is also suitable for studying household wealth accumulated for reasons beyond consumption, such as bequests and status. Linking household wealth to individual welfare through economies of scale has wide applications in optimal taxation and the measurement of inequality.

This paper extends the concept of economies of scale to household wealth. Does a given level of per-capita wealth yield the same level of welfare for a single individual vis-à-vis individuals in larger households? I test for household returns to scale using a structural model with direct utility from wealth. The theoretical centrepiece of this paper is a simple wealth-in-utility model (Bakshi and Chen 1996; Carroll 1998), in combination with a parametric equivalence scale to summarise scale effects. The model builds on the insight that wealth contributes to individual utility through non-pecuniary channels. For example, people enjoy utility from giving, without caring about the consumption of transfer recipients (Kopczuk 2007). Moreover, wealth can confer status on asset holders (Bakshi and Chen 1996; Michaillat and Saez 2021). The model serves as a measurement tool. It teases out the share of household wealth held for consumption purposes with traditional returns to scale (consumption wealth). The other component of household wealth generates direct utility, and has different scale effects (non-consumption wealth).

Assumptions about economies of scale often feature in research on taxation, household finance and inequality (Sierminska and Smeeding 2005; Christelis, Georgarakos, and Haliassos 2013; Frémeaux and Leturcq 2020; Kuhn, Schularick, and Steins 2020; Kindermann, Mayr, and Sachs 2020). Two extremes exist: The ownership perspective and the access-to-wealth perspective. The access-to-wealth approach assumes perfect economies of scale to household wealth. From this perspective, additional members do not reduce the welfare associated with access to a certain level of household wealth. Assuming that all household members share equal access to household wealth, no adjustment for size is necessary when comparing households with different compositions. In contrast, the ownership approach assumes that wealth is a purely private good. Under the equal sharing assumption, comparing wealth levels between households with different compositions is based on per-capita wealth.

Findings. Capitalising on German survey data to estimate the parameters of the individual utility function, I find that household returns to scale for wealth are almost perfect. Most in line with the access-to-wealth perspective, the equivalence scale elasticity for wealth corresponds to 0.03. As a result, households that hold a low share of their wealth for consumption enjoy high returns to scale. At the other side of the spectrum, households accumulating wealth for consumption only face returns to scale similar to traditional consumption scale effects. Applying the findings to the measurement of wealth inequality, I find that wealth inequality in Germany increases by up to 18% as measured by the Palma ratio. The Gini coefficient increases by up to 3%. I show that these findings are robust to a wide range of sensitivity checks, including portfolio composition, life-cycle savings patterns and assumptions about the utility function. In particular, I demonstrate that the economies of scale parameter estimated in this model falls in the category of unconditional equivalence relations - allowing welfare comparisons by taking into account the fertility preferences and the endogeneity of household size.

Contribution. This paper provides novel insights into a number of economic issues by exploring scale effects associated with household wealth. The first contribution is the integration of a parametric class of equivalence scales (summarising scale effects) with a wealth-in-utility model. This supplements ad-hoc approaches dominating the literature so far. The framework is readily applicable in Paretian social welfare functions. Secondly, I break new ground by offering empirical estimates of wealth economies of scale based on stated preferences data from Germany. In many cases, estimates of household returns to scale for wealth are a necessary component of normative policy analysis, but also the study of distributional outcomes more generally. The application to wealth inequality measurement in this study contrasts my approach with hitherto methods, unveiling strong implications for estimates of inequality.

Optimal taxation. This paper informs the literature on optimal taxation. In the design and appraisal of tax policy, a central principle is horizontal equity (Atkinson and Stiglitz 2015). While the view that household size is a criterion that justifies differential treatment of otherwise similar individuals is widely reflected in tax systems, it has also inspired horizontal equity constraints on utilitarian social welfare functions (Balcer and Sadka 1986; Muellbauer and Van De Ven 2004). By estimating the economies of scale parameter for household wealth, this paper informs discussions on horizontal equity for policy analysis.

Measurement. Household returns to scale for wealth are also subject to controversy when it comes to the measurement of wealth inequality (Sierminska and Smeeding 2005; Kuhn, Schularick, and Steins 2020; Cowell et al. 2017; Saez and Zucman 2020). Measures of wealth usually refer to the household level. When analysing inequality across households with different compositions, assumptions about economies of scale are necessarily involved. Different approaches to economies of scale matter: Cross-country comparisons show that differences in the household structure account for a substantial share of the cross-national variation in inequality (Fessler, Lindner, and Segalla 2014; Bover 2010). Some papers employ the ownership perspective, either using per-capita wealth at the household level or an allocation method to account for within household inequality in ownership (Davies et al. 2009; Frémeaux and Leturcq 2020). Others take household wealth (or the total wealth of a tax unit) as the starting point of their analysis, without making adjustments for individuals (Piketty and Saez 2003; Piketty, Saez, and Zucman 2018).[1] Finally, some contributions on wealth inequality strike a middle ground by adjusting household wealth for consumption economies of scale (Jäntti, Sierminska, and Van Kerm 2013; Fisher et al. 2020). The approach presented in this paper provides a theoretically informed parameter for wealth returns to scale

[1] From a welfare perspective, this would be equivalent in many cases to assuming that a couple filing jointly reaches the same level of welfare as an individual filer with the same level of wealth. This access-to-wealth perspective requires wealth to be a public good within the household or tax unit.

to household size. I explicitly take into account properties previously identified as desirable for this parameter (Sierminska and Smeeding 2005; Cowell et al. 2017). For example, the scale effects depend on individual and household motives for wealth accumulation.

Theory. Finally, the article relates to a set of studies that estimate parameters of utility functions from stated preferences. In contrast to previous contributions, I estimate a wealth-in-utility model, rather than focusing on the marginal utility of income (Layard, Mayraz, and Nickell 2008). Thus, I provide evidence on important structural parameters of a model type increasingly used by economists to study puzzles raised by traditional approaches to consumption and saving (Kumhof, Rancière, and Winant 2015; Michaillat and Saez 2021) and financial markets (Roussanov 2010; Michau, Ono, and Schlegl 2023).

Roadmap. This paper's argument proceeds as follows. Section 2 formalises the relative importance of different savings motives for household wealth accumulation, allowing returns to scale to differ across accumulation motives. Subsequently, Section 3 introduces the SOEP data, before Section 4 sets out the empirical approach. Estimates of wealth economies of scale follow in Section 5. Section 6 offers an application where I take economies of scale into account in the measurement of wealth inequality, before Section 7 concludes.

2. Utility from wealth and household size

This paper argues that models featuring wealth-in-utility accumulation motives are particularly suitable to study returns to scale for household wealth for several reasons. Firstly, this model type distinguishes wealth held for consumption purposes from wealth held for non-consumption purposes. While not very specific about the nature of the latter, the key feature of the model is that wealth does not only matter to utility because it provides consumption opportunities, but also for its own sake. Secondly, wealth-in-utility models can be extended to feature (families of) parametric equivalence scales, which gives a neat framework to directly estimate non-consumption scale effects as a structural model parameter. Subsequently, total scale effects for household wealth can be deduced from a weighted mixture of consumption and non-consumption economies of scale. The weights reflect the extent to which a household wealth portfolio consists of wealth held for non-consumption purposes. These weights are estimated using the model, along with the scale effect parameter for non-consumption wealth.

Formally, the wealth-in-utility model introduces wealth as an argument in the utility function in addition to consumption. Deciding on an allocation of resources between consumption $c_{t,k}$ and non-consumption wealth $w_{t+1,k}$ (both yielding utility directly), households (subscript k) face the following two-period maximisation problem:[2]

$$\max_{c_t}\{u(c_{t,k}); v(w_{t+1,k}) \text{ s.t. } w_{t+1,k} = w_{t,k} - c_{t,k}\} \tag{1}$$

The formulation of the utility function follows Bakshi and Chen (1996), assuming that consumption and wealth enter utility in a multiplicative way. The utility function has a Cobb-Douglas form, with two exponents ρ^{-1} and α^{-1}, where $\rho \geq \alpha$. The choice of a multiplicative utility function over an additive form as in Carroll (1998), for example, derives from its straightforward linearisation. Moreover, I construct the wealth-argument in the utility function such that a certain threshold level of wealth is required before the preference for wealth becomes operative (Carroll 1998; Francis 2009; Heng-fu 1995): The γ parameter ensures that up to a certain level of initial wealth, individuals will always derive more utility from consuming additional resources. In addition, a vector of variables considered to be exogenous enters the utility function. This results in the following utility function:

$$\begin{aligned} U_{i,k}(c_{t,k}, w_{t+1,k}, Z_{i,t,k}) &= u(c_{t,k})v(w_{t+1,k})g(Z_{i,t,k}) \\ &= \left(\frac{c_{t,k}}{h^e_{t,k}}\right)^{\frac{1}{\rho}} \left(\frac{w_{t,k} - c_{t,k}}{h^\tau_{t,k}} + \gamma\right)^{\frac{1}{\alpha}} \exp(\theta Z_{i,t,k}) \end{aligned} \tag{2}$$

In this specification, consumption $c_{t,k}$ and initial wealth $w_{t,k}$ are measured at

[2]The problem can also be interpreted as an agent deciding on lifetime consumption and bequests.

the household level. Divided by a power function of the household size $h_{t,k}$, only some ("equivalent") fraction of total household resources enters individual utility. The parameters in the exponent, τ and e, range between zero and unity. Perfect economies of scale correspond to a value of zero, while no benefits from sharing imply that the exponent amounts to unity.

Assuming that households choose welfare maximising levels of consumption wealth $c^*_{t,k}$ and non-consumption wealth $w^*_{t+1,h} = w_{t,k} - c^*_{t,k}$, it is possible to derive the first order condition. This gives the following optimal level of wealth held for consumption purposes:

$$c^*_{t,k} = \Psi\left(w_{t,k} + h^{\tau}_{t,k}\gamma\right), \quad \Psi = \frac{\alpha}{\alpha + \rho} \tag{3}$$

With a positive γ parameter, this rule implies that the share of non-consumption wealth will increase in total wealth held by a household. In addition, Equation 3 illustrates that the importance of wealth as an end may differ across household types, depending on the magnitude of the scale effects parameter τ. The lower the returns to scale to non-consumption wealth, the higher will be the share of consumption wealth in large households compared to small households.

Having derived the optimal allocation between consumption and non-consumption wealth, substitute Equation 3 into Equation 2 to obtain the following structural model:

$$\begin{aligned} &U(c_{t,k}, w_{t+1,k}) = \\ &\left(\Psi\frac{\left[w_{t,k} + h^{\tau}_{t,k}\gamma\right]}{h^{e}_{t,k}}\right)^{\frac{1}{\rho}} \left(\left[w_{t,k} + h^{\tau}_{t,k}\gamma\right]\left[\frac{\rho}{\alpha + \rho}\right] h^{-\tau}_{t,k}\right)^{\frac{1}{\alpha}} \\ &\exp(\theta Z_{i,t,k}) \end{aligned} \tag{4}$$

The structural model is extendable, such that it is capable of measuring differences in scale effects between children and adults. This requires adjusting the scale effects parameter τ as illustrated in Equation 5. σ captures that additional resource requirements differ between adults and children. A positive value for this parameter accounts for direct utility from children or differences in resource needs between children ($\bar{h}$) and adults ($h - \bar{h}$).

$$h_{t,k}^{(\tau - \sigma \bar{h}_{t,k})} \gamma) \tag{5}$$

In addition to the form of the utility function, the approach outlined in this section entails further simplifying assumptions. Firstly, the household is assumed to allocate wealth between consumption and non-consumption purposes in a joint decision. To ensure that this simplification does not drive the results, the baseline model includes the share of household wealth that belongs to individual i in $Z_{i,t,k}$. Thus, the model allows for household members that do not own any share in the household wealth to derive lower utility from household wealth. Secondly, the analysis largely abstracts from debt. The model ensures that households cannot consider debt in their optimal decision by imposing that $c^*_{t,k} \leq w_{t,k}$. Much like in the approach outlined by Carroll (1998), household consumption is constrained by the level of household wealth. Therefore:

$$c^*_{t,k} = \min(c^*_{t,k}, w_{t,k}) \tag{6}$$

Yet, ensuring that the choice of wealth concept does not affect estimation results, $Z_{i,t,k}$ also includes a measure of household debt. Thirdly, the model does not explicitly model inter-temporal optimisation over the entire life-cycle, following Carroll (1998). However, I carry out several robustness checks to appraise the sensitivity of the results to life-cycle effects, including the inclusion of age in the vector of observable characteristics $Z_{i,t,k}$.

The derivation of economies of scale for total wealth relies on the distinction between assets held for consumption purposes and wealth held for other reasons as stipulated by the wealth-in-utility model. I apply τ to the non-consumption component of total household wealth $w^*_{t+1,h}$, and e to consumption $c^*_{t,h}$. This gives adjusted wealth $\mathcal{W}_{t,k}$ at the household level:

$$\mathcal{W}_{t,k} = \frac{w^{*}_{t+1,h}}{h^{\tau}_{t,k}} + \frac{c^{*}_{t,k}}{h^{e}_{t,k}} \tag{7}$$

Crucially, Equation 7 is a tool to adjust household level wealth information for household scale effects.

3. Data

The main data source in this paper is the German Socio-Economic Panel (SOEP) (Liebig et al. 2019). Complementing comprehensive information on demographics, the SOEP includes a wealth-module for selected waves (2002, 2007, 2012, 2017). In addition, the SOEP provides a wide array of questions, not at least on the subjective wellbeing outcomes, which this treatment employs for identification. Another merit of the Socio-Economic Panel consists in the extensive survey metadata on the interview setting, which is important for the analysis of subjective outcomes.

The aim of this paper is to make wellbeing comparisons of individuals living in different types of households (Decancq, Fleurbaey, and Schokkaert 2015). To measure individual utility, the equalizandum, the paper relies on subjective wellbeing data. Satisfaction caters to a notion of utility where individuals assess the extent to which they can fulfil their life plans. Hence, it respects individual preferences in accordance with the paradigm of Preference Welfarism (Decancq, Fleurbaey, and Schokkaert 2015).

The variable capturing subjective satisfaction as a measure of individual utility is necessary for estimating Equation 4 directly from survey data. An exhaustive body of literature shows that stated preferences are suitably approximating individual utility (Frey and Stutzer 2002; Kaiser and Oswald 2022). Therefore, a number of studies has employed such data to identify structural parameters in utility functions (de Ree, Alessie, and Pradhan 2013; Layard, Mayraz, and Nickell 2008). More specifically, in the literature on measuring household economies of scale, such approaches are widely used (Schwarze 2003). In a similar vein, this paper relies on income satisfaction data to measure utility, captured by a 0-10 Likert scale which is collapsed into a binary outcome variable. Collapsing measures of income satisfaction from a ordered categorical variable into binary outcomes has previously been shown to have little implications for the results regarding the estimates of household returns to scale for income. Figure A3 in the Appendix illustrates the distribution of of the satisfaction measure by survey wave.

In addition, the analysis requires data on household wealth. I use total gross household wealth matched to individual members to be consistent with the dependent variable, which inquires about satisfaction with household level resources. This is the sum of all household members' individual reported assets holdings, aggregated across asset classes. The main part of the analysis does not differentiate between different asset classes when it comes to measuring the relationship between wealth, household size and welfare. Yet, the results also provide specifications where assets are decomposed into different types of assets. Not at least to account for non-response for wealth items in the survey, the data producer offers multiple imputations for the wealth variables. For this analysis, I take the multiply imputed data structure into account. This implies averaging across all five implicates to obtain point estimates and computing the standard errors accordingly following Rubin's rule. Even though the SOEP oversamples high-income households, there are issues with appropriately covering the top of the wealth distribution, both in terms of item-non-response and unit-non-response. The extent of this underestimation is difficult to quantify, owing to a lack of external sources such as wealth tax revenue statistics to validate the aggregates. A comparison with other German wealth surveys suggests that the SOEP underperforms slightly relative to the German Federal Bank's PHF (Private Haushalte und ihre Finanzen) survey in capturing the assets of the very affluent (Grabka and Westermeier 2015). Given the problems with covering wealth at the top of the distribution, I drop the top 2.5% of observations in terms of gross wealth from the individual level analysis in order to obtain clean estimates of the model parameters. However, the robustness checks also provide results for the full sample.

Another key variable is current household size, which is measured in the survey at the household level and matched to individual observations. In order to ensure that measurement issues do not affect the results, further variables enter the specification as controls. In particular, the estimation accounts for the presence of debt and the share of household wealth held by the respondent. In order to explore the robustness of the results, further variables such as age, gender or marital status feature in some specifications. These variables have previously been found to either impact response behaviour with respect to subjective satisfaction outcomes, or actual wellbeing. The sensitivity analysis features additional household characteristics matched to individual household members, including the interview mode, which have been shown to affect subjective measurement outcomes (Conti and Pudney 2011). Since the SOEP follows a "mixed mode approach" for interviews, this analysis differentiates between interviews carried out in presence and in absence of an interviewer. The first group includes the most prominent interview mode in the sample, which is computer-assisted personal interviewing (CAPI). The latter group of interviews includes those carried out in written correspondence via email, for example.

Table 1 provides descriptive statistics for the key variables in the German SOEP. It differentiates between variables measured at the household and the individual level. "Gross wealth" refers to total assets in €1,000. "Debt" is an indicator for the presence of debt in a household. "Household size" refers to the number of household members. Household income satisfaction data, the dependent variable, also features in Table 1. Summary statistics are provided both in terms of a 0 to 10 Likert scale and a binary scale collapsing all income satisfaction levels below 7 into zero and all other values into 1. The wealth share refers to the share of wealth held by each household member.

Figure 1 illustrates the bivariate realtionship between household size and wealth. It demonstrates how households that differ in their composition also have different levels of accumulated assets. On average, households with two members have twice as much wealth as single households. However, households comprising five members only have three times the amount of wealth that single households own.

For the appraisal of the implications of household size adjustments for inequality at the household level in Section 6, the entire sample features in the analysis, with the population weights employed accordingly to compile representative statistics. However, not all observations can be used for the individual level analysis carried out to obtain estimates of the scale effect parameter τ and Ψ in Subsections 5.1 and 5.3. Most importantly, while 55,254 household-wave observations with valid information on household wealth and composition exist for the years 2002, 2007, 2012 and 2017, only 95,495 individuals aged 18 years and above in

var	Min	Median	Mean	Max	sd
Household					
Gross wealth (k)	0	94.91	219.56	72085	854.97
Debt (0/1)	0	0	0.4	1	0.5
HH size (n)	1	2	2.38	13	1.36
Individual					
Satisfaction (lik)	0	7	6.43	10	2.24
Satisfaction (bi)	0	1	0.56	1	0.49
Wealth share (pct)	0	0.64	0.65	1	0.35

[1] Note: Minimum, mean, median, maximum and standard deviation for the key variables at household and individual level. Multiple imputations taken into account. 'k' means that the variable is measured in thousands, 'n' is number. 'bi', 'lik' and 'prct' refers to binary, Likert scale and percentage units respectively. Results pooled across all waves (2002, 2007, 2012, 2017).

[2] Source: SOEP v.35, own calculations.

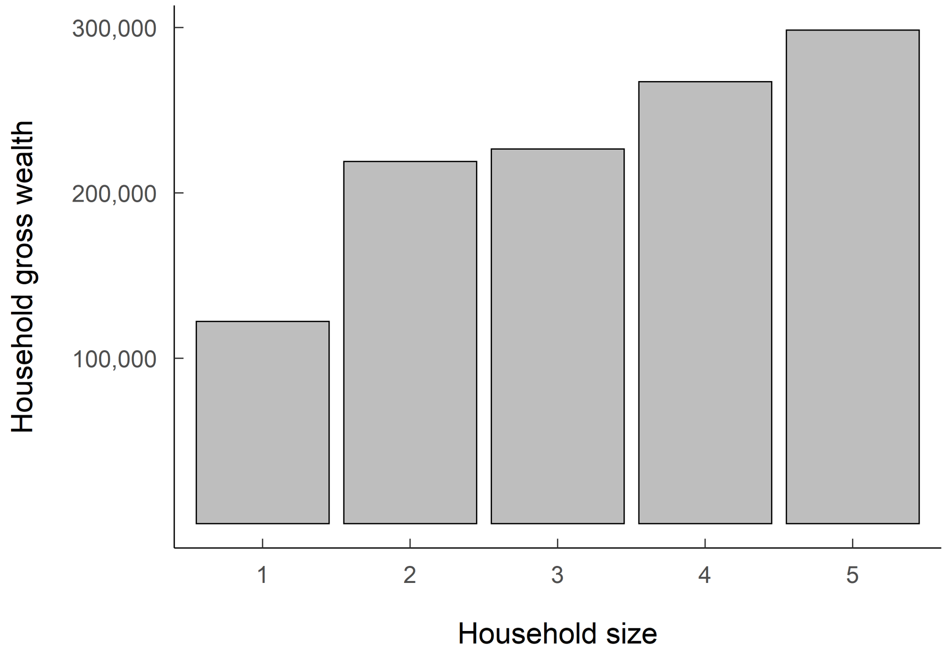
TABLE 1. Descriptive statistics

55,016 household-wave observations feature in the individual-level analysis. The reduction in the sampling size is due to the removing of all individuals with no or invalid information on satisfaction outcomes.

4. Estimation framework

The key parameters to be recovered from the structural model as set out in Equation 4 are ρ and α and τ. e is fixed to 0.5, which is a standard and widely used parameter to account for economies of scale regrading consumption, also known as the square root scale (OECD 2018). For γ, I start with a value of 750,000, which is common in the literature (Francis 2009; Tokuoka 2012). However, robustness checks explore the sensitivity of the results with respect to the parameter γ.

I recover ρ, α and τ from survey data employing generalised regression models with non-linearities in the parameters and the link function. In order to reduce the bias arising from measurement error and simplify the empirical implementation, the results rely on a linearised version of Equation 4. Taking the logarithms of



Mean gross wealth by household size for households with one to five members, 2.5% top coding. Source: SOEP v.35 (Waves: 2017), own calculations.

FIGURE 1. Meanwealth by household size

Equation 4 yields the following specification:

$$\log(U_{i,t,k}) = \delta + \lambda \log(w_{t,k} + h_{t,k}^{\tau}\gamma) + \zeta \log(h_{t,l}) + \sum_{n=1}^{N} \beta_n(Z_{t,i,k,n}) + \eta_{t,i} \tag{8}$$

where

$$\lambda = \frac{1}{\rho} + \frac{1}{\alpha} \quad \text{and} \quad \zeta = \left(\frac{e}{\rho} + \frac{\tau}{\alpha}\right)(-1) \tag{9}$$

Each of the n variables in $Z_{i,t,k}$ enters the model in an additive fashion along the other components. In addition to a set of standard control variables, the specification also features an error term $\eta_{t,i}$ and the intercept δ, which includes the constants remaining from the linearisation of Equation 4.

The estimator in the main specification is based on a binary logit link function to map the nonlinear predictor of Equation 4 and the control variables into the binary outcome variable. Section 5 also presents modifications of this choice. Most importantly, it also provides results for a log-transformed dependent variable that is based on a numeric approximation of the Likert-scale variable.

In view of identification, I do not model the endogeneity of fertility explicitly. However, the estimate of τ may still capture direct utility that individuals derive from additional household members, compensating the former for having to share a given wealth endowment with a larger household. If individuals do not only consider the costs of larger households but also draw direct utility from certain household compositions, the amount of additional wealth required to maintain a given level of welfare as size increases falls. This should be reflected in a lower τ parameter. Drawing welfare comparisons between individuals in different household types requires taking this stream of utility into account. Only then are returns to scale estimated unconditionally, rather than conditional given the choice of household size (Pollak and Wales 1979).

To test for the unconditional character of the results, I compare estimates of τ between families who have at least as many children as they desire to have with and families with more children. The latter situation may arise from imperfect foresight, time-inconsistent preferences and twin births, for example. The comparison of these groups allows for disentangling the extent to which the positive welfare effects of living with children dominate their costs in terms of economic resources. If the τ parameter captures both costs and utility from additional household members, the τ-estimates in the group witch children in excess of their desired household size will be higher - consequently, scale effects are expected to be lower. Therefore, the estimate's sensitivity to the sample split serves as a test for the unconditionality of the scale effects parameter τ and hence its applicability in welfare analysis and optimal taxation.

A second threat to identification is unobserved individual heterogeneity that correlates with the measure of individual welfare employed in this paper (Frijters, Haisken-Denew, and Shields 2004). If individual heterogeneity in subjective satisfaction is systematic, the cross-sectional estimation approach may not deliver unbiased results. Therefore, I supplement the main findings with results from fixed-effects estimation. This limits the analysis to intrapersonal comparisons of welfare, requiring only that individuals' preferences are stable over time (i.e. that preferences do not adapt to situations). Kaiser and Oswald (2022) provide evidence for the persistence of subjective satisfaction measures over different situations.

5. Results

This section starts out with the recovering of the structural model parameters as set out in the previous section. It presents various model specifications, discussing the sensitivity of the results. Subsequently, the estimates are used to arrive at each household's optimal combination of accumulation motives. To generate all results in this section, I use survey weights at the individual level. In addition to the reported coefficients, each model controls for the presence of debt in an individual's household, as well as the share of total household gross wealth held by the respondent.

5.1. Parameter estimates

Based on the SOEP data, Table 2 presents the estimates for λ, ζ and τ, along with the corresponding value of the term Ψ. This value derives from the point estimates of the other coefficients as set out in Equation 9. Standard errors are reported in parentheses. For each model, the underlying assumption on γ is reported in the bottom line. The first model refers to the baseline logit-model, whereas the second uses a probit specification. After column 3 presents results of the same specification, though with a continuous numeric dependent variable, column 4 reports the findings from a fixed effects estimation approach. In each model, income satisfaction features as the outcome variable.

The results in the first column imply a value of 3.36 for λ, while ζ, the coefficient on the log of household size is estimated to -0.47. Given the relatively small standard error, the estimate of λ is statistically significant at conventional levels. Crucially, the first specification suggests that τ is close to zero, though positive and statistically significant. The coefficient magnitude is 0.08. Using the estimates for λ, ζ and τ, and exploiting prior information implying that $e = 0.5$, Ψ follows.

Coefficient	Logit	Probit	Numeric	Fixed Effects
λ	3.355	1.992	0.536	2.7
	(0.094)***	(0.05)***	(0)***	(0.403)***
ζ	-0.474	-0.251	0.008	-0.425
	(0.096)***	(0.052)***	(0)***	(0.422)
τ	0.084	0.066	-0.122	0.093
	(0.029)**	(0.027)*	(0)***	(0.16)
Ψ	0.136	0.138	0.087	0.154
γ	750k	750k	750k	750k

[1] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Observations pooled across waves (2002, 2007, 2012, 2017). Each specification controls for debt and the personal wealth share. Standard errors in parentheses.
[2] Source: SOEP v.35, own calculations.

TABLE 2. Main results: Income Satisfaction

This yields an estimate of 0.14.

Rather than relying on a logit model, the next column describes a model based on the probit link function. The estimates for λ and ζ differ from the baseline estimates, both ranging at a significantly lower level in absolute terms. Even though both coefficients are affected by the changing estimation strategy, the composite effect on the Ψ ratio is negligible. Crucially, the estimate for τ only falls marginally in terms of coefficient magnitude when compared to the baseline logit model. The small changes suggest that τ is at 0.07, a point estimate that is smaller relative to the associated standard error compared to the previous column.

The third column in Table 2 summarises the results of a version of the baseline model with a numeric dependent variable. Rather than collapsing the Likert-scale of satisfaction scores of the dependent variable into a binary variable indicating high or low satisfaction, this specification treats the Likert-scale response as a random variable valued in real numbers. For the linearisation requires taking the logarithm at both sides of Equation 4, the Likert-scale outcomes are transformed using a log transformation. Column 3 reveals that some differences exist between the estimates based on a linear vis-à-vis binary dependent variable. The estimate for λ is significantly lower than in the initial specification. In contrast, ζ is somewhat higher. As a result, Ψ does change slightly when compared to the baseline specification. In contrast to the previous specifications, the estimate for τ falls, ranging at -0.12. This estimate is highly significant in statistical terms.

Column 4 replicates the baseline results using a fixed effects estimator. Thus, it can account for time constant, individual level factors that lead to higher income satisfaction. The results with fixed effects support the conclusions drawn from the first column. The key difference to the results without fixed effects is the estimate of λ, feeding into the estimate of the share of consumption wealth in total household wealth, Ψ. The fixed effects estimate of this parameter ranges slightly above the estimates reported in the first column. In contrast to the other models in Table 2, the scale effects estimate is indistinguishable from zero. However, in magnitude, it is comparable to the estimate from the logit model in column 1.

5.2. Conditional and unconditional scales

To what extent are the estimates of scale effects driven by sharing resources vis-à-vis the non-monetary benefits of larger households? To explore this question, I capitalise on a survey item inquiring about the ideal number of children that respondents would like to have.[3] Individuals who would like to have less children than they do in the current state of the world can be expected to generate less direct wellbeing from children compared to individuals with the optimal number of children. Conditional scales would not be sensitive to differences between those groups, since the economic implications of sharing are the same across those groups.

Table 3 replicates the baseline logit results from Table 2 for different subgroups of the sample. First, I reduce the sample to individuals that provided information on their ideal number of children in the survey. Then, I split this subsample into two groups: The first group in column 1 consists of individuals living in households with at least as many children as the preferred number of children. The second group in column 2 of Table 3 refers to individuals in households with more children than they prefer. Column 3 is based on the entire sample, introducing

[3] The survey elicits information on preferences over the ideal number of children in some waves for a subset of individuals. Therefore, only a limited number of observations where this data is available exists. The 2012 wave provides data on fertility preferences and wealth at the same time.

Coefficient	Optimal family	Excess kids	Children
λ	6.029	26.52	2.679
	(1.991)**	(5.467)***	(0.364)***
ζ	-1.804	-24.355	0.237
	(2.096)	(8.547)**	(0.302)
τ	0.262	0.938	-0.188
	(0.254)	(0.176)***	(0.17)
σ			0.003
			(0.003)
Ψ	0.022	0.137	0.124
γ	750k	750k	750k

[1] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Observations pooled across waves (2002, 2007, 2012, 2017). Each specification controls for debt and the personal wealth share. Standard errors in parentheses.
[2] Source: SOEP v.35, own calculations.

TABLE 3. Fertility

a parameter that allows to appraise whether scale effects are different between adults and children. Thereby, I test whether additional children in the household have different implications for welfare than adults, either due to differences in the economic cost or non-monetary benefits. For example, lower costs as sometimes implied by consumption scales would lead to higher estimates of τ.

To begin with, some elements in the first column differ from the results reported in the main results - while maintaining its key conclusions. Compared to the model in Table 2, the number of observations is substantially lower (2,069 observations instead of 92,228 in the baseline specification). λ almost doubles, maintaining its statistical significance. At the same time ζ drops. However, the estimate is not precise, and confidence intervals include zero. Compared to the results in Table 2, the scale effects parameter τ increases to 0.26. However, the standard error of this estimate is large, such that it is not statistically significant at conventional levels. The changes in the paramters also lead to a fall in Ψ, which ranges below the original estimate for the group of individuals who have exactly as many children as they would ideally like to have.

The coefficients in the second column point towards the sensitivity of the estimation to the conditionality of the scale effects. While only a small group of individuals has more children than they prefer (200 observations), λ and ζ in this group are substantially higher in absolute magnitude than in any other specification. The same holds for the scale effects parameter, which is now at 0.94. While this estimate is significantly different from zero at the usual significance levels, the 95%-confidence interval is still large and includes values of 0.45 for τ. Combining the parameter estimates to obtain Ψ yields a value of 0.13, which is consistent with the estimates provided in the main specifications.

Finally, the last column of Table 3 estimates a model where I substitute the second term of Equation 8 with the term in Equation 5. Therefore, the results feature the parameter σ. The λ estimate in this model is lower than in the baseline logit specification, while the estimate of ζ turns positive. τ drops to -0.18, though remains statistically insignificant. The estimate of σ is statistically insignificant and small in terms of its economic significance. Overall, the changes in the parameters do not affect the estimate of Ψ substantially, which remains close to its original estimate at 0.12.

5.3. Estimation sensitivity analysis

Table 4 provides additional specifications to explore the robustness of the results, reporting the same statistics as Table 2. To begin with, the first column in Table 4 adds further control variables to the initial specification which are known to impact survey respondents' perception of subjective wellbeing outcomes. In particular, this refers to the respondent age, gender, years of education, their marital status, as well as to the mode of data collection. To account for the latter, an indicator variable features in the model, distinguishing interviews where an interviewer was present from those that were carried out in the absence of an interviewer. I also include survey wave fixed effects. Both λ and ζ fall marginally to 3.15 and -0.53 respectively relative to the baseline logit model in Table 2. Both estimates maintain their statistical significance. The estimate of τ becomes statistically indistinguishable from zero, the point estimate ranging at 0.06. Compared to the previous results, Ψ assumes a relatively high value of 0.245.

The next column presents a model that controls for the household portfolio

Coefficient	Controls	Portfolio Composition	Credit constraints	50+	Net wealth
λ	3.147	3.782	2.689	3.494	2.53
	(0.104)***	(0.128)***	(0.095)***	(0.091)***	(0.342)***
ζ	-0.528	-0.445	-0.133	-0.429	-0.366
	(0.108)***	(0.111)***	(0.089)	(0.105)***	(0.688)
τ	0.06	0.066	-0.007	0.048	0.192
	(0.034)	(0.029)*	(0.036)	(0.032)	(0.233)
Ψ	0.245	0.117	0.109	0.164	0.108
γ	750k	750k	750k	750k	750k

[1] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Observations pooled across waves (2002, 2007, 2012, 2017). Each specification controls for debt and the personal wealth share. Standard errors in parentheses.
[2] Source: SOEP v.35, own calculations.

TABLE 4. Robustness analysis

composition. It extends the baseline model by adding control variables for the share of household wealth held in home equity, business wealth, and tangible assets. This constitutes the majority of rather non-liquid assets. The estimates of λ and ζ increase, bringing ζ closer to zero while λ is estimates to 3.78. At the same time, τ remains in proximity to its value in the baseline model. The precision of the estimate increases relative to the specification with controls in the previous column, such that it becomes statistically significant at the five percent level. The resulting value of Ψ is marginally lower than the estimates resulting from the baseline model. Table A1 in Appendix A explores the role of scale effects for household wealth of different asset classes in more detail. It investigates the idea that rather than the wealth-in-utility model, the types of assets held by a household may provide information on accumulation motives, implying that different returns to scale are associated with various types of assets. The results generally support the use of the baseline model: Irrespective of asset class, the parameters are similar to those in the baseline model.

Subsequently, the column labelled "Credit constraints" controls for household credit constraints. Being credit constrained means that households need to hold higher levels of wealth than they would desire in absence of such constraints, since they cannot borrow to smooth consumption. If this prevents households from consuming all wealth, even though that would imply higher welfare, biased results could be the consequence. The specification uses an indicator assuming unity if liquid assets fall below two months of household income to measure credit constraints (Jappelli, Pischke, and Souleles 1998). Compared to the baseline estimates in Table 2, both λ and ζ shrink towards zero, while τ falls slightly below zero to -0.01. Overall, the effect on Ψ is small, resulting in an estimate of 0.11.

The fourth column labelled "50+" explores the role of expectations and the reference time period. Do individuals think of their current household size when they respond to questions on satisfaction with material circumstances, or do they consider future household compositions? In addition to controlling for household size, this column provides further results for the subsample of older individuals. As opposed to younger individuals who are more likely to increase their household size in the future when they raise children, older individuals may expect their household size to decline. Even if the sample is restricted to the older population, the differences to the baseline specification remain relatively limited. λ increases by a small margin to 3.49 relative to the first column in Table 2. ζ falls slightly, even though no changes in terms of statistical significance occur. The estimate of τ approaches zero, such that it becomes statistically insignificant. The changes in the parameter estimates result in an augmented value for Ψ, which is now at 0.16. The limited differences to the estimates reported in the baseline specification suggest that expectations concerning changes in the household composition that are not captured by the baseline specification do not jeopardise the conclusions.

Finally, the last column "Net wealth" changes the definition of gross wealth to net wealth. At the same time, I also substitute the personal share in household gross wealth for an individuals share in net wealth as a control variable. Still, the specification controls for debt. λ (ζ) is lower (higher) than in the main specification, while the estimate of τ increases to 0.19 from 0.08 in the main specification reported in column 1 of Table 2. However, due to the relatively high standard error, the estimate is not statistically significant at conventional levels. Overall, compared to the main results, Ψ falls to 0.11.

The robustness checks reveal little sensitivity of the results for τ to changes in the model specification. In most cases, confidence intervals either include zero or the estimate of the baseline specification in Table 2. This can be considered as evidence in favour of the main finding: $\tau < e$. In addition, the estimates for Ψ exhibit only little variation. Across all specifications, this parameter ranges between 0.11 and 0.25.

Overall, the parameter estimates reported in Section 5 are realistic and consistent with previous research. Regarding the estimates for τ, it has been noted previously that if wealth is accumulated for the purpose of “status or power, there is little reason to adjust wealth for household size at all” (Cowell et al. 2017, p.177) – implying $\tau = 0$. If one interprets the non-consumption wealth component as a bequest motive, there are also arguments supporting high scale effects. For example, Kopczuk (2007) finds that bequest motives do not depend on whether an individual has children. This is in line with the high scale effects for τ, suggesting that a larger household does not induce the need for more wealth to be distributed among household or family members.

5.4. Consumption and non-consumption wealth

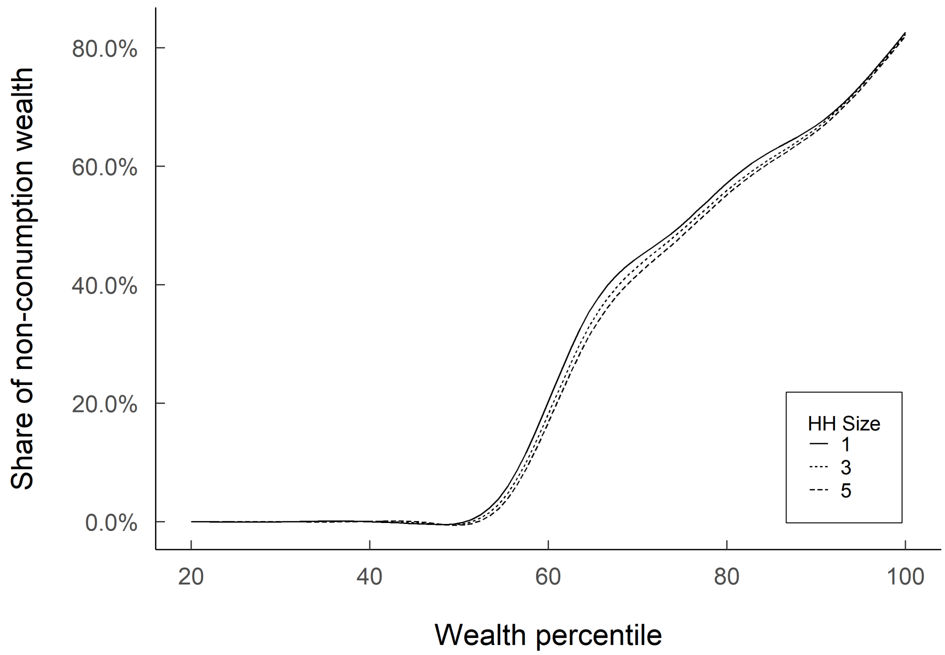
This section uses the parameter estimates for τ and Ψ to derive the proportion of wealth held for consumption vis-à-vis non-consumption purposes for each household. I take a value of 0.13 for Ψ, corresponding to the average from the main specifications in Table 2. τ is taken to be 0.03 - again the average of point estimates from Table 2. Combining this information with data on gross wealth in Equation 3 yields for each household k wealth accumulated for the purpose of consumption $c^*_{t,k}$. Then, $w^*_{t+1,h}$ follows.

Figure 2 illustrates the result. It shows the share of non-consumption wealth along the distribution of gross wealth for all survey waves. The percentile grouping rests on the overall population rank of households in the distribution within each wave, rather than on their relative wealth rank within each household type. The y-axis gives a smoothed estimate of the mean share of non-consumption wealth by household. I obtain the smoothed curve through a generalized additive model featuring a penalized cubic regression spline. It is constructed by minimizing the following expression, where y_i is the share of non-consumption wealth for each household:

$$\sum_{i=1}^{n} \{y_i - g(x_i)\}^2 + \lambda \int g''(x)^2 dx \tag{10}$$

This smoother strikes a balance between model fit, quantified by the squared difference between y_i and the free parameters of the cubic spline, denoted as $g(x_i)$, and a penalty term for ensuring smoothness (Wood 2017). This penalty term corresponds to the widely-utilized integrated square second derivative cubic spline penalty. I employ a total of ten knots, which are evenly distributed across the covariate values.

Across waves, households hold all savings for consumption purposes up to roughly the 58^{th} percentile. This corresponds to approximately €132,000 in household gross wealth. As household wealth increases, the share of non-consumption wealth approaches $1 - \Psi$. Note that the share of wealth devoted to consumption does not only depend on the total level of household wealth. It is also a function of household size: Especially in the middle of the distribution, larger households

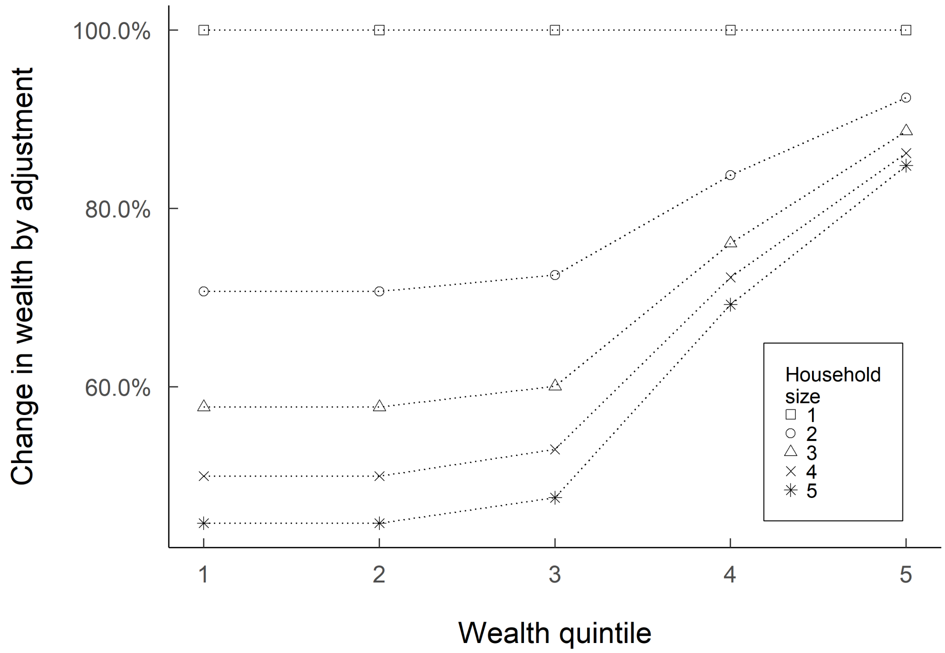


Share of non-consumption wealth (ordinate) by percentile of household gross wealth (abscissa). Smoothed estimate. Lower cutoff at percentile 20. Lines represent different household sizes, $\tau = 0.03$ and $\Psi = 0.13$. Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

FIGURE 2. Share of non-consumption wealth by percentiles

tend to allocate more wealth to consumption than smaller households. This results from the τ parameter in Equation 3, which determines $c^*_{t,k}$.

Following the adjustment set out by Equation 7 yields $\mathcal{W}_{t,k}$. While for single households, $\mathcal{W}_{t,k} = w_{t,k}$, this is not true for households with more than one member, where it generally holds that $\mathcal{W}_{t,k} < w_{t,k}$. Since the share of wealth held for consumption purposes is particularly high among households with a low level of assets, the adjustment has pronounced effects in the lower parts of the distribution. In contrast, among affluent households, the adjustment has more moderate effects. This is illustrated in Figure 3. It plots adjusted wealth $\mathcal{W}_{t,k}$ as a share of unadjusted wealth $w_{t,k}$ for different household sizes by unadjusted gross wealth quintile. The adjustment for scale effects has the strongest implications among large households – in this graph, households with five members – across the distribution.



Ratio of adjusted wealth $\mathcal{W}_{t,k}$ to unadjusted wealth $w_{t,k}$ (ordinate) by quintile of the gross wealth distribution (abscissa), $\tau = 0.03$ and $\Psi = 0.13$, Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

FIGURE 3. Ratio adjusted to unadjusted wealth

6. Adjusted wealth and inequality

The asymmetric effects of adjusting for scale effects among households at different parts of the wealth distribution gives rise to distributional effects. Yet, the effects depend on the inequality measure by which the wealth distribution is summarised, since indicators vary in the extent to which they place weight on different parts of the distribution. A comparison of the influence functions of different inequality measures suggests that some indicators emphasise observations at the top of the distribution more strongly than others (Cowell and Flachaire 2007). Therefore, the higher the influence of households at the top for a given inequality measure, the lower will be the impact of the scale effects adjustment on inequality. Table 5 explores this proposition, examining the impact of the scale effects adjustment using different indicators for all SOEP waves featuring a wealth module. The results show that the impact of adjusting wealth for household scale effects depends on the inequality indicator.

	Gini		Palma	
	unadjusted	adjusted	unadjusted	adjusted
2002	0.72	0.74	60.88	71.73
2007	0.72	0.74	58.07	67.95
2012	0.70	0.72	50.21	59.38
2017	0.71	0.72	62.42	72.64

Note:
Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations. τ = 0.03, Ψ =0.13

TABLE 5. Scale effects and inequality

Overall, Table 5 suggests that there is some impact of the household scale effects adjustment on the Gini coefficient. The changes are most pronounced in earlier waves of the SOEP, while in 2017, the effects of the adjustment are less substantial. Across waves, the index increases by one to two percentage points. This may result from the Gini's relative strong emphasis on affluent households. The second pair of columns in Table 5 displays the effect of adjusting for household scale effects on distributional outcomes in terms of the Palma ratio. The ratio summarises the share of wealth held by the top decile relative to the share of wealth held by the bottom 40%. In contrast to the Gini-based assessment of the effect of household size adjustments, the changes are more significant. Indeed, the Palma ratio increases by more than 15 percent across all indicators, with a maximum increase in the 2002 and 2012 waves amounting to 18%.

It is noticeable that the household size adjustment proposed here differs from household size adjustments commonly employed to adjust household income. Using the square root scale or the OECD-scale for income adjustment, distributions tend to become more equal. Applying either of those scales to the wealth distribution has similar effects, leading to less dispersion. Table 6 illustrates this. For example, in 2017, the Palma ratio for household gross wealth is 62.42. Dividing by the square root of household size yields 56.31 for the same statistic. Employing the modified OECD scale yields even lower inequality, at a level of 55.67. Adjusting household wealth for scale effects in line with the procedure advanced here, the adjusted distribution for 2017 has a Palma ratio of 72.64. Despite the dramatic

	2002	2007	2012	2017
Household wealth: $w_{t,k}$	60.88	58.07	50.21	62.42
Wealth scale: $\mathcal{W}_{t,k}$	71.73	67.95	59.38	72.64
Square root scale: $w_{t,k}/h^{0.5} = w_{t,k}/\sqrt{h}$	53.09	51.83	45.60	56.31
OECD Scale	52.10	51.14	45.01	55.67

Note:
Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.
$\tau = 0.03$, $\Psi = 0.13$

TABLE 6. Household size adjustment and inequality: Palma ratios

contrast to hitherto approaches, employing an adjustment procedure for wealth that differs along the distribution is sensible, since the nature of wealth ownership changes with the rank in the distribution.

The equivalisation procedure proposed in this paper is useful to draw cross-national comparisons involving countries with different household structures. A back-of-the-envelope calculation in Appendix C illustrates the impact of applying the wealth adjustment procedure estimated for Germany to other European economies. Based on data from the Household Finance and Consumption Survey (HFCS), the analysis reveals that country rankings in terms of the wealth Gini coefficient change substantially.

7. Conclusion

The goal of this paper is to provide a theoretical framework and empirical estimates for the household scale effects associated with wealth. While economies of scale for consumption are a well established as a concept, consumption is only an important driver of wealth accumulation at the lower tail of the distribution. Scale effects may differ if wealth is held for reasons other than consumption. I propose economies of scale that depend on the accumulation purpose. The paper shows that wealth-in-utility preferences combined with parametric equivalence scales to represent economies of scale can serve both as a theoretical framework for appraising the implications of scale effects regarding household wealth. I also demonstrate that this approach can be employed for empirical estimation.

The paper draws on subjective satisfaction data to recover structural model parameters, including the parameter τ which represents economies of scale for non-consumption wealth. An empirical application to the measurement of wealth inequality suggests that scale effects have significant distributional implications.

This approach marks an important theoretical contribution to existing scholarship on household wealth. Rather than making more or less explicit ad-hoc assumptions about economies of scale at the household or tax-unit level, the paper offers a framework that is tailored to the study of household wealth. At the same time, it is the first to provide empirical estimates of a scale effects parameter. The estimation results suggest that household economies of scale are almost perfect for non-consumption wealth - corresponding to the access-to-wealth perspective. The application to inequality measurement suggests that the novel adjustment approach yields results that stand in sharp contrast to previous findings in the literature: Accounting for scale effects at the household level according to the approach outlined in this paper has disequalising effects on the distribution, rather than leading to a compression.

Future research could extend the framework offered in this article. Even though the analysis demonstrates that life-cycle patterns do not drive the findings, expectations could still play a role. For example, uncertainty about income or expenditure could be integrated in a more complex accumulation model.

Looking forward, I expect the economies of scale parameter to inform the monitoring of wealth inequality, both over time and across countries. Not at least against the background of demographic change and changing cohabitation patterns across countries, considering household structure for assessments of inequality will become even more crucial. In view of policy, models in optimal taxation may benefit from a clarification of the household's role in moderating the relationship between household wealth and welfare. For example, it allows appraising the implications of wealth taxation for horizontal equity. Another example is the design of inheritance taxation, where tax rates in practice are often functions of family size.

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Appendix A. Portfolio composition and returns to scale

In addition to the results provided in Table 4, this section investigates the sensitivity of the results in view of portfolio composition further. Arguably, the types of assets held by an agent could provide information on the underlying accumulation motives. For example, home owners can be considered to have some housing-consumption motive, suggesting that some, though not perfect, economies of scale may be present. Against this background, it may not seem intuitive to adjust all wealth for perfect returns to scale, including housing assets. Instead, one might want to test for asset-specific household size returns to scale. Table A1 estimates returns to scale for household wealth by excluding different portfolio components from the analysis.

Coefficient	2017 wave	Wealth + Vehicles	Durables	Financial wealth
λ	3.02	3.073	2.873	10.575
	(0.07)***	(0.075)***	(0.041)***	(0.372)***
ζ	-0.192	-0.202	0.038	2.816
	(0.062)**	(0.066)**	(0.041)	(0.269)***
τ	0.025	0.024	-0.062	-0.276
	(0.023)	(0.023)	(0.016)***	(0.033)***
Ψ	0.081	0.086	0.086	0.012
γ	750k	750k	750k	750k

[1] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Columns 1 - 3: 2017 wave. Column 4: observations pooled across waves (2002, 2007, 2012, 2017). Each specification controls for debt and the personal wealth share. Standard errors in parentheses.
[2] Source: SOEP v.35, own calculations.

TABLE A1. Portfolio composition

In order to fully explore this issue, the results reported in columns 1 to 3 are based on data from the 2017 wave only, because it is the only wealth survey wave of the SOEP that provides information on the value of vehicles owned by households. This allows studying whether the results are robust to including vehicles in the definition of household wealth. The first column relplicates the baseline logit model for the 2017 wave only, before the second column of Table 2 adds the value of vehicles to the measure of total gross wealth that underlies the estimation. The third column restricts the wealth measure to vehicles and the value of the main residence (durable goods). The final column estimates the model using only financial wealth. Overall, the results remain relatively stable in the first three columns. In particular, the τ estimate ranges around zero, while Ψ ranges slightly under the baseline estimate. In the final column that considers financial assets only, the estimates of τ and Ψ drop. The τ estimate corresponds to -0.28. The results for τ in particular suggest that the findings of Table 2 are widely robust across asset classes. In particular, the hypothesis that $\tau < e$ cannot be rejected.

Appendix B. Further sensitivity analysis

This section offers further robustness checks. The first column in Table A2 shows the results from the full sample, removing the top coding. Including the top 2.5% of the sample in terms of gross wealth does affect the results. The outliers at the top drag down the estimate for τ. As a consequence, it ranges somewhat above -0.12. While this demonstrates some sensitivity of the results to the sample selection, it strengthens evidence against the hypothesis that the true value of τ is greater or equal to the parameter e, summarising returns to scale from household consumption. Compared to the baseline estimates, the absolute values of the coefficients on λ and ζ fall. In sum, the estimate for Ψ is higher than in the baseline model only by a small margin. Therefore, the results in column three do not contradict the baseline model findings.

The subsequent columns explore the sensitivity of the results to variations in the γ parameter. While in column 2, the parameter ranges 250,000 above the level assumed in the baseline specification, it is by 250,000 lower than in the baseline model in the next column. The results suggest that λ is positively related to the underlying value of γ. This does not hold for the ζ estimate. Crucially, in neither specification, a substantial change in γ leads to extreme variations in the τ estimate. The latter remains robustly close to zero for reasonable values of γ. Even so, changing γ is reflected in the resulting value of Ψ. High values for γ result in a lower value for Ψ.

Coefficient	No Top Coding	High γ	Low γ
λ	2.497	4.241	2.46
	(0.025)***	(0.107)***	(0.076)***
ζ	0.048	-0.595	-0.36
	(0.001)***	(0.113)***	(0.083)***
τ	-0.115	0.096	0.066
	(0.002)***	(0.026)***	(0.036)
Ψ	0.156	0.108	0.183
γ	750k	1000k	500k

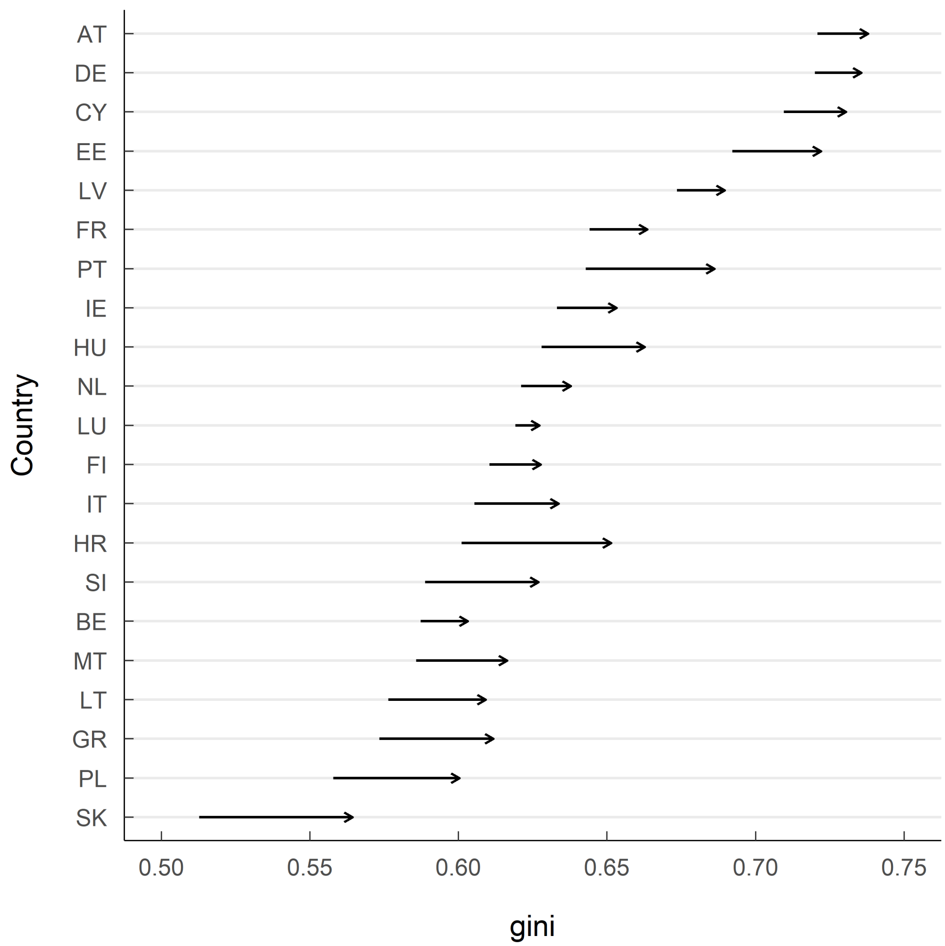
[1] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Observations pooled across waves (2002, 2007, 2012, 2017). Each specification controls for debt and the personal wealth share. Standard errors in parentheses.
[2] Source: SOEP v.35, own calculations.

TABLE A2. Robustness analysis

Appendix C. Cross-country comparisons and returns to scale

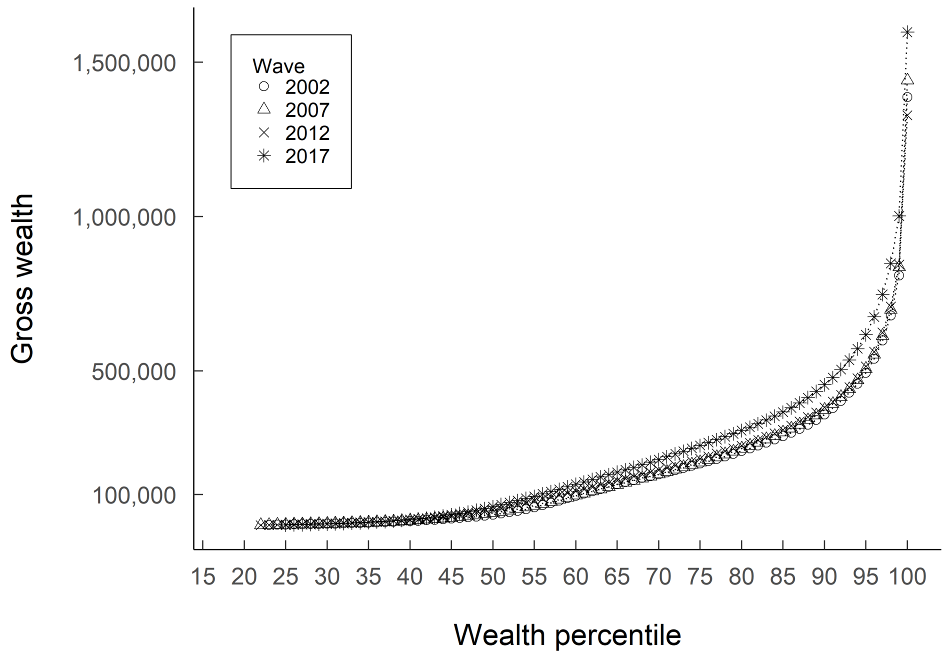
This section explores the implications of adjusting for household size for comparative cross-national wealth research, drawing on data of the HFCS. The HFCS is a dataset, originating from a research initiative conducted by the European Central Bank (ECB). It provides information about the the financial well-being of households within the Eurozone. Modelled after the Survey of Consumer Finances (SCF), the HFCS covers household balance sheets, income and employment characteristics, demographics, and a set of behavioural variables (including economic expectations, for example). It comes as a multiply imputed dataset with five implicates and complex survey weights. The data collection for the HFCS takes place in roughly triennial intervals, starting in 2010. For this paper, I use the third wave. Fieldwork for the third wave happened between 2016 and 2018 across the participating countries. The ECB European Central Bank (2020) provides detailed methodological reports.

In order to arrive at results comparable to those of the SOEP, I harmonise definitions. The underlying wealth concept in Figure A6 is gross wealth. Moreover, I deduct the value of vehicles from the gross-wealth measure. Results for the Gini coefficient are reported. Croatia and Slovakia see the most substantial relative increases in the Palma ratio and the Gini coefficient respectively. The Palma ratio increase in the first is approximately one third, and the Gini increase in the latter is approximately ten percent.



Impact of using the household size adjustment for wealth across countries. Across countries, the figure applies $\tau = 0.03$ and $\Psi = 0.13$. Source: ECB 2017, own calculations.

FIGURE A1. Comparative effect of scale effects adjustment



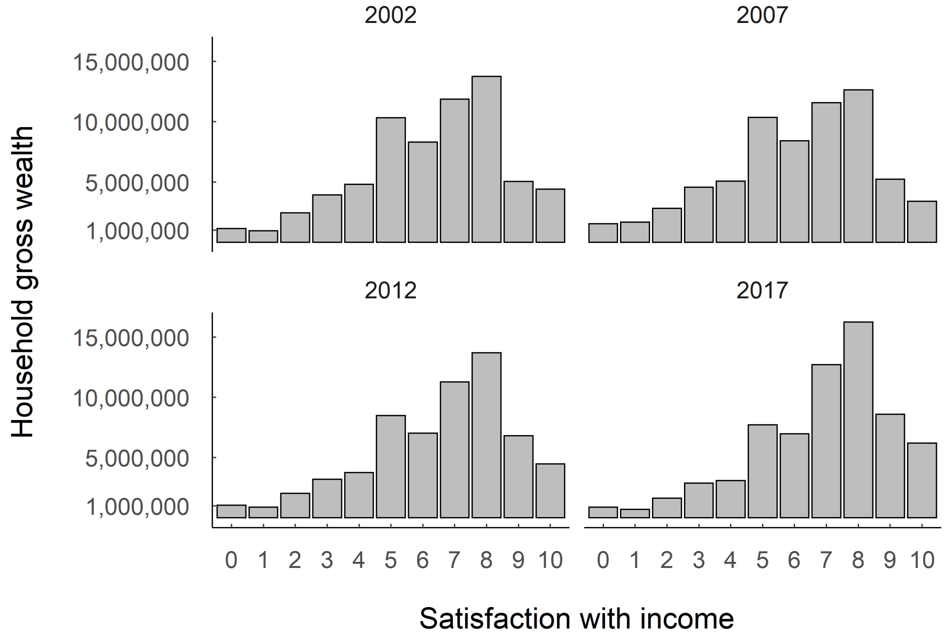
Graph displays average wealth for each percentile of the wealth distribution. No data can be reported for percentiles below 20 due to zero gross wealth observations and the smoothing method (rolling mean). Survey weights and multiple imputations are taken into account. Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

FIGURE A2. Average gross wealth by decile of the gross wealth distribution

Appendix D. Further descriptive statistics

This section provides additional descriptive statistics, supplementing Table 2 and Figure 1. First, Figure A2 illustrates mean gross wealth by percentile of the distribution of gross wealth. Each line represents one wave of the SOEP. Approximately 20% of the population do not own wealth. Therefore, the graph leaves out the lowest quintile of the population in terms of net wealth.

Figure A3 summarises the distribution of the dependent variable. Before I collapse income satisfaction into a binary variable, it ranges from 1 to 10. There is also a number of individuals who do not respond to the question on income satisfaction. For the analysis, I drop these observations from the sample. In all waves of the SOEP, most respondents rate their income satisfaction at eight out of ten. The second largest group reports seven out of ten. The distribution of



Income satisfaction responses by survey wave. Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

FIGURE A3. Distribution of income satisfaction

satisfaction is slightly skewed to the left. A sharp drop exists between four and five, where a substantial majority rates satisfaction above at five and above.

Appendix E. Results for net wealth

This section applies the parameters for net wealth to household net wealth outcomes. I take parameter estimates from the final column of Table 4. Figure A4 illustrates the share of net wealth held for consumption as a share of total household net wealth. Crucially, consumption wealth cannot be negative (Equation 6). Compared to the results for net wealth, non-consumption wealth gains relevance already around the fifth decile of the net wealth distribution. This shift is a result of the lower Ψ, falling by more than 0.1 units. Consequently, the effects of the household size adjustment are also concentrated in the lower sections of the wealth distribution. Figure A5 illustrates that it is primarily the first to third quintile of the wealth distribution that is affected by the adjustment.

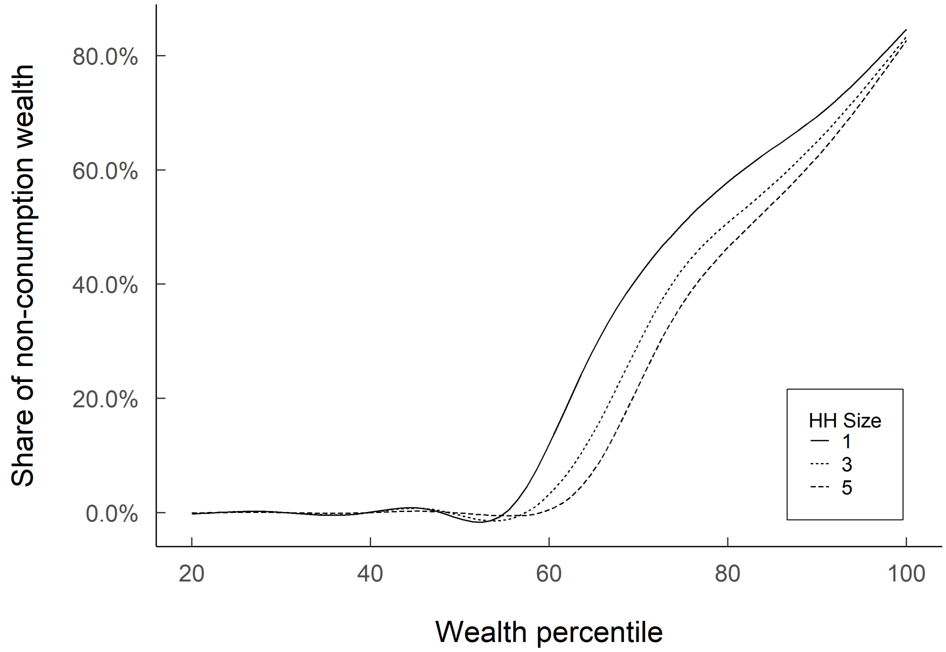


FIGURE A4. Share of non-consumption net wealth by percentiles

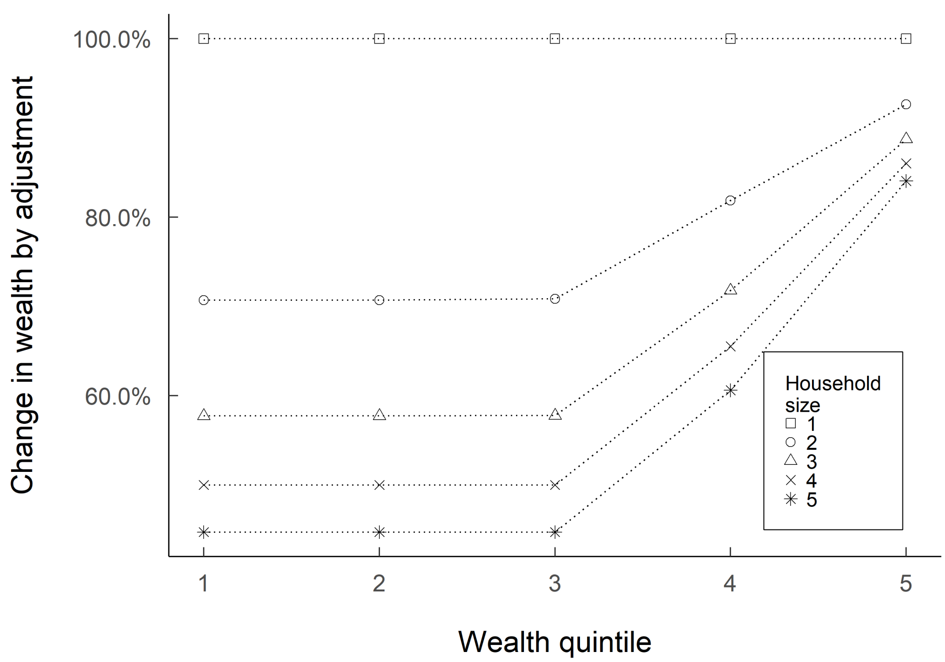


FIGURE A5. Share of non-consumption net wealth by percentiles - Net wealth

	Gini		Palma	
country	unadjusted	adjusted	unadjusted	adjusted
AT	0.72	0.74	40.66	47.62
BE	0.59	0.60	6.95	7.87
CY	0.71	0.73	17.22	22.25
EE	0.69	0.72	14.93	17.52
FI	0.61	0.63	10.84	12.65
FR	0.64	0.66	16.87	20.47
GR	0.57	0.61	6.54	8.27
HR	0.60	0.65	6.60	8.96
HU	0.63	0.66	7.70	9.45
IE	0.63	0.65	10.57	13.17
IT	0.61	0.63	9.33	12.26
LT	0.58	0.61	4.95	5.91
LU	0.62	0.63	8.58	9.25
LV	0.67	0.69	15.78	16.91
MT	0.59	0.62	5.58	6.98
NL	0.62	0.64	15.78	18.27
PL	0.56	0.60	5.05	6.35
PT	0.64	0.69	9.07	12.22
SI	0.59	0.63	6.47	8.20
SK	0.51	0.56	3.57	4.71

Note:
Data from HFCS 3rd wave 2017. $\tau = 0$, $\Psi = 0.15$

TABLE A3. Cross-national evidence

	Gini		Palma	
	unadjusted	adjusted	unadjusted	adjusted
2002	0.76	0.78	-91.09	-184.50
2007	0.77	0.78	-118.53	-220.18
2012	0.75	0.77	-61.79	-100.13
2017	0.74	0.75	-205.89	-527.10

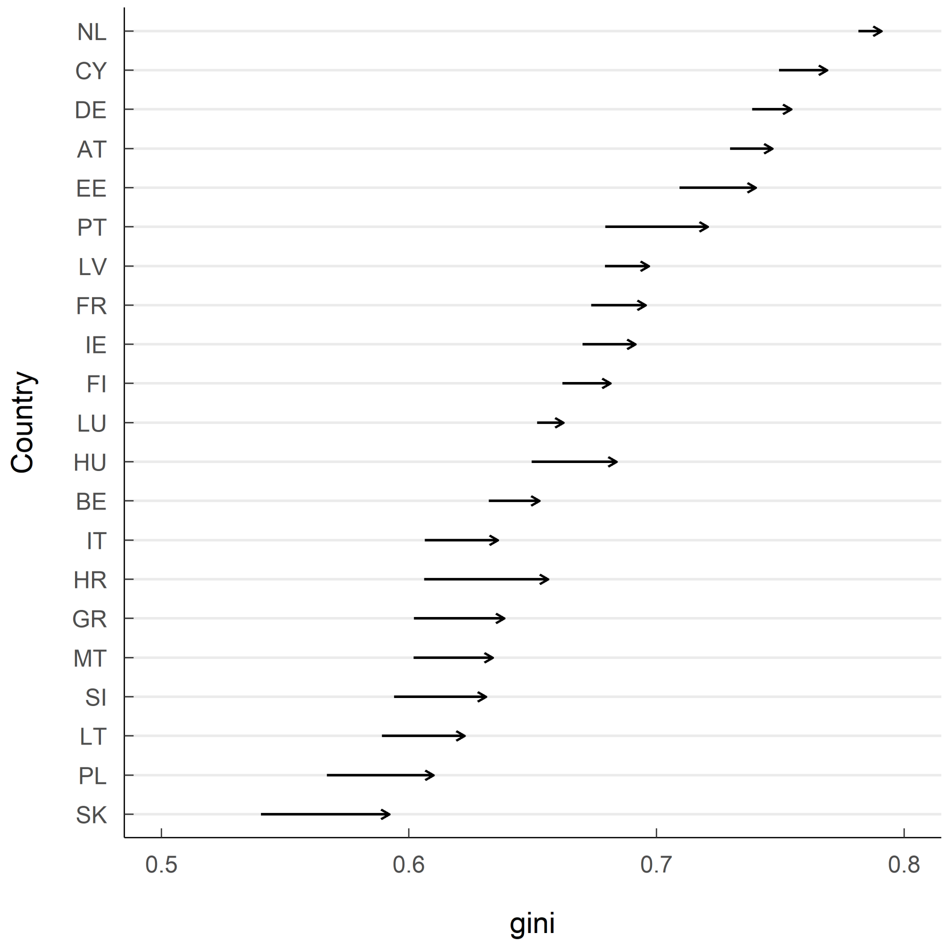
Note:
Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations. τ = 0.19, Ψ =0.11

TABLE A4. Scale effects and inequality

	2002	2007	2012	2017
Household wealth: $w_{t,k}$	-91.09	-118.53	-61.79	-205.89
Wealth scale: $\mathcal{W}_{t,k}$	-184.50	-220.18	-100.13	-527.10
Square root scale: $w_{t,k}/h^{0.5} = w_{t,k}/\sqrt{h}$	-138.19	-169.40	-77.51	-411.55
OECD Scale	-146.54	-177.29	-82.06	-456.22

Note:
Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations. τ = 0.19, Ψ =0.11

TABLE A5. Household size adjustment and inequality: Palma ratios



Impact of using the household size adjustment for wealth across countries. Across countries, the figure applies $\tau = 0.19$ and $\Psi = 0.11$. Source: ECB 2017, own calculations.

FIGURE A6. Comparative effect of scale effects adjustment - Net wealth

	Gini		Palma	
country	unadjusted	adjusted	unadjusted	adjusted
AT	0.73	0.75	42.91	47.88
BE	0.63	0.65	10.98	14.00
CY	0.75	0.77	37.65	54.26
EE	0.71	0.74	17.61	21.21
FI	0.66	0.68	23.33	29.83
FR	0.67	0.70	22.77	29.57
GR	0.60	0.64	9.17	11.70
HR	0.61	0.66	6.92	9.40
HU	0.65	0.68	9.43	11.69
IE	0.67	0.69	17.45	24.45
IT	0.61	0.64	9.33	12.38
LT	0.59	0.62	5.45	6.53
LU	0.65	0.66	12.25	14.12
LV	0.68	0.70	16.75	18.67
MT	0.60	0.63	6.38	8.22
NL	0.78	0.79	-26.84	-40.56
PL	0.57	0.61	5.46	6.86
PT	0.68	0.72	12.91	17.75
SI	0.59	0.63	6.88	8.67
SK	0.54	0.59	4.36	5.82

Note:
Net wealth including vehicles. Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations. τ = 0.19, Ψ =0.11

TABLE A6. Cross-national evidence - Net wealth