Household Economies of Scale for Wealth: The Benefits of Sharing with Wealth-in-Utility

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Abstract

Measures of private wealth often refer to households or tax-units. But how does household wealth map into individual welfare? Analogous to household economies of scale for consumption, this paper is the first to offer a methodology and empirical results to account for household wealth scale effects. I propose scale effects that differ by savings purpose – funding consumption as opposed to holding wealth for motives such as status (wealth-in-utility savings). Using the German Socio-Economic Panel's stated preference data, I estimate that economies of scale for wealth-in-utility savings are high. In addition, the paper offers an empirical application to inequality measurement. Since high wealth-in-utility economies of scale dominate among the wealthy, estimates of inequality increase. Accounting for scale effects increases inequality estimates, such as the Palma ratio for Germany by up to 21% and the Gini index by 3%. The results matter for the measurement of inequality and optimal taxation.

Keywords— Inequality, Wealth distribution, Economies of scale, Measurement, Subjective wellbeing

JEL-Codes: D31, J10, D1

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1 Introduction

Introducing his study on consumption and household size of Belgian worker-families, (Engel, 1895) 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 analyzing household expenditure. However, it is not clear whether the traditional notion of scale effects is also suitable for studying household wealth held for reasons beyond funding consumption, such as bequests and status. 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?

It is possible to think of economies of scale for wealth in terms of two extremes (Frémeaux & Leturcq, 2020):[1] 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. This paper offers a framework to integrate these perspectives and intermediate approaches based on a model of consumption and savings. I employ this framework to obtain empirical estimates of economies of scale and adjust inequality estimates for the benefits of sharing.

The first contribution of this paper is theoretical. It departs from the idea that economies of scale are independent of people's motives to hold wealth. To accommodate this insight, I integrate a parametric class of equivalence scales with a simple wealth-in-utility model (Bakshi & Chen, 1996; Carroll, 1998). On the one hand, parametric equivalence scales are a flexible way to express the ratio of

[1] Examples of either extreme or an intermediate version of both in research on taxation, household finance and inequality include Christelis et al. (2013), Kindermann et al. (2020), and Kuhn et al. (2020).

household resources to scale-effects adjusted individual resources as a function of household characteristics.[2] On the other hand, the model can explain what savings motive dominates in a given household. It assumes that wealth contributes to individual utility through both consumption and non-consumption channels. For example, people enjoy utility from warm-glow bequests (Kopczuk, 2007) and status that wealth confers on asset holders (Bakshi & Chen, 1996; Michaillat & Saez, 2021).[3] The model yields an optimal allocation of wealth between consumption and wealth-in-utility savings - the residual of total household wealth and consumption. If economies of scale for consumption and wealth-in-utility savings differ, the relative importance of different savings motives determines the magnitude of overall wealth scale effects. Founding economies of scale for wealth in economic theory supplements ad-hoc approaches dominating the literature so far.

In addition to providing a theoretical framework for wealth scale effects, I break new ground by exploring wealth economies of scale empirically. Are empirical estimates of economies of scale closer the ownership or the access-to-wealth perspective? I use stated preferences from German survey data to approximate utility, and estimate the parameters of the equivalence scale, which reflect the structural model parameters of the utility function. Therefore, I fit several non-linear regression equations to both dichotomized and linearized data, drawing on cross-sectional and panel estimation. The third contribution in this paper is an empirical application of the calibrated equivalence scale to the measurement of wealth inequality. The application contrasts my approach with hitherto methods, unveiling strong implications for estimates of inequality.

Overall, I find that household returns to scale for wealth are almost perfect as the share of wealth-in-utility savings reaches its maximum. In line with the access-to-wealth perspective, the equivalence scale for wealth-in-utility savings is

[2]For an application of the standard parametric equivalence scale $E = h^{\theta}$ (a function of household size h and the equivalence scale elasticity θ) to household wealth, see Sierminska and Smeeding (2005).

[3]The idea of wealth-in-utility features already in early economic thinking. This includes the writings of Adam Smith (1853), John Maynard Keynes (1932) and Max Weber (1934). However, wealth-in-utility preferences are also becoming increasingly common in modern economics (Benhabib & Bisin, 2018; Michaillat & Saez, 2021; Rannenberg, 2021; Saez & Stantcheva, 2018). Most frequently, a preference for holding wealth is rationalized through power, status/prestige, and security that comes with wealth ownership. Further microfoundations for wealth-in-utility preferences are benefits from entrepreneurship, bequest motives and liquidity (Stantcheva, 2020). It may also be the case that individuals save for the mere satisfaction they derive from wealth accumulation (Steedman, 1981).

close to unity and only weakly dependent on household size, as the equivalence scale elasticity is estimated to range between 0.001 and 0.06. This implies that wealth-in-utility household savings enter individual utility almost directly. As a result, households that hold a low share of their wealth to fund 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. Correcting for returns to scale in the measurement of wealth inequality, I find that wealth inequality in Germany increases by up to 21% 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.

This paper is related to the literature in several ways. Firstly, it informs the debate on optimal taxation. In the design and appraisal of tax policy, a central principle is horizontal equity (Atkinson & Stiglitz, 2015; Saez & Stantcheva, 2016). The view that household size is a criterion that justifies differential treatment of otherwise similar individuals is widely reflected in tax systems. For example, the Swiss wealth tax, levied at the household level, features strong differential treatment of couple households vis-à-vis individuals in some cantons with substantial tax allowances. In the literature, horizontal equity considerations have been integrated into utilitarian social welfare functions (Balcer & Sadka, 1986; Muellbauer & Van De Ven, 2004). The empirical estimates of economies of scale in this paper can inform assessments of horizontal equity, by quantifying the welfare effects of sharing household wealth. My findings emphasize the importance of accumulation motives for assessing horizontal equity.

Household returns to scale for wealth are also subject to controversy when it comes to the measurement of wealth inequality (Cowell et al., 2017; Kuhn et al., 2020; Saez & Zucman, 2020; Sierminska & Smeeding, 2005). Measures of wealth usually refer to the household level. When analyzing 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 (Bover, 2010; Fessler et al., 2014). 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 & 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 & Saez, 2003; Piketty et al., 2018).[4] Finally, some contributions on wealth inequality strike a middle ground by adjusting household wealth for consumption economies of scale (Fisher et al., 2020; Jäntti et al., 2013). The approach presented in this paper provides a theoretically informed parameter for wealth returns to scale to household size. I explicitly take into account properties previously identified as desirable for this parameter (Cowell et al., 2017; Sierminska & Smeeding, 2005). For example, the scale effects depend on individual and household motives for wealth accumulation.

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 et al., 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 et al., 2015; Michaillat & Saez, 2021) and financial markets (Michau et al., 2023; Roussanov, 2010).

This paper's argument proceeds as follows. Section 2 formalizes the relative importance of different savings motives for household wealth accumulation, allowing returns to scale to differ across accumulation motives. Subsequently, section 4 introduces the SOEP data, before section 3 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

The goal of subsection 2.1 is to derive a functional form for linking wealth measured at the household or tax unit level to individual welfare. It derives an optimal allocation between consumption and wealth-in-utility savings at the household level. In a second step, subsection 2.2 combines the functions determining optimal be-

[4]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.

havior with a flexible family of equivalence scales describing economies of scale as a function of household size and a set of parameters. This yields an expression of equivalent wealth, lending itself to welfare analysis and further empirical estimation.

2.1 Accumulation Motives and Individual Utility

Accumulation models with wealth-in-utility preferences distinguish wealth held for consumption purposes from wealth that individuals own because they derive direct utility from wealth (wealth-in-utility savings). 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. Importantly, this captures several more specific motives for deriving direct utility from wealth accumulation, including the non-monetary benefits of home-ownership, bequests and status, as long as they enter utility as a type of luxury good. Secondly, wealth-in-utility preferences can be extended to feature economies of scale, which gives a neat framework to directly estimate wealth-in-utility savings scale effects as a structural model parameter.

Formally, the wealth-in-utility model introduces wealth as an argument in the utility function in addition to consumption. Households have a fixed initial wealth endowment w_k (which is a stock). Deciding on an allocation of resources between consumption c_k and wealth-in-utility savings s_k (both yielding utility directly), individuals i in households k face a one-period maximization problem. This setup resembles the approach of Carroll (1998), where individuals allocate their lifetime resources between consumption and savings and the stock of wealth left at the end of life corresponds to the savings flow out of the initial wealth endowment. Considering the remaining lifetime of each individual as one period is a simplification that yields an analytical solution and parsimonious expressions.[5] The

[5]Modelling the prevalence of different savings motives over the life-cycle may reveal that a larger share of wealth serves funding future consumption among individuals close to retirement as opposed to individuals at the end of their life-cycle, for example. Therefore, some applications may require adjusting wealth for age effects before deriving the optimal allocation between consumption and the share of wealth-in-utility savings. Whereas adjusting wealth for age is not the primary focus of this paper, an extensive literature discusses this issue. For example, Almås and Mogstad (2012) provide a methodology compatible with the adjustment discussed in this paper. In view of the one-period approach's capacity to serve as a structural model for estimating parameters empirically, the robustness checks demonstrate that the estimates of wealth-in-utility savings scale effects are not sensitive to controlling for age in the estimation, and to residualizing wealth for age.

latter can be used for household size adjustments and empirical estimation with low data requirements. With wealth in the utility function, individuals choose consumption levels to maximize utility over consumption and wealth-in-utility savings $s_k = w_k - c_k$:

$$\max_{c_k}\{u_i(c_k, w_k - c_k)\} \tag{1}$$

Next, I make an explicit assumption on the utility function, detailed in equation 2. The formulation of the utility function follows Bakshi and Chen (1996), assuming that consumption and wealth-in-utility savings enter utility in a multiplicative way. The utility function has a form similar to the one in Bakshi and Chen (1996), with two exponents ρ and λ, where λ is a scaling factor and $0 \leq \rho \leq 1$. The choice of a multiplicative utility function over an additive form as in Carroll (1998), for example, derives from its straightforward linearization. Moreover, I construct the wealth-in-utility savings 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. This gives a Cobb-Douglas utility function with consumption and wealth-in-utility savings.[6]

$$U_{i,k}(c_k, s_k|Z_{i,k}) = \left(\frac{c_k}{E}\right)^{\rho\lambda}\left(\frac{w_k - c_k}{T} + \gamma\right)^{(1-\rho)\lambda} \tag{2}$$

In this specification, consumption c_k and initial wealth w_k refer to household level concepts. Divided by the equivalence scales E and T, only some ("equivalent") fraction of total household resources enters individual utility. Importantly, it is possible that $E \neq T$. If scale effects were only a function of household size, perfect economies of scale and the access to wealth perspective would imply unity for E and T, while no benefits from sharing imply that the denominator corresponds to the household size (ownership perspective). It is important to note that the aim of this paper is to make wellbeing comparisons of individuals living in dif-

[6]The use of this type of preferences makes this paper closely related to other contributions that use Stone-Geary preferences in connection with Linear Expenditure Systems (Phlips, 1972).

ferent types of households (Decancq et al., 2015). Modelling economies of scale and equivalence scales as a part of individual utility functions as in equation 2 implies a utilitarian approach to welfare, where individual utility is the equalizandum.

Assuming that households choose welfare maximizing levels of consumption c_k^* and wealth-in-utility savings $s_k^* = w_k - c_k^*$, it is possible to derive the first order condition. This gives the following optimal level of consumption:

$$c_k^* = \rho \left(w_k + T\gamma \right) \tag{3}$$

Equation 3 illustrates has several important properties of optimal behavior. Firstly, with a positive γ parameter, this rule implies that the share of wealth-in-utility savings in total wealth will increase in total household wealth. Secondly, equation 3 illustrates that the importance of wealth-in-utility savings may differ across household types, depending on the magnitude of scale effects T. The lower the returns to scale to wealth-in-utility savings, the higher will be the share of wealth put aside for consumption in large households compared to small households. Finally, optimal consumption c_k^* is positively related to ρ, which reflects the parameter in the exponent of the utility function.

In addition to the form of the utility function, the approach outlined in this section entails further important assumptions. Firstly, the household is assumed to allocate wealth between consumption and wealth-in-utility savings in a joint decision.[7] Secondly, the model ensures that households cannot reach an optimum by accumulating negative wealth.[8] Therefore, I impose that $c_k^* \leq w_k$. Much like in the approach outlined by Carroll (1998), household consumption is constrained by the level of initial household wealth:

[7] A collective model of household behavior would require information on the sharing rule of wealth within the household. Potentially, individually owned assets may provide an indication of these shares - information that only a minority of wealth data sources offers. However, other factors may be relevant as well when it comes to the intra-household sharing of wealth-in-utility savings. To simplify the analysis and offer an approach that is implementable in the absence of individual wealth data, this paper builds on a unitary model.

[8] This guarantees that households with positive wealth will not have negative wealth once it is adjusted for economies of scale.

$$\bar{c_k} = \min(c_k^*, w_k) \tag{4}$$

This constraint gives rise to a kink in the consumption and savings function. One way to describe the resulting solution is the use of an activation function for the optimal level of wealth-in-utility savings. The activation function ensures zero wealth-in-utility savings at wealth levels where equation 3 implies negative wealth-in-utility savings, while maintaining the allocation from equation 3 where wealth-in-utility savings are positive. An activation function that is frequently used in economics and machine learning is the SoftPlus[9] function (Mian et al., 2021), which I will use to approximate the optimal policy with the borrowing constraint.

2.2 A Parametric Family of Equivalence Scales

The literature on household scale effects has found a number of ways to express and operationalize household scale effects. One approach that maintains flexibility and allows the incorporation of different assumptions on scale effects is to choose a parametric family of equivalence scales to represent E (Buhmann et al., 1988; Coulter et al., 1992). This paper combines E and T in a family of equivalence scales for household wealth. In principle, parametric families of equivalence scales have the following form,[10] where equivalized consumption $\tilde{c}$ is consumption c divided by the scale E, which is a function of c, household characteristics x and a set of parameters θ:

$$\tilde{c} = \frac{c}{E(c, x, \theta)} \tag{5}$$

The most common and simple choice of $E()$ is a power function of household size, where the exponent θ ranges between zero and unity.[11] In one extreme with

[9]The SoftPlus corresponds to $\mathrm{SP}(x) = \log(1 + \exp(x))$

[10]Household subscripts of c and x are omitted for simplicity.

[11]Most equivalence scales used in practice to adjust income for household size are well approximated by this functional form (Buhmann et al., 1988). However, it should be noted that some scales do not only take household size, but also age structure, into account when adjusting income or consumption for scale effects (Coulter et al., 1992; OECD, 2018). In

$\theta = 0$, economies of scale are perfect. In the other, $\theta = 1$ such that there are no economies of scale. The well-known square root equivalence scale is a special case where $\theta = 0.5$. Combining this parametric family of equivalence scales with the model set out in subsection 2.1 results in the replacement of E and T with functions of household size such that:

$$E = h^e \quad \text{and} \quad T = h^\tau \tag{6}$$

Thus, I maintain the idea that scale effects associated with consumption and wealth-in-utility savings may differ from each other. The equivalence scale for the initial wealth endowment w_k is a function of the scale effects parameters for consumption and wealth-in-utility savings, household size and wealth, in addition to γ and ρ. It follows from 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 wealth-in-utility component of total household wealth $\bar{s_k}$, and e to consumption $\bar{c_k}$. This gives an analogous expression to equation 5 for equivalized wealth $\mathcal{W}_k$:[12]

$$\mathcal{W} = \frac{\bar{s}}{h^\tau} + \frac{\bar{c}}{h^e} = \begin{cases} 0 & \text{if } w = 0 \\ \dfrac{w}{h^{\tau+e}\left[h^\tau + \frac{\text{SP}(w-\rho(w+h^\tau\gamma))}{w}(h^e - h^\tau)\right]^{-1}} & \text{if } w > 0 \end{cases} \tag{7}$$

Equation 7 is a tool to adjust household level wealth information for household scale effects. Following the logic of parametric equivalence scales, the denominator of equation 7 allows for a straightforward appraisal of the sensitivity of an outcome of interest to the choice of different values of the parameters. For example, when measuring dispersion in the distribution of wealth, one may vary the parameters to explore whether household size adjustments affect the conclusions on levels and trends of inequality. Alternatively, one may try to find reasonable values for the parameters. Subjective judgements of the analyst or other evidence on social values could inform the choice of plausible values. While a large literature exists

particular, one may argue that children should be considered to impose lower costs on households than adults. I explore this proposition by estimating scale effects for households with and without children separately. The results of this exercise are summarized in section A.3 in the appendix.

[12]Again, dropping subscript k for $\mathcal{W}$, w and h, $\bar{s}$ and $\bar{c}$ in equation 7.

on the equivalence elasticity for consumption e,[13] the following section offers a methodology to recover the parameters ρ and τ from survey data taking e and γ as given.

3 Estimation Framework

Having derived the optimal allocation between consumption and wealth-in-utility savings and an equivalence scale to adjust household wealth for size, I use this information to estimate the parameters of the equivalence scale in equation 7. e is fixed to 0.5, which is a standard and widely used parameter to account for economies of scale regarding 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, the appendix A.4 explores the sensitivity of the results with respect to the parameter γ. The parameters τ and ρ are of primary interest in the following.

The identification starts with the assumption that households allocate wealth between consumption and wealth-in-utility savings optimally.[14] Therefore, it is possible to substitute the expressions for optimal consumption and wealth-in-utility savings based on equations 3 and 6 back into the utility function set out in equation 2. The structural model in equation 8 follows:

$$U(c_k, s_k) = \left(\rho \frac{[w_k + h_k^{\tau}\gamma]}{h_k^e}\right)^{\rho\lambda} \left([w_k + h_k^{\tau}\gamma]\,[1-\rho]\,h_k^{-\tau}\right)^{(1-\rho)\lambda} \tag{8}$$

To facilitate the empirical estimation, the results rely on a linearized version of equation 8. Taking the logarithms of equation 8 yields the following specification:

$$\log(U_{i,k}) = \delta + \lambda\log(w_k + h_k^{\tau}\gamma) + \zeta\log(h_k) + \eta_{i,k} \tag{9}$$

where

[13] For reviews see Coulter et al. (1992, 1992), Cowell and Mercader-Prats (1999), Lewbel and Pendakur (2006), and Schröder (2009).

[14] The estimation relies mainly on c^* and s^* as the optimal policy. This approach facilitates the linearization of the estimation equations and ensures algorithmic convergence of the estimator. In appendix A.1, I show that the conclusions drawn from models based on the constrained values of consumption and wealth-in-utility-savings yield qualitatively similar results.

$$\zeta = \lambda \left(e\rho + \tau(1-\rho) \right) (-1) \tag{10}$$

In addition to year fixed effects, the specification also features an error term $\eta_{i,k}$ and the intercept δ, which includes the constants remaining from the linearization of equation 8. In addition to a household index k, the dependent variable and the error also feature an index i identifying individuals in the household. This reflects the fact that utility is an individual concept, and that questions related to wellbeing are answered by several individuals within a household. I estimate equation 9 at the household member level.

The second assumption necessary for the identification is that utility can be approximated by direct survey responses on subjective satisfaction with economic outcomes (stated preferences). If it holds, equation 9 can be estimated directly from survey data. An exhaustive body of literature shows that stated preferences are suitably approximating individual utility (Frey & Stutzer, 2002; Kaiser & Oswald, 2022). Therefore, a number of studies has employed such data to identify structural parameters in utility functions (de Ree et al., 2013; Layard et al., 2008). The use of data on satisfaction with economic outcomes is particularly popular in the recent literature on economies of scale (Abanokova et al., 2022; Spitzer et al., 2022). Note that satisfaction is a specific type of utility. It 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 et al., 2015).

The estimator in the main specification is based on a binary logit link function to map the nonlinear predictor of equation 8 and the control variables into the ordinal variable. In addition to the ordinal results, I show that the estimates are similar to the results obtained from a non-linear least squares estimator.

Drawing welfare comparisons between individuals in different household types requires taking into account that people may enjoy living in larger households. 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. Only then are returns to scale estimated unconditionally, rather than conditional given the choice of household size (Pollak & Wales, 1979).

While there is no obvious way to directly test for the effect of the utility from children in this paper's setup, it is informative to consider survey data on the desired number of children that people would ideally like to have. If perefrences over children are reflected in this paper's wellbeing measure, individuals who have more than their ideal number of children will report lower wellbeing. The results in the appendix related to this question suggest that the measure of economies of scale captures utility from children to some extent, though this is unlikely to affect the estimates dramatically.[15]

A second threat to identification is unobserved individual heterogeneity that correlates with the measure of individual welfare employed in this paper. 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 a battery of robustness checks that aims to capture this heterogeneity. This includes controlling for a set of observable characteristics that are known to affect responses to wellbeing questions, such as marital status, gender and employment status. The robustness checks also offer specifications with individual fixed effects. 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.

4 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

[15] A regression of a dummy variable identifying individuals who have more than their ideal number of children on the measure of satisfaction used in this paper suggests that individuals with an excess number of children tend to report marginally lower levels of wellbeing, on average. This relationship is statistically significant, but small in magnitude compared to the effects of other variables usually used to explain subjective wellbeing.

on the subjective wellbeing outcomes, which this treatment employs for identification. Generally, the SOEP follows a "mixed mode approach" for interviews. The most prominent interview mode is computer-assisted personal interviewing (CAPI). Other interview modes include interviews carried out in written correspondence via email, for example.

For subjective wellbeing, 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. Schwarze (2003) demonstrates using SOEP data that the equivalence scale elasticities obtained from the collapsing of the ordered response variable with multiple categories into a binary variable does not affect the results. While satisfaction data generally comes in more than two categories, collapsing a more granular variable into two categories results in a loss of information. Yet, this simplification is necessary to obtain reliable parameter estimates while still treating satisfaction as a categorical measure. To obtain a binary response variable, I assign all individuals with satisfaction levels of seven or higher "high satisfaction", and "low satisfaction" to the other respondents, which ensures that each group contains approximately 50% of respondents. Satisfaction is measured at the household member level, such that there are multiple measures of satisfaction in each household. However, the question refers to satisfaction with household resources, making the question ideal to study economies of scale. Figure 9 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. This is the sum of all household members' individual reported asset 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 the composition of wealth is taken into account. 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

Table 1: Descriptive Statistics

Variable	Min	Median	Mean	Max	SD
Household					
Gross wealth (in Thousands)	0	94.91	219.56	72085	854.97
HH size (n)	1	2	2.38	13	1.36
Individual					
Satisfaction (Likert Scale)	0	7	6.43	10	2.24
Satisfaction (Binary)	0	1	0.56	1	0.49

[a] Note: Minimum, mean, median, maximum and standard deviation for the key variables at household and individual level. Multiple imputations taken into account. Observations pooled across all waves (2002, 2007, 2012, 2017).
[b] Source: SOEP v.35, own calculations.

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 & Westermeier, 2015).

To ascertain the robustness of the findings, I use control variables. Additional household and individual characteristics include respondent age as well as gender, whether they are a German citizen, their marital and employment status (employed/unemployed), respondent years of education, and the type of a households neighborhood area (residential/mixed/commercial/industrial).

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. "HH 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.

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 comprizing four members have less than three times the amount of wealth that single households own.

Figure 1: Mean Wealth by Household Size
[FIGURE 1 HERE]

[a] Note: Mean gross wealth by household size for households with one to four members.

[b] Source: SOEP v.35 (Waves: 2017), own calculations.

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 ρ in subsections 5.1 and 5.2. While 55,254 household-wave observations with valid information on household wealth and composition exist for the years 2002, 2007, 2012 and 2017, it is 95,495 individuals aged 18 years and above in 55,016 household-wave observations that 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.

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, models control for wave fixed effects unless stated otherwise. The underlying value of γ is 750,000, while the equivalence scale elasticity for consumption is assumed to be 0.5, which is the commonly used square root scale. I do not report the underlying parameters λ and ζ from equation 10, since they do not feature in the equivalence scale in equation 7. Of course, it is possible to arrive at their values as set out in section 3. Standard errors are reported in parentheses.

Table 2: Main Results: Income Satisfaction

Coefficient	Logit	NLS	Probit
τ	0.001	0.001	0.065
	(0.003)	(0.001)	(0.002)***
ρ	0.097	0.044	0.092
	(0.003)***	(0.001)***	(0.002)***
Fixed effects	Time	Time	Time

[a] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Standard errors in parentheses.
[b] Source: SOEP v.35, own calculations.

5.1 Parameter Estimates

Based on the SOEP data, table 2 presents the estimates for τ and ρ, the former referring to the scale effects elasticity for wealth-in-utility savings and the latter to the exponent in the utility function. For the main results, I do not include any control variables except wave fixed effects, and simply focus on the estimation of the regression equation detailed in section 3. The first model refers to the baseline logit-model with the binary measure of satisfaction as the dependent variable. The second column reports the estimates for a non-linear least squares (NLS) approach that treats the discrete integer measuring subjective economic wellbeing similar to a continuous linear variable. Finally, column three refers to a probit model, with the same outcome variable as in the first column.

The results in the first column imply that τ is close to zero. Yet, the estimate is not statistically different from zero. The coefficient magnitude is 0.001, in line with the idea that economies of scale are high for wealth-in-utility savings. Using the estimates for λ, ζ and τ, and exploiting prior information implying that $e = 0.5$, ρ follows. This yields an estimate of 0.097. The estimate is statistically significant at the 0.1 percent level.

The second column in table 2 summarizes the results of a version of the baseline model with an integer 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 uses the full range of information that the 10 level scale of wellbeing offers. For the linearization requires taking the logarithm at both sides of equation 8, the Likert-scale outcomes are transformed using a log transformation. Column 2 suggests in line with the findings from column 1 that τ is very close to zero. However, the estimate has a smaller standard error. Still, τ is not different from zero in terms of statistical significance according to the non-linear least squares estimate. The estimate of ρ is below the estimate reported in the first column. In this specification ρ amounts to 0.044. While the coefficient magnitude falls, it is still statistically significant.

Rather than relying on a logit model as in the first column, the third column describes a model based on the probit link function. According to the probit model, the estimate of τ increases compared to the previous two specifications. It is now at 0.065. Compared to the logit specification, the parameter is estimated with a somewhat higher precision, such that it is statistically significant at conventional levels. The estimate of ρ is 0.092, which is very close to the estimate reported in the first column.

5.2 Estimation Sensitivity Analysis

Table 3 provides additional specifications to explore the robustness of the results, reporting the same statistics as table 2. As opposed to the table 2, each specification discussed in this subsection features basic demographic control variables, set out in section 4. All models in the table refers to a binary response logit model as in column 1 of the table 2.

To begin with, the first column in table 3 simply adds further demographic control variables to the initial specification which are known to impact survey respondents' perception of subjective wellbeing outcomes. Both τ and ρ increase marginally to 0.05 and 0.12 respectively relative to the baseline logit model in table 2. Paralleling the results from the baseline model, the estimate for τ remains statistically insignificant, while ρ is highly significant at the 0.1 percent level.

The next column presents a model that controls for the household portfolio composition and other additional wealth-related variables. It extends the baseline model by adding control variables for the share of household wealth held in the household's main residence, business wealth, and the share of household wealth held in financial assets, in addition to demographic control variables. Moreover, I control for the share of household wealth owned by the respondent, as opposed to other household members. Finally, I also take into account whether a household

Table 3: Robustness Analysis

Coefficient	Controls	Portfolio Composition	Credit Constraints	Age Residualised	Net Wealth	Individual FE
τ	0.058	0.084	0.108	0.072	0.086	0.01
	(0.048)	(0.038)*	(0.048)*	(0.246)	(0.095)	(0.24)
ρ	0.12	0.093	0.12	0.26	0.018	0.152
	(0.004)***	(0.005)***	(0.005)***	(0.003)***	(0.002)***	(0.695)
Fixed effects	Time	Time	Time	Time	Time	Individual

[a] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Standard errors in parentheses.

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

has debt. The estimate of τ increases again slightly, ranging at 0.08 in the second model of table 3. In contrast to the previous estimates that are based on logit models, the coefficient estimate is statistically significant at the 5 percent level. The estimate of ρ is close to the baseline estimate at 0.093, and highly significant in statistial terms.

Subsequently, the column labelled "Credit constraints" adds a control variable for household credit constraints to the demographic set of controls. The specification uses an indicator assuming unity if liquid assets fall below two months of household income to measure credit constraints (Jappelli et al., 1998). 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 estimate for τ corresponds to 0.11. As in the model that considers portfolio composition, the coefficient estimate is statistically significant. The estimate of ρ corresponds to 0.12, and parallels the results in the baseline model in terms of statistical significance.

The fourth column explores the sensitivity of the estimates to lifecycle effects. While previous models include age as a control variable, column 4 is based on a residualized measure of household wealth. Residualized wealth are residuals from a regression of household gross wealth on a flexible age polynomial, corresponding to a piecewise polynomial function of age with three knots at 25, 50 and 75. The appendix illustrates wealth and residualized wealth graphically as a function of age. The estimate of τ does not differ substantially from previous estimates. At 0.72, it is higher in magnitude than the baseline estimate. However, it is not statistically significant at conventional levels. In contrast, the ρ estimate more than doubles compared to the baseline estimates, amounting to 0.26 in the model with age residualized wealth. The estimate is also statistically significant.

Next, the fifth column "Net wealth" changes the underlying wealth measure from gross wealth to net wealth. This approach requires a substitution of the log specification in equation 9, since net wealth can be negative. To ensure that the model can be estimated, I use the inverse hyperbolic sine transformation instead of the log in this specification. The estimate of τ is above the estimates obtained from gross wealth. Even though the estimate ranges at 0.086, it is not statistically significant. The estimate of ρ is below the baseline estimate: According to the model in column 5, ρ correspond to 0.02. The estimate is statistically significant at conventional levels.

Finally, the last column in table 3 introduces individual fixed effects. This specification does not allow accounting for survey weights. Therefore, the results are not fully comparable to the other estimates offered in this section. Even so, the estimate for τ is relatively close to the baseline estimate, corresponding to 0.01. ρ is estimated to be higher than in the baseline model, amounting to 0.152. It is noteworthy that this estimate is relatively imprecise, and cannot be distinguished from zero in view of its statistical significance.

The robustness checks suggest that taking into account demographic factors and further control variables instead of relying on a very simple model may overall lead to somewhat higher estimates of both τ and ρ. However, 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 favor of the main finding: $\tau < e$. It also gives additional credibility to the idea that the exponent of the consumption argument in the utility function, ρ, is smaller in magnitude than the exponent of the argument with wealth-in-utility savings $(1 - \rho)$.

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 wealth-in-utility savings 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.

5.3 Consumption and Wealth-in-Utility Savings

Before showing the results for equivalized wealth $\mathcal{W}_k$ using the parameter estimate of τ, figure 2 illustrates the mechanics of scale effects at a given level of ρ (0.07, corresponding to the rounded average from the main specifications in table 2). The illustration is based on a household comprizing five individuals. The three panels refer to different levels of household initial wealth (w_k), from (€ 10,000) low to high (€ 1,000,000). On the x-axis, the equivalence scale elasticity for consumption e changes from zero to one. The y-axis refers to τ. The shade refers to the equivalence scale for household wealth ($w_k/\mathcal{W}_k$). The darker the shade, the higher the equivalence scales. Figure 2 illustrates important dynamics. The implications of varying e and τ differ for households at different levels of wealth. The different shadings of the panels make the importance of initial wealth explicit. For instance, considering the first panel only, it is evident that changes in τ do not affect the scale effects for total wealth at low levels of wealth. At € 10,000 in w_k, all wealth is consumed such that only e matters. At higher levels of wealth w_k, total scale effects for wealth are a negative function of both e and τ.

Figure 2: Household Wealth Relative to Equivalized Wealth along τ and e
[FIGURE 4 HERE]

[a] Note: Shade refers to ratio of household wealth w_k relative to equivalized wealth $\mathcal{W}_k$. The x-axis displays different values for $e \in [0; 1]$. The y-axis refers to $\tau \in [0; 1]$. $\rho = 0.07$ $\gamma = 750,000$. Planes refer to different levels of w_k. Simulation for 5-person household.

[b] Own calculations.

Next, I use the estimates of both τ and ρ to derive the proportion of consumption vis-à-vis wealth-in-utility savings for each household. τ is taken to be 0.02 - again the average of point estimates from table 2. Combining this information with data on gross wealth yields for each household k the level of wealth accumulated for the purpose of consumption $\bar{c_k}$ and $\bar{s_k}$.

Figure 3 illustrates the result. It shows the share of wealth-in-utility savings along the distribution of gross wealth across 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 wealth-in-utility savings 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 wealth-in-utility savings for each household:

$$\sum_{i=1}^{n}\{y_i - g(x_i)\}^2 + \lambda \int g''(x)^2 dx \tag{11}$$

Figure 3: Share of Wealth-in-Utility Savings by Percentiles
[FIGURE 3 HERE]

[a] Note: Share of wealth-in-utility savings (ordinate) by percentile of household gross wealth (abscissa). Smoothed estimate. Lower cutoff at percentile 20. Lines represent different household sizes, $\tau = 0.02$ and $\rho = 0.07$.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

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 47^{th} percentile in 2017. This cutoff point is slightly above the median in 2002. As household wealth increases, the share of wealth-in-utility savings approaches $1 - \rho$. 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 tend to allocate more wealth to consumption than smaller households. This results from the τ parameter in equation 3, which determines c_k^* and hence $\bar{c_k}$.

Following the adjustment set out by equation 7 yields $\mathcal{W}_k$. While for single households, $\mathcal{W}_k = w_k$, this is not true for households with more than one member, where it generally holds that $\mathcal{W}_k < w_k$. Since the share of wealth held for consumption purposes is particularly high among households with a low level of assets, the equivalization 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 4. It plots equivalized wealth $\mathcal{W}_k$ as a share of unadjusted wealth w_k for different household sizes by equivalized 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.

Figure 4: Ratio Equivalized to Household Wealth
[FIGURE 4 HERE]

[a] Note: Ratio of equivalized wealth $\mathcal{W}_k$ to household wealth w_k (ordinate) by quintile of the gross wealth distribution (abscissa), $\tau = 0.02$ and $\rho = 0.07$

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

Table 4: Scale Effects and Inequality

	Gini		Palma	
	unadjusted	adjusted	unadjusted	adjusted
2002	0.72	0.74	60.9	73.3
2007	0.72	0.74	58.1	69.3
2012	0.70	0.71	50.2	60.6
2017	0.71	0.71	62.4	73.9

[a] Note: $\tau = 0.02$, ρ =0.07.
[b] Source: SOEP v.35, own calculations, own calculations.

6 Equivalized 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 summarized, 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 are more sensitive to high-leverage outliers than others (Cowell & Flachaire, 2007). Therefore, the higher the influence of high-leverage observations at the top for a given inequality measure, the lower will be the impact of the scale effects adjustment on inequality, which mainly affect wealth at the lower part of the wealth distribution. Table 4 examines 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.

Overall, table 4 suggests that there is some impact of the household scale effects adjustment on the Gini coefficient. The changes are most pronounced in

Table 5: Household Size Adjustment and Inequality: Palma Ratios

	2002	2007	2012	2017
Household wealth: w_k	60.90	58.09	50.18	62.41
Wealth scale: $\mathcal{W}_k$	73.33	69.32	60.61	73.89
Square root scale: $w_k/\sqrt{h}$	53.09	51.83	45.60	56.31
Modified OECD Scale	52.10	51.14	45.01	55.67

[a] Note: $\tau = 0.02$, ρ =0.07.
[b] Source: SOEP v.35, own calculations, own calculations.

earlier waves of the SOEP, while in 2017, the indicator does not change at all. In the earlier waves, the index increases by one to two percentage points. The second pair of columns in table 4 displays the effect of adjusting for household scale effects on distributional outcomes in terms of the Palma ratio. The ratio summarizes 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 10 units across all indicators, with a maximum increase in the 2012 wave amounting to 20.7%.

It is noticeable that the household size adjustment proposed here differs from household size adjustments commonly employed to adjust household consumption or income. Using the square root scale or the modified OECD-scale, distributions tend to become more equal compared to an adjustment based on the factor of unity (w_k in table 5). Applying the modified OECD-scale or the square root scale to the wealth distribution has similar effects, leading to less dispersion. Table 5 illustrates this. For example, in 2017, the Palma ratio for household gross wealth is 62.41. 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 equivalized distribution for 2017 has a Palma ratio of 73.89. Despite the dramatic 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 equivalization 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 A.5 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, households hold wealth for reasons that go beyond consumption. This is especially true at the top 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 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 wealth-in-utility savings. An empirical application to the measurement of wealth inequality suggests that scale effects have significant distributional implications for some inequality indicators and affect cross-country comparisons of inequality.

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, making theoretical assumptions explicit. The estimation results suggest that household economies of scale are almost perfect for wealth-in-utility savings - 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 disequalizing 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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A Appendix

A.1 Constrained Consumption

In section 3, the optimal consumption level derives from equation 3, before both c_k^* and s_k^* are constrained such that there is no negative level of wealth-in-utility savings. This appendix uses the constrained values $\bar{c_k}$ and $\bar{s_k}$ to estimate the parameters ρ and τ directly. Therefore, I estimate the following specification:

$$\begin{aligned} \log(U_{i,k}) = \delta + \lambda\rho\log(w_k - SP(w_k - \rho(w_k + h_k^\tau\gamma)) \\ + \lambda(1-\rho)\log(h_k^\tau\gamma + SP(w_k - \rho(w_k + h_k^\tau\gamma)) + \eta_{i,k} \end{aligned} \tag{12}$$

This specification features more non-linearities compared to the initial model set out in equation 8. Therefore, it is harder to achieve convergence of the estimation algorithm. Table 6 presents results that parallel the setup in the models presented in the tables 2 and 3.

The first column uses a logit link function to map the non-linear predictor into the binary measure of economic wellbeing. The estimate of τ is marginally above the estimate in the main specifications in table 2, corresponding to 0.059. This is still relatively close to zero, though the estimate is highly significant in statistical terms. The estimate of ρ is also above the estimate in the main table, ranging at 0.15 in the first column of table 6. Again, this estimate is highly significant.

The second column in table 6 reports the estimates from a logit model with the same binary outcome variable as in the first column. However, in contrast to the first column, this model features individual fixed effects. The estimate of τ is 0.038, and precisely estimated to be different from zero. The estimate for ρ is 0.205, which is again above the results reported in the baseline results. Introducing fixed effects have a similar effect in this model as above in table 3 on the standard error of ρ, which increases substantially. As a result, the ρ estimate that is high in magnitude is not statistically significant.

Overall, the results confirm the findings presented as main results. The estimate of τ is close to zero, though in both specifications slightly larger than in the baseline results. Likewise, ρ estimate is elevated in magnitude. This range is consistent with the range of estimates presented in the tables 2 and 3. However, all estimates lie within the range of estimates reported in either the main results

Table 6: Robustness Analysis: Constrained consumption

Coefficient	Logit	Individual FE
τ	0.059	0.038
	(0.002)***	(0.01)***
ρ	0.156	0.205
	(0.027)***	(0.198)
Fixed effects	Time	Individual

[a] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Standard errors in parentheses.
[b] Source: SOEP v.35, own calculations.

or other results in the sensitivity analysis.

A.2 Life-cycle effects

Wealth accumulation is a phenomenon closely associated with the lifecycle. Figure 5 illustrates this idea, providing a smoothed estimate of mean wealth over the lifecycle. Indeed, wealth is strongly dependent on age.

Figure 5: Household mean gross wealth over the lifecycle
[FIGURE 5 HERE]

[a] Note: Smoothed estimate (cubic spline, 10 knots) of mean gross wealth over the lifecycle, pooled across waves for first implicate.
[b] Source: SOEP v.35 (Waves: 2002, 2007,2012, 2017), own calculations.

For this reason, I control for age in all models summarized in table 3. As an additional robustness check, the table offers estimates of the model parameters based on wealth residualized for age. Figure 6 shows that the residualized measure of wealth does not exhibit a strong age dependence any more.

A.3 Children and Fertility Choice

This appendix studies differences in economies of scale between households with children and households without children. Among the former, it also zooms in

Figure 6: Residualized household mean gross wealth over the lifecycle
[FIGURE 6 HERE]

[a] Note: Smoothed estimate (cubic spline, ten knots) of residualized mean gross wealth over the lifecycle, pooled across waves for first implicate. Residuals follow from a regression of wealth on individual age with a b-spline term (cubic, three knots).

[b] SOEP v.35 (Waves: 2002, 2007,2012, 2017), own calculations.

on subjective economic wellbeing among individuals who have a higher number of children than they would have ideally according to their stated preferences. The analysis of children is illuminating for two reasons.

Firstly, research on economies of scale for consumption suggest consistently that the additional cost of children to a household are lower than the additional cost of an adult. As a result, estimates of scale effects will be higher if household size increases due to the presence of children rather than the presence of additional adults. Analyzing households with and without children separately allows to test whether a similar sensitivity exists for wealth economies of scale. The first pair of columns in table 7 replicates the first model of the results in table 3 for households without children (column 1) and households with children (column 2) respectively.

Secondly, considering households with children can shed light on the nature of the scale effects estimates that this paper recovers. As section 3 details, the interpretation of the scale effects measured in this paper as either conditional on household size or unconditional (i.e. accounting for the utility individuals derive from having children) depend on the sensitivity of the wellbeing measure to preferences over the number of children. Therefore, the third column in table 7 estimates the difference in wellbeing between individuals who have as many children as they ideally would like to have, and individuals with more children.

Reducing the sample to individuals without children (aged below 15 years) has implications for the results. In the first column of table 7, based on a logit model with controls suggests that τ is higher among households without children, such that economies of scale are lower. The estimate of τ increases to 0.24, and proves to be highly significant in statistical terms. The impact of reducing the sample to childless households is much more limited in view of the estimate of ρ. The estimate is 0.086, statistically significant at the 0.1 percent level. The next column considers households with at least one child exclusively. The estimate of

Table 7: Robustness Analysis: Children

Coefficient	No children	1 child	Ideal children
τ	0.241	0.085	
	(0.024)***	(0.004)***	
ρ	0.086	0.163	
	(0.009)***	(0.007)***	
Want less children			-0.026
			(0.007)***
Fixed effects	Time	Time	

[a] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Standard errors in parentheses.
[b] Source: SOEP v.35, own calculations.

τ is close to the estimates reported in table 3, and statistically significant. At the same time ρ is estimated to 0.163 among households with at least one child. Overall, these results are consistent with the expectation of a lower scale effects parameter in the presence of children.

Finally, the last column of table 7 estimates a model where the binary measure of subjective economic wellbeing is still the dependent variable, but the regressors are the set of demographic controls used in the previous two columns as well as an indicator on whether the number of children in an individual's household is consistent with their preferred number of children. Since this data is only available in the 2012 SOEP wave, the wave fixed effects are dropped. The statistically significant coefficient on the dummy variable indicating that the respondent has more children than they would prefer suggests that there is an influence on reported wellbeing. However, compared to the impact of demographic variables such as gender and age, this effect is moderate.

A.4 Assumptions on γ

This section offers further robustness checks in view of assumptions made on the parameter γ. This is necessary, because γ features in the empirical model that is estimated in tables 2 and 3. Against this backdrop, table 8 explores the sensitivity of the parameter estimates in the first column of table 3 in view of different

Table 8: Robustness Analysis: γ

Coefficient	γ 1. mio	γ 500k	γ 250k
τ	0.08	0.036	0.049
	(0.045)	(0.042)	(0.039)
ρ	0.091	0.174	0.298
	(0.005)***	(0.003)***	(0.002)***
Fixed effects	Time	Time	Time

[a] Note: * p<0.05; ** p<0.01; *** p<0.001. Survey weights and multiple imputations taken into account. Standard errors in parentheses.
[b] Source: SOEP v.35, own calculations.

assumptions on the γ parameter.

The first column increases γ to 1,000,000. Compared to the first column in table 3, this results in a marginal increase in the estimated value of τ, though the coefficient remains statistically insignificant. The estimate of ρ falls slightly to 0.091, while maintaining its statistical significance. Next, column 2 is based on a γ value of 500,000, which is below the one used in the main part of this paper. The estimate of τ drops to 0.036, while remaining statistically indistinguishable from zero at conventional levels. The parameter estimate for ρ increases to 0.174. Finally, the last column in table 8 reports estimates based on a γ value of 250,000. Again, τ remains robustly close to zero, maintaining statistical insignificance. ρ, in contrast, increases further to 0.298

Overall, it seems to be the case that it is primarily the estimate of ρ that is sensitive to different assumptions on γ. A negative relationship exists: The higher γ, the lower the estimate of ρ. In contrast to ρ, τ is relatively robust.

A.5 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 wellbeing of households within the Eurozone. Modelled after the Survey of Consumer Finances

Figure 7: Comparative Effect of Scale Effects Adjustment
[FIGURE 7 HERE]

[a] Note: Impact of using the household size adjustment for wealth across countries. Across countries, the figure applies $\tau = 0.02$ and $\rho = 0.07$.

[b] Source: ECB 2017, own calculations.

(SCF), the HFCS covers household balance sheets, income and employment characteristics, demographics, and a set of behavioral 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 provides detailed methodological reports (European Central Bank, 2020).

In order to arrive at results comparable to those of the SOEP, I harmonize definitions. The underlying wealth concept in figure 7 and table 9 is gross wealth. Moreover, I deduct the value of vehicles from the gross-wealth measure. Results for the Gini coefficient are reported. Croatia, Hungary and Slovakia see the most substantial relative increases in the Palma ratio and the Gini coefficient respectively.

A.6 Further Descriptive Statistics

This section provides additional descriptive statistics, supplementing table 2 and figure 1. First, figure 8 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 gross wealth.

Figure 9 summarizes the distribution of the dependent variable. Before I collapse income satisfaction into a binary variable, it ranges from 0 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 satisfaction is slightly skewed to the left. A sharp drop exists between four and five, where a

Table 9: Cross-National Evidence - Gross Wealth

	Gini		Palma	
Country	Unadjusted	Adjusted	Unadjusted	Adjusted
AT	0.72	0.73	40.66	48.39
BE	0.59	0.59	6.95	7.34
CY	0.71	0.72	17.22	19.70
EE	0.69	0.72	14.93	18.11
FI	0.61	0.62	10.84	11.95
FR	0.64	0.65	16.87	19.80
GR	0.57	0.61	6.54	8.68
HR	0.60	0.65	6.58	9.39
HU	0.63	0.67	7.70	9.97
IE	0.63	0.64	10.58	11.92
IT	0.61	0.62	9.30	11.20
LT	0.58	0.61	4.95	6.12
LU	0.62	0.62	8.58	8.87
LV	0.67	0.70	15.78	18.55
MT	0.59	0.60	5.58	6.23
NL	0.62	0.63	15.78	17.90
PL	0.56	0.60	5.05	6.71
PT	0.64	0.67	9.07	11.80
SI	0.59	0.61	6.47	7.92
SK	0.51	0.56	3.57	4.89

[a] Note: $\tau = 0.02$, $\rho = 0.07$.
[b] Source: HFCS 3rd wave 2017, own calculations.

substantial majority rates satisfaction above at five and above.

A.7 Weighed Results by Household Size

This section refers to the application of wealth equivalence scales to inequality measurement. In contrast to the results reported in section 6, I reproduce the key statistics, while multiplying the population weights of each household by the number of its members. I employ the same measure for $\mathcal{W}_k$ as in the main analysis. In the following table 10, table 4 is reevaluated with weights reflecting household size.

Figure 8: Average Gross Wealth by Decile of the Gross Wealth Distribution
[FIGURE 8 HERE]

[a] Note: 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.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

Figure 9: Distribution of Income Satisfaction
[FIGURE 9 HERE]

[a] Note: Income satisfaction responses by survey wave.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

References

European Central Bank. (2020). *The household finance and consumption survey: Methodological report for the 2017 wave.* Publications Office.

Figures for "Household Economies of Scale for Wealth: The Benefits of Sharing with Wealth-in-Utility"

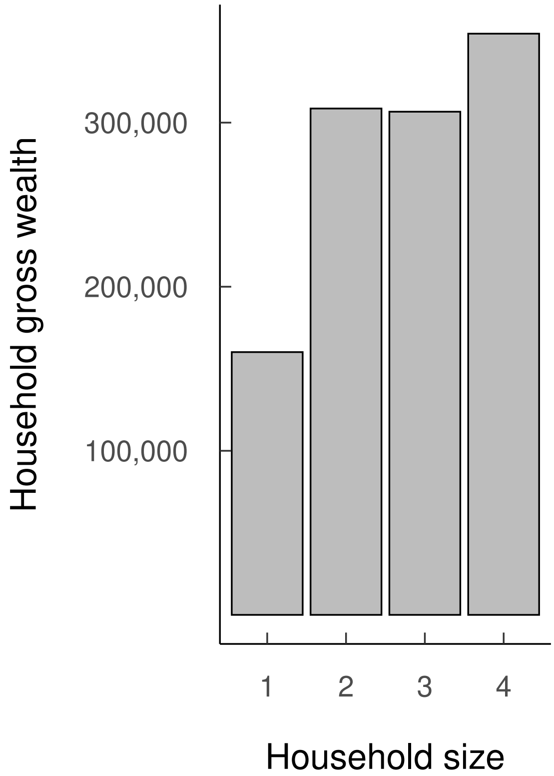
August 2, 2024

Table 10: Scale Effects and Inequality Weighted by Household Size

	Gini		Palma	
	unadjusted	adjusted	unadjusted	adjusted
2002	0.69	0.71	39.3	54.5
2007	0.69	0.71	35.8	49.5
2012	0.67	0.68	28.6	39.3
2017	0.67	0.69	36.5	49.4

[a] Note: τ = 0.02, ρ =0.07.
[b] Source: SOEP v.35, own calculations, own calculations.

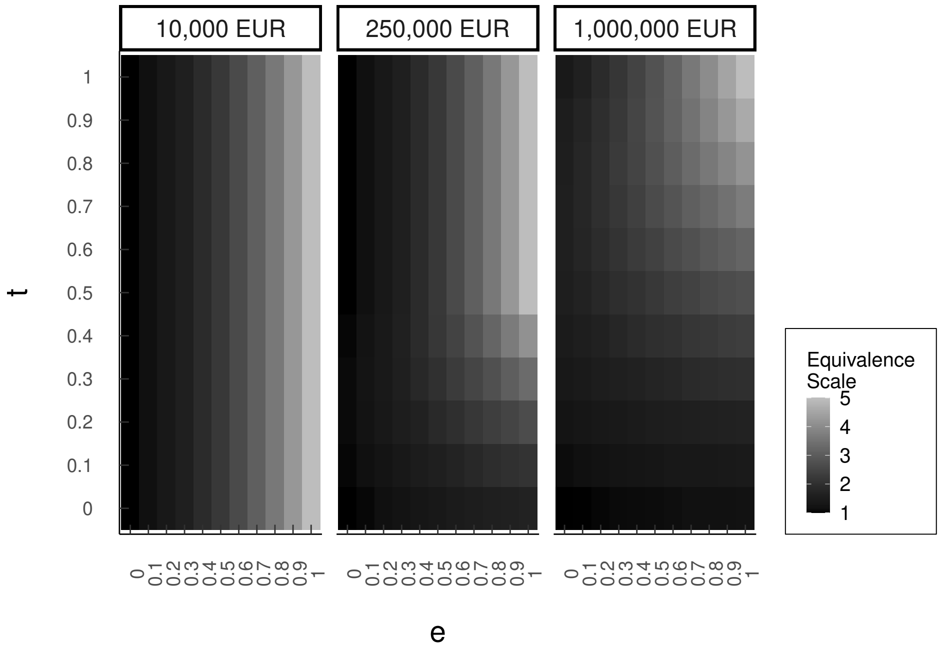
Figure 1: Mean Wealth by Household Size



[a] Note: Mean gross wealth by household size for households with one to four members.

[b] Source: SOEP v.35 (Waves: 2017), own calculations.

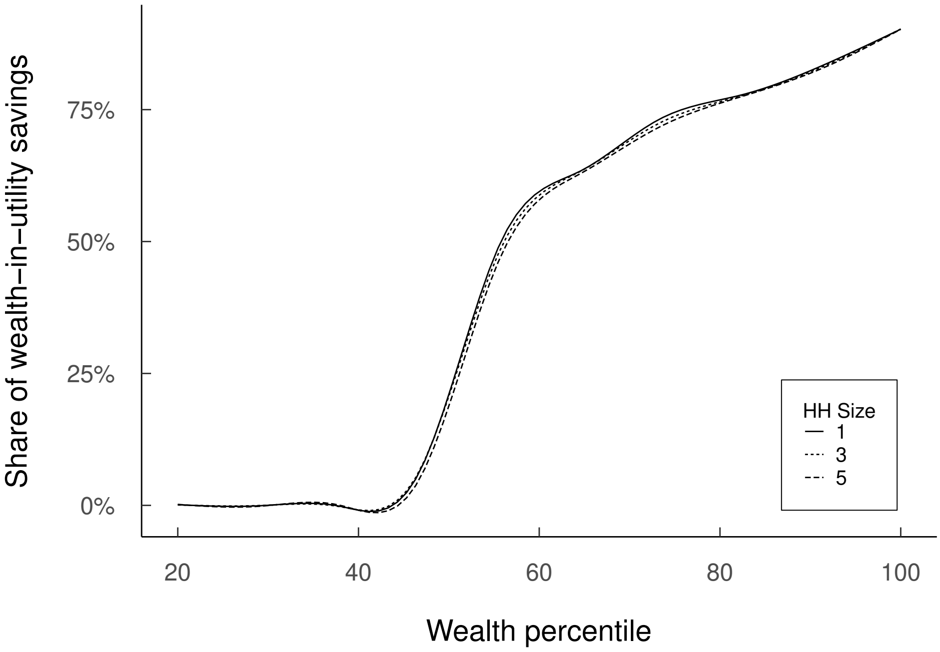
Figure 2: Household Wealth Relative to Equivalized Wealth along τ and e



[a] Note: Shade refers to ratio of household wealth w_k relative to equivalized wealth $\mathcal{W}_k$. The x-axis displays different values for $e \in [0; 1]$. The y-axis refers to $\tau \in [0; 1]$. $\rho = 0.07$ $\gamma = 750,000$. Planes refer to different levels of w_k. Simulation for 5-person household.

[b] Own calculations.

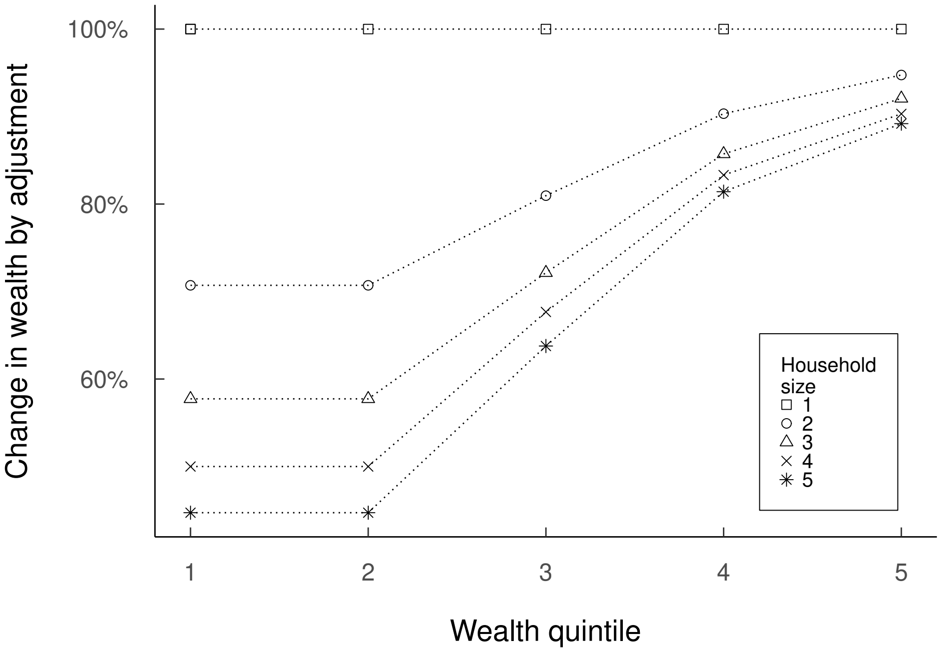
Figure 3: Share of Wealth-in-Utility Savings by Percentiles



[a] Note: Share of wealth-in-utility savings (ordinate) by percentile of household gross wealth (abscissa). Smoothed estimate. Lower cutoff at percentile 20. Lines represent different household sizes, $\tau = 0.02$ and $\rho = 0.07$.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

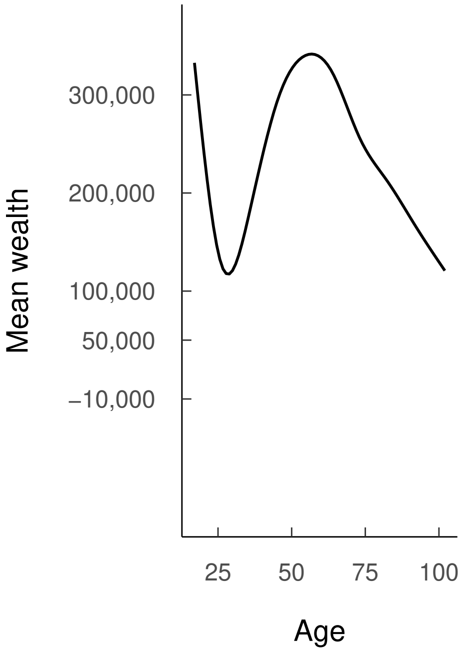
Figure 4: Ratio Equivalized to Household Wealth



[a] Note: Ratio of equivalized wealth $\mathcal{W}_k$ to household wealth w_k (ordinate) by quintile of the gross wealth distribution (abscissa), $\tau = 0.02$ and $\rho = 0.07$

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

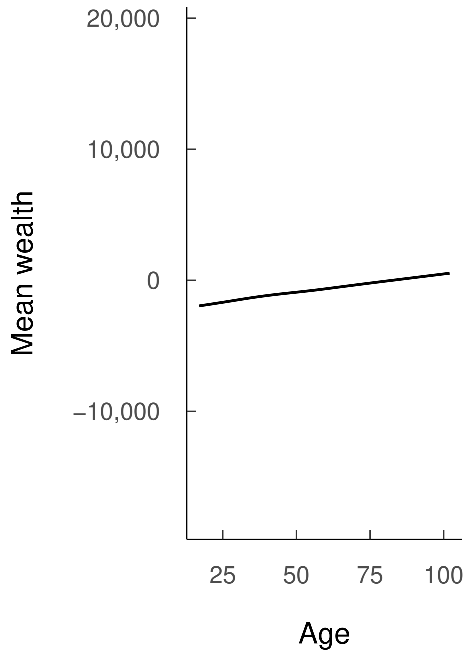
Figure 5: Household mean gross wealth over the lifecycle



[a] Note: Smoothed estimate (cubic spline, 10 knots) of mean gross wealth over the lifecycle, pooled across waves for first implicate.

[b] Source: SOEP v.35 (Waves: 2002, 2007,2012, 2017), own calculations.

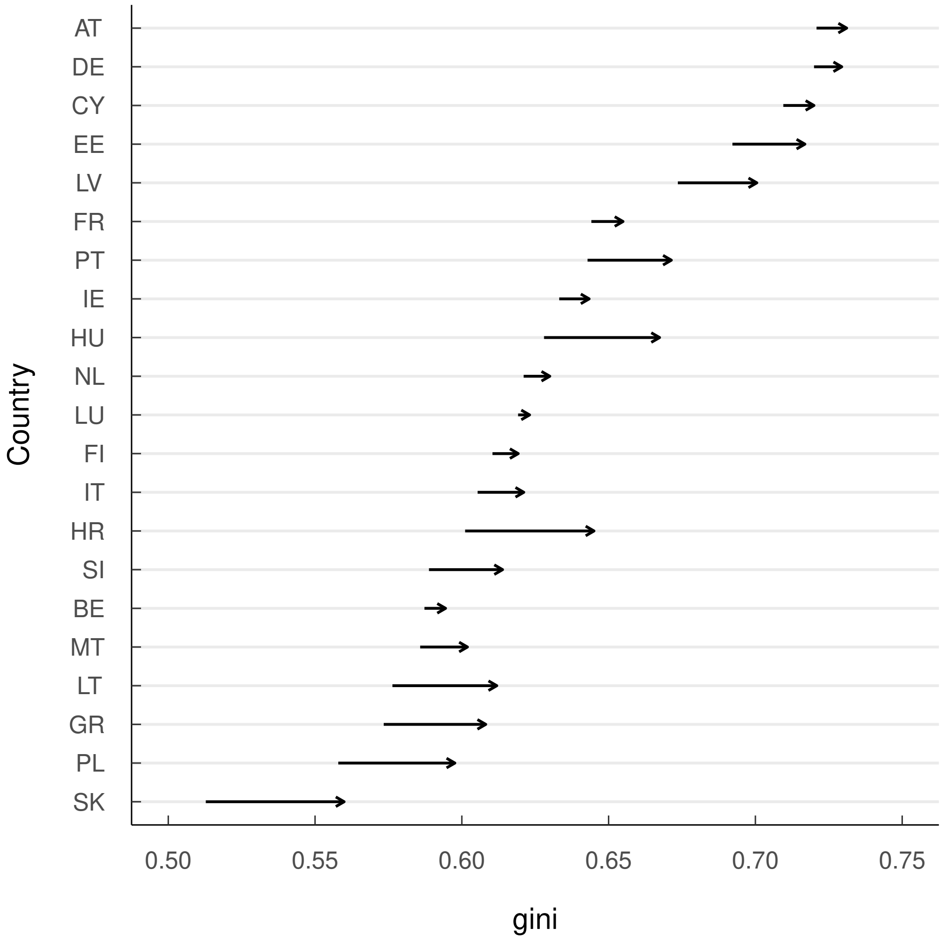
Figure 6: Residualized household mean gross wealth over the lifecycle



[a] Note: Smoothed estimate (cubic spline, ten knots) of residualized mean gross wealth over the lifecycle, pooled across waves for first implicate. Residuals follow from a regression of wealth on individual age with a b-spline term (cubic, three knots).

[b] SOEP v.35 (Waves: 2002, 2007,2012, 2017), own calculations.

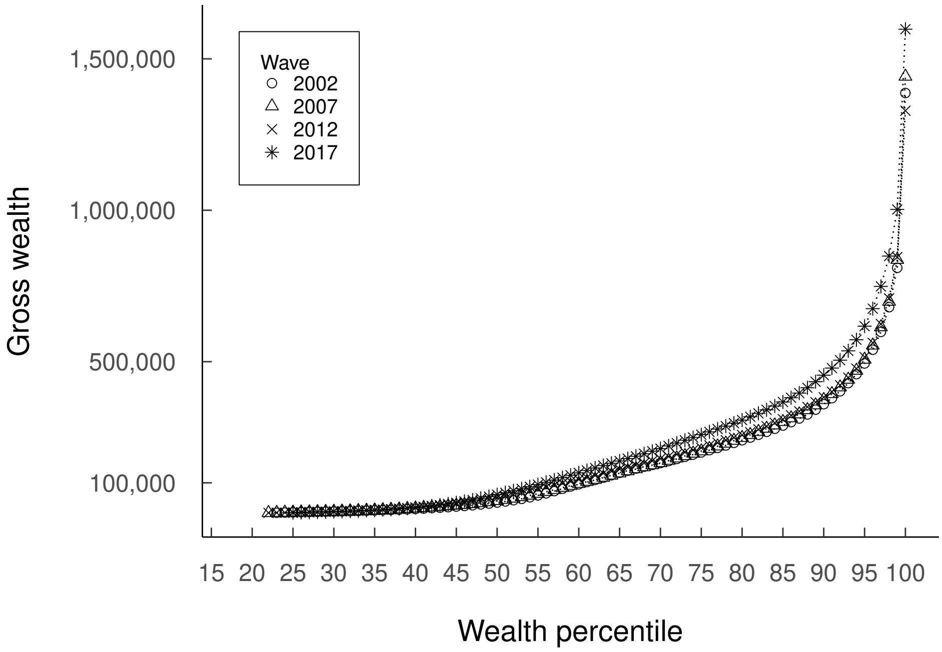
Figure 7: Comparative Effect of Scale Effects Adjustment



[a] Note: Impact of using the household size adjustment for wealth across countries. Across countries, the figure applies $\tau = 0.02$ and $\rho = 0.07$.

[b] Source: ECB 2017, own calculations.

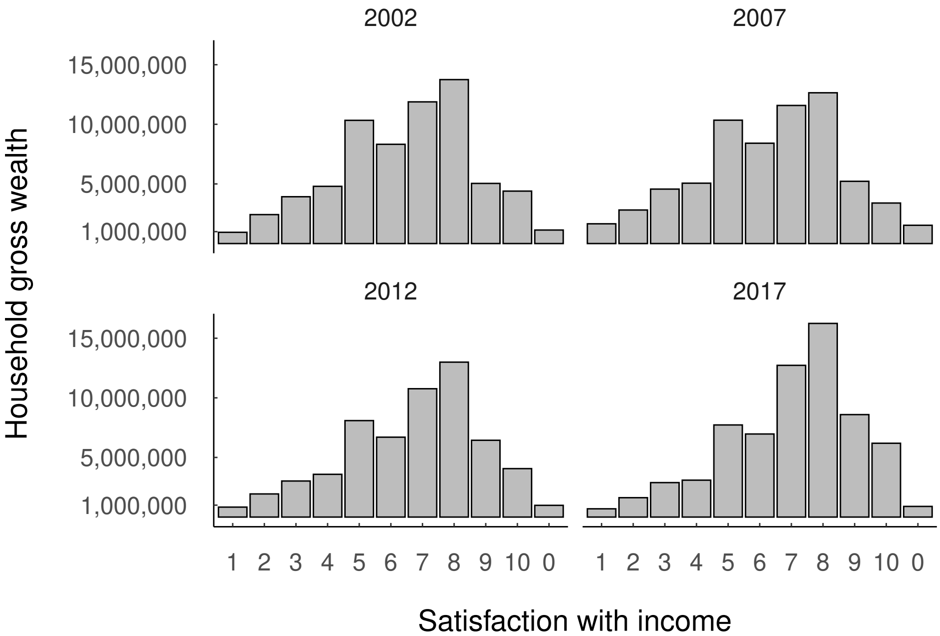
Figure 8: Average Gross Wealth by Decile of the Gross Wealth Distribution



[a] Note: 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.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.

Figure 9: Distribution of Income Satisfaction



[a] Note: Income satisfaction responses by survey wave.

[b] Source: SOEP v.35 (Waves: 2002, 2007, 2012, 2017), own calculations.