

Garbuszus, Jan Marvin; Ott, Notburga; Pehle, Sebastian; Werding, Martin

Working Paper

Development of family income since the 1990s: A fresh look at German microdata using income-dependent equivalence scales

SOEPpapers on Multidisciplinary Panel Data Research, No. 987

Provided in Cooperation with:

German Institute for Economic Research (DIW Berlin)

Suggested Citation: Garbuszus, Jan Marvin; Ott, Notburga; Pehle, Sebastian; Werding, Martin (2018) : Development of family income since the 1990s: A fresh look at German microdata using income-dependent equivalence scales, SOEPpapers on Multidisciplinary Panel Data Research, No. 987, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin

This Version is available at:

<https://hdl.handle.net/10419/183590>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

SOEPpapers

on Multidisciplinary Panel Data Research

SOEP – The German Socio-Economic Panel study at DIW Berlin

987-2018

Development of family income since the 1990s: A fresh look at German microdata using income-dependent equivalence scales

Jan Marvin Garbuszus, Notburga Ott, Sebastian Pehle, Martin Werding

SOEPPapers on Multidisciplinary Panel Data Research at DIW Berlin

This series presents research findings based either directly on data from the German Socio-Economic Panel study (SOEP) or using SOEP data as part of an internationally comparable data set (e.g. CNEF, ECHP, LIS, LWS, CHER/PACO). SOEP is a truly multidisciplinary household panel study covering a wide range of social and behavioral sciences: economics, sociology, psychology, survey methodology, econometrics and applied statistics, educational science, political science, public health, behavioral genetics, demography, geography, and sport science.

The decision to publish a submission in SOEPPapers is made by a board of editors chosen by the DIW Berlin to represent the wide range of disciplines covered by SOEP. There is no external referee process and papers are either accepted or rejected without revision. Papers appear in this series as works in progress and may also appear elsewhere. They often represent preliminary studies and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be requested from the author directly.

Any opinions expressed in this series are those of the author(s) and not those of DIW Berlin. Research disseminated by DIW Berlin may include views on public policy issues, but the institute itself takes no institutional policy positions.

The SOEPPapers are available at
<http://www.diw.de/soeppapers>

Editors:

Jan **Goebel** (Spatial Economics)
Stefan **Liebig** (Sociology)
David **Richter** (Psychology)
Carsten **Schröder** (Public Economics)
Jürgen **Schupp** (Sociology)

Conchita **D'Ambrosio** (Public Economics, DIW Research Fellow)
Denis **Gerstorff** (Psychology, DIW Research Fellow)
Elke **Holst** (Gender Studies, DIW Research Director)
Martin **Kroh** (Political Science, Survey Methodology)
Jörg-Peter **Schräpler** (Survey Methodology, DIW Research Fellow)
Thomas **Siedler** (Empirical Economics, DIW Research Fellow)
C. Katharina **Spieß** (Education and Family Economics)
Gert G. **Wagner** (Social Sciences)

ISSN: 1864-6689 (online)

German Socio-Economic Panel (SOEP)
DIW Berlin
Mohrenstrasse 58
10117 Berlin, Germany

Contact: soeppapers@diw.de



Development of family income since the 1990s: A fresh look at German microdata using income-dependent equivalence scales

Jan Marvin Garbuszus^{*1}, Notburga Ott^{†2}, Sebastian Pehle^{‡3}, and Martin
Werding^{§4}

^{1,2,3,4}*Ruhr University Bochum, Faculty of Social Science*
⁴*CESifo Research Network*

October 10, 2018

Abstract

Income inequality and poverty risks receive a lot of attention in public debates and current research. However, the situation of families that differ in size and composition is rarely considered more closely in this context. Relevant research typically relies on equivalence scales to make income comparable across different types of households. The standard approach for doing so is based on the so-called “(modified) OECD scale”. Instead, we apply income-dependent equivalence scales in this paper to assess how the financial situation of families living in Germany has developed since the early 1990s. Among other things, our results indicate that poverty risks for households with children – especially for single parents – are considerably higher than was previously found. We conclude that the application of income-dependent equivalence scales is required for applied research in income inequality, especially if one is concerned with the composition, not just the size of the population at poverty risk.

Keywords: Equivalence scales; family income; household needs; inequality measurement; poverty risks

JEL Classification: D12, I32, J12

^{*}Corresponding author; address: Ruhr University Bochum, Universitätsstr. 150, 44870 Bochum, Germany; email: jan.garbuszus@ruhr-uni-bochum.de

[†]Email: notburga.ott@ruhr-uni-bochum.de

[‡]Email: sebastian.pehle@ruhr-uni-bochum.de

[§]Email: martin.werding@ruhr-uni-bochum.de

1 Introduction

Analyzing the income position of families is challenging – both on the empirical and the conceptual side. As to the empirical side, data sources are needed which provide information on the financial situation of various household types. However, representative assessments are often limited to household types that can be observed very frequently, e.g., couples with one or two children. Reliable data for couples with three or more children or for single parents with more than one child are often lacking. On the conceptual side, problems arise because income is not just another socio-economic characteristic reflecting the well-being of families and other households. Rather, it is the outcome of decisions and negotiations of household members concerning, *inter alia*, the formation and expansion of a family. Further problems are due to the fact that income cannot be easily compared across households of different size or composition.

Decisions to start a family often go along with voluntary reductions of labour force participation and, hence, earned income of at least one parent. At the same time, income still accruing to the household is shared with an additional member. Therefore, actual household income or its use can never be taken to be a comprehensive welfare indicator. Yet, it accrues under typical sets of constraints which are much the same for most households. It also limits access to market goods and services for the household and all of its members, so that it can be considered an indicator of material prosperity which matters for applied research on inequality. Comparing income positions of households of different size and composition may also inform potential parents about important consequences of their options. Regarding this point, existing data limitations add an interesting insight: in Germany, families are continuously becoming rarer and smaller which, in turn, increases the problems of empirically investigating their situation (Statistisches Bundesamt, 2017).

This paper focuses on the problem of making income data comparable across households. Equivalence scales are a standard tool that is generally used in this context (Lewbel and Pendakur, 2008). Widely used scales such as the (modified) OECD scale (Hagenaars et al., 1994)¹ typically apply a fixed scale weight for a given household type across the entire range of income. However, the OECD scale rests on experts' choice, rather than on empirical analyses. Empirical estimates allowing for this feature typically indicate that appropriate scale weights are income-dependent. Resulting equivalence scales mostly decrease with income, such that the scale weight for a couple with one child compared to a single adult may be far greater than unity when income is low, but rather close to unity in the range of higher income (Donaldson and Pendakur, 2004; Koulovatianos et al., 2005;

¹Henceforth, we will call this scale “OECD scale”. It was introduced modifying a scale which was much used earlier and is now called “old OECD scale” or “Oxford scale”.

Biewen and Juhasz, 2017; Garbuszus, 2018). The scale weights applied in this paper are obtained using a two step-approach which combines statistical matching with the estimation of linear expenditure systems (Dudel et al., 2017a) for four waves of the quinquennial German Sample Survey of Income and Expenditure (EVS) for the years 1998 to 2013 (Garbuszus et al., 2018).

The paper presents and discusses the core findings of Garbuszus et al. (2018) on how family income has developed in Germany since the 1990s. The new income-dependent equivalence scale is applied to data on family income provided by the German Socio-economic Panel (SOEP) for the period from 1992 to 2015. Comparing our results to those deriving from an income-independent scale, we show that (i) the choice between equivalence scales really matters and (ii) applying our income-dependent scale specifically increases at-risk-of-poverty (ARP) rates. This finding is persistent over the years. It suggests that, thus far, ARP rates for families living in Germany have been severely underestimated. We therefore contribute to previous literature on income distribution and poverty, in Germany and elsewhere, that mostly relies on the OECD scale (e.g., Grabka and Krause, 2005; Grabka and Frick, 2010; Stichnoth, 2016). We provide a fresh look at these issues, to the best of our knowledge being the first to apply expenditure-based equivalence scales to the analysis of family income in Germany. Our findings are highly relevant for policymakers as well as for applied inequality research.

The remainder of this paper is structured as follows: Section 2 provides an overview of the literature on income of families living in Germany, followed by brief descriptions of the equivalence scale applied and the data used (sections 3 and 4). Empirical findings regarding the development of family income since the 1990s are presented in section 5. In section 6, we discuss the practical implications of our findings. Section 7 concludes.

2 Literature on income of families

Detailed studies regarding the income positions of German families were provided by Becker (2003), Eggen and Rupp (2006), or Schulze (2009). Based on data taken from the SOEP, the EVS and the Microcensus, mean equivalent net income of households is measured in these contributions and compared across family households and to other household types. In addition, researchers from the DIW Berlin, where the SOEP is based, have contributed a lot to the literature on income distribution in Germany (see, e.g., Grabka and Krause, 2005; Krause and Zähle, 2005; Grabka and Frick, 2010; Goebel et al., 2015), however, without putting much emphasis on the situation of different types

of families.² Some insights are also offered by studies relating to official reports on poverty (Juncke and Henkel, 2013; Deckl, 2013; Boockmann et al., 2015). An analysis of long-term trends in family income was made by Büchel and Trappe (2001).

Overall, findings in these studies suggest that mean household net income of couples and – at a lower level – of single parents increases with the number of children living in the household. At the same time, equivalized income shows opposite trends, with more children implying a decrease in material well-being. This comes as no surprise. The use of equivalence scales rests on the ideas that (i) individual needs vary for different household members and (ii) economies of scale and scope allow larger households to utilize income more efficiently than a single person does. However, expenditure on additional household members typically exceeds observed increases in non-equivalized household income.

Research on the development of family income over time supports these findings. Accounting for the effects of nominal or real growth, observations mostly remain unchanged over the observed periods of time (Büchel and Trappe, 2001; Schulze, 2009). Taking closer looks at income distributions relating to different household types reveals further details: equivalent income of families is less dispersed than for households without children and rarely reaches the range of higher and very high income levels; this observation is *a fortiori* true for single parents (Becker, 2003; Boockmann et al., 2015).

With respect to poverty risks for families, the results of existing studies are not entirely consistent (see, in addition, Deutscher Bundestag, 2001, 2005; Hauser and Becker, 2001, 2004). In a number of studies, ARP rates for couples with children turn out to be higher than for childless couples or all households, but there are exceptions with differing results. Couples with three or more children and single parents appear particularly likely to be faced with increased poverty risks. Regarding the age of children, households with younger children typically show higher ARP rates than households with older children. However, long-term trends in specific ARP rates for different household types are rather unstable and exhibit high variation.³ Therefore, a general trend of an increasing share of family households living in poverty cannot be stated without further ado (Lautherbach, 2003).

The majority of studies mentioned here, especially those published more recently, assess equivalized income using empirical set-ups that are essentially identical, applying the OECD scale (mostly) to SOEP data. Exceptions that compare and discuss results based on different types of equivalence scales are studies by Becker (2003) and by ZEW and IAW (part 3.3 of Boockmann et al., 2015). Options for assessing the variance of

²Family types that are usually considered in these studies are single parents or couples with any number of children. In other studies providing in-depth analyses of income inequality specific results for families are lacking entirely (see, e.g., Feld and Schmidt, 2016; Felbermayer et al., 2016).

³Up to a point, this is due to the fact that, with widely used data bases, differentiation by family types soon runs into problems related to sample size.

differing inequality measurements are discussed in Dudel (2017).

3 Equivalence scales

Intensive research on the estimation of equivalence scales took place in the 1970s and 1980s (Kapteyn and Van Praag, 1976; Deaton and Muellbauer, 1980; Browning, 1992; Pollak and Wales, 1992; Nelson, 1993). However, the topic has recently gained attention again (Blundell et al., 2003; Donaldson and Pendakur, 2006; Chiappori, 2016). In this study, we will demonstrate the effects on the income distribution when an income-dependent equivalence scale is applied to data on family income, rather than an income-independent one. As an income-independent scale we are using the OECD scale which has become a quasi-standard in current research on income inequality and poverty.⁴ The OECD scale has no direct empirical basis, but was essentially meant to reconcile diverging empirical findings available at the time of their introduction, mainly in order to provide a default scale for analyses lacking more detailed results that could be used for comparing income across countries (Hagenaars et al., 1994).⁵

Here, we confront the OECD scale with an income-dependent (ID) scale estimated in Garbuszus et al. (2018). The motivation for estimating this scale stems from the suspicion that the OECD scale may not be appropriate for low-income households, underestimating additional expenditure on additional household members in many cases. This is suggested by the observation that, in many countries, income support for poor households increases much more with additional members, adults or children, than the OECD scale would imply.

To obtain an income-dependent scale, we applied an approach described in Dudel et al. (2017a) to each quintile of the income distribution of each household type for which we had sufficient numbers of observations in our data (EVS, waves 1998, 2003, 2008, 2013). The scale is thus based on a combination of statistical matching (of households in the relevant quintile with reference households that typically had one member less)⁶ with regressions based on observed household expenditure. For the regressions, the FELES expansion of a linear expenditure system (Stone, 1954; Merz, 1983; Conniffe and Keogh, 1988) was applied. With this set-up, the determinants of scale weights – specifically, the

⁴ The OECD scale attaches a weight of 1.0 to a single adult or to one adult living in a larger household; weights for additional household members are 0.5 (if they are aged 14 and older) or 0.3 (if they are aged less than 14).

⁵Dudel et al. (2017b) compare different methods for estimating income-independent equivalence scales. Based on German microdata, they find that the results are mostly close to the OECD scale, regardless of the precise approach employed.

⁶For a more careful description of the procedures employed, see Garbuszus et al. (2018).

Engel-curves for each category of goods we distinguished – are assumed to be piece-wise linear across quintiles, but allow for variation in their slope. In line with most of the literature on income-dependent scales, the resulting ID scale implies that scale weights decrease with income.⁷

Figure 1 shows the results we obtained from data of the most recent wave of the EVS (2013). The estimations provide scale weights for single adults (“A”), single parents with one child (“AC”) as well as couples with no (“AA”), one (“AAC”), two (“AACC”), or three (“AACCC”) children. For each of these family types, the ID scales show a convex shape declining with income, while scale weights basically increase with the number of children and/or the number of individuals in the household.⁸ ID scales deriving from earlier waves of the data base look essentially the same when corrected for changes in nominal income.⁹

Given the tasks of this paper, it is interesting to note that each of the ID graphs included in figure 1 intersects with the horizontal lines reflecting corresponding values of the OECD scale. Intersections are mostly located in the first or second quintile, i.e., in the range of lower income. Only for single parents with one child, the relevant point is reached at relatively high levels of income, given the specific income distribution of this household type.¹⁰ In all cases, ID scale weights exceed those implied in the OECD scale for families with low household income, while they converge to levels below the corresponding values of the OECD scale as income becomes high. In other words, with its fixed weights, the OECD scale tends to overestimate equivalent income of poor households and to underestimate equivalent income of rich households. This indicates that the application of income-dependent equivalence scales may have considerable effects for the resulting distributions of equivalent income.

To assess equivalent income for all the household types covered, the scales of Garbuszus

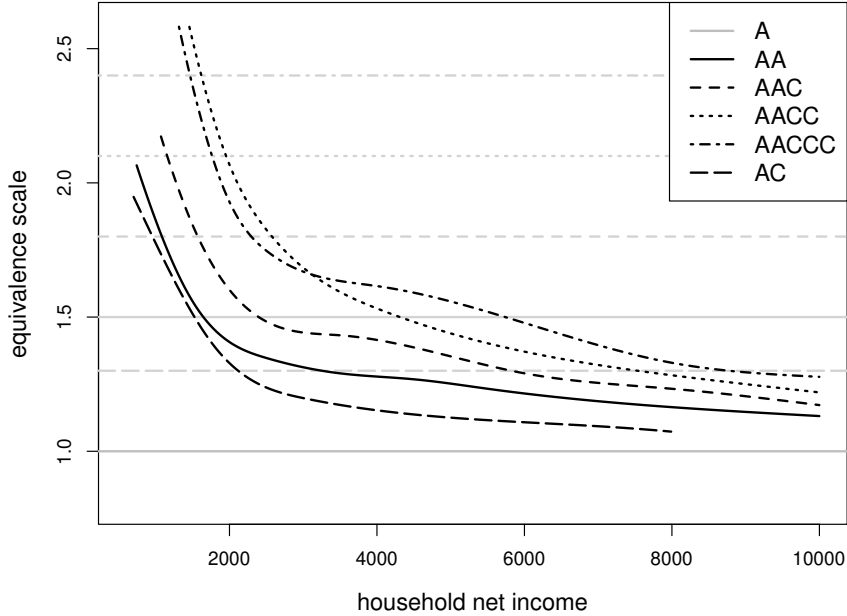
⁷Income dependence of scales of different types has been tested thoroughly by, e.g., Plug and Van Praag (1995); Aaberge and Melby (1998); Blundell et al. (2003); Donaldson and Pendakur (2004); Koulouvatianos et al. (2005).

⁸The results for couples with three children show weaknesses in the range of lower income, where estimated scale weights are slightly lower than those for couples with two children. It is possible that additional weights for third children are low (as they are for higher income), but it is clearly implausible that they should become negative in this range. These problems are mainly due to small sample size, as we are going to the limits of what our data can provide here. Also, peculiarities in employment behavior of this particular household type create difficulties for the matching procedure applied in the first step of our approach.

⁹For couples with three children, these results look better, some even showing weights which exceed those for couples with two children by a small margin throughout, but they are still not fully satisfactory.

¹⁰ For couples with three children, the intersection point lies at a particularly low level instead. This is not only due to low ID scale weights for low-income household of this type. Also, by its simple, additive structure, the OECD scale attaches a weight to this type that appears relatively high. So weaknesses of the two scales probably coincide here.

Figure 1: Income-dependent equivalence scales for monthly household income in EUR. Horizontal lines represent OECD scale weights for each household type (based on constant weights of 0.3 for a child aged less than 14). Source: EVS (2013), Garbuszus et al. (2018).



et al. (2018) are used as follows. The ID scales estimated on a cross-section basis (for 1998, 2003, 2008, 2013) are linearly interpolated for the years in between¹¹ and applied to data on household net income taken from the SOEP. Rather than dropping results for couples with three children entirely, we replace them by scale weights for couples with two children whenever they fall below the latter. This can be considered a lower bound for meaningful weights, but results should certainly be interpreted with some caution for this specific family type.

4 Data on household income

Empirical studies analyzing the income distribution of families and other households in Germany usually rely on data of the German Socio-Economic Panel (SOEP; Goebel et al., 2018). This longitudinal survey is conducted annually since 1984. It provides detailed information on household and person-level characteristics regarding socio-demographics,

¹¹Originally, the EVS 1993 was meant to be used as well for estimating scales weights. This turned out impossible, as the wave lacks detailed information regarding the employment status of all household members, which was required for the matching step. Due to the very limited variation of scales over time, we maintained the intention to look at family income starting from the early 1990s, keeping the 1998 scale unchanged for earlier years; the same applies to the 2013 scale and the years until 2015.

income, and many other aspects of life. The population represented in the survey are private households living in Germany and all their members above the age of 17, while those below this age – if not interviewed as well through special questionnaires – are registered as additional household members to determine the household composition.

The original SOEP sample, drawn in 1984, was gradually expanded with refreshment samples, catching up on the representativeness for the German population in general, or for migrants or high-income households in particular. The recent inclusion of the FiD study (“Families in Germany”; Schröder et al., 2013) lead to an overall increase in the number of family households in the sample. FiD was meant to cover family types which are not well represented in other surveys, such as young families and single parents or couples with large numbers of children. Sample weights provided always allow for extrapolations to the total population living in private households (Pischner, 2007).¹²

The SOEP sample we are using in this study is a subset covering only those six household types which are explicitly covered in our estimates based on EVS data: single adults, single parents with one child, and couples with up to three children, where singles and childless couples are needed for comparison. A couple is defined as a household containing two adults that are living in a partnership. A child is every person aged less than 18, the age of consent in Germany, living in the household.¹³ Households containing adults above the age of 65 are excluded; the same applies to households in which at least one member is a pensioner. This should mainly increase homogeneity among households without children and facilitate comparisons of households in this group to households with children.

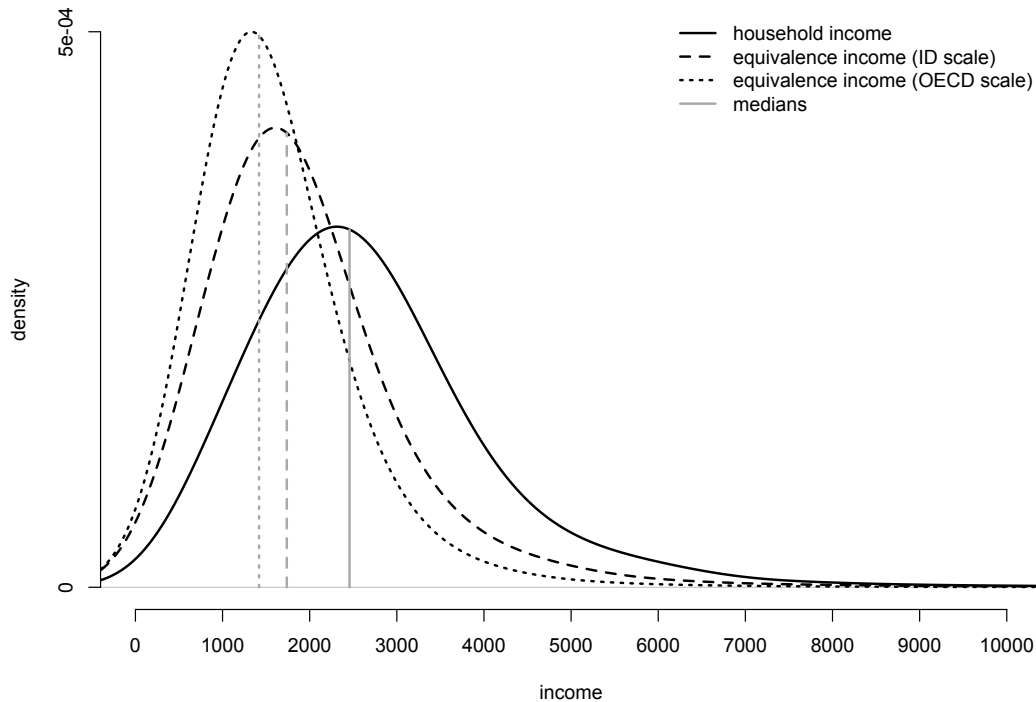
The final sample contains 68,924 individuals in 26,256 households covering the time-span from 1992 to 2015. Inclusion of the FiD study leads to an increase in the numbers of observations for all family types and for the years since 2010. For earlier years, observed numbers of single parents (100–200) and couples with three children (170–320) were rather limited, with a steeply declining trend over time in the latter case.

SOEP data offer a variety of different income variables (individual income v. household income; gross or net figures; monthly income in the current year or annual income in the previous year). To make sure that information on income corresponds to the current situation, unbiased by job changes, job losses, retirement, or changes in household size and composition, the ID scales presented in section 3 are applied to data on current monthly net household income.

¹²For the graphs that follow, data are weighted at the household level.

¹³This relates to every child in the household, including step-children, etc.

Figure 2: Density of (un-)equivalized household net income. Source: SOEP v32.1, Garbuszus et al. (2018).



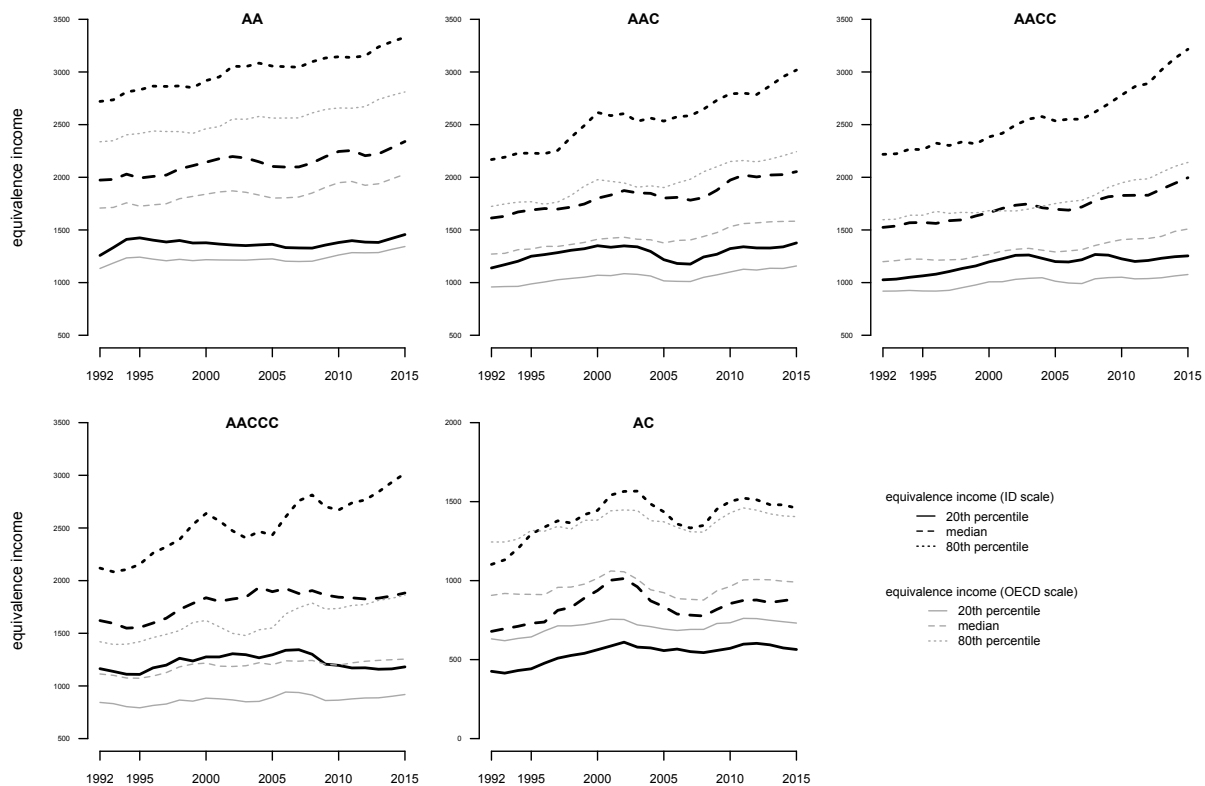
5 Development of family income since 1992

5.1 Equivalence scales and income distributions

We first demonstrate the effects of using income-dependent scale weights instead of the fixed OECD weights showing density functions of household income and equivalent income for all types of households pooled across all 24 waves of the SOEP we are using (see figure 2, where median values for each graph are also indicated). Applying equivalence scales to (raw) household income typically results in a greater compression of the income distribution, as most amounts of income are divided by a factor exceeding 1. This compression turns out to be strong when applying the OECD scale, while it is more moderate for the income-dependent (ID) scale.

Varying degrees of compression of the income distribution are a natural effect of the two types of equivalence scales we are comparing. Compared to the ID scale, the OECD scale implies that scale weights are applied to the whole range of household income that are too high for the majority of households. This tends to underestimate their equivalent income. At the same time, the OECD scale overestimates income for households at the bottom end of the income distribution. Overall, this results in a stronger compression. What is interesting, then, is how these differences between the two scales affect different

Figure 3: Median, upper and lower quintile of equivalent household net income. Source: SOEP v32.1, Garbuszus et al. (2018).



types of households, especially families.

5.2 Development of equivalent income

Applying the two different equivalence scales has a considerable impact on relative income positions of families. Figure 3 represents¹⁴ the median, the 20th and 80th percentile of equivalent income across the entire observation period, differentiated by household types. This gives an impression how income positions of households on low, medium and high income have evolved over time. Throughout, equivalent income has been adjusted to year-2010 prices to correct for inflation.

In general, equivalent incomes displayed in figure 3 increase up to the early 2000s, but then level off or even fall to pre-2000 levels until 2008 for all household types. Afterwards, a new upward trend is visible in many, but not all cases. Basically, these trends apply to all levels of income. However, high levels of income show larger increases than median and

¹⁴The graphs included in figures 3 through 6 have been smoothed by central moving averages over adjacent years.

low income, as was already shown by Goebel et al. (2015) and Feld and Schmidt (2016).

What is most interesting here is the impact of applying different equivalence scales. Equivalent income and its long-term increases are generally higher for the income-dependent ID scale than for the OECD scale. This is true not only for median equivalent income, but also at the 20th and 80th percentile. Yet, differences are much smaller at the 20th percentile, and they increase with the levels of income considered. Also, differences between results for the ID scale and the OECD scale are larger for families than for childless couples. This indicates that potential biases caused by the application of the income-independent OECD scale are stronger for families than for other household types.

Finally, there is one important exception to much of what we have just said. For single parents, equivalent income has not only remained below the year-2000 level until today. Median income and income at the 20th percentile are also lower based on our ID scale compared to results for the OECD scale. The effect that the OECD scale assumes scale weights which are too high for higher income becomes negligible for a household type that rarely reaches this range of income.

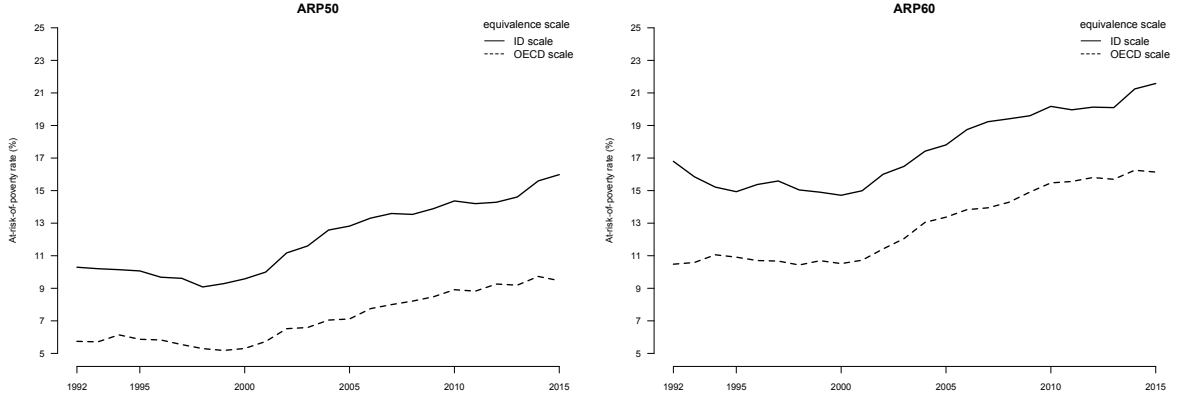
For the other types of households, we obtain the familiar result (see section 2) that equivalent income – at the median as well as at the 20th and 80th percentile – decreases with the number of children, certainly from childless couples to couples with two children. For couples with three children, this holds true only in more recent years. Over time, increases in income differ across household types. They are similar for couples without and with one or two children, while couples with three children (and, again, single parents) show smaller increases in equivalent income over the last two and a half decades. This is especially true for households at the 20th percentile. The reasons are related to changes in labour-force participation of parents, especially mothers, which has not expanded as much in these households as it has among couples with one or two children.

5.3 Poverty risks for families

As we have shown, relative income positions of families vary depending on the type of equivalence scales applied. For a majority of households, the ID scale leads to higher equivalent income compared to income-independent equivalence scales like the OECD scale. The opposite holds true for households on low income. In fact, the financial situation of families with low net household income turns out to be substantially worse than is indicated by equivalent income based on the OECD scale. The reason is that, through higher scale weights, the ID scale corrects an overestimation of equivalent income at the lower end of the income distribution (see section 3).

A key parameter in current research on income inequality and poverty is the at-risk-

Figure 4: At-risk-of-poverty rates with thresholds of 50% (ARP50) and 60% (ARP60) of median equivalent net income. Source: SOEP v32.1, Garbuszus et al. (2018).



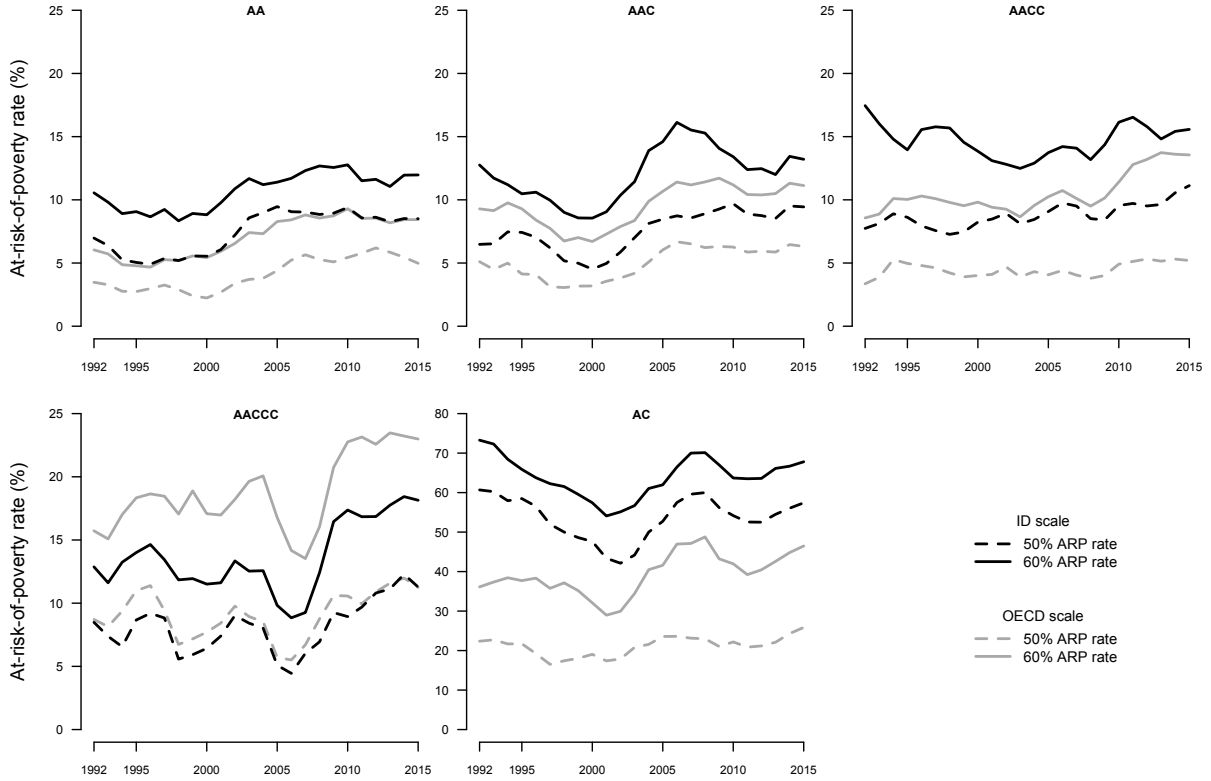
of-poverty (ARP) rate. It is defined as the share of households or individuals in the population that have less than 60% of the median equivalent net income at their disposal. This concept of relative poverty – dating back to Fuchs (1965) who had suggested a 50%-threshold¹⁵ – can be debated, *inter alia*, due to the arbitrary nature of the thresholds applied (Hauser, 2012). To demonstrate the effects of different equivalence scales and to compare results relating to different thresholds for relative income, figure 4 shows the development of ARP rates – or, strictly speaking, of ARP rates (60%) and poverty rates (50%) – for equivalent income based on the ID scale and the OECD scale.

As shown in the figure, the impact of applying different thresholds for assessing ARP or poverty rates is sizable. However, differences relating to the type of equivalence scale applied are almost as important. In both dimensions, shares of the population living in poverty (risks) differ by approximately 5 percentage points, with the income-dependent ID scale consistently producing higher rates than the OECD scale. Therefore, levels of ARP rates have been underestimated in previous poverty research, due to the use of an equivalence scale that is not really appropriate for households at the lower end of the income distribution.

Figure 5 reveals that differences relating to the two types of equivalence scales become even larger if one takes a closer look at poverty (risks) for different types of households. For all but one of the household types considered, ARP rates are higher based on the ID scale than when the OECD scale is used. Furthermore, differences vary in levels as well as in their changes over time. The exemption is given by couples with three children (for which our results regarding the ID scale are not fully plausible and for which OECD scale

¹⁵Poverty research in the US mostly sticks to the 50%-threshold. In Europe, the switch to a 60%-threshold reflecting “poverty risks”, but not necessarily “poverty”, was meant to indicate a more careful use of notions of relative poverty. In practice, however, poverty risks and poverty are now often confused.

Figure 5: At-risk-of-poverty (ARP) rates with thresholds of 50% and 60% of median equivalent net income by household types. Source: SOEP v32.1, Garbuszus et al. (2018).



weights are relatively high; see footnote 10). For all other types of families, 50%-poverty rates based on the ID scale are closer to the 60%-ARP rate for the OECD scale than they are to the 50%-rate for this latter scale. The most striking result relates to the situation of single parents with one child. It appears to be far worse in terms of poverty (risks) than has ever been shown using the OECD scale – which gives this household type a particularly low weight. Using conventional procedures for assessing equivalent income, their ARP rate has been fluctuating around no less than 40% throughout the observation period, while it fluctuates around 65% when the ID scale is applied.

6 Discussion

The results presented here highlight the fact that equivalence scales based on household expenditure vary substantially with household income, if one allows for this kind of variation in the empirical assessment. They also demonstrate that, neglecting this property, the widely used OECD scale applies scale weights which are particularly inadequate for

ranges of income where poverty thresholds are usually located. This leads to distorted results regarding the level of poverty and/or the structure of households exposed to poverty risk.

Our results are based on empirical work that was deliberately designed to follow a piece-meal approach, running separate estimates for each wave of our data base, for each of the household types considered, and for each quintile of their income distributions. Therefore, the results indicate that the structure of income-dependent scale weights is very stable over time, and that their decline with income is not an artifact of assumptions regarding any predefined overall shape. Building on these insights, one could certainly go for analyses which are more comprehensive and more elegant – and could also improve on weaknesses of our results, such as the implausibly low scale weights for low-income couples with three children.¹⁶

But then, what are the practical implications of our findings? Do we recommend to replace the OECD scale with income-dependent equivalence scales in all future work on inequality and poverty? The answer is both yes and no. The answer is (partly) “yes” because the OECD scale rests on over-simplifications that render it particularly ill-suited for measuring poverty lines and assessing poverty rates – an area where it has become an international quasi-standard in recent years.¹⁷ But the answer must be (partly) “no” because it is impossible to replace the OECD scale, or alternatives which are similarly simple, in all of their current applications.

The new OECD scale was suggested mainly as a compromise between a multitude of other scales, meant to be used for cross-country comparisons in cases where more detailed and generally agreed results were lacking (Hagenaars et al., 1994, p. 194). In this role, simple defaults like the OECD scale are clearly indispensable. But even for work focusing on just one country, it is all but easy to replace such scales, since simplicity has its merits also at this level. An advantage of the OECD scale is that it is represented by essentially three figures relating to three types of household members (see footnote 4), while income-dependent scales like the one used here need to be spelt out in long arrays of scale weights relating to different household types and, in addition, to each percentile of the income

¹⁶In fact, Garbuszus (2018) already provides an example for these possible improvements. There, income-dependent scale weights are derived from pooled data of all the EVS waves from 1998 to 2008, which slackens data limitations, employing a version of the Quadratic Almost Ideal Demand System (QUAIDS) suggested by Donaldson and Pendakur (2004) (building on Deaton and Muellbauer, 1980; Banks et al., 1997). The results look much like those from Garbuszus et al. (2018), but are in line with reasonable expectations also for AACCC households across the entire range of income (and cover households of type ACC as well).

¹⁷Interestingly, in a methodological note that is still valid the OECD confronts the “modified” OECD scale with the “old” one and with the “square-root” scale and concludes: “In general, there is no accepted method for determining equivalence scales, and no equivalence scale is recommended by the OECD for general use” (OECD, n.y.).

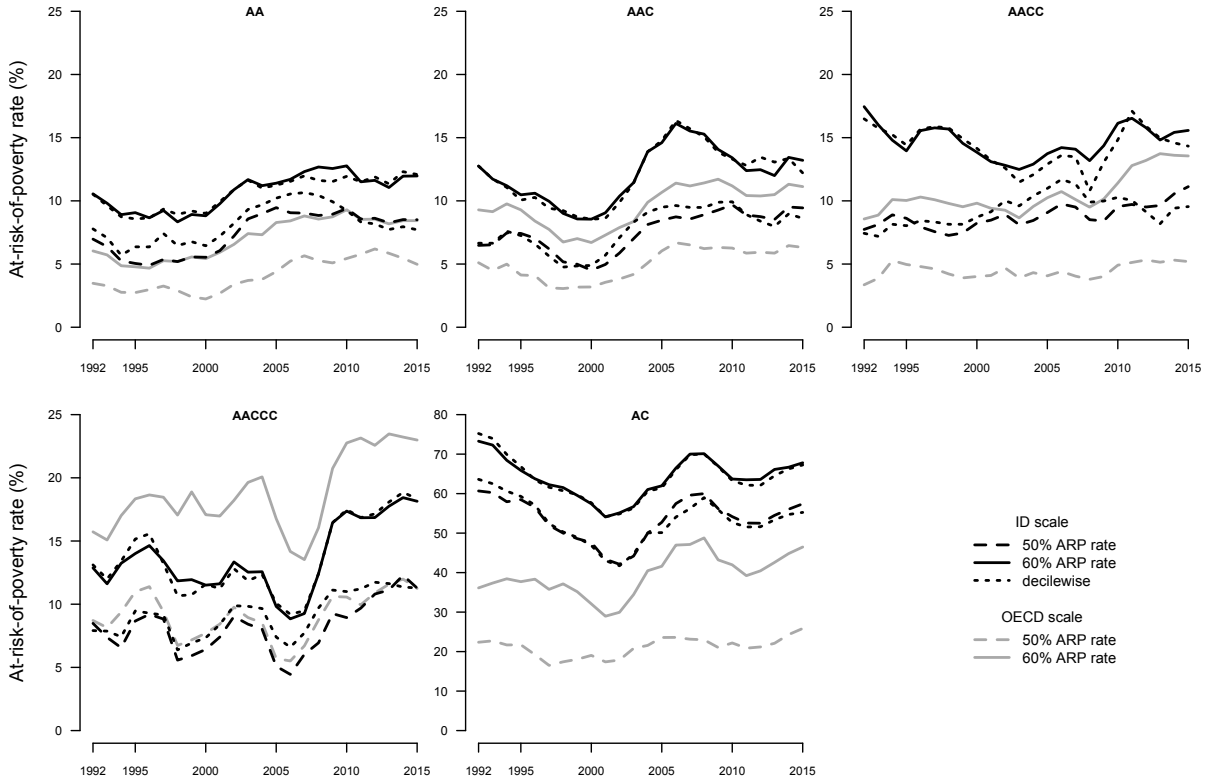
distribution – or some higher or lower resolution. A related advantage of the OECD scale is that, due to its “Lego brick” logic, it can be applied to all types of households included in a given population, whether this may be appropriate or not. Income-dependent scales have to be determined specifically for each household type, which almost inevitably runs into problems with data limitations for a non-negligible percentage of the population.

As long as there is mainly an interest in aggregate figures and trends – e.g., poverty rates or ARP rates among the entire population and their development over time – the OECD scale may therefore have to do. We have shown here that, compared to results based on our ID scale, aggregate levels of poverty rates and ARP rates are underestimated considerably using the OECD scale (see figure 4). But the time trends of these indicators are practically unaffected over more than 20 years, and the level effect of the equivalence scales applied is very similar to that of the choice of a particular income threshold, say, at 50% or 60%. Choosing the simplified OECD scale could therefore be considered as just another arbitrary choice that is helpful, and probably needed, to make use of analytical concepts allowing for rough comparisons across countries as well as over time.

However, if the interest lies with the composition of the population in poverty or at poverty risk, or with poverty (risks) for specific types of households, equivalence scales ought to become more elaborate. Specifically, their income-dependence matters in these cases to avoid not only substantial measurement error, but also misleading policy conclusions. This can also be seen from our results, as the levels *and* time trends of poverty rates and ARP rates start to vary a lot more depending on the equivalence scale applied when they are differentiated by household types (see figure 5). For applications of this kind, the fact that income-dependent scales can only be determined for household types that are observed frequently enough to allow for representative assessments is not much of a limitation. Furthermore, the complexity of our ID scale could be reduced, e.g., by using scale weights which only differ by deciles of household specific distributions of net household income.

Reducing the resolution of the original ID scale clearly carries a cost. But with a differentiation by deciles, the loss in the accuracy of results appears to be tolerable. This can be seen in figure 6 which compares poverty rates for different household types based on the original version and an “abridged” version of the ID scale. The decilewise scale weights used here are documented in an appendix of this paper. They are basically portable across data bases and over time, so that they could be applied by anyone who is interested in exploring the implications of our findings. In any case, we think that further work on income-dependent scales, plus agreements on when and how to use them, would be beneficial for the research community and the greater public, including people in politics and public administration who are interested in the issues discussed here.

Figure 6: At-risk-of-poverty (ARP) rates by household types based on an ID scale by income deciles. Source: SOEP v32.1



7 Conclusion

The present paper should be taken mainly as a word of caution. Equivalence scales play a major role in research on income inequality and poverty, especially with respect to results for different types of households. Although the (modified) OECD scale has become a quasi-standard for applied research in this area, this role should be reflected and probably reconsidered. Currently, assumptions underlying this scale are disregarded by many researchers and certainly by the greater public.

Based on German microdata, this study shows considerable differences in equivalent household net income across different household types, depending on which type of equivalence scale is used. The income-dependent scale which is applied here as an alternative does not so much lead to new insights for households on median and high income, but definitely for those on low income. Our findings confirm that family households tend to be worse off in terms of equivalent income than childless households that are otherwise similar. At the same time, they suggest that a majority of family households are in a better income position than was previously assumed. By contrast, the situation of families

on low income is even more difficult than has thus far been known. Specifically, poverty rates and poverty risks rise to alarming levels for single parents when income-dependent equivalence scales are used, while their situation was considered unfavourable already based on income-independent scales. The sensitivity of our results to different types of equivalence scales, plus the sensitivity to changes in poverty (risk) thresholds suggest that, quite generally, blindly following conventional patterns in applied poverty research is not exactly an ideal solution.

We conclude from this study that the impact of income-dependent equivalence scales is important. Scales of this type should be explored more fully, using different data bases, different approaches and empirical specifications, and they should also be subjected to comparative work at an international level. The task of this work should be to develop new, more reliable standards for applied research on distribution and poverty.

References

- Aaberge, R., Melby, I., 1998. The Sensitivity of Income Inequality to Choice of Equivalence Scales. *Review of Income and Wealth* 44, 565–569.
- Banks, J., Blundell, R., Lewbel, A., 1997. Quadratic engel curves and consumer demand. *Review of Economics and Statistics* 79(4), 527–539.
- Büchel, F., Trappe, H., 2001. Die Entwicklung der Einkommensposition kinderreicher Familien in Deutschland. *Zeitschrift für Familienforschung* 13(2), 5–28.
- Becker, I., 2003. Familien im Spektrum der Einkommensverteilung: Eine Bestandsaufnahme für Deutschland. *Sozialer Fortschritt* 52(1), 2–10.
- Biewen, M., Juhasz, A., 2017. Direct Estimation of Equivalence Scales and More Evidence on Independence of Base. *Oxford Bulletin of Economics and Statistics* 79(5), 875–905.
- Blundell, R., Browning, M., Crawford, I. A., 2003. Nonparametric Engel Curves and Revealed Preference. *Econometrica* 71(1), 205–240.
- Boockmann, B., Kleimann, R., Meythaler, N., Nasgowitz, A., Nielen, S., Späth, J., Blömer, M., Dolls, M., Löffler, M., Markefke, T., Peichl, A., Stichnoth, H., Ungerer, M., Biewen, M., 2015. Analyse der Verteilung von Einkommen und Vermögen in Deutschland. Bundesministerium für Arbeit und Soziales, Berlin.
- Browning, M., 1992. Children and Household Economic Behavior. *Journal of Economic Literature* 30(3), 1434–1475.
- Chiappori, P.-A., 2016. Equivalence versus Indifference Scales. *The Economic Journal* 126(592), 523–545.
- Conniffe, D., Keogh, G., 1988. Equivalence Scales and Costs of Children. Number 142 in General Research Series, The Economic and Social Research Institute.
- Deaton, A. S., Muellbauer, J., 1980. An Almost Ideal Demand System. *The American Economic Review* 70(3), 312–326.
- Deckl, S., 2013. Einkommensungleichheit, Armut und materielle Entbehrung. In: Statistisches Bundesamt, Wissenschaftszentrum Berlin (Eds.), *Datenreport 2013*, p. 158–167, Bundeszentrale für politische Bildung, Bonn.
- Deutscher Bundestag, 2001. Lebenslagen in Deutschland: Erster Armuts- und Reichtumsbericht der Bundesregierung. Number 14/5990 in BT-Drs.
- Deutscher Bundestag, 2005. Lebenslagen in Deutschland: Zweiter Armuts- und Reichtumsbericht der Bundesregierung. Number 15/5015 in BT-Drs.
- Donaldson, D., Pendakur, K., 2004. Equivalent-expenditure functions and expenditure-dependent equivalence scales. *Journal of Public Economics* 88(1–2), 175–208.
- Donaldson, D., Pendakur, K., 2006. The Identification of Fixed Costs from Consumer Behavior. *Journal of Business & Economic Statistics* 24(3), 255–265.
- Dudel, C., 2017. Variance estimation for sensitivity analysis of poverty and inequality measures. *Survey Research Methods* 11(1), 81–92.
- Dudel, C., Garbuszus, J. M., Ott, N., Werding, M., 2017a. Matching as Non-Parametric Preprocessing for the Estimation of Equivalence Scales. *Journal of Economics and Statistics* 237(2), 115–141.
- Dudel, C., Garbuszus, J. M., Schmied, J., 2017b. Assessing differences in household needs: A comparison of approaches for the estimation of equivalence scales using German expenditure data. *Ruhr Economic Papers* (723), 1–23.

- Eggen, B., Rupp, M., 2006. Einkommenssituation großer Familien. In: Eggen, B., Rupp, M. (Eds.), *Kinderreiche Familien*, p. 85–111, VS Verlag, Wiesbaden.
- Felbermayer, G., Battisti, M., Lehwald, S., 2016. Entwicklung der Einkommensungleichheit: Daten, Fakten und Wahrnehmungen. Stiftung Familienunternehmen, München.
- Feld, L. P., Schmidt, C. C., 2016. Jenseits der schrillen Töne: Elemente für eine rationale Diskussion über die Ungleichheit von Einkommen und Vermögen in Deutschland. *Perspektiven der Wirtschaftspolitik* 17(2), 188–205.
- Fuchs, V. R., 1965. Towards a theory of poverty. In: Task Force on Economic Growth and Opportunity (Ed.), *The Concept of Poverty*, p. 71–91, Chamber of Commerce of the United States, Washington D.C.
- Garbuszus, J. M., 2018. Quadratische Engelkurven. Schätzung von nutzenabhängigen Äquivalenzskalen, *Wissenschaftliche Beiträge aus dem Tectum Verlag. Reihe: Sozialwissenschaften*, volume 86. Tectum Verlag, Baden-Baden.
- Garbuszus, J. M., Ott, N., Pehle, S., Werding, M., 2018. Wie hat sich die Einkommenssituation von Familien entwickelt? Bertelsmann Stiftung, Gütersloh.
- Goebel, J., Grabka, M. M., Liebig, S., Kroh, M., Richter, D., Schröder, C., Schupp, J., 2018. The German Socio-Economic Panel (SOEP). *Jahrbücher für Nationalökonomie und Statistik/Journal of Economics and Statistics*.
- Goebel, J., Grabka, M. M., Schröder, C., 2015. Einkommensungleichheit in Deutschland bleibt weiterhin hoch. *DIW-Wochenbericht* 82(25), 571–586.
- Grabka, M. M., Frick, J. R., 2010. Weiterhin hohes Armutsrisiko in Deutschland: Kinder und junge Erwachsene sind besonders betroffen. *DIW-Wochenbericht* 77(7), 2–11.
- Grabka, M. M., Krause, P., 2005. Einkommen und Armut von Familien und älteren Menschen. *DIW-Wochenbericht* 72(9), 155–162.
- Hagenaars, A. J., Vos, K., Zaidi, M. A., 1994. Poverty statistics in the late 1980s. Theme / Statistical Office of the European Communities : 3, Population and social conditions : Series C, Accounts, surveys and statistics, Off. of Official Publ. of the Europ. Communities, Luxembourg.
- Hauser, R., 2012. Das Maß der Armut: Armuts Grenzen im sozialstaatlichen Kontext - Der sozialstatistische Diskurs. In: Huster, E.-U., Boeckh, J., Mogge-Grotjahn, H. (Eds.), *Handbuch Armut und Soziale Ausgrenzung*, p. 122–146, VS Verlag/Springer, Wiesbaden.
- Hauser, R., Becker, I., 2001. Einkommensverteilung im Querschnitt und im Zeitverlauf 1973-1998. Johan-Wolfgang-Goethe-Universität, Frankfurt/Main, typescript.
- Hauser, R., Becker, I., 2004. Verteilung der Einkommen 1999-2003. Johann-Wolfgang-Goethe-Universität, Frankfurt/Main, typescript.
- Juncke, D., Henkel, M., 2013. Mehrkindfamilien in Deutschland: Dossier. Bundesministerium für Familie, Senioren, Frauen und Jugend, Berlin.
- Kapteyn, A., Van Praag, B., 1976. A new approach to the construction of family equivalence scales. *European Economic Review* 7(4), 313–335.
- Koulovatianos, C., Schröder, C., Schmidt, U., 2005. On the income dependence of equivalence scales. *Journal of Public Economics* 89(5-6), 967–996.
- Krause, P., Zähle, T., 2005. Einkommen und Armut bei Haushalten mit Kindern. *Zeitschrift für Familienforschung* 17(2), 189–207.
- Lautherbach, W., 2003. Armut in Deutschland und mögliche Folgen für Familien und

- Kinder. Oldenburger Universitätsreden (143).
- Lewbel, A., Pendakur, K., 2008. Equivalence scales. In: Durlauf, S., Blume, L. E. (Eds.), *New Palgrave Dictionary of Economics*, volume 3, pp. 26–29, Palgrave MacMillan, Hampshire/New York, 2nd edition.
- Merz, J., 1983. FELES: The functionalized extended linear expenditure system: Theory, estimation procedures and application to individual household consumption expenditures involving socioeconomic and sociodemographic characteristics. *European Economic Review* 23(3), 359–394.
- Nelson, J. A., 1993. Household Equivalence Scales: Theory versus Policy? *Journal of Labor Economics* 11(3), 471–493.
- OECD, n.y. What are equivalence scales? OECD Income Distribution Database (IDD): Methods and Concepts, <http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf>.
- Pischner, R., 2007. Die Querschnittsgewichtung und die Hochrechnungsfaktoren des Sozio-oekonomischen Panels (SOEP) ab Release 2007 (Welle W): Modifikationen und Aktualisierungen. *DIW Data Documentation* 22.
- Plug, E. J. S., Van Praag, B. M. S., 1995. Family Equivalence Scales Within a Narrow and Broad Welfare Context. *Journal of Income Distribution* 4(2), 171–186.
- Pollak, R. A., Wales, T. J., 1992. *Demand System Specification and Estimation*. Oxford University Press.
- Schröder, M., Siegers, R., Spieß, C. K., 2013. Familien in Deutschland - FiD. *Schmollers Jahrbuch* 133(4), 595–606.
- Schulze, A., 2009. *Sozioökonomische Konsequenzen der Fertilität: Folgen der Geburt von Kindern für den Wohlstand von Paarhaushalten*. Springer VS, Wiesbaden.
- Statistisches Bundesamt, 2017. *Haushalte und Familien. Ergebnisse des Mikrozensus. Fachserie 1 Reihe 3*. Statistisches Bundesamt, Wiesbaden.
- Stichnoth, H., 2016. *Verteilungswirkungen ehe- und familienbezogener Leistungen und Maßnahmen*. Heinrich-Böll-Stiftung, Berlin.
- Stone, R., 1954. Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. *The Economic Journal* 64(255), 511–527.

Appendix

Table 1: Income-dependent equivalence scales for monthly household income by deciles.
Source: SOEP v32.1, Garbuszus et al. (2018).

Household type	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AA	1.64	1.41	1.34	1.31	1.30	1.29	1.28	1.27	1.25	1.20
AAC	1.80	1.60	1.51	1.46	1.44	1.43	1.43	1.41	1.39	1.31
AACC	2.29	1.94	1.81	1.73	1.68	1.64	1.58	1.54	1.48	1.35
AACCC	2.29	1.91	1.78	1.71	1.67	1.63	1.61	1.59	1.54	1.41
AC	1.90	1.79	1.71	1.64	1.57	1.49	1.41	1.33	1.27	1.21

NOTE: All values reflect mean scale weights over deciles of the income distributions differentiated by household types; households are pooled across all waves of our SOEP sample; net household income is measured at year-2010 prices.