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Abstract

Income and wealth are important determinants of individual economic well-being because they are a fundamental resource for consumption.
Due to increasing inequality the distribution of income and wealth has moved more and more into the focus of scientific and political attention.
The aim of this paper is to determine the extent and the intensity of multidimensional polarization of both income and wealth. Individual well-being is modeled by a well-being function directly affected by income and wealth. In order to have a flexible functional form for the well-being function the translog function is chosen. The parameters of the well-being function are not chosen arbitrarily but determined by the German population.
From the perspective of an interdependent relation of the polarization dimensions income and wealth, the extent of multidimensional poverty and affluence is represented by the number of people who are assigned to be multidimensionally poor or affluent. The polarization intensity is measured by the multidimensional mean minimum polarization gap (2DGAP). This polarization intensity measure provides a transparent representation of each singular attribute and account for their possible interdependent relations. The data basis for the empirical investigation is the SAVE study from 2010 for Germany.

JEL: I32, D31, J22

Keywords: *Multidimensional polarization, polarization intensity, income, wealth, poverty, affluence, translog well-being function, Minimum Multidimensional Polarization Gap (2DGAP).*

Zusammenfassung

Einkommen und Vermögen leisten einen wichtigen Beitrag zur individuellen ökonomischen Wohlfahrt, da sie eine wichtige Grundlagen für den Konsum von Gütern sind. Aufgrund einer zunehmenden Ungleichheit ist die Verteilung von Einkommen und Vermögen privater Haushalte in den letzten Jahren in der Bundesrepublik Deutschland zunehmend in das Zentrum der wissenschaftlichen und politischen Aufmerksamkeit gerückt.
Das Ziel dieser Arbeit ist, das Ausmaß und die Intensität der Polarisation von Einkommen und Vermögen zu bestimmen. Die individuelle Wohlfahrt wird von einer Wohlfahrtsfunktion modelliert, die direkt von Einkommen und Vermögen abhängt. Für eine möglichst flexible funktionale Form der Wohlfahrtsfunktion wurde die Translog Funktion gewählt. Die Parameter der Wohlfahrtsfunktion werden nicht willkürlich gewählt, sondern anhand der deutschen Bevölkerung bestimmt.
Unter der Perspektive einer interdependenten Betrachtung wird das Ausmaß der multidimensionalen Polarisierung über die Anzahl der Personen in den Polen belegt. Die Polarisationsintensität wird über den Mean Minimum Polarization Gap (2DGAP) gemessen. Dieses Maß der Polarisierungsintensität berücksichtigt transparent jede einzelne Dimension und erlaubt gleichzeitig eine interdependente Betrachtung beider Dimensionen. Als Datengrundlage für die empirische Untersuchung wird die SAVE–Studie von 2010 für Deutschland verwendet.

JEL: I32, D31, J22
Schlagwörter: *Multidimensionale Polarisierung, Polarisierungsintensität, Einkommen, Vermögen, Armut, Reichtum, Translog-Nutzenfunktion, CES Nutzenfunktion, Minimum Multidimensional Polarization Gap (2DGAP).*

1 Introduction

Income and wealth are important determinants of individual economic well-being because they are a fundamental resource for consumption.
Due to increasing inequality the distribution of income and wealth has moved more and more into the focus of scientific and political attention. While income inequality is currently slightly decreasing, an increase in inequality of net private wealth distribution is emerging in Germany (Bundesregierung 2008). Increasing inequality, especially in the form of polarization, leads to a greater sense of injustice among the population and thus threatens social coherence (cf. Esteban and Ray 1999).
The aim of this paper and its contribution to the polarization discussion is to determine the extent and the intensity of polarization of both income and wealth. Well-being is modeled by a well-being function directly affected by income and wealth. In order to have a flexible functional form for the well-being function the translog is chosen. This function allows a quantification of the trade-off between the well-being dimensions without restrictions on their substitutability. The parameters of the well-being function are not chosen arbitrarily but determined by the German population.
From the perspective of an interdependent relation of the polarization dimensions income and wealth, the extent of multidimensional poverty and affluence is represented by the number of the people who are assigned to be multidimensionally poor or affluent. The polarization intensity is measured by the multidimensional mean minimum polarization gap (2DGAP). This polarization intensity measure provides a transparent representation of each singular attribute and account for their possible interdependent relations. The data basis for the empirical investigation is the SAVE study from 2010 for Germany.
The paper is organized as followed: section 2 demonstrates the relevance and the importance of considering polarization. The empirical analysis in section 3.1 begins with a summary of the survey data on wealth for Germany and an overview of the SAVE study which is used in the empirical application. The following section 3.2 discusses the wealth components and their influence on well-being. After this discussion the appropriate wealth components can be chosen and the poverty and affluence thresholds are determined in section 3.3. Section 4 presents some results for unidimensional polarization of income and of wealth, and section 5 examines multidimensional polarization concerning income, net assets and financial assets. The conclusion in section 6 compares the results of unidimensional polarization and multidimensional polarization. Section 6 further compares the results of the polarization intensities concerning the well-being function which is based in income and net worth with the results of the polarization intensities based on the well-being function which depends on income and financial assets. Finally a short outlook of further planned extensions is given.

2 Economic, Social and Political Relevance of the Analysis of Income and Wealth Polarization

A polarized distribution is characterized by structural shifts so that both the upper and the lower tail of the distribution increase while the central part decreases. Polarization is a special form of inequality. In economic terms, while income inequality is a basis for

economic growth (cf. Knell 1998, Hirschman and Rothschild 1973), a polarized distribution of income can facilitate a sense of injustice in the population and represents a potential hazard to the structural relationship of business and society. For this reason the phenomenon of income polarization requires a closer look.

Drewnoski 1978 argues the importance of simultaneous consideration of both poles on the income distribution and their mutual dependence. The abundance of resources at the upper pole leads to a lack of resources at the lower pole. It is indisputable that a stable middle class and a decrease in those who are poor have a positive impact on overall social well-being. The middle class is an important factor for societal development and growth. It comprises a large part of the labor force and thus provides a large proportion of the direct and indirect tax revenues of a country. Easterly 2001 has shown that a higher fraction of income in the middle class is associated with higher growth, more education, better health, and less political instability in society. Furthermore, the middle class has a major influence on the outcome of elections and thus attracts the attention of the political parties (cf. Downs 1957, Arndt 2012).

Nevertheless, the focus of political action is often especially on the lower pole of the income distribution. Arrangements such as establishing a recognized subsistence level or introducing a minimum wage, may limit the extent of income poverty. A higher proportion of the population being at the lower pole, especially if associated with a high fraction at the upper pole of the income distribution, tends to increase feelings of injustice among the population and thus provides the basis for social conflicts. The economic, political and structural consequences of a high proportion of the population being poor, such as low tax revenues, high social expenditure, formation of slums, low education levels and bad health outcomes (see McDonough and Berglund 2003) are obvious, and emphasize the relevance of the analysis of the lower pole of the income distribution.

But the consideration of the upper income group is just as important for several reasons. Atkinson and Piketty 2007 argue the relevance of the upper pole via its impact on resources (tax revenue), on persons (lobbying) and its global significance. The affluent typically contribute a disproportionate share of the tax revenues of a country. According to the OECD (Organization for Economic Co-operation and Development) the richest ten percent of the population contributes 31 percent of tax revenues in Germany (Förster 2008). And, a large proportion of the corporate sector is in the possession of the rich, so they have great economic and political influence (cf. Waldenström 2009).

This study argues that additionally to the traditional income dimension wealth should be incorporated into analyses of polarization because income and wealth are closely related. The major function of income is to allow consumption of goods and services. Wealth can generate income through interest revenues or rental income and wealth is used to compensate loss of income and therefore guarantees consumption. This is particular a key function of wealth in retirement. Wealth and income allow securing of social status and can be used to finance the maintenance and education of children. Furthermore, wealth can be transferred intergenerationally (cf. Grabka and Frick 2009). Consequently, income and wealth are substitutes. The degree of the substitutability, i.e. perfect or imperfect substitutes, is an empirical question and will be evaluated by the German population. It is assumed that income and wealth are not perfect substitutes because of saving plans and income transfers in the future and consequently cannot be added up.

Therefore, the modeling of the relation between income and wealth requires a multidimensional consideration and will be quantified here by a well-being function determined by both dimensions. Because income and wealth are amongst others a basic resource for consumption, they are important determinants of well-being (see Ferrer-i-Carbonell 2005, Frey and Stutzer 2005, Sacks et al. 2013, Slesnick 1998).
The resulting translog well-being function allows a variable substitution for different levels of income and wealth for the poor and the affluent.

3 Empirical Analysis of Income and Wealth Polarization in Germany

The focus of the empirical investigation is the analysis of multidimensional polarization of income- and wealth distribution in Germany. There are already some studies on unidimensional income polarization in Germany available (cf. Goebel et al. 2010, Grabka and Frick 2008, Merz 2007). Many of the studies show an increasing polarization of net household equivalent income since 2000. In section 4 some brief results for unidimensional polarization of income and wealth distribution based on the SAVE data set are presented in order to perform some comparisons with the results for multidimensional polarization.
So far however, only a few measures exist to measure polarization in a multidimensional context. Gigliarano and Mosler 2009 construct various multidimensional polarization indices by a decomposition of inequality measures. The decomposition allows the measurement of inequality within groups, inequality between groups and group size. Polarization is then defined by these three characteristics. Gigliarano and Mosler analyze multidimensional polarization in terms of education and income and detect a slight decrease in polarization between 1994 and 2002 for Germany.
The multidimensional polarization measure developed by Scheicher 2010 deals with the distances of the individuals at the poles to the respective unidimensional poverty or affluence threshold. These distances are summed over the dimensions for each individual. The index corresponds to the mean value of the aggregate distance of all individuals.
Scheicher employs this multidimensional polarization index on the distribution of household income and annual hours worked. He concludes that there has been an increasing polarization between 1986 and 2006 for Germany.
Under the multidimensional perspective, the substitutability of income and wealth is an import point, as discussed in section 2. The measurement by Scheicher does not allow a substitution of the considered attributes, the approach by Gigliarano and Mosler includes a substitution parameter by using a particular inequality measure.
Merz and Scherg 2014 elected to measure the polarization intensity by the Mean Minimum Polarization Gap (2DGAP). This approach is based on a CES (constant elasticity of substitution) well-being function, which there is a function of income and genuine personal leisure time. Based on this modeling, an interdependent view of both dimensions is feasible. It is possible to account for a compensation of income below the poverty line by some amount of genuine personal leisure time, as well as a compensation for a small amount of genuine personal leisure time by higher income. The methodology of this approach is briefly described in section 5.3.1. Their study indicates an increase of the polarization intensity of income and genuine personal leisure time from 1992 to 2002 in Germany.

This 2DGAP approach is applied in the following analysis on the dimensions of income and wealth. As a new extension, a more flexible translog well-being function is used instead of the CES function. Before determining the polarization level of a distribution, however, an empirical characterization of both poles must first be made. In section 3.3, the definition of the thresholds of the lower and upper poles is discussed and implemented.

3.1 Data: Survey on the Financial Situation of German Households

For the analysis of the financial situation extensive wealth information is required. However, this is not easily available for Germany. The largest surveys that contain information about wealth are the Income and Expenditure Survey (EVS) and the German Socio-Economic Panel (SOEP).
The Income and Expenditure Survey (EVS) comprises approximately 60,000 private households in Germany, making it the largest survey of its kind within the European Union. The EVS provides, among other statistical information, features of consumer goods and income, asset and debt situation as well as the consumption expenditure of households. The Income and Expenditure Survey (EVS) has been conducted every five years since 1963.
The SOEP is a representative longitudinal survey of socio-economic information about private households in the Federal Republic of Germany, which has been collected annually since 1984. However, wealth data are so far available only for 2002 and 2007.
The German Federal Bank has been surveying German households and their financial situation since 2010. The results are summarized in the panel study "Households and their finances" (PHF). The data include demographic characteristics, information on employment, the balance sheets of households, their pension rights, saving behavior and income. The PHF is part of a new harmonized survey, which is conducted in all euro area countries. This dataset has been available since April 2013.
Because the PHF so far is only available for a few years, in the following analysis the SAVE data set is used. The SAVE (savings behavior and retirement in Germany) study was launched by the Mannheim Institute for the Economics of Aging (MEA) in 2001 and has been conducted annually since 2005. In addition to socio-economic characteristics of the household members, such as age, education and labor force participation, extended information of savings and the handling of income and wealth are also surveyed. Respondents are asked about their income from various sources, their possession and amount of different types of financial wealth, private and occupational pensions, ownership and value of land and business assets and liabilities of all kinds. By focusing on saving behavior and wealth creation, the SAVE data set is particularly well suited for the analysis of income and wealth polarization.
SAVE surveyed a representative sample of German households. The questionnaire was completed by an adult in the household who answered the questions about his or herself and his or her household. Budget-related questions refer to the respondent his or herself and his or her partner. Children and other adults living in the household are not considered in the household income or assets. Both income and wealth are retrospectively evaluated for the previous year. The last available data of the SAVE study is from 2011.

But a lot of variables that has been collected in previous years were not requested in 2011, so for the following cross-sectional analysis the SAVE data set from 2010 is used.
To obtain information about an individual's income situation the net equivalence income is calculated from the net household income (see also Question 49: *"If you now count all sources of income in total, not just income from wages and salaries: What is the average monthly net income you and your partner have after deduction of taxes and social security contributions from all these sources in 2009? "*, translated by the author). The respective equivalent weight is based on the new modified OECD scale, weighting the head of the household by a factor of 1.0, all other members of the household aged 14 and over by 0.5, and all other by 0.3. This takes into account different household sizes, with economies of scale occurring in larger households (e.g. through sharing of housing and household appliances).
Wealth is recorded in the SAVE data set by Question 67: *"Have you or your partner possessed one of the following types of assets in December 2009"*, translated by the author). Household wealth is weighted similarly to household income, with the same equivalence scale, because household wealth is considered here as a substitute for income which can be used for consumption.
According to the German Federal Bank, the gross assets of private households consist of non-financial assets (real estate, industrial units, vehicles, collections, jewelry etc.), financial assets (savings and checking accounts, credit balances from building society savings, fund units, shares, derivatives and certificates) and assets from private pensions and life insurance. Operating life and retirement insurance and the so-called Riester pensions are not allocated to private wealth.
These gross assets, less liabilities (mortgage, consumer loans), are the net assets of a household. All wealth components are contained in the SAVE data set.
Income is specified as the average monthly income for December 2009, and assets are also queried for December 2009. This means that both variables are regarded as stock figures for the year 2009.
For the multidimensional polarization measurement, well-being resulting from wealth and income is needed. As a proxy for this well-being the satisfaction with standard of living is available (*cf. Question 1: "First, some aspects are listed below, which play a role in life. Please evaluate on a scale of 0 to 10, to what extent are you satisfied with each. Here, "0" designates completely dissatisfied and "10" completely satisfied "" How satisfied are you with your standard of living?"*, translated by the author*).*

3.2 Which Types of Assets Increase Well-Being?

In this study it is argued that an individual benefits from consumption which is facilitated by income and wealth. Therefore, the direct availability of wealth components is very important to enable a possible substitution of income and wealth. Only realizable assets can be converted into ‘money’ which can be used directly for consumption purposes. This means, if for example real estate or tangible assets are considered; only assets which are not financed by loans can be used for consumption purposes (by selling these assets). In this section disposability and accounting liquidity for different wealth components are discussed so that a decision can be made which wealth components are appropriate for the multidimensional well-being analysis.

Financial assets
Concerning financial assets, the relationship to an increase in individual well-being is quite clear. Financial assets in general are associated with an increase in well-being, because they can be used directly for consumption or generate new income through interest rates and returns. Because of their direct availability, financial assets are therefore suitable for the interdependent multidimensional analysis and will be considered in the empirical application.

Gross assets
Gross assets sum up all active asset components. Liabilities are not considered. Here an increase in well-being might be expected only if active assets are not financed by credits. For example, considering real estate assets, it is debatable to what extent a house financed by debts increases well-being compared to a rented apartment. Only when the house is free of debt, an increase in well-being will be expected, caused by a reduction of rent or mortgage payments.
Wealth, such as real estate or business assets, which are only liquidable in the term, is recognized amount in gross assets in full amount. This possibly leads to an underestimation of poverty and wealth thresholds. Considering for example the German poverty threshold based on gross assets, which is €33,000.00 (cf. Table 3), then bearing in mind that these assets also include real estate and business assets, this threshold seems too low. Based on this threshold, any person who is a home owner would likely not be considered as poor, regardless of the liabilities facing the house. Also, business assets are contained in gross assets. Particularly, concerning the self-employed this low poverty line could lead to an underestimation of the poverty rate. For example, entrepreneurs with small businesses would then not be poor only because of their business assets, regardless of their liabilities. Therefore, gross assets are not included in the analysis.

Net assets
Net assets summarize the financial and non-financial assets less liabilities. It can be assumed that net assets can be liquefied in either short or long term, and thus can be used for consumption purposes. Hence, it can be expected that positive net assets influence individual well-being positively. Negative net assets occur if liabilities exist for which no corresponding tangible assets are available, for example, a debt for a holiday trip, for repairs, or education loans. Education loans can be identified in the data and, due to the lack of clarity of the effect on individual well-being; these loans are excluded from the analysis. Loans for vacations or repairs, for example, might cause an increase in well-being but are not clearly identifiable in the dataset. Since the reason for the loan is not identifiable, negative net assets will not be considered any further. Because ‘satisfaction with the living standard’ is used as a proxy for well-being it is desirable to include real estate assets and tangible assets in the study. Financial assets are included in net assets, but should be considered separately because of the high accounting liquidity.
To summarize: in the present multidimensional analysis two different cases will be considered. That is, the analysis will be based on two different well-being functions: one will depend on net assets and income and the other on financial assets and income.

3.3 Classification of Poverty and Affluence on Income and Wealth

Poverty and affluence can be defined in two ways, in an absolute and a relative sense. Absolute poverty can be defined as a condition in which a person is not able to meet his or her basic needs such as food, clothing, housing and health care to ensure his or her independence. This limit is determined by physical subsistence. Relative poverty is defined by a selecting minimum distance to a societal mean value. This distance then presents an appropriate way to demarcate a person's relative shortage of resources (Klee 2005).
Whereas a certain consensus has been reached on the definition of being poor, being rich is an open question. Sen 2001 takes affluence to mean access to a very high level of realization opportunities. However, significantly more often, relative affluence definitions can be found in the literature. Krause and Wagner 1997, for example, define relative income affluence as access to resources that exceeds the needs of the average demand in the population. Following the most common approach, affluence is understood here in monetary terms.

3.3.1 Income Thresholds

The definition of income poverty is clearly defined for the EU Member States. By EU convention, poverty is measured relative to the median net equivalence income. The net equivalence income takes the household composition into account by weighting the head of the household with the factor 1.0, every adult who is living in the household with 0.5 and every child with 0.3. Individuals, who receive 60% of the median net household equivalence income or less, are defined to be poor.
Regarding affluence, however there is no similar EU convention. Other affluence definitions have been suggested. Since the poverty threshold is relatively fixed, it seems appropriate to define a relative affluence threshold as well.
For the affluence limit the mean is more appropriately used as a reference point rather than the median, as is the case in the poverty measurement. Using the mean allow situations of extremely high income to be included (with a median measure would be robust against "outliers") (Grabka et al. 2007, Hajek 2013). The most commonly used relative affluence thresholds are 150%, 200% or 300% of the mean (cf. Arndt et al. 2010, Merz 2004, Merz et al. 2005, Merz and Böhm 2009, Hajek 2013). The 200% threshold has been established in many studies as an affluence limit (cf. Hajek 2013, Grabka et al. 2007, Krause and Wagner 1997).
Table 1 shows a summary of the numbers of individuals at the poles of these various relative limits. The lowest limit of 150% of the mean income classified as rich all individuals, whose equalized monthly net income is at least €2,257.22. Thus this low limit seems to be more a classification of prosperity than of affluence. The 300% threshold, however, seems too high as, there are only 22 individuals in the dataset who would be rich according to this classification. Therefore, in this study, all individuals who own 200% of mean income or more are classified as rich.

3.3.2 Wealth Thresholds

As poverty and affluence are evaluated in this multidimensional view not only on the basis of income, but also wealth, a threshold on wealth must be determined as well. Wealth threshold values are rare in the literature. When wealth thresholds are taken into account a common approach is the consideration of the upper quantiles, e.g. the richest 10%, 5%, 1% or 0.1% of the wealth distribution.

Table 1: Summary statistics for individuals at the poles based on different income thresholds, Germany, 2010

Monthly Household Net Equivalence Income	Obs.	Mean in €	Std.Dev in €.	Min in €	Max in €
Poor					
60% of the Median (€800)	324	601.16	163.67	71.43	800.00
Affluent					
150% of the Mean (€2257.22)	282	3,235.48	1,936.51	2,264.67	20,000.00
200% of the Mean (€3009.63)	98	4,529.82	2,874.95	3,055.56	20,000.00
300% of the Mean (€4514.45)	22	7,937.94	4,815.04	4,666.67	20,000.00

Source: Own calculations, SAVE 2010, weighted data

In this study, the same threshold values as for income are used, i.e. individuals who have an equivalence wealth of 60% of the median or less are poor in wealth terms. Individuals are classified as rich when they reach 200% of the mean equivalence wealth or more.
Table 2 provides some statistics for net household equivalence income and various types of assets. The mean of the monthly net income is €1,504.82; average net assets amount to €126,177.00; average gross assets to €141,113.40; and average financial assets to €25,902.08. Significantly, the median income and, especially, median assets are significantly much smaller than the average values.

Table 2: Summary statistics for income and wealth, Germany, 2010

	Median in €	Mean in €	Standard-deviation in €
Net equivalence income	1,333.33	1,504.82	1,045.776
Net assets	37,000.00	126,177.00	423,101.50
Gross assets	55,000.00	141,113.40	430,420.80
Financial assets	8,000.00	25,902.08	64,348.68

Source: own calculations, SAVE 2010, weighted data

Consequently, outliers appear to be present. The median income is €1,333, the median net worth €37,000, the median of gross assets €51,000 and median financial assets €8,000.
These medians and means determine the poverty and affluence thresholds depicted in Table 3. An individual is income poor if he or she earns €800 or less. He or she is classified as wealth poor if his or her net assets are €22,200.00 or less, his or her gross assets are a maximum of €33,000.00, or his or her financial assets are a maximum of €4,800. In contrast, a person is income affluent if his or her income (need-adjusted)

amounts to at least €3,009.63, and wealth rich if his or her net assets are at a minimum of €252,354.00, his or her gross assets amounts to €282,226.80 and more, or his or her financial assets are at least €51,804.16.

Table 3: Poverty and affluence thresholds, Germany, 2010

	Poor in €	Affluent in €
Net equivalence income	800.00	3009.63
Net assets	22,200.00	252,354.00
Gross assets	33,000.00	282,226.80
Financial assets	4,800.00	51,804.16

Source: own calculations, SAVE 2010, weighted data

4 Unidimensional Polarization for Germany

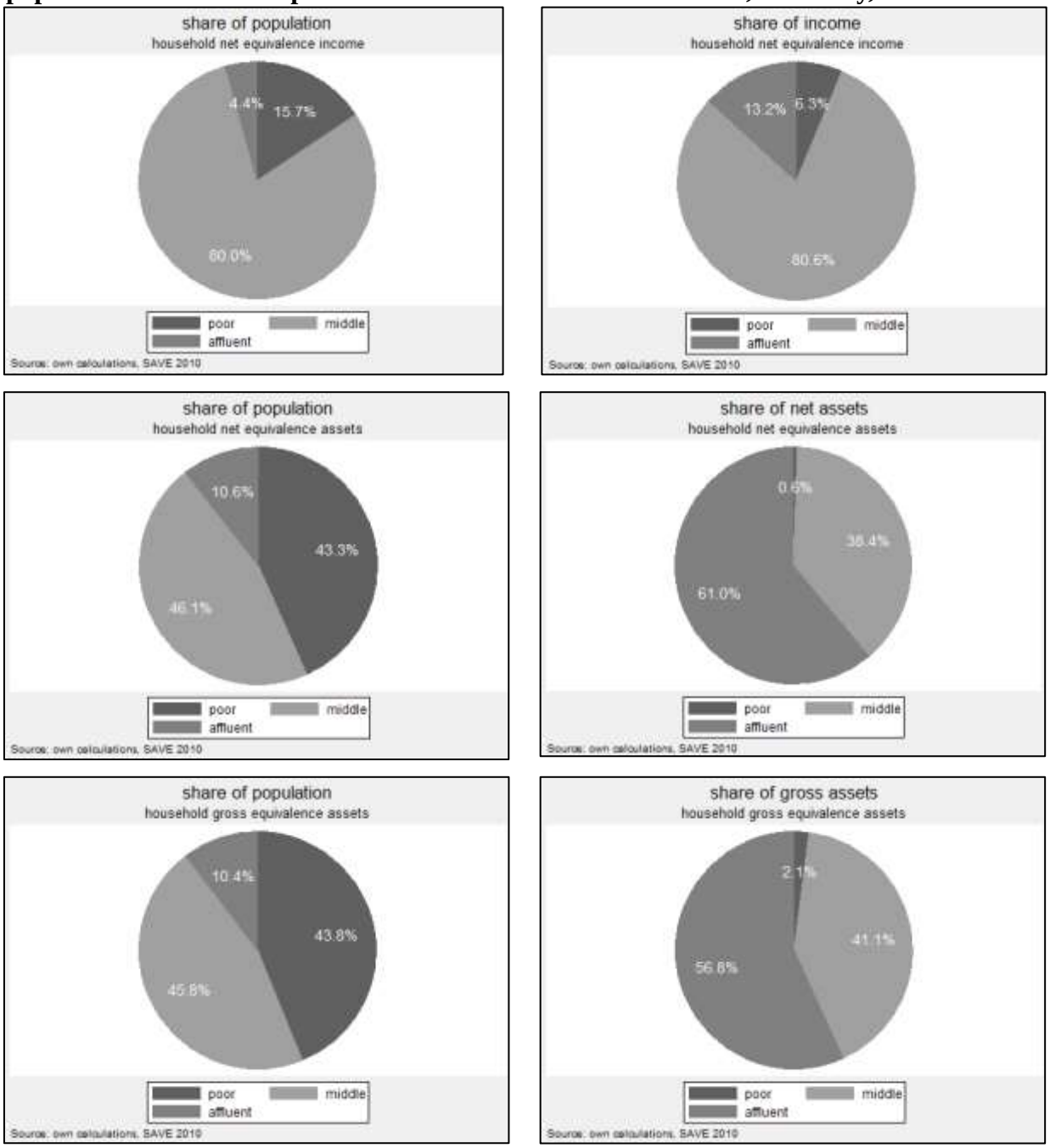
Before focusing on the multidimensional case some brief results for unidimensional polarization of income and of wealth are presented.

4.1 The Extent of Unidimensional Poverty and Affluence: Headcount Ratios

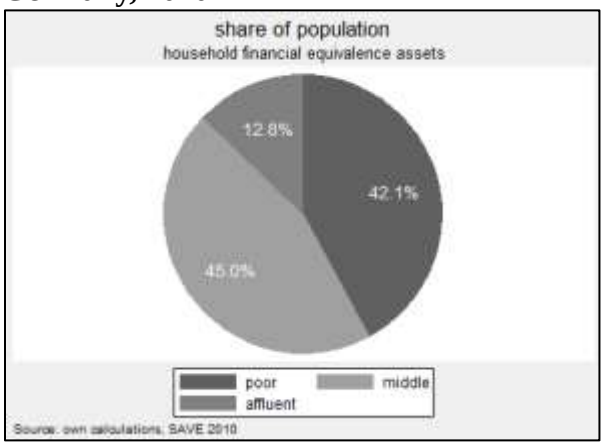
Based on the thresholds discussed in section0 (cf. Table 3), Figure 1 presents the share of population corresponding to income and wealth of the poles and middle of the distribution. Comparing the population shares with their respective income and wealth shares, income is clearly more equally distributed than the given wealth components. While the middle class comprises 80% of the population and earns nearly 80% of the entire income, 15.7% of the population is poor but earns only about 6.3% of the entire income. The population share of the rich is 4.4% but with a proportion of 13.2% of the entire income

Regardless of if gross assets, net assets or financial assets are considered, a similar picture of an unequal distribution results. A very high percentage, nearly 43% of the population, possesses wealth that is under the poverty threshold. The total wealth in this lower pole comprises only about 0.6% to 2.1% of the entire wealth. In comparison, the upper pole constitutes a population share of nearly 10% to 12% but comprises 56% to 63% of the entire wealth. A tabular version of these results is presented in Table 4.

Figure 1: Income and Wealth (net/gross/financial assets) and corresponding population shares at the poles and the middle of the distribution, Germany, 2010



Continued Figure 2: Income and Wealth (net/gross/financial assets) and corresponding population shares at the poles and the middle of the distribution, Germany, 2010



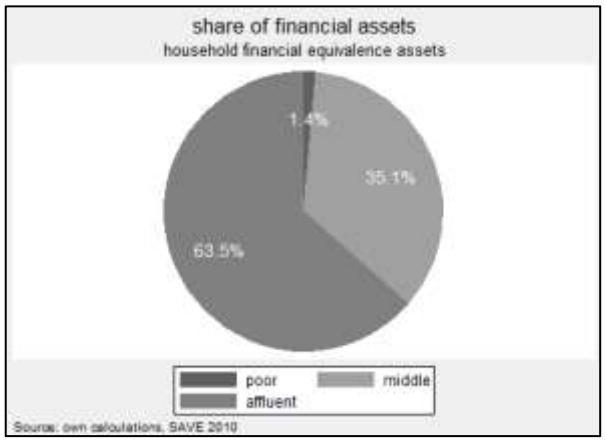


Table 4: Income and Wealth (net/gross/financial assets) and corresponding population shares at the poles and the middle of the distribution, Germany, 2010, shares in %

	Net income		Net assets		Gross assets		Financial assets	
	Population share	Income share	Population share	Asset share	Population share	Assets share	Population share	Assets share
Poor	15.7	6.3	43.4	0.6	43.8	2.1	42.1	1.4
Middle	80.0	13.2	46.1	38.4	45.8	41.1	45.0	35.1
Affluent	4.4	80.6	10.6	61.6	10.4	56.8	12.8	63.5

Source: own calculations, SAVE 2010, weighted data

4.2 Unidimensional Polarization Results

For this unidimensional polarization analysis, four polarization indices and the Gini coefficient are considered. Overall and as expected, all polarization indices show significantly stronger polarization of wealth in comparison to net household income.

The polarization index of Esteban et al. 2007 divides the population into as equal groups as possible and measures the distance of these groups to each other. Higher polarization is characterized by a greater distance between the groups, and an increase in group size. Applying this index here, the population was divided into three groups. While the income has a polarization index 0.09, the polarization index of assets is 0.2957 to 0.3151, about three times larger.

The polarization index of Wolfson 1994 divides the population into two groups at the median. This index can be regarded as a weighted difference between within inequality and between inequality. It measures the bipolarity of a distribution. The polarization index with respect to income takes a value of 0.23. On the presented dataset, the Foster and Wolfson index for assets is five to six times larger (1.0045 to 1.3055).

The polarization measurements by Wang and Tsui 2000 and Scheicher 2010 measure the average relative difference of individual income or assets to a defined threshold. Wang

and Tsui use the median and consider all individual incomes and their absolute distance to the median. Scheicher selects the poverty and affluence thresholds and considers only the incomes of the poor and the rich individuals, whose distance is measured to the poverty or affluence threshold, respectively.

Again, the polarization index of income is five times smaller than the polarization index of assets. In the separate consideration of the poles, it is noticeable that the average distance (to the poverty line) at the lower pole is greater than the average distance (to the affluence line) at the upper pole (see Scheicher poor and rich in Table 5). The polarization index based on the lower pole of net assets is close to one, these results from a large number of assets of zero.

Finally, Table 5 presents measures for inequality of the unidimensional income and wealth distributions. This also demonstrates significantly greater unequal distributions of both assets and income. At the lower pole the inequality of wealth is greater than at the upper pole.

Table 5: Unidimensional polarization and inequality measures, Germany, 2010

Polarization measure	Income	Net assets	Gross assets	Financial assets
Esteban, Gradín und Ray	0.0963	0.3151	0.2957	0.3075
	(0.0042)	(0.0116)	(0.0113)	(0.0099)
Wolfson	0.2307	1.3055	1.0045	1.2245
	(0.0060)	(0.0711)	(0.0575)	(0.0631)
Wang und Tsui	0.4236	3.2663	2.3617	3.0180
	(0.0141)	(0.2482)	(0.1687)	(0.1722)
Scheicher				
poor	0.2643	0.9248	0.7974	0.8166
	(0.0110)	(0.0226)	(0.0096)	(0.0101)
n	*332*	*799*	*794*	*814*
rich	0.2205	0.3802	0.3719	0.4082
	(0.0197)	(0.0175)	(0.0174)	(0.0166)
n	*96*	*228*	*223*	*273*
Gini	0.2859	0.7663	0.7237	0.7369
	(0.0088)	(0.0178)	(0.0188)	(0.0117)
Gini at the poles				
poor	0.1505	0.6508	0.6750	0.7414
	(0.0083)	(0.0162)	(0.0137)	(0.0138)
rich	0.2159	0.4914	0.4735	0.3844
	(0.0449)	(0.0444)	(0.0445)	(0.0301)

Source: own calculations, SAVE 2010, weighted data
standard errors in brackets

5 Multidimensional Polarization for Germany

For the multidimensional analysis, a particular well-being function must first be specified. This well-being function should combine income and wealth together into a single well-being value. On the other hand, this well-being function should also allow a possible substitution of these two attributes.

5.1 Translog Well-Being Function

For the specification of a suitable well-being function some conditions must be fulfilled:

Complete substitutability: It is assumed that income can be completely replaced by wealth and vice versa.
Diminishing marginal well-being: the well-being cannot be increased infinitely by an increase in income and/or wealth.

A well-being function that satisfies these conditions is the translog well-being function, which includes, among others, the well-known CES and Cobb-Douglas functions as special cases (cf. Christensen et al. 1975). The translog has great flexibility. It has a variable elasticity of substitution, which is the "easiness" of substitution, and can vary for different combinations of goods. The translog function is a non-homothetic well-being function. In production theory non-homothetic functions are general functions for which at given factor prices the optimal consumption ratio is not a priori predetermined, but depends also on the level of production. This flexible form of the translog function appears to be best suited to model the interaction and the substitution of income and wealth. Other functions such as the CES or Cobb-Douglas function are more restrictive and thus are not explicitly considered here.

(1) Translog function

$$\ln(Y) = \ln(a_0) + a_1 \ln(x_1) + a_2 \ln(x_2) + 0.5a_3(\ln(x_1))^2 + 0.5a_4(\ln(x_2))^2 + a_5 \ln(x_1)\ln(x_2)$$

In the empirical application, the translog function is estimated in its delogarithmized form, which represents the indifference curves in the income and wealth space. These are presented in Figure 2 to 5.

(2) Delogarithmized translog function

$$Y = a_0 x_1^{a_1} x_2^{a_2} e^{(0.5a_3(\ln(x_1))^2 + 0.5a_4(\ln(x_2))^2 + a_5 \ln(x_1)\ln(x_2))}$$

with *Y* representing well-being-level, x_1 and x_2 well-being dimensions

Estimation problems: satisfaction scale and logarithm
To estimate the parameters of the delogarithmized well-being function ‘satisfaction with the living standard’ is used as a proxy for the well-being level (cf. Clark et al. 2008, Frey

and Stutzer 2005). This endogenous variable is measured by a 10-point-scale satisfaction level given by the survey respondents. The ordinal scale produces some difficulties estimating the parameters of the translog function. Models like the ordered probit or ordered logit models would be appropriate. But due to the nonlinear form, an ordered probit or logit estimation cannot be used. So, the translog well-being function is estimated by nonlinear least square. However, this method requires a metric endogenous variable. To acquire this, the satisfaction levels are normalized (cf. Wooldridge 2013, p.187, Freeman 1977, p. 2). The individual satisfaction levels scaled from one to ten are first transformed into Z values

(3) Z-Scores

$$Z = \frac{x_i - \bar{x}}{S_x}$$

with x_i being the satisfaction level of the *ith* individual, $\bar{x}$ the mean of satisfaction and S_x the standard deviation of satisfaction.
Because these Z scores include a range of values from -3 to 3, but negative well-being values are not valid for the outcome of a well-being function by definition, these Z-Scores are converted to T-Scores.

(4) T-Scores

$$T = 50 + 10 \cdot Z$$

The transformed satisfaction then has a mean of 50 and a standard deviation of 10 (c.f. Bühner 2006, p.112). Due to utilizing this transformation the distances between the values can now be interpreted in terms of the standard deviation, and the delogarithmized translog function can be estimated with non-linear least squares.
The data set includes many declarations of wealth which are equal to zero. The delogarithmized translog function includes logarithmic terms, which are not defined for zero values. As usual these wealth values of zero are transferred as one-cent amounts.

The estimated parameters of the translog well-being function regarding income and net assets are presented in Table 6. All parameters are significant on a 10% significance level.

Table 6: Estimated parameters of the translog well-being function concerning net assets, nonlinear least square, Germany, 2010

Parameters	Estimates	Std.Error.	t-value	P>|t|	Confidence interval	
					lower bound	upper bound
a_0	6.322	2.787	2.270	0.023	0.856	11.788
a_1	0.465	0.125	3.720	0.000	0.220	0.710
a_2	-0.022	0.014	-1.610	0.107	-0.048	0.005
a_3	-0.054	0.018	-2.980	0.003	-0.089	-0.018
a_4	0.001	0.000	2.790	0.005	0.000	0.002
a_5	0.004	0.002	1.870	0.062	0.000	0.008

Source: own calculations, SAVE 2010, n=1873, R^2=0. 9666, weighted data

The estimation comprises 1,873 observations, with all negative net assets being deleted (see discussion in section 3.2).
In the following Table 7, the estimates of the well-being function of income and financial assets are presented. All parameters are significant on a 12% significance level. The non linear least square estimation is based on 2,043 observations.

Table 7: Estimated parameters of the translog well-being function for financial assets, nonlinear least square, Germany, 2010

Parameters	Estimates	Std.Error.	t-value	P>|t|	Confidence interval	
					lower bound	upper bound
a_0	9.433	4.066	2.320	0.020	1.459	17.407
a_1	0.309	0.120	2.580	0.010	0.074	0.545
a_2	0.017	0.010	1.630	0.103	-0.003	0.037
a_3	-0.026	0.017	-1.540	0.124	-0.059	0.007
a_4	0.003	0.001	5.790	0.000	0.002	0.004
a_5	-0.003	0.002	-1.680	0.093	-0.006	0.000

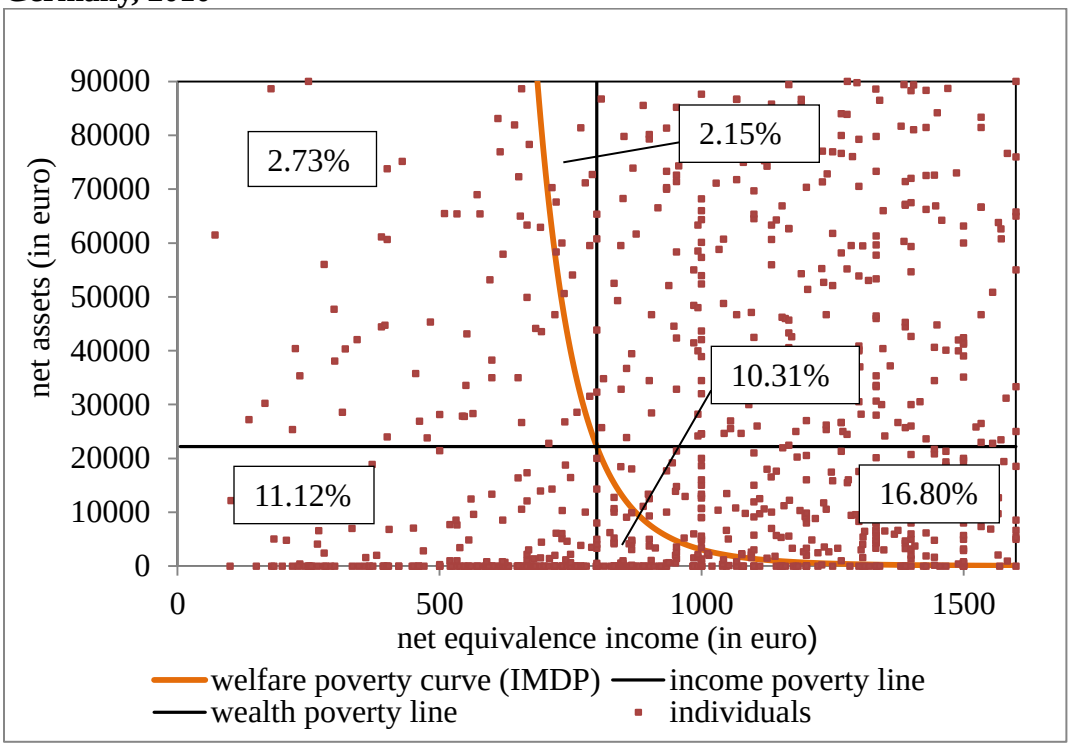
Source: own calculations, SAVE 2010, n=2043, R^2=0,9661, weighted data

5.2 Extent of Multidimensional Poverty and Affluence: Headcount Ratios

This section presents the extent of multidimensional poverty and affluence measured by headcount-ratios. Also, a distinction is made here, between types of assets.

Net Assets
Figure 3 and Figure 4 both present the well-being curve that determines poverty and the well-being curve that determines affluence, respectively, depending on net assets and income. Both curves run through the crossing point of the unidimensional thresholds. In these figures different interesting regions of well-being status can be identified. In Figure 3, in the lower left region, 11.12% of the individuals are assigned to be poor in both dimensions i.e. income and net assets. About 2.73% of the individuals fall in the upper left region, where they are classed as multidimensionally poor although their net assets are above the wealth poverty line. Hence, their wealth does not compensate their low income.
10.31% of the individuals appear to be multidimensionally poor although their income is higher than the income poverty threshold. Thus, their net assets are so low that they are not compensatable by income above poverty line.
Further regions are marked by being not multidimensionally poor although an individual possesses income or wealth below the unidimensional poverty threshold. According to this 16.80% of the individuals are marked as not multidimensionally poor despite an income below the income poverty line. Their wealth is high enough to ‘escape’ the poverty region. 2.15% of the individuals appear as not multidimensionally poor although their income is below the income poverty line. These people possess ‘enough’ wealth, in combination with their income, to be outside the multidimensional poverty region.

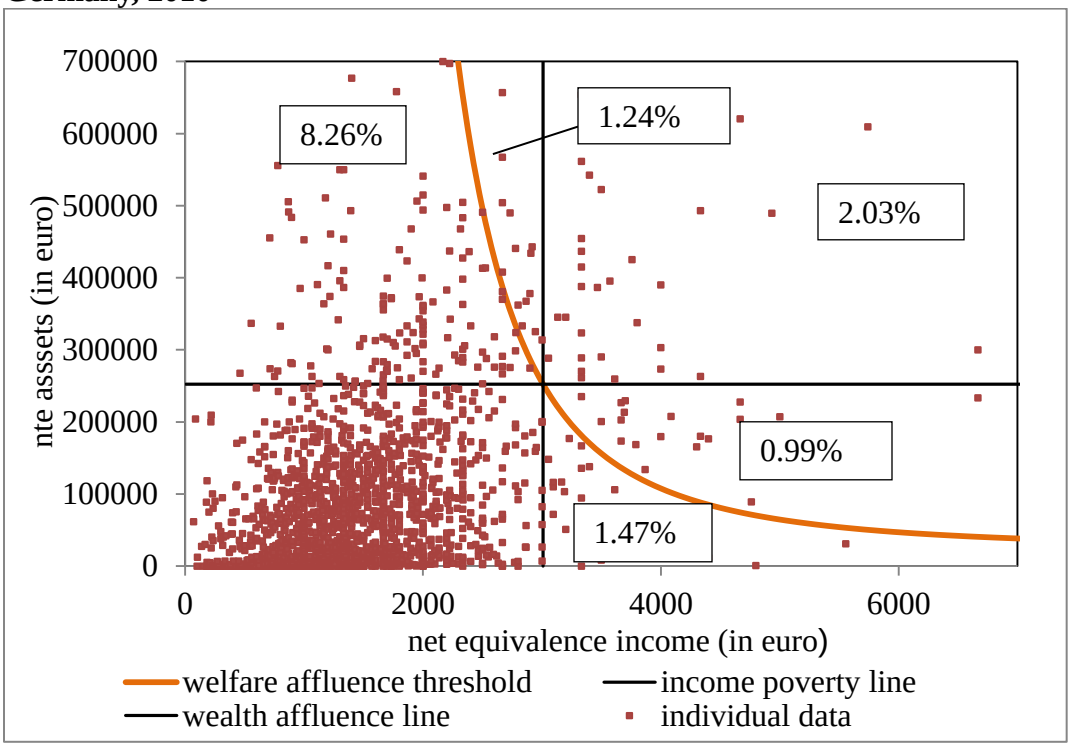
Figure 3: Multidimensional Poverty Regions based on Income and Net Assets, Germany, 2010



Source: own calculations, SAVE 2010

Figure 4 presents the multidimensional affluence curve. Similar to the poverty well-being regions, the picture in general shows a relatively small percentage of multidimensionally affluent individuals. The regions at the upper pole can be interpreted as follows: 2.03% of the individuals come out as rich in both dimensions. 0.99% and 1.24% of the individuals are classed as multidimensionally rich although their income or wealth, respectively, is below the unidimensional affluence thresholds. Therefore, their wealth or income, respectively, is high enough to compensate their income or, respectively, wealth being under the affluence threshold. In contrast 8.26% and 1.47% of the individuals are affluent in unidimensional space but because of their low income or wealth, respectively, being not compensatable in the other dimension they are classified as not multidimensionally affluent.

Figure 4: Multidimensional Affluence Regions based on Income and Net Assets, Germany, 2010



Source: own calculations, SAVE 2010

Financial Assets

Figure 5 and Figure 6 present the results of the estimated well-being poverty and affluence curves. In Figure 5, the well-being poverty curve and the shares of population in the different well-being regions are shown. 12.67% of the individuals are assigned to be poor in both dimensions. This percentage is a little larger than in the net assets case. 1.25% of the individuals are in the region where they are multidimensionally poor although their financial assets are above the wealth poverty line. Therefore, their wealth cannot compensate their low income.

13.82% of the individuals are classed as multidimensionally poor although their income is higher than the income poverty threshold. Their net assets are so low that they are not compensatable by income above the poverty line.

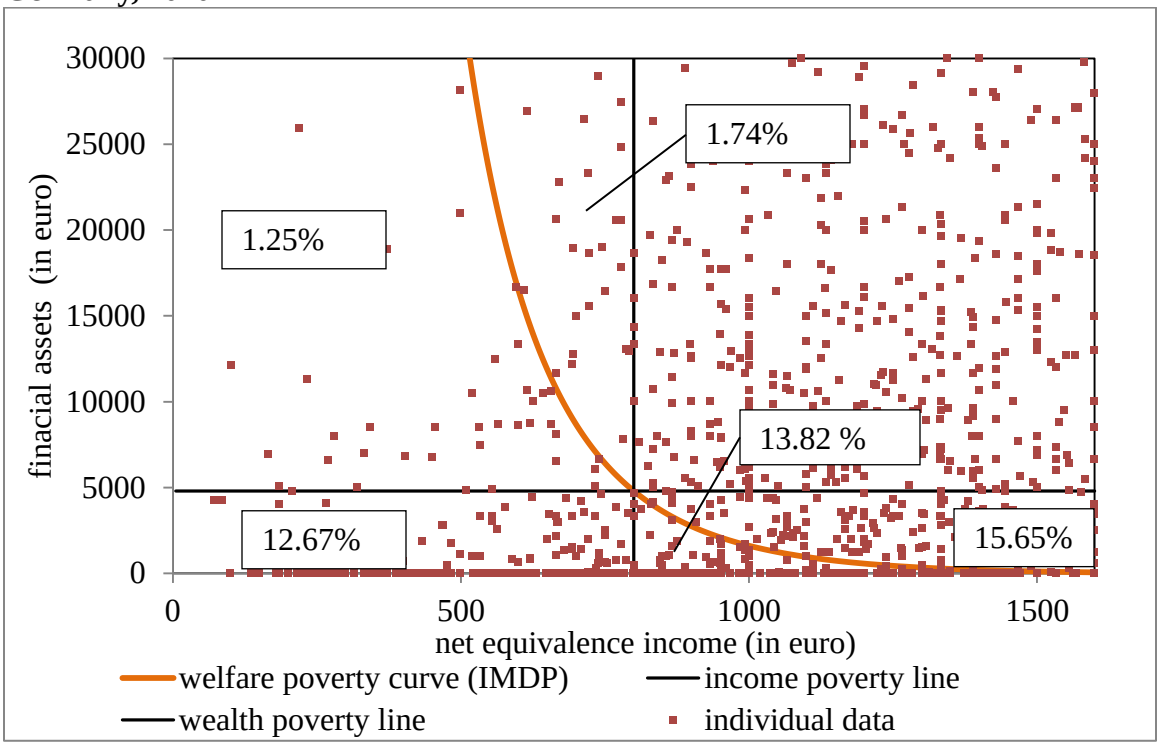
Further regions are marked by being not multidimensionally poor although individuals here possess income or wealth below unidimensional poverty threshold. Thus, 15.65% of the individuals are marked as not multidimensionally poor despite their income being below income the poverty line. Their wealth is high enough to "escape" the poverty region. 1.74% of the individuals are classed as not multidimensionally poor although their wealth is below the wealth poverty line. These individuals have enough income at their disposal to be out of the multidimensional poverty regions.

Figure 6 presents the well-being curve that determines affluence and the different well-being regions at the upper pole. 2.10% of the individuals are affluent in both dimensions. 2.63% are not income affluent, while 0.80% of the individuals are not affluent in financial assets but they can compensate these deficits by high financial assets or income so that they are count as multidimensionally rich. However, despite financial assets or

income above the unidimensional affluence line, 8.09% and 1.48% of the individuals are not multidimensionally rich because these individuals have a deficit in the other relevant dimension which cannot be compensated by financial assets or income.

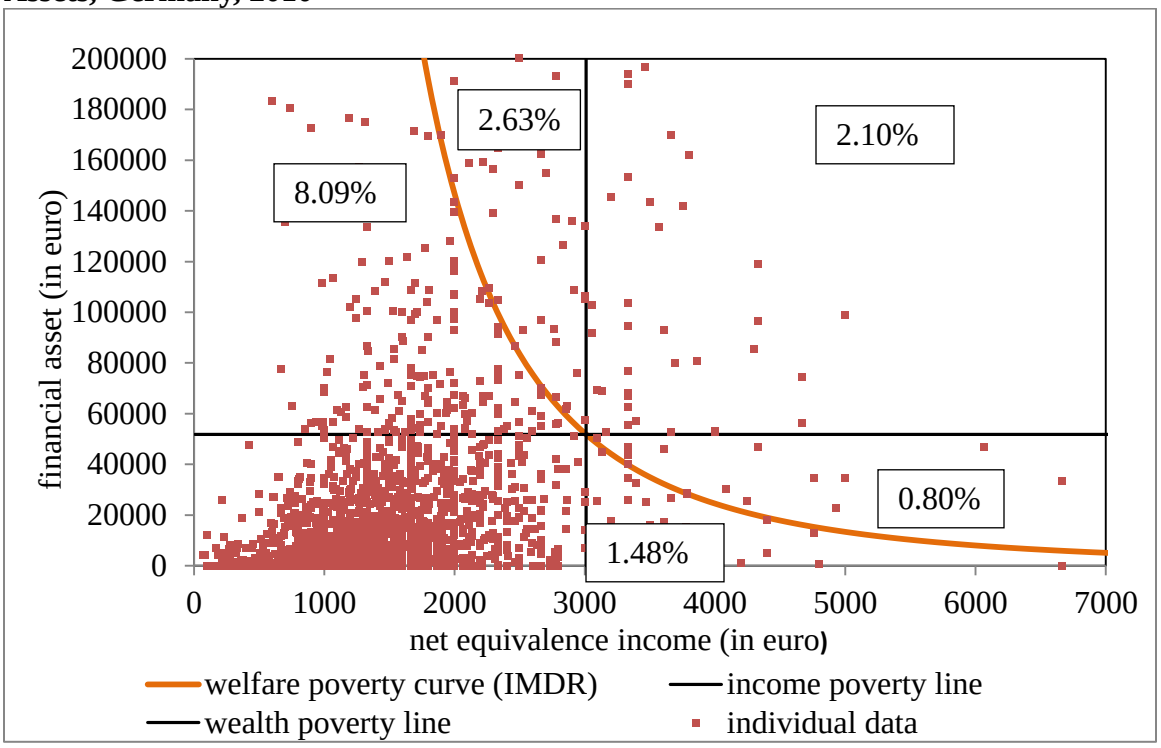
Altogether the population shares in the well-being regions based on the two wealth components net assets and financial assets do not differ significantly. Therefore, the remaining wealth components in net assets, such as tangible assets or real estate, do not seem to matter very much in regard to classification into well-being regions.
And, as expected, the share of population at the upper poles is very low, no matter if net assets or financial assets are considered.

Figure 5: Multidimensional Poverty Regions based on Income and Financial Assets, Germany, 2010



Source: own calculations, SAVE 2010

Figure 6: Multidimensional Affluence Regions based on Income and Financial Assets, Germany, 2010



Source: own calculations, SAVE 2010

5.3 Multidimensional Polarization Intensity

The multidimensional analysis begins with a short description of the method which is used to measure the polarization intensity. Then the results for the whole population and different socio-economic subgroups are presented.

5.3.1 Measuring Polarization Intensity: Mean Minimum 2DGAP

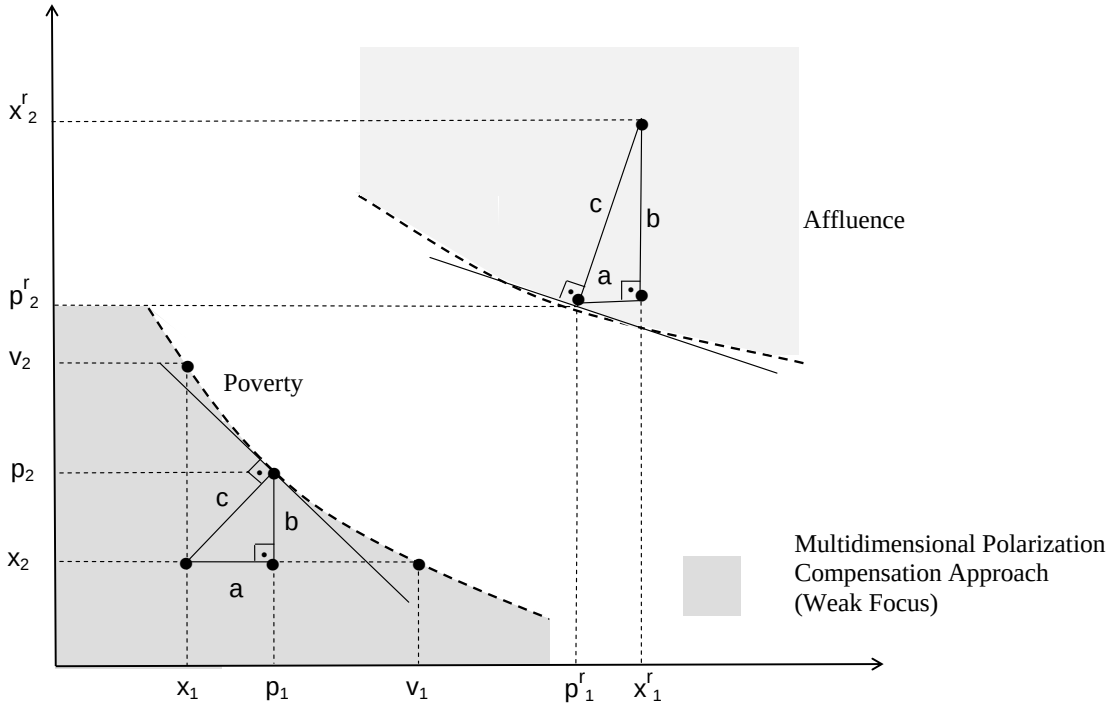
The approach used here to measure multidimensional polarization is based on, which is an extension of the multidimensional poverty analysis of time and income by Merz and Rathjen 2011, 2014. In particular, polarization intensity is measured by the Minimum 2DGAP approach.

The Minimum 2DGAP, which is the distance c in Figure 7 is the shortest distance from a specific individual well-being situation to either the poverty or affluence well-being threshold curve in the two-dimensional well-being input space. Here only the individuals at the poles are considered. The shortest length corresponds to the path which is orthogonal to the tangent at the well-being curve.

As well as c, the distances a and b offer the unidimensional contributions of income and wealth, respectively, to moving out of the multidimensional poverty or affluence regions. The shorter the distance c the lower is the poverty or affluence intensity and therefore, the easier it is for the individual to leave the poverty or the affluence region.

For a more detailed description of this measure in the context of time and income polarization see Merz and Scherg 2014.

Figure 7: Illustration of the Minimum 2DGAP Polarization Measure



Source: Merz and Scherg 2014

5.3.2 Multidimensional Polarization Results Overall

This section presents the results for the polarization intensity based on a translog well-being function which is generated on income and net assets or financial assets, respectively.
It should be noted that the polarization results are based on one cross section. To measure polarization in a longitudinal perspective so that the levels of polarization may be compared to get information about its development would be rather more desirable. Yet, the longitudinal consideration is planned for future research.

First, the polarization intensity results for the whole population at the lower and at the upper pole are presented, each separated by net assets and financial assets. Then, in the following section 5.3.3, the results are presented for different socio-economic subgroups.

Net Assets
Table 8 provides the polarization intensities for the lower and the upper poles. The average shortest distance to the well-being poverty curve (c) is €1,123.23; this distance corresponds to mean compensation amounts of €1,081.37 additional income (a) and €258.27 additional net assets (b) being required to reach the poverty curve.
Of particular interest in that the distances of €1,123.23, and of €1,081.37 in the income dimension, are quite large in comparison with the income poverty threshold of €800. The

data show that this comparatively large distance results from net assets of zero which need to be compensated.
At the upper pole the direct distance to the well-being affluence curve averages to €1,434.91 and therefore a loss of €1,434.89 income and €3.29 net assets would cause a loss of the status of being affluent. The very small amount of net assets results from the almost vertical downward running well-being curve in this region. This curve progression signifies that income and net assets are not really substitutable, because someone in thus situation will not be willing to change any income against net assets.
Altogether the affluence intensity is somewhat larger than the poverty intensity.

Table 8: Polarization intensity (2DGAP) regarding income and net worth

Poor (n=417)	**Mean (in €)**	**Std. Dev. (in €)**	**Min. (in €)**	**Max. (in €)**
c	1,123.32	254.06	442.69	1,326.86
a (income)	1,081.37	221.55	442.69	1,252.80
b (net worth)	261.26	203.22	0.01	437.09
Affluent (n=91)				
C	1,434.99	2,417.91	34.58	15,290.47
a (income)	1,434.97	2,417.90	34.58	15,290.47
b (net worth)	3.13	9.17	0.02	83.82

Source: own calculations, SAVE 2010, weighted data

Financial Assets
The results for the 2DGAP based on the well-being function, which depends on income and financial assets, differ from the results regarding net assets. Concerning the well-being function, there are more individuals at the poles. 522 persons are poor compared with 417 persons and 121 persons are classed as rich compared with 91 persons at the upper pole, respectively restricted by income and net assets.
In the multidimensional poverty region the 2DGAP distances average €1,301.60 which corresponds to an income contribution of €1,295.95 and a contribution of financial assets of €47.28. In the affluence region the average gap of the individuals considered is a little smaller than at the lower pole. The mean shortest distance is €1,213.21.

Table 9: Polarization intensity (2DGAP) regarding income and financial assets

Poor (n=522)	**Mean (in €)**	**Std. Dev. (in €)**	**Min. (in €)**	**Max. (in €)**
c	1,301.60	257.26	455.82	1,861.78
a (Income)	1,295.95	259.76	455.82	1,861.78
b (Financial Assets)	47.28	105.68	0.01	482.28
Affluent (n=121)				
C	1,213.21	1,822.33	10.52	15,284.07
a (Income)	1,213.09	1,822.30	10.52	15,284.05
b (Financial Assets)	10.11	17.75	0.06	126.03

Source: own calculations, SAVE 2010, weighted data

Overall, in the lower pole the polarization intensities are quite large in comparison to the income poverty threshold due to wealth assets of zero which need to be compensated. Regarding net assets the polarization intensities in the upper pole are larger than in the financial assets case because additional wealth components (i.e. tangible assets and real estate assets) are included.

5.3.3 Multidimensional Polarization Results for Socio-Economic Groups

In regard to which socio-economic groups might differ in respect to polarization measures, four characteristics of age, employment status, occupational status and place of residence (i.e. in which German Federal State) are chosen as especially relevant. Age is an interesting differentiation because, based on the Live-Cycle-Hypothesis of Modigliani 1966, wealth accumulation is age-dependent. Clearly, employment status is important, because the income expectations of full-time and different types of part-time labor are different. Occupational status is chosen because of general questions about whether the kind of employment matters for income and wealth polarization.[2] A division in terms of German Federal States is made because of differences in macroeconomic characteristics.

Net Assets

Dividing the considered individuals into age-groups in Table 10, there are no large differences at the lower pole in terms of the average distances to the well-being poverty curve. At the upper pole, individuals between 45 and 50 years of age are farthest from the affluence threshold (i.e. closest to the pole). Their average 2DGAP distance (C) is €2,278.45. This result conforms to the expectation that this age-group would be at or near the maximum for the age-earning profiles. The age-group from 55 to 60 has the shortest average distance to the affluence well-being curve at €1,101.95. One possible reason for this distance being the shortest might be that the people in this age group sometimes avail of early retirement or part-time employment options. Being basically affluent they might afford to exchange some income loss for increased leisure time, an option not available to less well-off persons.

Further, Table 10 presents the average distances to the well-being curves subdivided by the employment status. Similar to the age-groups, there are no large differences at the lower pole concerning the poverty intensity. The average distance to the poverty well-being curve is between €1,084.85, for the marginally employed worker, and €1,221.63, for the temporary employed worker. At the upper pole, full-time workers are, as expected, the group which has the greatest distance to the affluence curve at €1,539.34. This 2DGAP is corresponds with an income contribution of €1,133.08 and a net asset contribution of €291.05.

At the upper pole, individuals who are not employed are located far away from the affluence curve in comparison to the other groups except the full-time workers. And, this group comprises the highest number of individuals compared to the other groups. The group of not employed persons includes retired or unemployed persons, individuals who are on maternal or parental leave, and house-wives or house husbands. Their direct

[2] The occupational status, in particular the division between self-employed and employees, showed remarkable different results for multidimensional poverty analyses (Merz and Rathjen 2012) and affluent investigations (Merz 2004).

distance to the well-being curve is €1,496.63. A division of this group into the named subgroups shows, that the most individuals are retired.
Regarding occupational status, Table 10 again shows no big differences between self-employed, employees and not employed at the lower pole. Their average gap is between €1,049.52 and €1,191.78, combined with respective income contributions of €1,013.74 to €1,111.80 and net assets contributions of €215.15 to €312.83. This result deviates from the study by Merz und Rathjen 2012 which is based on the Socio Economic Panel and the German Time Use Survey and shows that the self-employed are stronger affected by poverty than the employees with respect to unidimensional income poverty and multidimensional income and time poverty for 1992 and 2002 (Merz and Rathjen 2012, p. 179).

Table 10: Polarization intensity (2DGAP) regarding income and net worth, subdivided by socio-economic groups

Socio-Economic Groups	**Poor**			**Affluent**		
	c (in €)	**a (Income) (in €)**	**b (Net worth) (in €)**	**c (in €)**	**a (Income) (in €)**	**b (Net worth) (in €)**
Age						
30-44	1,217.70	1,167.96	313.47	1,381.65	1,381.64	3.83
45-54	1,167.80	1,118.73	296.23	2,278.45	2,278.36	8.39
55-64	1,144.89	1,103.33	258.99	1,101.95	1,101.95	2.26
ab 65	1,207.80	1,153.11	331.66	1,307.01	1,307.01	1.83
Employment Status						
full-time	1,179.66	1,133.08	291.05	1,539.34	1,539.33	2.88
part-time	1,134.16	1,096.35	240.66	734.15	733.89	16.39
marginally employed[1]	1,084.85	1,042.23	255.00	1,034.43	1,034.43	1.20
temporary employed[2]	1,221.63	1,170.82	320.62	328.95	328.95	0.65
not employed[3]	1,191.78	1,140.41	312.83	1,496.63	1,496.62	2.41
Occupational Category						
Self-employed	1,049.52	1,013.74	215.15	1,539.05	1,539.04	1.89
Employed	1,155.75	1,111.80	274.23	1,209.39	1,209.34	5.60
Not empoyed	1,191.78	1,140.41	312.83	1,496.63	1,496.62	2.41

Source: own calculations, SAVE 2010, weighted data
[1]According to legal framework in Germany: marginal employment is denoted by a low absolute income level of €450 a month (status: January 2013)
[2]The legal framework also defines: temporary employment as being limited to 2 months or 50 working days per calendar year and temporary employment is not allowed to be professional if the pay is over 450 euros a month.
[3] The not employed category includes retirement, unemployment, maternity leave, parental leave and homemaking

In the multidimensional affluence region the self-employed have the largest gap, of €1,539.05, to the affluence curve, followed by the not employed persons with a distance of €1,496.62. Employees have the shortest distance to the well-being curve, which is €1,209.39, about €300 less than both other categories. Therefore the employees have the greatest risk of losing the status of being affluent.
Table 11 presents the polarization gaps subdivided by the German Federal States. Particularly in the affluent region there are remarkable differences in the mean distances to the affluence well-being curve.

Table 11: Polarization intensity (2DGAP) regarding income and net worth, subdivided by German Federal States

Federal State	Poor			Affluent		
	c (in €)	a (Income) (in €)	b (Net Worth) (in €)	c (in €)	a (Income) (in €)	b (Net Worth) (in €)
Schleswig-Holstein	1,103.43	1,066.77	242.65	607.55	607.50	5.53
Hamburg	1,295.72	1,229.46	400.41	376.05	376.04	2.51
Niedersachsen	1,217.11	1,159.10	344.42	726.33	726.33	0.91
Bremen	1,301.37	1,229.55	421.39			
Nordrhein-Westfalen	1,236.90	1,179.08	349.35	725.07	725.07	1.66
Hessen	1,208.93	1,155.54	324.18	1,849.60	1,849.60	3.85
Rheinland-Pfalz	1,096.74	1,059.40	227.34	1,289.21	1,288.98	15.74
Baden-Württemberg	1,137.74	1,097.20	250.99	3,139.37	3,139.36	4.97
Bayern	1,161.93	1,117.71	272.93	1,508.90	1,508.90	1.01
Saarland	1,334.24	1,258.90	441.98	558.81	558.80	2.32
Berlin	1,134.89	1,090.63	271.28	186.56	186.56	0.40
Brandenburg	1,085.18	1,048.29	227.57	160.60	160.60	0.46
Mecklenburg-Vorpommern	1,164.26	1,126.58	249.49			
Sachsen	1,164.26	1,126.58	249.49	145.74	145.74	0.35
Sachsen-Anhalt	1,214.14	1,159.92	324.60	411.68	411.68	0.25
Thüringen	987.68	964.52	149.80	1,032.79	1,032.79	1.24

Source: own calculations, SAVE 2010 weighted data

The Eastern German Federal States of Mecklenburg-Vorpommern, Sachsen, Brandenburg and Berlin have very few or zero individuals at the upper pole and their distances to the affluence wellbeing curve are quite short (respectively €145.74, €160.60, €186.56).
In contrast, Hessen, Bayern and Baden-Württemberg, each of which has nearly twenty individuals are located at the upper pole, offer large distances to the affluence well-being curve (respectively €1,849.60, €1,508.90, €3,139.37). These three German Federal States are the donor states in the Financial Equalization System between the Federal Government and the German Federal States. Sachsen and Berlin are the recipient states which benefit most from the Financial Equalization Scheme (cf. Bundesfinanzministerium 2011).

Therefore, the German Federal States seem to have an important influence on the displacement at the poles, especially at the upper pole.

Financial Assets

Similar to the results in the net assets case there are no large differences in the polarization intensities at the lower pole across the age-groups considered. The polarization intensity in Table 12 varies from €1,314.16 to €1,366.17. At the upper pole the youngest age-group (between 30 and 44 years of age) has the smallest distance to the affluence curve. They are most in danger of losing the status of being affluent, a loss of €773.29 income and €21.40 financial assets being sufficient to lose the status. The age-group which is the closest to the affluence pole is again the individuals between 45 and 55 years of age with an average 2DGAP of €1,322.56.

Table 12: Polarization intensity (2DGAP) regarding income and financial assets, subdivided by occupational category

Socio-Economic Groups	Poor			Affluent		
	c (in €)	a (Income) (in €)	b (Financial assets) (in €)	c (in €)	a (Income) (in €)	b (Financial assets) (in €)
Age						
30-44	1,323.81	1,316.65	63.09	773.69	773.29	21.40
45-54	1,366.17	1,361.17	36.69	1,322.56	1,322.51	6.55
55-64	1,314.16	1,309.63	41.45	1,253.45	1,253.32	11.01
ab 65	1,348.88	1,343.12	42.54	1,146.99	1,146.95	6.18
Employment Status						
full-time	1,314.59	1,308.23	53.81	1,167.75	1,167.62	10.87
part-time	1,304.71	1,293.01	90.40	646.59	646.28	15.33
marginally employed	1,355.59	1,354.08	19.94	935.21	935.17	9.18
tempory employed	1,314.97	1,312.29	33.25	1,049.32	1,049.30	5.99
not employed	1,343.57	1,338.16	41.39	1,278.10	1,278.04	7.24
Occupational Category						
Self-employed	1,271.67	1,260.98	84.16	1,719.45	1,719.41	1,719.45
Employee	1,324.05	1,317.66	53.98	788.51	788.31	788.51
Not employed	1,343.57	1,338.16	41.39	1,278.10	1,278.04	1,278.10

Source: own calculations, SAVE 2010, weighted data

Subdivided by occupational categories in Table 12, the self-employed are an interesting group. They have the shortest average distance to the poverty well-being curve, which is €1,271.67, and clearly the largest gap, €1,719.45, to the affluence curve.

Regarding the employment status presented in Table 12, the polarization intensity for the different employment categories does not differ much in the poverty region. By contrast,

in the affluence region there are remarkable variations. The shortest gap to the affluence well-being curve is exhibited by the part-time worker, of only €646.59, followed by marginally employed persons, with a gap of €935.21. After the full-time workers (with a gap of €1,167.75) it is the group of the not employed persons who has the largest distance to the affluence well-being threshold, which is €1,278.10. By subdividing the not employed persons into further different categories, it can be seen that this group comprises 51 persons who are retired and 8 housewives or house-husbands, respectively. Somewhat surprising is the result for the employees at the upper pole. Their distance to the affluence curve is about two to three times shorter in comparison to the self-employed or not employed. It is only €788.51.

Table 13: Polarization intensity (2DGAP) regarding income and financial assets, subdivided by German Federal States

Federal State	Poor			Affluent		
	c (in €)	a (Income) (in €)	b (Financial Assets) (in €)	c (in €)	a (Income) (in €)	b (Financial Assets) (in €)
Schleswig-Holstein	1,313.13	1,298.55	112.93	1,310.70	1,310.69	4.82
Hamburg	1,392.63	1,357.94	190.24	351.47	351.45	3.71
Niedersachsen	1,347.70	1,346.74	15.64	971.39	971.36	5.64
Bremen	1,394.05	1,367.91	140.00	321.82	321.82	0.50
Nordrhein-Westfalen	1,392.32	1,387.65	35.43	1,022.23	1,022.10	9.93
Hessen	1,307.91	1,301.88	48.91	1,561.30	1,561.16	12.96
Rheinland-Pfalz	1,161.60	1,158.37	32.74	1,226.73	1,226.71	6.07
Baden-Württemberg	1,273.59	1,269.80	35.04	1,025.27	1,025.09	13.27
Bayern	1,307.43	1,299.28	62.67	1,573.49	1,573.37	8.71
Saarland	1,454.84	1,454.84	0.01	171.70	171.69	2.05
Berlin	1,348.05	1,345.79	23.89	240.37	240.32	4.55
Brandenburg	1,281.92	1,279.98	25.52	645.37	645.33	6.68
Mecklenburg-Vorpommern	1,437.95	1,433.64	28.51	571.62	571.62	1.87
Sachsen	1,280.43	1,270.18	88.60	374.16	374.15	3.78
Sachsen-Anhalt	1,394.19	1,392.48	18.28	1,501.50	1,501.50	1.54
Thüringen	1,195.57	1,193.08	33.52	1,310.70	1,310.69	4.82

Source: own calculations, SAVE 2010, weighted data

Regarding the well-being gaps subdivided by German Federal States and based on financial assets and income in Table 13, some different results to the net asset case in Table 11 can be observed. The poverty well-being gaps are larger for all German Federal States than in the net assets case. At the upper pole the distances to the well-being curve are shorter but again differ greatly across the different states. The shortest mean well-

being gap is in Saarland with €171.70, followed by Berlin (€240.37), Bremen (€321.82), Hamburg (€351.47) and Sachsen-Anhalt (€374.16). The German Federal States with the largest well-being gaps are Schleswig-Holstein, Hessen and Bayern (€1,310.70, €1,561.30, €1,573.49, respectively).
Overall, then, occupational group and the German Federal State in which individuals live seem to have an important role in polarization intensity measurement. By contrast, polarization intensity shows no relation to either age or employment status.
It is important to note that the investigation here relied on relatively few observations. Thus, although appropriate weighting was used, the conclusions can only be indicative. Nevertheless, they do suggest some preliminary insights into polarization intensity measurement.

6 Conclusion

This paper is about the extent and the intensity of polarization of income and wealth in Germany.
The examination of unidimensional polarization shows a very high percentage of wealth poor individuals no matter which kind of wealth, i.e. net assets or financial assets, is considered. About 43% of the individuals studied are poor in terms of net assets, financial assets or gross assets. This relatively high share of poor individuals possesses only 0.6% to 2.1% of the total national wealth. This is a remarkable result and to some extent comparable to the fourth Armuts- und Reichtumsbericht (Bundesregierung 2013). Unidimensional polarization of income measured by different polarization indices is considerably less than the polarization of net assets and financial assets. The comparison of net and financial assets shows that net assets are only marginally more polarized than financial assets. Therefore, it can be assumed that the influence of the other components, like real estate assets or tangible assets included in net assets is not very high.
In the multidimensional application, the well-being curves are modelled by a translog well-being function which allows interdependence between income and wealth to be modelled. The curvature of the estimated translog well-being curve evaluated across the German population shows the empirical based importance of the trade-off between income and wealth.
At the polarization regions, 42.6% and 49.8% of the multidimensionally poor are assigned to be poor, in terms of net assets or financial assets, respectively, although their income is above the income poverty threshold. Their net assets or financial assets are too low not to be multidimensionally poor. In contrast, at the upper pole 29.1% (net assets) and 47.5% (financial assets) of the multidimensionally affluent are classed as affluent although their income is below the income affluence threshold. Therefore, their relatively high net assets or financial assets, respectively, can compensate their income below the affluence threshold.
The multidimensional application also shows little poverty intensity differences between these two wealth components. The average poverty intensity in the financial assets case (€1,301.61) is a little more than for net assets (€1,123.32). In contrast, the mean affluence intensity determined by net assets and income is stronger (€1,434.99) than the affluence identified by examination of the well-being situation based on financial assets and income (€1,213.21). A possible reason might be that tangible assets and particular real

estate assets are not as existent in the poverty region as in the affluence region. Therefore, tangible assets and reals estate assets, which are the two components, that differentiate net assets from financial assets, do not influence the poverty intensity but the affluence intensity.
Dividing the population into socio-economic subgroups, only in the affluence region are remarkable differences. In this context, the group of those not employed is important to mention. In comparison to other occupational categories and employment statuses, the not employed group, which mainly consists of retired persons, has a very large distance to the affluence well-being curve. Thus, they have a very high well-being status and are not in as much danger of losing their status of being affluent than the other groups.
The second interesting group are the self-employed, who have a large gap to the affluence curve, too. Their polarization intensity based on financial assets is twice as larger as the polarization intensity of employees. On the basis of the well-being curve which depends on net assets, the differences between self-employed and employees are not so large. Subdividing across the German Federal States reveals remarkable differences at the upper pole. The German Federal State in which individuals live seems to influence the polarization intensity quite significantly.

Altogether, this study proves that income and net assets or financial assets, respectively, are substitutive as evaluated by the German population.
Explicit differences in the polarization intensities between regarding net assets and financial assets only appear in the affluence region, because here tangible assets and real estate assets are more existent than in the poverty region.
As already mentioned, the results here are based on data for only one year. It is therefore crucial to expand this polarization study longitudinally to get information about the changes and the development of the polarization intensity. A polarization study of longitudinal data will be the next step of this research with the goal of getting information of the development of the income and wealth polarization.

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