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SOCIAL WELFARE, INCOME, CONSUMPTION, ENERGY, AND THE INEQUALITY AVERSION OF SOCIETY – A CASE STUDY FROM GERMANY

Abstract

The basis for measuring the distribution of income and consumption is the social welfare function. The Atkinson index is an inequality measure based on the social welfare function. Our analysis shows that the social welfare function and the Atkinson index provide a powerful tool not only to measure the social welfare and the distribution of income in Germany but also to estimate for the first time the distributional dimensions of consumption and energy expenditures in Germany. With the epsilon parameter, the Atkinson index explicitly reveals the inequality aversion of society. The epsilon represents the social trade-off between social equality and economic efficiency and represents a connection between the universal equal political rights of the citizens and the efficiency criterion of the economy.

For our analysis, we used disaggregated consumption and income data from the German Household Expenditure Survey conducted by the German Federal Statistical Office. The results of applying social welfare functions and the Atkinson index could make a significant contribution to science and policy debates on social welfare, income, consumption and energy equity in Germany.

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Key words:

Social Welfare, Income Distribution, Consumption, Energy.

JEL: O150, Q400, Q410.

1. Introduction

Distribution effects are of great political interest at a time when the discussion about growing social dissimilarities is playing an increasing political role in public discussions in Europe and Germany (Sen, 1997, Wilkinson and Pickett, 2010, European Commission, 2010, Stiglitz et al., 2009, Jackson, 2009). Inequality is thereby seen as a socially corrosive threat to societies (Wilkinson and Pickett, 2010).

Nicolas Sarkozy took up this discussion and asked J. Stiglitz, A. Sen and J. P. Fitoussi to create and chair a study commission called the «Commission on the Measurement of Economic Performance and Social Progress» (Stiglitz et al., 2009). The Stiglitz Commission recommended that more prominence should be given to the distribution of income, consumption and wealth in society, because «a rise in average income could be unequally shared across income groups, leaving some households relatively worse-off than others. Thus, average measures of income, consumption and wealth should be accompanied by indicators that reflects their distribution across persons and households» (Stiglitz et al., 2009). Income forms the basis for consumption decisions by households, which decisively determines our well-being (Sen, 2003) and as Weitzman pointed out in 1976: «Economic activity has as its ultimate end consumption, not capital formation (Weitzman, 1976).»

Political reforms can be enforced more easily when they are seen to include political measures that contribute to the social justice of society. Social justice is thereby always connected to the distribution of the material welfare of society (Brümmerhoff, 2007). The political interpretation of the distribution of social welfare confronts society with a structural political problem. On one side, the political and social institutions grant the same universal rights and privileges to all citizens. «But its economic institutions rely on market-determined incomes that generate substantial disparities among citizens in living standards and material welfare (Gordon, 1975).» This mixture of the same rights and unequal income

generates social tensions between the political principles of society and the economic principles of capitalism.

«At some points along the way, society confronts choices that offer somewhat more equality at the expense of efficiency or somewhat more efficiency at the expense of equality. In the idiom of the economist, a trade-off emerges between equality and efficiency (Gordon, 1975).»[1] In the following, we want to examine the extent of this trade-off, while determining the dimension of the economic inequality. In addition, we will examine not only the distribution of income and welfare, but also the distribution of the overall consumption and the energy consumption in Germany. Income covers the contribution of the individual to the national economic production, while consumption expresses the opportunity for individuals to lay a claim to the goods produced (Brümmerhoff, 2007).

Income forms the basis for consumption decisions by households, which decisively determines our well-being (Sen, 2003). Or as Pigou said: «The economic welfare of a community consists in the balance of satisfactions from the use of the national dividend (or, as we should say, national product) over the dissatisfactions involved in the making of it (Pigou, 1932).» Hence, the quality of life is determined by income and by consumption (Hicks, 1975).

Therefore, the basic idea of our paper is to help to close the research gap identified by the Stiglitz Commission by measuring the distribution of welfare, income, consumption, and energy consumption thus revealing the structure of German society. If we understand the inequalities better, we can develop policy measures to handle the wellbeing and the quality of life of societies better (Wilkinson and Pickett, 2010), because we are so strongly affected by inequality and our position in society (Wilkinson and Pickett, 2010).

2. Theoretical foundation of the Atkinson index

2.1. Social welfare function (SWF)

The basis for measuring the distribution of income and consumption is the social welfare function (Cowell, 2000a, Lüthi, 1981), which determines the whole benefit for society by summing up the single benefit for individuals in society. Thereby, we assume that the welfare of society is, in contrast to Aristotle's «The

[1] Kermit Gordon (1916–1976) was Director of the United States Bureau of the Budget (now the Office of Management and Budget) (December 28, 1962 – June 1, 1965) during the administration of Lyndon Johnson and President of the Brookings Institution. He oversaw the creation of the first budgets for Johnson's Great Society domestic agenda. Gordon was a member of the Council of Economic Advisors, 1961–1962.

whole is more than the sum of its parts (Aristotle, 2008)«, not more than the sum of the benefits of its individuals, and the welfare of the other society members leaves every individual absolutely unaffected (Hauser, 1996). The distribution of social welfare based on income can be determined with the help of the Atkinson index (Atkinson, 1970)[2].

2.2. SWF-Based Inequality Measure – The Atkinson Index

The Atkinson index is an inequality measure based on the social welfare function (Cowell, 2000b), which defines maximum inequality with 1 and maximum equality with 0 (Sen, 1973). Y_i is the income of individuals in the i[th] income range (N ranges altogether), f_i is the proportion of the population with income in the i[th] range, $\overline{Y}$ is the mean household income (Atkinson, 1970), resulting in the following Atkinson equation (Atkinson, 1983, Atkinson, 1975):

$$I_R = 1 - \left[\sum_{i=1}^{n} \left(\frac{Y_i}{\overline{Y}} \right)^{1-\varepsilon} f_i \right]^{\frac{1}{1-\varepsilon}}, \text{ if } \varepsilon \neq 1.$$

$$I_R = 1 - \exp\left[\sum_{i=1}^{n} f_i \log_e \frac{Y_i}{\overline{Y}} \right], \text{ if } \varepsilon = 1^{3}.$$

The Atkinson index measures the distribution of the welfare that is determined decisively by the net income of the households (Barr, 1993, Atkinson, 1970, Atkinson, 1973, Atkinson, 1975, Atkinson, 1983). Rising net income also implies rising welfare. The welfare of the single individual is measured independent of the income of other individuals.

Several authors have shown within the scope of the axiomatic approach that the Atkinson index fulfils six axioms for inequality measures (Lüthi, 1981, Litchfield, 1999, Cowell, 2000b, Seidl, 2001, Cowell, 2000a). «The axiomatic methodology … consists of a rule-based system of thought which enable us to state precisely what we mean by inequality comparison, and thereby mean what we mean by inequality (Amiel and Cowell, 1999).» The Atkinson index fulfils

[2] See also inequality measures such as the Gini coefficient, Dalton's inequality measure and the Theil measure (Cowell, 2000a).

[3] The special case of Atkinson index $\varepsilon = 1$ is also known as the measure of Champernowne (Champernowne, 1974). It corresponds to the hypothesis of Bernoulli that the marginal utility of the income is inversely proportional to the income level (Lüthi, 1981).

- the Bresciani-Turroni condition (income scale independence) (Diekmann, 1981),
- the criterion of the independence of the population size (principle of population (Dalton, 1920, Amiel and Cowell, 1999, Cowell, 2000a)),
- anonymity condition (Cowell, 2000a, Litchfield, 1999),
- the Pigou-Dalton transfer principle (Dalton, 1920, Pigou, 1912, Amiel and Cowell, 1992, Cowell, 2000a),
- the operationality condition (Lüthi, 1981), and
- the decomposability condition (Diekmann, 1981, Cowell, 2000b, Litchfield, 1999, Cowell and Bosmans, 2009, Amiel and Cowell, 1999, Cowell, 2000a).

The Atkinson index fulfils these six axioms and thus allows inequality to be measured (Cowell, 1985).

2.3. Epsilon – Trade-off between equality und efficiency

However, the Atkinson index has a specific feature for calculating distribution, namely the parameter epsilon ε. Epsilon is the distribution focus of the distribution analysis. «This parameter represents the weight attached by society to inequality in the distribution (Atkinson, 1983).» With the parameter epsilon ε, the size of the welfare difference of additional income can be fixed between a person with a high income and a person with low income.

Epsilon ε «is clearly a measure of the degree of inequality-aversion – or the relative sensitivity to transfer at different income levels. As ε rises, we attach more weight to transfers at the lower end of the distribution and less weight to transfers at the top (Atkinson, 1970).»

The epsilon parameter defines how sensitively the Atkinson index should react to income inequalities. The greater epsilon is, the stronger the Atkinson index reacts to inequalities. Epsilon therefore represents the inequality aversion of the society. It ranges from zero if the society is totally indifferent to the distribution of income to infinity if the society only looks after the position of the lowest income group[4].

[4] This analytic view is based on Rawls theory of justice, where inequality is determined by «position of the least advantage members of society. Where epsilon lies between these extremes depends on the importance attached to redistribution towards the bottom (Atkinson, 1983).»

One can say that epsilon represents the social trade-off between social equality and economic efficiency. With the Atkinson parameter, a normative dimension is therefore incorporated into the inequality analysis, which allows a degree of social aversion to be introduced into the inequality analysis. The advantage of the Atkinson index is that the epsilon parameter can be varied in such a way that the welfare of the lower income groups is weighted strongly or weakly in the welfare measurement.

In the following, we address the question of what the socially acceptable value for epsilon is, which represents Gordon's social trade-off between equality and efficiency. A socially acceptable value for the parameter epsilon can be determined with Okun's leaky bucket experiment (Okun, 1975, Atkinson, 1983, Barr, 1993, Seidl, 2001, Lüthi, 1981).

Okun assumes in his experiment that 20% of American families in 1974 had an average net income of $ 5,000 and that the uppermost 5% of families had a net income of $ 45,000. If the uppermost 5% pay an additional income tax of 9% ($ 4,000) to the lowest 5%, and if we take into consideration that the lowest 20% comprises 4 times more people, then every family in the lower income group receives $ 1,000 (Okun, 1975). «However, the program has an unsolved technological problem: the money must be carried from the rich to the poor in a leaky bucket. Some of it will simply disappear in transit, so the poor will not receive all the money that is taken from the rich. The average poor family will get less than $ 1000, while the average rich family gives up $ 4000 (Okun, 1975).»

Okun assumes that every economic transfer is associated with transaction costs (administrative costs, work effort, savings and investment, socioeconomic leakages) (Okun, 1975), which reduce the economic contribution to the poor. From this the question arises as to how high the transaction costs can increase so that the transfers can still be justified by society (Okun, 1975).

This question can be answered with the following formula (Lüthi, 1981):

$$\frac{1}{(1-x)} = 2^{\varepsilon}, \text{ x = transfer share}$$

If one assumes a socially acceptable transaction share of 29.5%, we receive the following value for epsilon:

$$\frac{1}{(1-x)} = 2^{\varepsilon}$$

$$\frac{1}{1-0.295} = 2^{\varepsilon}$$

$$1.418 = 2^{\varepsilon}$$

$$\frac{\ln(1.418)}{\ln(2)} = \varepsilon$$

$$0.5 = \varepsilon$$

If society accepts transaction costs of 50%, then we get an epsilon value of 1. If a transfer loss of 75% is accepted, the epsilon value is 2. However, if society only accepts a transfer loss of 10%, than we get an epsilon value of 0.15.

According to Okun, the question of the socially accepted epsilon value can be answered from two different perspectives: if the main focus is on the question of social equality in the sense of Rawls or on economic efficiency in the sense of Milton Friedman (Okun, 1975, Rawls, 1971, Friedman, 1962), epsilon can be interpreted in the sense of Gordon as the relation of social equality and economic efficiency:

$$\varepsilon = \frac{\text{equality i.S. Rawls}}{\text{efficiency i.S. Friedman}},$$

Okun has decided for himself that he «would stop at a leakage of 60 percent» (Okun, 1975) in his example, representing an epsilon value of 1.3. Samuelson reports, that the «Internal Revenue Service spends only half a penny on administrative costs for each dollar of collected revenues (Samuelson and Nordhaus, 2010).»

In the redistribution from the rich to the poor, we have to consider that the marginal social benefit of the poor is higher than that of the rich. In other words, only a fraction of that taken from the rich must be given to the poor to attain a constant social welfare of society, as the following example shows.

Table 1

Income and Expenditures of the German private households

Income Groups of German Households All Households	overall average	Monthly net income from ... to in €							
		under 900	900 - 1300	1 300 - 1 500	1 500 - 2 000	2 000 - 2 600	2 600 - 3600	3 600 - 5000	5 000 - 18 000
Households (1 000)	38110	3041	4669	2321	5298	5609	7323	5540	4308
Share of income group on all households	100%	8,0%	12,3%	6,1%	13,9%	14,7%	19,2%	14,5%	11,3%
Gross income in €	3561	811	1282	1714	2151	2822	3885	5414	8729
Net income in €	2833	704	1111	1401	1743	2295	3063	4202	6867
Total private consumption	1314	807	1099	1334	1580	1983	2473	3061	4117
Energy consumption	202	82	109	135	155	193	238	277	332

Source: German Federal Statistical Office, 2006, EVS 2003 and own calculation IEK 2011

In our analysis, as Table 1 shows, the richest income group (€ 5000–18000) has an average income about 10 times higher than that of the poor (under € 900). The gross income in the lowest income group is € 811 and the net income € 704, whereas in the highest income group the average gross income is € 8729 and the net income is € 6867. In this case, the social welfare function remains unchanged if the income of the rich is reduced by 10^{ε}, i. e. society will not face a social welfare loss through the redistribution (Lüthi, 1981).

The social welfare remains unchanged,

- for $\varepsilon = 0.1$, if we take € 1.25 from the rich and give € 1 to the poor,
- for $\varepsilon = 0.5$, if we take € 3.2 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.0$, if we take € 10 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.5$, if we take € 32 from the rich and give € 1 to the poor,
- for $\varepsilon = 2.0$, if we take € 100 from the rich and give € 1 to the poor.

If we use the social welfare function on the basis of epsilon 0.1, the social welfare remains unchanged if we take € 1.25 from the rich and give € 1 to the poor. The transaction costs increase with rising epsilon. With an epsilon of 2, the social well-being function remains unchanged if we take € 100 from the rich and give € 1 to the poor (Lüthi, 1981). The available redistributions increase from € 1.25 to € 100 due to the increase in the inequality aversion of society. Societies with an epsilon parameter of 2.0 accept higher transaction costs and redistributions without a loss of social welfare than 0.1-epsilon societies. Hence, the potential loss of social welfare of society through redistribution depends on the values of society and how society regards itself, i. e. the meaning equality has for society.

In the following, we also look at the effect of epsilon on the social welfare of consumption and energy consumption and the consequences of redistribution. We thereby interpret consumption and energy consumption as indicators of social welfare and quality of life.

In the case of consumption, the lowest income group has an average consumption of € 807 and the highest income group has an average consumption of € 4117, which is 5 times higher than that of the lowest income group. Social welfare would therefore remain untouched,

- for $\varepsilon = 0.1$, if we take € 1.18 from the rich and give € 1 to the poor,
- for $\varepsilon = 0.5$, if we take € 2.3 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.0$, if we take € 5.1 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.5$, if we take € 11.5 from the rich and give € 1 to the poor,
- for $\varepsilon = 2.0$, if we take € 26.0 from the rich and give € 1 to the poor.

These data show that if we sustain the social welfare function in the case of epsilon 0.1, we can only take € 1.18 from the rich and give € 1 € to the poor without losing social welfare. In this case the transaction costs are just € 0.18. The transaction costs increase to € 26, if we use an epsilon value of 2.0.

In the case of energy consumption, the highest income group has an average energy consumption of € 332. i. e. 4 times higher than that of the poor (under € 900) with € 82. Based on these data the social welfare of energy expenditures would remain unchanged,

- for $\varepsilon = 0.1$, if we take € 1.15 from the rich and give € 1 to the poor,
- for $\varepsilon = 0.5$, if we take € 2.0 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.0$, if we take € 4.0 from the rich and give € 1 to the poor,
- for $\varepsilon = 1.5$, if we take € 8.1 from the rich and give € 1 to the poor,
- for $\varepsilon = 2.0$, if we take € 16.4 from the rich and give € 1 to the poor.

If we now also use the social welfare function for energy on the basis of epsilon 0.1, social welfare remains unchanged if we take € 1.2 from the rich and give € 1 to the poor. The transaction costs increase with rising epsilon. With an epsilon of 2, the social wellbeing function remains unchanged if we take € 16.4 from the rich and give € 1 to the poor (Lüthi, 1981). In the field of energy consumption, the redistribution requirements are significantly lower to sustain social energy welfare than in the case of income and consumption.

The analysis has shown that the redistribution costs depend on the spread of inequality between the lowest and the highest income group and the chosen epsilon parameter, which represents the inequality aversion of society. The redistribution costs therefore depend on the values of society with respect to fairness and equality, i. e. how society regards itself and its values.

In the following, we will examine the distribution of income, consumption and energy consumption in more detail with the Atkinson Index.

We have shown in this analysis that the epsilon parameter of the Atkinson index reveals both the values of society with respect to distributional justice and the willingness of society to accept transfer costs to achieve distributional justice. Epsilon indicates how high the welfare difference can be between the lower and higher income groups from society's viewpoint. The epsilon parameter represents a connection between the universal equal political rights of the citizens and the efficiency criterion of the economy, and it defines fairness from the perspective of society.

Finally, it has to be pointed out, that no objective statistically neutral inequality measures exist. Every measure contains implicit evaluations about a desirable distribution of income. The degree of the inequality cannot be measured without taking social judgments into consideration. «Measures such as the Gini coefficient are not purely «statistical» and they embody implicit judgments about

the weight to be attached to the inequality at different points on the income scale (Atkinson, 1983).»

If the Gini coefficient indicates a decrease in inequality, then not everyone must agree with that judgment (Hauser, 1996). Due to the fact that inequality measures contain implicit judgments about a certain distribution, is it sensible to use inequality measures that reveal this judgment explicitly. The Atkinson index reveals its values explicitly because the distribution parameter epsilon can be chosen freely (Atkinson, 1975). The index makes clear «just what distributional objectives are being incorporated (Atkinson, 1983)« in the distribution analysis. We will carry out our distribution analysis on the basis of the German household expenditure survey data (EVS) of the German Federal Statistical Office (Statistisches Bundesamt (Federal Statistical Office), 2005b, Statistisches Bundesamt (Federal Statistical Office), 2005a).

3. Data base – Household Expenditure Survey data (EVS)

The EVS data provide information on German economic life and the consumer behaviour of private households. These data provide a basis for estimating the effects of economic policy. The EVS is constructed according to the methodological Eurostat[5] recommendations «Household Budget Surveys in the EU. Methodology and recommendations for harmonisation – 2003 (Statistisches Bundesamt (Federal Statistical Office), 2005a).» Every five years, a selection of German households (0.2% of all German households) is questioned as part of a household expenditure survey. The households are questioned about their income, expenditures, assets, consumer goods and residential situation. The 2003 survey was the ninth survey, following surveys in 1962/63, 1969, 1973, 1978, 1983, 1988, 1993 and 1998. (Statistisches Bundesamt (Federal Statistical Office), 2005b). The 2008 survey has not yet been published in full.

The main focus of this survey lies in collecting income and expenditure data on the households (Statistisches Bundesamt (Federal Statistical Office), 2005a). The Federal Statistical Office thus delivers important data for the assessment of the income situation, standard of living and the expenditure behaviour of the whole population and its different social groups (Statistisches Bundesamt (Federal Statistical Office), 2005a)

The EVS delivers detailed data on the distribution of household incomes, co-paid by the households. Therefore, the data enable us to estimate the consequences of income changes, tax alterations and the changes in consumer prices and social security contributions for the consumption behaviour of households,

[5] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Household_budget_survey_%28HBS%29

as well as the consequences for a country's economic development (Statistisches Bundesamt (Federal Statistical Office), 2005a).

The household is the most important socioeconomic investigation unit in the EVS. To separate a household in the statistical sense and to create an option of grouping multiperson households according to different social issues (e.g. social status, age, household income class, tenants/owners of apartments), the statistical issue of the main income recipient of the household was introduced in 1998. The EVS in 1998 defined the main income recipient as that person in the household who contributes the biggest share to the household income.

The Federal Statistical Office understands a private household to be a group of related or personally linked (not necessarily family-related) persons, which belongs together in terms of income and consumption. A household must dispose together over one or several incomes or over income shares, and it must be supplied completely or predominantly within the scope of the household. An individual living alone also counts as a household unit (Statistisches Bundesamt (Federal Statistical Office), 2005a). The key statistical issue in EVS is the income and expenditure of private households. For the coverage of income and expenditure of the households, the Federal Statistical Office uses the market concept. This means that the only expenditure that is registered is expenditure over the market for goods and services (Statistisches Bundesamt (Federal Statistical Office), 2005a, Burghardt, 2000, Münich, 2000).

The most important group for the organization of households within EVS 2003 is the social position of the main income recipient, the age of the main income recipient, household size, household type and the monthly net income. For our analysis, we concentrated on the household net income and household type. The following household groups were analysed:

- All households
- Single woman, single man
- Single parent
- Married couple without children
- Married couple with children

A household's gross income comprises all income received from employment and self-employment, public and private transfer payments and subleases (Statistisches Bundesamt (Federal Statistical Office), 2005a). The gross income from employment does not contain the employer's contributions to the social security system. The net income is calculated by subtracting taxes and contributions to the social security system from the gross income. The expenditures of the households consist mainly of expenditures for private consumption. Based on the statistical data basis of the EVS, we examined the distribution of income and consumption in Germany.

4. Measuring inequality in Germany – results

In the first step, the social welfare function was determined, followed by the Atkinson index.

4.1. Social welfare function

A starting point for our calculation was the social welfare function and its characteristics (Cowell, 2000a, Cowell, 2000b). These characteristics (individualistic, nondecreasing, symmetric, additive, strictly concave, and constant elasticity) enabled us to aggregate the individual utility level of the households to an aggregated social welfare function (Lüthi, 1981):

$$SWF = \sum_{i=1}^{n} U\left(y_i\right),$$

where $U\left(y_i\right)$ represents the utility level of the i[th] household, which is defined as follows:

$$U\left(y_i\right) = \frac{1}{1-\varepsilon} y_i^{1-\varepsilon}.$$

On account of the additivity condition of the social welfare function, the single utility levels of the households can be aggregated to a social welfare function.

$$SWF = \sum_{i=1}^{n} \frac{1}{1-\varepsilon} y_i^{1-\varepsilon}$$

On the basis of the social welfare function, the social welfare can be calculated for the whole society, as can the consumption of society and the energy consumption (residential energy and car traffic). We will show how different epsilon values will affect the distribution results. This approach allows the effect of the inequality aversion of society to be considered.

We get the following additional sector welfare functions:

Social consumption welfare function:

$$SWF_{PK} = \sum_{i=1}^{n} \frac{1}{1-\varepsilon} PK_i^{1-\varepsilon}$$

Social energy welfare function:

$$SWF_E = \sum_{i=1}^{n} \frac{1}{1-\varepsilon} E_i^{1-\varepsilon}$$

Social residential welfare function:

$$SWF_{EW} = \sum_{i=1}^{n} \frac{1}{1-\varepsilon} EW_i^{1-\varepsilon}$$

Social car traffic energy welfare function:

$$SWF_{EK} = \sum_{i=1}^{n} \frac{1}{1-\varepsilon} EK_i^{1-\varepsilon}$$

On the basis of the described functions, we can define for all households the social welfare depending on the chosen epsilon parameter. The values are not comparable for different values of epsilon; they can only be interpreted as indices (Lüthi, 1981).

For the household group of all households, the indices (Table) reveal that under the condition of low aversion against welfare differences (epsilon 0.1), the social welfare would increase if all households were to receive the average income. An increase in social welfare through the distribution of the average income would decrease with an epsilon value of 0.5 because the transfer costs would increase with increasing epsilon values. With epsilon parameters of 1.5 and 2.0 and transfer costs of 65–75%, no additional welfare would occur through a redistribution of income.

The analysis also shows that with a low epsilon parameter and low transfer costs, welfare gains occur in the private consumption, energy consumption, residential energy consumption and car energy consumption of all households. However, it also shows that for an epsilon value greater than 1.5, no more welfare gains appear in private consumption. In the area of energy, small welfare losses appear when all households consume the average energy services. This means that in spite of high transfer costs, the social well-being function does not move because of the redistribution. If we take a more differentiated look at the households, a slightly modified picture arises. In the household group of single women, the welfare gains decrease with increasing epsilon when every household is assigned the average consumption. Some welfare losses were detected for single-woman households in the energy sector. Therefore, we can summarize that the social welfare of this group does not increase when the transfer costs rise more than 50%. This development trend also appears within the social group of single men, single-parent households, married couples without kids and married couples with kids.

The present analysis has shown the influence of the epsilon parameter on social welfare, i. e. how the inequality aversion of society influences the social welfare of that society. In the following, we will examine what influence the inequality aversion of the epsilon parameter has on the distributional effect measured by the Atkinson index.

Table 2

Social Welfare

Social welfare as function of epsilon - Index values					
		All households			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10572	7595	991	630	428
0.5	779	666	215	168	132
1.5	0	0	-1	-2	-2
2.0	0	0	0	0	0
		Households of single women			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10685	7182	784	577	255
0.5	782	648	190	161	101
1.5	0	0	-1	-2	-3
2.0	0	0	0	0	0
		Households of single men			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10693	7182	853	523	390
0.5	782	648	199	152	128
1.5	0	0	-1	-2	-2
2.0	0	0	0	0	0
		Households of single parents			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10504	8384	970	664	368
0.5	779	702	214	174	117
1.5	0	0	-1	-1	-2
2.0	0	0	0	0	0
		Households of maried couples			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10537	9065	1076	684	436
0.5	777	739	277	177	129
1.5	0	0	-1	-1	-2
2.0	0	0	0	0	0
		Households of maried couples with children			
Epsilon	income	private consumption	energy	residential energy	car energy
0.1	10210	8398	1044	643	474
0.5	731	671	213	164	136
1.5	-2	-2	-3	-3	-4
2.0	-1	-1	-1	-1	-1
Source: Own calculation					IEK-STE 2011

4.2. Atkinson Index – Inequality of income and consumption by population subgroups

For the determination of the distributional effect of income and energy, we will use the Atkinson index in the following. For the calculation of the distribution of the gross and net income for the different social groups, we used the modified Atkinson index AI_g:

$$AI_g = 1 - \left[\sum_{i=1}^{n} \left(\frac{Y_{i,g}}{\overline{Y_g}} \right)^{1-\varepsilon_1} f_{i,g} \right]^{\frac{1}{1-\varepsilon_1}}, \text{ for } \varepsilon_1 \neq 1.$$

$$AI_g = 1 - \exp\left[\sum_{i=1}^{n} f_{i,g} \log_e \frac{Y_{i,g}}{\overline{Y_g}} \right], \text{ for } \varepsilon_1 = 1 .$$

$Y_{i,g}$ represents the income of individuals in the i[th] income range (n sum of the income classes) in the g social groups (all households, single women, single men, single parent with kids, married couple, married couple with kids), $f_{i,g}$ is the proportion of the population in the social groups with income in the ith income range, $\overline{Y_g}$ is the mean household income of the social group, and the epsilon parameter for all groups is ε.

For the calculation of the distribution of the private consumption, we also used a modified Atkinson index AIK_g:

$$AIK_g = 1 - \left[\sum_{i=1}^{n} \left(\frac{K_{i,g}}{\overline{K_g}} \right)^{1-\varepsilon_2} f_{i,g} \right]^{\frac{1}{1-\varepsilon_2}}, \text{ for } \varepsilon \neq 1.$$

$$AIK_g = 1 - \exp\left[\sum_{i=1}^{n} f_{i,g} \log_e \frac{K_{i,g}}{\overline{K_g}} \right], \text{ for } \varepsilon = 1.$$

$K_{i,g}$ represents the consumption expenditures of the individuals in the i[th] income range of the social group g, $f_{i,g}$ is the proportion of the population in the social group g in the i[th] income range, and $\overline{K_g}$ is the average household consumption.

For the calculation of the distribution of energy consumption $E_{i,g}$ in the various social groups, we used the following modified Atkinson index AIE_g :

$$AIE_g = 1 - \left[\sum_{i=1}^{n} \left(\frac{E_{i,g}}{\overline{E_g}} \right)^{1-\varepsilon_3} f_{i,g} \right]^{\frac{1}{1-\varepsilon_3}}, \text{ for } \varepsilon \neq 1.$$

$$AIE_g = 1 - \exp\left[\sum_{i=1}^{n} f_{i,g} \log_e \frac{E_{i,g}}{\overline{E_g}} \right], \text{ for } \varepsilon = 1.$$

$E_{i,g}$ represents the energy consumption expenditures of the individuals in the i[th] income range of the social group g, $f_{i,g}$ is the proportion of the population in the social group g in the i[th] income range, and $\overline{E_g}$ is the average energy household consumption in that social group.

For the calculation of the distribution of the residential energy and car energy used by the various social groups, we used the following modified Atkinson indices $AIEW_g$:

Residential energy:

$$AIEW_g = 1 - \left[\sum_{i=1}^{n} \left(\frac{EW_{i,g}}{\overline{EW_g}} \right)^{1-\varepsilon_4} f_{i,g} \right]^{\frac{1}{1-\varepsilon_4}}, \text{ for } \varepsilon \neq 1.$$

$$AIEW_g = 1 - \exp\left[\sum_{i=1}^{n} f_{i,g} \log_e \frac{EW_{i,g}}{\overline{EW_g}} \right], \text{ for } \varepsilon = 1.$$

$EW_{i,g}$ represents the energy consumption expenditures of the individuals in the i[th] income range of the social group g, $f_{i,g}$ is the proportion of the population in the social group g in the i[th] income range, and $\overline{EW_g}$ is the average energy household consumption in that social group.

Car energy:

$$AIEK_g = 1 - \left[\sum_{i=1}^{n} \left(\frac{EK_{i,g}}{\overline{EK_g}} \right)^{1-\varepsilon_5} f_{i,g} \right]^{\frac{1}{1-\varepsilon_5}}, \text{ for } \varepsilon \neq 1.$$

$$AIEK_g = 1 - \exp\left[\sum_{i=1}^{n} f_{i,g} \log_e \frac{EK_{i,g}}{\overline{EK_g}}\right], \text{ for } \varepsilon = 1.$$

$EK_{i,g}$ represents the energy consumption expenditures of the individuals in the i[th] income range of the social group g, $f_{i,g}$ is the proportion of the population in the social group g in the i[th] income range, and $\overline{EK_g}$ is the average energy household consumption in that social group. The following table 2 shows the results of our calculations using the various Atkinson indices.

Table 3 shows that the value of the Atkinson index increases when a higher weight is attached to the lower income groups with rising epsilon. This development is independent of the chosen household type. However, differences exist between the social groups. The Atkinson index increases from 0.02 to 0.3 for all households when epsilon increases to 2.0, i. e. the inequality increases with rising inequality aversion. The increase in the Atkinson index is a little lower for the social group of single women than for the group of single men. Households with couples and single parents exhibit the average of all households.

The analysis of consumption expenditures results in a similar picture for the social groups. The social inequality of the private consumption increases with rising epsilon values, and the increase is lower for families than for all households and single households. Therefore, no great differences exist in the consumer behaviour of families. The necessary family consumption decisions are independent of family income. This shows the energy expenditures where the Atkinson index measures no big increase in inequality with rising epsilon.

Table 3 also shows that private consumption is more equally distributed amongst the social groups than income. It also shows that energy consumption is more equally distributed than consumption expenditure, and that residential energy expenditure is more equally distributed than car energy consumption.

A similar picture was revealed for the social groups when consumption expenditure was analysed. The social inequality increases for all social groups with an increasing epsilon, whereby the increase is lower for families than for all households and the single households. In other words, the consumption expenditure of families differs only slightly.

Table 3 also makes clear that the energy expenditures are distributed almost equally between the households, and that they do not increase very much with increasing income. Energy expenditures thus play a much more important role for the lower income groups than for the upper income class, and price changes will have a higher impact on their household budget.

Table 3

Distribution of income and consumption in Germany

Atkinson Index of selected household groups					
Atkinson epsilon	Net income	Private Consumption	Energy	Residential Energy	Car energy*
			All households		
0.1	0.02	0.01	0.01	0.01	0.02
0.5	0.09	0.05	0.04	0.03	0.07
1.0	0.19	0.10	0.08	0.05	0.15
1.5	0.24	0.13	0.09	0.06	0.16
2.0	0.30	0.17	0.12	0.08	0.19
			Single women		
0.1	0.01	0.01	0.00	0.00	0.01
0.5	0.07	0.03	0.02	0.01	0.06
1.0	0.12	0.06	0.04	0.02	0.12
1.5	0.20	0.09	0.05	0.04	0.13
2.0	0.27	0.12	0.07	0.05	0.16
			Single men		
0.1	0.02	0.01	0.00	0.00	0.01
0.5	0.10	0.03	0.02	0.02	0.03
1.0	0.18	0.07	0.04	0.03	0.07
1.5	0.27	0.10	0.09	0.07	0.13
2.0	0.35	0.13	0.11	0.09	0.14
			Single parent with children		
0.1	0.01	0.00	0.00	0.00	0.06
0.5	0.05	0.02	0.02	0.01	0.09
1.0	0.10	0.04	0.04	0.02	0.02
1.5	0.16	0.07	0.02	0.02	0.06
2.0	0.22	0.10	0.05	0.03	0.10
			Married couple		
0.1	0.01	0.00	0.00	0.00	0.00
0.5	0.05	0.02	0.01	0.01	0.01
1.0	0.11	0.04	0.02	0.02	0.03
1.5	0.15	0.06	0.03	0.01	0.07
2.0	0.19	0.08	0.04	0.02	0.07
			Married couple with children		
0.1	0.01	0.01	0.00	0.00	0.01
0.5	0.04	0.02	0.01	0.01	0.01
1.0	0.08	0.03	0.01	0.01	0.01
1.5	0.12	0.04	0.02	0.01	0.03
2.0	0.15	0.06	0.02	0.02	0.03

*) car energy = Fuel and lubricant

Source: Own calculations based on Statistisches Bundesamt 2003 IEK-STE 2011

5. Outlook

In our analysis, we take up the suggestion of the Stiglitz Commission and present our ideas for giving more prominence to distributional effects. We elucidate the advantage of the epsilon parameter, which represents the values of society and reveals how society regards itself and its own values.

Our analysis has shown the influence of the epsilon parameter on social welfare, i. e. how the inequality aversion of society influences the social welfare of society and that the Atkinson index based on the social welfare function provides not only a tool to measure the distribution of income but also to estimate the distributional dimensions of energy consumption. With the epsilon parameter, the Atkinson index explicitly reveals the inequality aversion of society, and this enables us to define how sensitively the Atkinson index should react to inequalities. The Atkinson index enables us to define the distribution of the quality of life.

Our analysis has also shown that energy is currently more or less equally distributed between the households and can be seen as a central basic good for all households. The Atkinson index has the advantage of revealing possible social tensions caused by rising energy prices in the future. If the energy prices increase, inequality would probably also rise and this would occur against the background of a society which is used to equally distributed energy consumption. This development can cause social tensions in German society, because the growing trade-off between efficiency and equality will not only take place in the economic processes in general but also for energy consumption.

Our analysis has shown that a distribution analysis based on the Atkinson index can make an important contribution to the social debate about the distributional justice of income, consumption, and energy.

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