The Distributional Impact of Subsidies to Higher Education – Empirical Evidence from Germany

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Abstract

In the following paper I present empirical evidence concerning the distributional impact of public higher education in the cross section view for West Germany in 1997/98. Contrary to a widespread hypothesis in economics, My findins do not show evidence for a regressive impact. The use of a net-transfer calculation provides a clearly progressive distributional effect of the benefits from subsidization. The deciding factors are the general social stratification within the weighted income deciles and the incidence of the granted benefits. Furthermore, I analyzed the distributional impact within the households with children enrolled in higher education and performed statistical inference via bootstrapping. The use of BC_a confidence intervals is proposed as a helpful procedure for analysing fiscal activity.

Keywords:
higher education funding, income redistribution, Bootstrap procedure, Economics of Education

JEL-Classification:
H22, H23, I22, I28

I. Introduction

It has become part of the conventional wisdom in the economics of education that subsidies to higher education have a regressive distributional effect. Given that the wealthier families enroll more children in higher education, particularly many economists assume an unwanted distributional impact of these subsidies to higher education. *The poor many are being taxed to help increase the income of the richer few*, as it is sometimes bluntly put.

This reproach concerning the fiscal activity in higher education is – at least in Germany - as old as the claim to subsidize tuition fees. In 1875, the German social-democratic party (SPD) in their *Gotha Program* expressed for the first time the claim for a "free instruction". Karl Marx and Friedrich Engels were the first to question this in their *Critique of the Gotha Program*: Free instruction infact "only means in fact defraying the cost of education of the upper classes from the general tax receipts." (Marx/Engels 1875:30; own translation)

In the following more than hundred years the critique not only came from the Marxist's side. The most popular economist who expressed the thesis noted above was Milton Friedman. He assumed public higher education to produce a "perverse distribution of income" (Friedman 1962:105) and because of Friedman's expression this thesis was named the *Friedman-thesis*.

The first empirical research on the distributional impact carried out by Hansen and Weisbrod in 1969. In their article they showed that in California worse-off households gain less from higher education subsidies than better-off households even after allowing for the fact that they also contribute less in taxes to support public colleges and universities. Therefore, they reasoned that the Californian system of subsidizing higher education out of public funds redistributes income from the poor to the rich. Although they confirm a widespread thesis, they provoked a large debate on the distributional impact, called the "Hansen-Weisbrod-Pechman" debate (Conslik 1977), which lasted nearly ten years.

Pechman (1970) was the first to poopse Hansen and Weisbrod's thesis. As he argued, "at no point do Hansen and Weisbrod compare the benefits and costs of public higher education at different levels, as they seem to suggest. Their comparison is between benefits and taxes paid on the average by families with and without children enrolled in the California system." (Pechman 1970:361). He shows that Hansen and

Weisbrod's data can be reworked to turn their results upside down and the distributional impact would then be clearly progressive. A similar procedure was used by McGuire (1976) using Hansen and Weisbrod's data (updated to 1971-72). Additionally, he argued that the family group with the haed of the familiy being between 35 and 60 years of age is the most appropriate universe with which to compare the income of student's parents, and that student financial aid must be added to tuition subsidies to obtain the total subsidy given to students in California public higher education. Taking into account these adjustments, McGuire concluded that the subsidy granted to students in each segment of public higher education in California was, both on the average and in the aggregate, larger for students from below-average-income families than that granted to students from families with above-average incomes.

Nevertheless, even if the Hansen-Weisbrod-Pechman debate does not provide a definite result of the distributional impact, it is consensual in that the point at issue should be measured by using a net transfer calculation (cf. Blaug 1982). The idea of such a calculation is to break the population of households into income brackets and then to check whether each class gains more or less in subsidy benefits than it pays in taxes in order to support higher education. The pattern of such net-transfers depends on a) the student representation effect, that is, does each income class contribute a pro rata share of students to the higher education system, along with b) the tax incidence effect. The tax incidence, resulting from both the comprehensive tax rate structure and the distribution of the tax base among income brackets, will determine the implicit share of the costs of higher educations subsidies being imposed on each income class. If the benefits attributable to a particular income bracket, as determined by the share of students it contributes, differ from its implied share of the cost of subsidization, as determined by the tax incidence among income brackets, then a transfer among these income brackets has occurred.

Machlis (1973) for New York, Fields (1974) for Kenya, Crean (1975) for Canada, Merz (1981) for Switzerland, James/Benjamin (1987) for Japan, Lemelin (1992) for Quebec and Grüske (1994) for Germany used a net-transfer calculation. Except for Fields and Merz, all authors found that the distributional impact is progressive. Merz concluded with a proportional incidence and Fields determined the middle-income groups as the net wealthier. Probably because of a lack in data, neither of these authors considered equivalence scales to define in a common way, which household is wealthy and which is poor.

More recent studies concern equivalence scales. Tsakloglou/Antoninis (1999) used the equivalence consumption expenditure for each household as an indicator for the household's welfare level. To judge, whether inequality has reduced through public education on various levels, they used some inequality indices. Unfortunately, they did not consider the incidence of the tax burden to finance the subsidization and no concern is done to statistical inference. Irrespective of these methodological problems, they ascertained an unambiguous result.The first research using equivalence incomes and a net-transfer calculation was done by Sturn/Wohlfahrt (1999). Their conclusion is that public subsidization in Austria for 1994 had a clearly progressive impact.

Blaug (1982) was certainly right to ask in surprise: "how is it possible that so many commentators keep repeating the Hansen-Weisbrod results as if they were gospel truths?"

Regardless of the fact that the empirical evidence is at least inconclusive, international research and most textbooks always refer the thesis of a regressive distributional impact and many models take it as given.

The following paper presents new empirical evidence from Germany using a net transfer calculation with weighted income data. In this way, the same procedure as used by Sturn/Wohlfahrt (1999) was applied (section IV). The empirical evidence from Germany emphasizes that it would be advisable to deal careful with the Friedman-thesis.

Additionally, in section V it is investigated how the various kinds of benefits from public higher education affect the income distribution within households with children enrolled in higher education. To judge the statistical inference, *bias corrected and accelerated* confidence intervals (BC_a) via bootstrapping are used. The main goal of this procedure is to point out which kind of benefit significantly affects the income distribution within the subgroup that consists only of net-wealthier.

II. Methodology and Data

The amount an income bracket contributes to finance higher educations subsidies depends on the tax system. Every household pays taxes and by doing so this household supports the costs of subsidization. If X % of the public budget is spend for subsidy, every household will therefore support with X % of his own tax burden this fiscal activity. Since the comprehensive tax burden should be considered (direct as well as indirect taxes), in absence of detailed data concerning the tax incidence the assumption of a proportional tax incidence is made. This assumption implies that the regressivity of the indirect taxation offset the progressivity of the indirect taxation. Empirical research for Germany (Grüske 1978) and for the USA (Pechman 1986) show that this assumption is an acceptable approximation for the incidence of the tax burden and it is also used in the distributional investigations of Sturn/Wohlfahrt (1999) and Grüske (1994).

The amount of benefits a population subgroup receives depends in particular on the amount of students from the income bracket enrolled in universities. In Germany, households with students receive not only in-kind benefits from the higher education system (tuition fee subsidy), but also child benefit or alternatively child allowance if the relief of it exceeds the child benefit. If a household does not profit from income splitting (e.g. because of a divorce), it can demand an allowance called *Haushaltsfreibetrag*. Every household with children enrolled in the education system can furthermore demand an education allowance (Ausbildungsfreibetrag) and profits through other separate settlement in tax laws, which are not considered in the present investigation[1]. Students / households receive also cash benefits through the student financial assistance scheme (Bafög). Since a large share of the public higher education funding are research- and health expenditures, the amount of in-kind benefits every student/household receives can not be exactly measured. From the total amount of public expenditure for higher education I deduct the health expenditure and define half of the rest as public subsidization. By doing this, every student /

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[1] For the 1st and 2nd child a household in 1998 received an amount (child benefit) of monthly 220 DM, 300 DM for the 3rd and 350 DM for the 4th, 5th and so on. Better off households assert a child allowance of 288 DM (divorced parents) and 576 for married parents. The *Haushaltsfreibetrag* was an allowance of monthly 468 DM and the *Ausbildungsfreibetrag* about 200 DM.

household receives an amount of 558 DM/month as in-kind benefit from public funding in higher education.

Aside from the in-kind benefits and the student financial assistance scheme the other cash benefits are part of the general family promotion and do not origin from higher education subsidy. But the entitlement of all of these cash benefits would expire if the children would not be enrolled in higher education. Therefore, it seems indispensable to take into consideration these benefits and also the tax burden, which is necessary to finance these kinds of indirect higher education subsidy.

The amount students receive as cash benefit from Bafög depends primarly on the income of their parents. The basic intention of the Bafög is to enable students from worse-off households to study and is only granted to this group. Therefore, the incidence of the Bafög is straightforward progressive. On the other hand, it is clear that the relief from the various allowances is (measured in absolute quantities) higher if the income of the household is higher, due to income tax progression. The incidence of such an allowance is less clear-cut by measuring the relief in relative quantities. The exact impact of these benefits is presented in Section V.

The incidence of the tax burden for simplicity reaons will be called the *revenue incidence* (tax incidence, therefore revenue of the state) and *expenditure incidence* for the benefits, respectively. The difference between the two is the result of the net transfer calculation and can be called the *net incidence* (cf. Grüske 1994).

If there are no subsidies, the net transfer for all income brackets will be close to zero. Therefore, the situation without public higher education funding is the one with which the the observed situation will be compared with and if an arbitrary income bracket obtains a positive net transfer, it gains from public subsidization and vice versa.

In this paper I present a net-transfer calculation for the ten income deciles in Germany (without the area of the former German Democratic Republic) in the cross-section view for the years 1997/1998. Additionally, I analyze the distributional impact within families with children enrolled in higher education using the standard inequality indices.

The data are taken from the 15th survey concerning the socio-economic picture of students in Germany (bmbf 1998). In this survey, students pointed out the monthly net-income of their parents. Additionally, they pointed out the number of brothers and sisters living at the household of their parents and if their parents were living together in the same household or not. Using these numbers, the household size be taken into account using equivalence scales to receive a weighted distribution of the net-income. The sample contains 11,509 households. Data for the income distribution of the whole population are taken from the German Socio-Economic Panel (GSOEP, cf. SVR 1999).

As noted above, the deciding factor for the result of both points of research is the distribution of children from various income brackets in the higher education system. Therefore, section III presents empirical evidence for this distribution, section IV contains results of the net-transfer calculation and section V presents results of the distributional impact for the household subgroup with children enrolled in higher education.

III. The Distribution of Children from various income brackets in German Higher Education System

FIGURE 1 HERE

In contrary to common belief, no empirical evidence could be found for the thesis that students from better-off households are significantly over-represented. In Figure 1 the income distribution of the households with children enrolled in higher education is compared with the whole population. In this figure, as income brackets the income deciles are chosen. Figure 1 shows that 4.33 % of all households with children enrolled in higher education receive a disposable income that is lower than the upper bound of the bottom decil, so it is under-represented in higher education. In contrast to the bottom decil, the second to the 7th deciles are over-represented in higher education. The 8th, 9th, and 10th deciles are again under-represented. The over-representation of the lower decles can be explained if we take into account that households with children are strongly concentrated in the lower and middle-income deciles meanwhile single- and *Dinks*-households constitute the majority in the upper deciles. The under representation of the bottom deciles could also be explained by social stratification: the majority of the bottom decil is constituted by pensioners and young single parent households. All of these households could not bring out students in the cross-section view and it follows that students are enrolled from the lower and middle income deciles, because the mass of households with children is concentrated there.

Note that we have to distinguish between various subpopulations within the entire population other. Figure 2 illustrates the various subgroups. The first subgroup consists of all households with children. A second subgroup consists of all households with children being relevant for the higher education system (e.g., between 19 and 26 years of age). A third subgroup is part of the second: the households with children enrolled in higher education. From this third subgroup the sample was drawn. Because of a lack in data, no precise estimates could be done for the distribution of the third subgroup compared with the second one.

FIGURE 2 HERE

To draw the comparison in Figure 1, weighted income data are used. The equivalence scale used is the *square root scale*. This equivalence scale is often used for German socio-economic data and weights the net income of household with the square root of the number of household members. Therefore, the *square root scale* weights less than the well known *modified OECD scale*[2]. Both equivalence scales produce similar results for most of the unweighted samples, e. g., a family with two adults and two young children is weighted with the factor 2.1 using the modified OECD scale (1+0.5+0.3+0.3) and weighted with the equivalence digit 2.0 ($=\sqrt{4}$) using the *square root scale*. But the equivalence digits differ significantly if children are aged over 15 years, which applies to enrolled students, because in contrast to the modified OECD scale the square root scale does not take into account decreasing economies of scales with increasing age of children. Figure 3 compares the alternative use of the equivalence scales.

FIGURE 3 HERE

It follows from this difference in the equivalence digits that by comparing the whole population with the subgroup of households with children enrolled in higher education the alternative use of the equivalence scales brings out significantly different results.

Therefore, the share of households with children enrolled in higher education would be higher in the lower deciles by using the modified OECD scale. While the net transfer calculation depends in particular on the amount of students from the income bracket enrolled in universities, the use of the square root scale is more conservative (i.e., brings out a less progressive distributional impact).

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[2] The modified OECD scale assigns a weight of one to the household head, a weight of 0.5 to each remaining adults (including children of an age over 15 years) and a weight of 0.3 for younger members of the household.

Note that the data presented in Figure 1 give no information as to the selectivity of the educational system because I only investigated the distribution of households with children enrolled in higher education and I compared it with the distribution of the whole population. It is not investigated the enrollment within families with children in a comparable age. Therefore, at no point the well-documented empirical results (cf. Shea 2000, Blossfeld/Shavit 1993, McPherson/Shapiro 1991, Mare 1980) concerning the social selectivity in educational system are contradicted[3].

IV. Net Transfer Calculation

FIGURE 4 HERE

Figure 4 shows the revenue incidence, the expenditure incidence and the net incidence for each income decile. The bottom decil receives 13.09 percent of the whole benefits but contributes only 2.7 percent of the taxes to finance it. By subtracting the tax burden from the received benefit share the bottom decil gains with a net transfer of approximately 10.39 percent. The lowest four deciles receive a positive net transfer and the other deciles a negative one. In absence of any public benefits each income decile would pay exactly for what they receive and therefore, no income bracket could gain from redistribution through fiscal activity in higher education; so the data show that the distributional impact is clearly progressive.

This progressive incidence is in particular explainable through three effects: 1. the general social stratification within the income deciles, 2. the proportional tax incidence and 3. the distribution of the whole benefits in relation to the distribution of the enrolled children.

First of all, the general social stratification as explained in section III determines the progressive distributional impact. Furthermore, the assumption of a proportional revenue incidence (tax incidence) implies that a distributional-neutral situation (i.e., a situation where every income bracket receives a zero net-benefit) could only be obtained if the share of students descended raises proportionally with the gross income.

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[3] Even if such data would be analyzed, they could give only a bad information on the educational attainment, because – as Mare (1980, 1993) pointed out - the exclusively use of shares and ratios ignore that in the long run two different processes are on work: an expansion of the educational system and the processes of selection and allocation of students.

For example, consider two gross-income brackets, one with an income of 2500 units and the other with an income of 5000 units and a given distribution of the benefits proportional to the student-distribution (i.e., if an income bracket enrolls y % of the whole students it would also receive y % of the benefits), the net incidence for both is zero only if the better-off household group enrolls for two times more students in higher education. Therefore, the given (but not empirical observable) fact that wealthier households enroll more children in higher education is not sufficient for the Friedman-thesis.

Furthermore, the distribution of the benefits for the income deciles is not proportional to the student-distribution but instead unambiguous. The bottom and the 2nd decile receive a disproportionate high share of the whole benefits (e.g., 4.34 % of the students are enrolled from the bottom decile, but the same decile receives 13.09 % of the whole benefits), which is caused in particular by the student financial assistance scheme. The contrary applies to the second up to the seventh decile. They receive a share of the whole benefits that is below the share of the enrolled students. Only a small share of these subgroups benefits from Bafög and the relief from the allowances is (compared with the upper deciles) small. The relation between received benefits and enrolment is only slightly positive for the three upper deciles. They also do not profit from Bafög but they receive a relief from the allowances that is relative high, caused by income tax progression. Therefore, the distribution of the benefits is unambiguous when measuring it in absolute terms.

These interpretations rise the question if some kinds of benefits influence the final result more than other ones. In particular, we would like to know if the allowances affect the income distribution significantly. It is obvious that the student financial assistance scheme affects the income distribution because it is granted only to worse-off households. While the in-kind benefits are (more or less) evenly distributed to all households, the broad tendency is a decrease in inequality. Section V gives more detailed information on the incidence of the various kinds of benefits. However, we could not simply rework figure 4 by subtracting the benefits from the student financial assistance scheme, because we could expect a correlation between the grant of this cash-benefit with the enrollment and therefore with the shares expressed in Figure 1. McPherson/Shapiro (1991) investigated the overall schemes between student aid and enrollment. Their analysis indicates that changes in the net price (e.g., a decrease of the student aid) facing lower-income students have significant effects on their enrollment behavior. Suppose, all students from the bottom decile would not enrolled if a repeal of the student aid would occur. Then, the bottom deciles would have a negative net-transfer because they would contribute in taxes to support the other benefits but would not profit from any of these. In other words: the isolated effect of a benefit could only be investigated precisely if we consider the enrollment elasticity with respect to the net price. Unfortunately, no data about these elasticities for the various income brackets are available.

To get at least an approximation for the distributional impact by a repeal of the student financial assistance scheme, I construct two scenarios, presented in Figure 5. The first scenario an elasticity equal to zero is supposed; so, no student would correct his or her enrollment behavior by a repeal of the student aid. In the second scenario I an infinitely large elasticity is supposed. In this case, the enrollment changes considerably. In Figure 4, the net incidence curve has a correlation coefficient of –0.92. This coefficient rise to –0.86 if a repeal of the student aid occurs but no effect on enrollment is supposed. The correlation coefficient rise to –0.17 in the second scenario. With other words, in the first scenario the distributional impact is less progressive, crucially on second deciles expense. By considering the second scenario, the distributional impact changes considerably. The lowest deciles would become net-payer and the changes would be clearly in favor of the middle income deciles. This result is congruent with predictions from political economy literature. In their article, Fernandez / Rogerson (1995) show in a political economy model that transfers of resources from lower income brackets to higher ones are possible if households vote over the extent to which they subsidize education. If education is only partially subsidized, poorer households who are credit constrained cannot afford to obtain an higher education and are thereby excluded from benefiting from the subsidies.

Another approximation is done in section V: the isolated effects of every kind of benefits on the income distribution for the subpopulation of households with enrolled children is investigated. Furthermore, in section V the distributional impact of public higher education within households with children enrolled in higher education is analyzed.

V. The Distributional Impact within Households with children enrolled in higher education.

Besides the general distributional impact it is interesting to analyze the distributional effects within households with children enrolled in higher education. It is trivial to say that each member of the group gains from public subsidization. But how does each benefit work concerning the income distribution? Additionally, it will be investigate if the public subsidization in the whole affects the income distribution within the subgroup of households with children enrolled in higher education. While we could expect that within the subgroup of households with children between 19 and 26 years of age the wealthier ones will enroll with higher probability children in higher education, it is not as straightforward if the benefits reduce or increase inequality. If wealthier households increase their income to a higher share (compared with their income) than worse-off households do, the distributional impact would be regressive. Note that inequality decreases if every household receives the same (absolute) amount and remains unaffected if the benefits increase or reduce income by the same amount relative to the former income.

To analyze both points of interest, both equivalence scales discussed are used, the square root scale and the modified OECD scale. Before the results are presented, some notes on statistical inference are given.

Statistical Inference

A major shortcoming to literature about income inequality is the lack of statistical inference; in most studies, no attempt is made to determine the statistical significance of observed differences in the computed values of a particular measure. As Mills/Zandvakili (1997) pointed out, the need for statistical inference with small samples should be obvious, but even for large samples it may be essential to report statistical measures of precision. Since confidence interval estimates available from asymptotic theory may not be accurate (see for details: Mills/Zandvakili (1997)), an advisable method for computing confidence intervals is to bootstrap. These intervals have been shown to be superior to asymptotic intervals both theoretically and in a variety of applications (e. g., Burr (1994) studied bootstrap confidence intervals for three types of parameters in Cox's proportional hazards model, Mills/Zandvakili (1997) using the bootstrap percentile method proposed by Efron/Tibshirani (1993), Xu (2000) appealing inference using the iterated-bootstrap method proposed by Hall (1992)).

In this paper I compute *bias-corrected and accelerated* confidence intervals (BC$_a$). The BC$_a$-method is an improved version of the percentile method and is second-order correct in a wide class of problems.

Let $\hat{q}$ be an estimator of a parameter, the percentile interval $\left(\hat{q}_{lb},\hat{q}_{ub}\right)$ of intended coverage 1-2α, is obtained directly from these percentiles, therefore, $\left(\hat{q}_{lb},\hat{q}_{ub}\right)$ = $\left(\hat{q}^{*(a)},\hat{q}^{*(1-a)}\right)$, where $\hat{q}^{*(a)}$ indicates the $100\cdot a$ th percentile of B bootstrap replications. Percentiles of the bootstrap distribution also give the BCa intervals endpoints, but they further depend on an *accelerator* (acc) and the *bias-correction* (z_0). The BC$_a$ interval of intended coverage $1\text{-}2a$, is given by $\left(\hat{q}_{lb},\hat{q}_{ub}\right)=\left(\hat{q}^{*(a_1)},\hat{q}^{*(a_2)}\right)$, where

$$a_1=\Phi\left(\hat{z}_0+\frac{\hat{z}_0+z^{(a)}}{1-acc(\hat{z}_0+z^{(a)})}\right)$$

$$a_2=\Phi\left(\hat{z}_0+\frac{\hat{z}_0+z^{(1-a)}}{1-acc(\hat{z}_0+z^{(1-a)})}\right)$$

$\Phi(\bullet)$ is the standard normal cumulative distribution function and $z^{(a)}$ is the $100\,a$ th percentile point of a standard normal distribution (see for further details Efron/Tibshirani 1993). To obtain BC$_a$ intervals the package "bootstrap" for the statistical software R was used.

Various situations are compared and in order to judge whether the difference between two point estimates is statistical significant, the overlap between the two associated BC$_a$ confidence intervals is examined. As pointed out by Schenker/Gentleman (2001), the method of examining overlap is more conservative (i.e., rejects the null hypothesis less often) than the standard method when the null hypothesis is true, and it mistakenly fails to reject the null hypothesis more frequently than does the standard method when the null hypothesis is false.

For the present investigation, the following inequality indices are used: standard deviation ($sd=\sqrt{s_X^2}$), coefficient of variation ($cv=\sqrt{s_X^2}\big/m_X$), the variance of the logarithm of income ($vli=1/n\cdot\sum_{i=1}^{n}\left(\ln x_i-\ln m_X\right)^2$), the Gini-coefficient

$(gini = 1 + \frac{1}{n} - \frac{2}{n^2 \cdot m_X}(x_1 + 2 \cdot x_2 + \ldots + n \cdot x_n)$ for $x_1 \geq x_2 \geq \ldots \geq x_n)$, the Atkinson inequality measure $(A = 1 - \left[\sum_{i=1}^{n} \left(\frac{x_i}{m_X} \right)^{1-e} \cdot f(x_i) \right]^{\frac{1}{1-e}} ; e \neq 1)$ and the Theil's entropy measure $(theil = \ln n - \sum_{i=1}^{n} y_i \cdot \ln \left(\frac{1}{y_i} \right)$, for $y_i \equiv \frac{x_i}{n \cdot m_X}$).

Where $m_X \equiv$ sample mean, $s_X^2 \equiv$ sample variance, $f(x_i) \equiv$ density function and n indicates the sample size.

Results

Table 1 presents results for both situations, the observed and the theoretical one. Θ indicates the distribution of the net income and additionally the whole benefits from higher education subsidization. Ψ indicates the non-observable situation in which no subsidization takes place. All the households lost from the absence of subsidization but gained from lower tax burden, because the tax-revenue to finance the benefits would not contribute. It is assumed that in absence of the public subsidization all tax rates would decrease in a way which leads untouched the general assumption about the revenue incidence (so, the concept of the *Budget Incidence* was used, cf. Musgrave/Musgrave 1984, Ch. 12). The square root scale is used in the left columns and the modified OECD scale in the right ones. As can easily be seen, even if the estimators differ by the alternative use of the equivalence scales, the changes are almost similar. As can also be seen in Table 1, the public subsidization reduces inequality, independently of the used inequality measure and with 99% confidence.

For more detailed analyses on how the single benefits work on the inequality measures, the procedure as in table 1 was repeated for 5 situations using the square root scale. Situations 1 = "SOEP" indicates the net income. The other situations are the net income plus child benefit/allowance (2 = "KG/KFB"), the net income plus the cash benefits through the other allowances (3 = "HFB/AFB"), the net income plus the in-kind benefits (4 = "in-kind") and finally, 5 = "Bafög" indicates the net income plus cash benefits from the student financial assistance scheme. The results are shown in Table 2, where the subscript "Sample" indicates the sample estimator, the subscript "Bootstrap" the Bootstrap-estimator, based on 1000 replications and "lb" and "ub" stands for the lower bound and the upper bound, respectively. An asterisk locates overlapping intervals.

Table 2 shows that both forms of the direct subsidization (in-kind benefits and Bafög) reduce inequality (in despite of the standard deviation in the in-kind column). The only kinds of indirect subsidization not leading to a significantly decrease of inequality are the various allowances (*Haushaltsfreibetrag* and *Ausbildungsfreibetrag*). Only the Atkinson measure with an $\varepsilon = 2.0$ indicates non-overlapping intervals with 95 % confidence. Note that every sample and bootstrap estimator (beside of the mean and the sd) in the column HFB/AFB lies under the estimators in the column SOEP and without considering the statistical inference via bootstrapping the results can be misinterpreted to stand on its head. At this point, the importance for statistical inference in distributional analysis can clearly be proved.

FIGURE 6 HERE

Figure 6 shows the box plots of every situation. The two middle quartiles mark the ends of the box, while the median is shown as the vertical line close to the middle of the box. An extended line shows the range of the distribution on each side. For example, the difference between the median and the end of the 1st quartile is significantly smaller in “Bafög” than in “SOEP”, because the cash-benefits from the student aid are granted in particular to households with an income below the median. In this way, the income distribution rams and this explains the significant changes in the inequality measures. In contrary to “Bafög”, in “in-kind” every household receives the same amount and so the differences between the median and both quartiles remains unchanged. Therefore, the box goes upwards but does not ram.

VI. Conclusion

In the last decades, more effort has been made to discuss the consequences of a given unwanted distributional impact of public higher education. Less attention has been given to empirical investigations and the few ones are often ignored by textbook authors as well as by some model constructors.

On the other hand, up to now no examination had been carried in which the distributional impact was analyzed by using a net-transfer calculation with weighted income data and with notes on statistical inference. The only examination that considered the net transfer calculation and used weighted income data is the work of Sturn/Wohlfahrt (1999).

The main results of the present investigation can be summarized as follows: the distributional impact in Germany for 1997/98 is clearly progressive. The distributional impact of a change of the net price depends crucially on the enrollment elasticity with respect to the net price. Therefore, some empirical findings for other countries can be confirmed. The distributional impact within households with children enrolled in higher education is also progressive. The deciding factors for these results are:

1. the general social stratification because the majority of the better-off households (i.e., the households in the upper income deciles) are not households with children.
2. the structure of the subsidization that is clearly in favor of worse-off households, especially the student financial assistance scheme.

Unfortunately, because of the lack of better data some strong assumption (first of all, the proportional tax incidence) had to be made. Bedau/Teichmann (1995) showed that in Germany in 1994 the indirect tax regression did not settled the progressivity of the income taxation and that the whole tax system was slightly progressive. Therefore, it can be noted that my assumptions are conservative and considering a progressive taxation the results showed in Figure 4 would be stronger in favor of the lower income brackets. The same can be resumed about the used square root scale, which concentrates the income stronger than the modified OECD scale. Furthermore, since the Socio-Economic Panel defines a household that consists only of a student as an independent household, some households are counted twice. Single-student households are (because the majority of this group receives a lower disposable income) mainly part of the bottom decile and therefore, the share of enrolled students from the bottom decile is underestimated. This problem could not be solved because of a data-lack but if we could deduct these households from the whole population, the result would still be more in favor of the lower deciles.

On the other hand, this problem leads to a slightly overestimate of the decile bounds, so this data problem leads to an overestimate of the progressive incidence. All in all, summarizing the data problems and the assumptions done, we could assume that these will lead to an underestimation of the progressive incidence.

Beside the interesting questions related to the distributional impact in the cross section view it is often expressed that the distributional impact in the long run should be considered, too. As Musgrave/Musgrave pointed out, by discussing the incidence of various fiscal activities in the longer run, the distributional impact will depend on the resulting effects on factor supplies, rates of return, and growth (cf. Musgrave/Musgrave 1984:678). Additionally, an examination for the long run needs the use of longitudinal data and an own framework to analyze the impact; a simple application of the net transfer calculations would not produce helpful results.

VII. References

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VIII. Figures and Tables

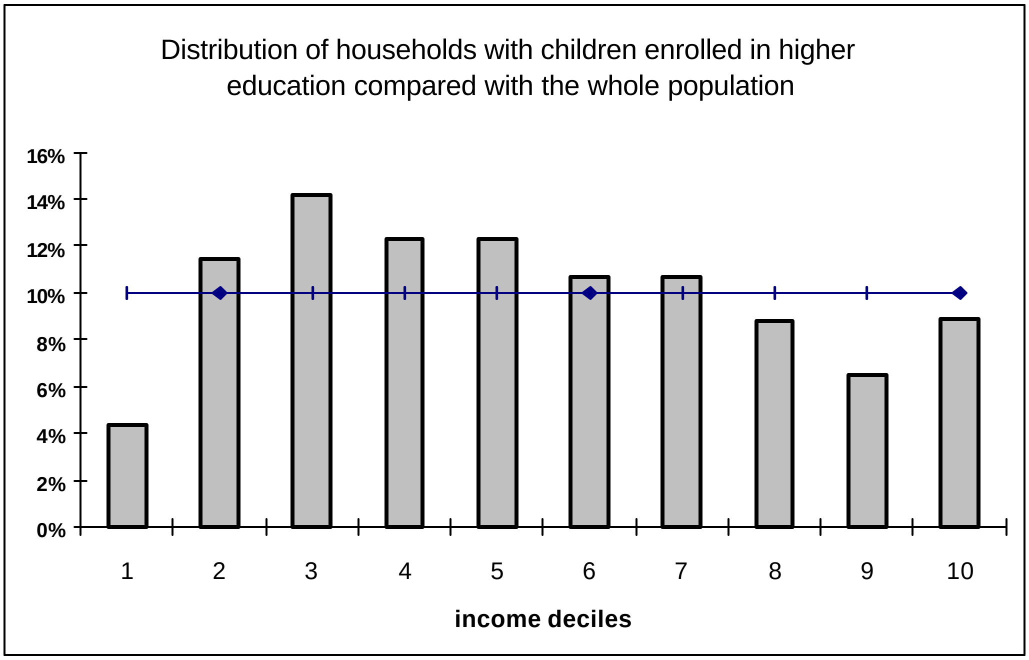

Figure 1. Source: bmbf, SVR, own calculations

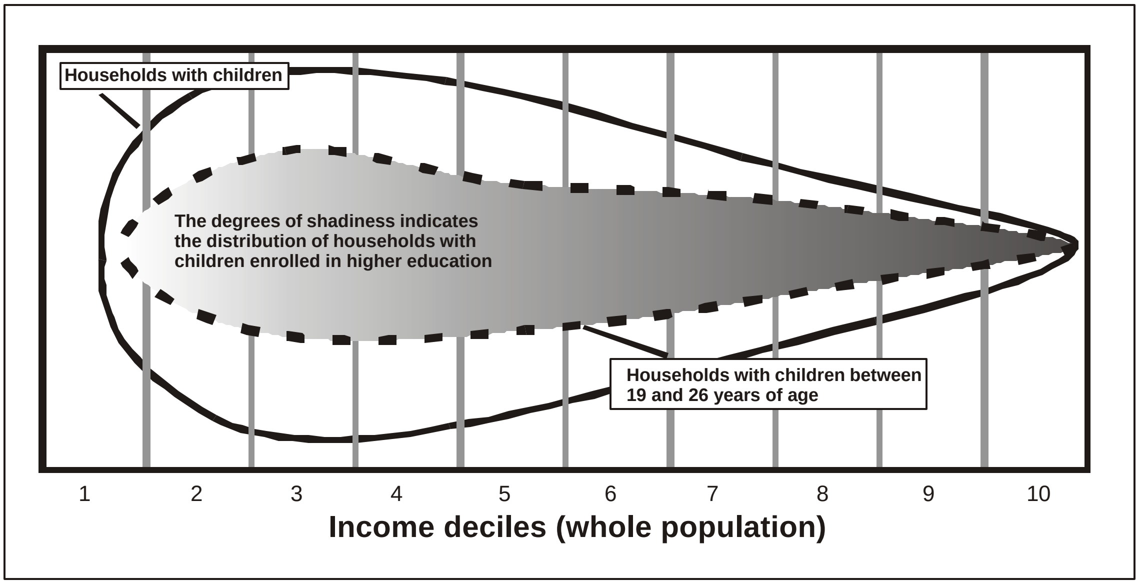

Figure 2. Own illustration

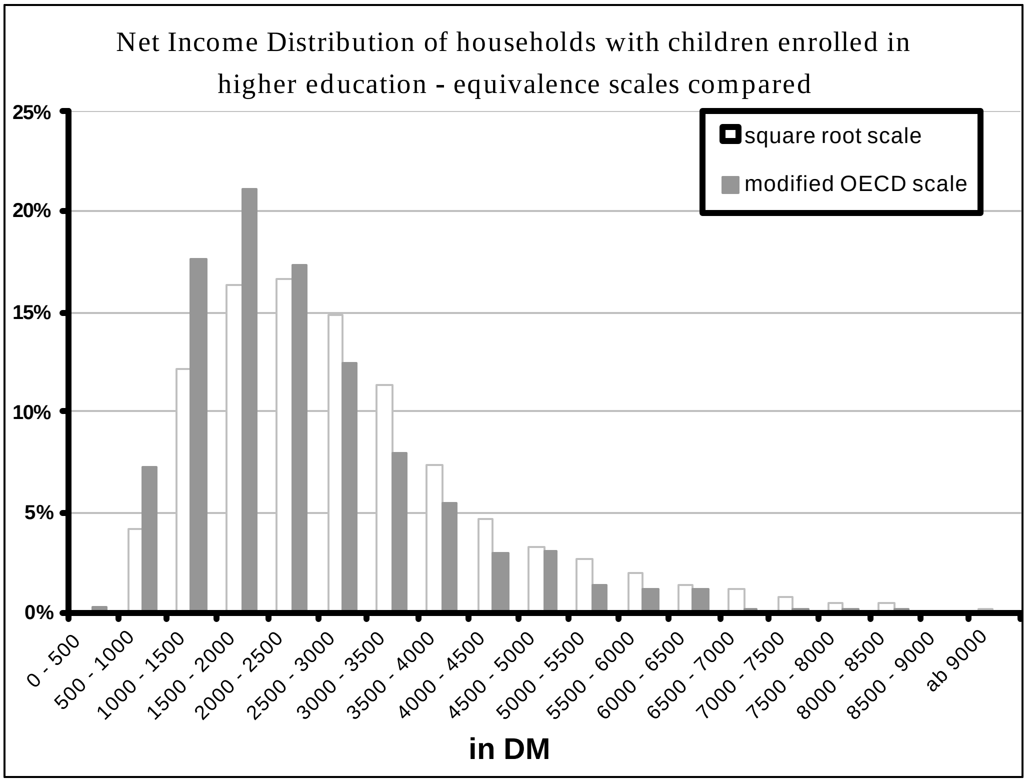

Figure 3. Source: bmbf, own calcuations

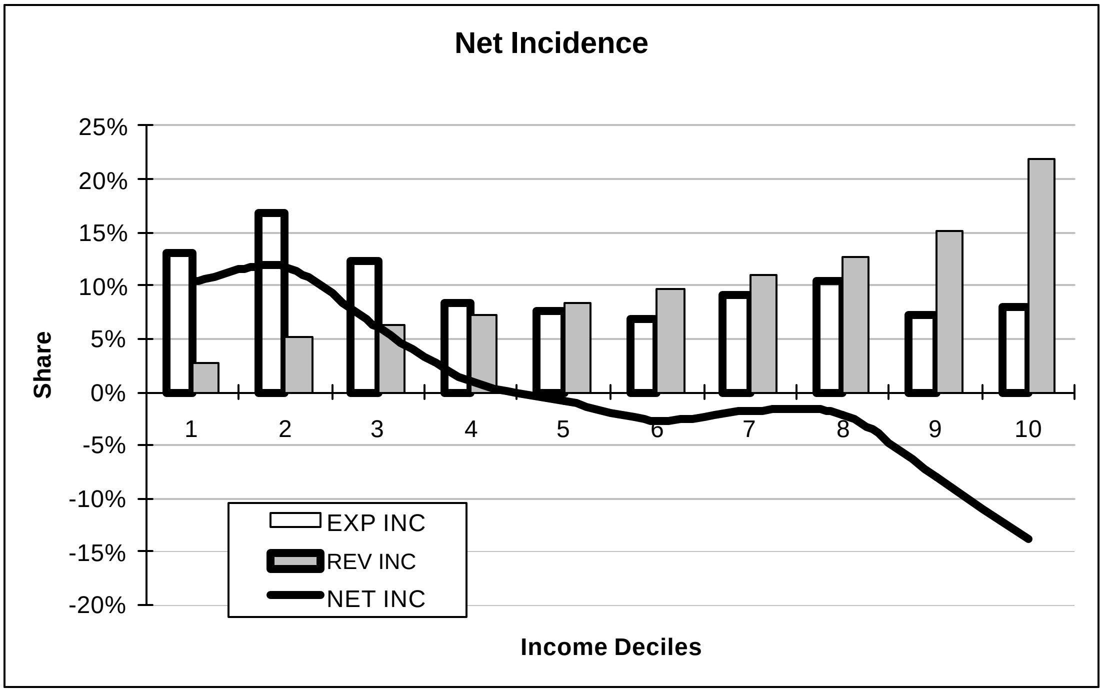

Figure 4. Source: bmbf, SVR, own calculations.

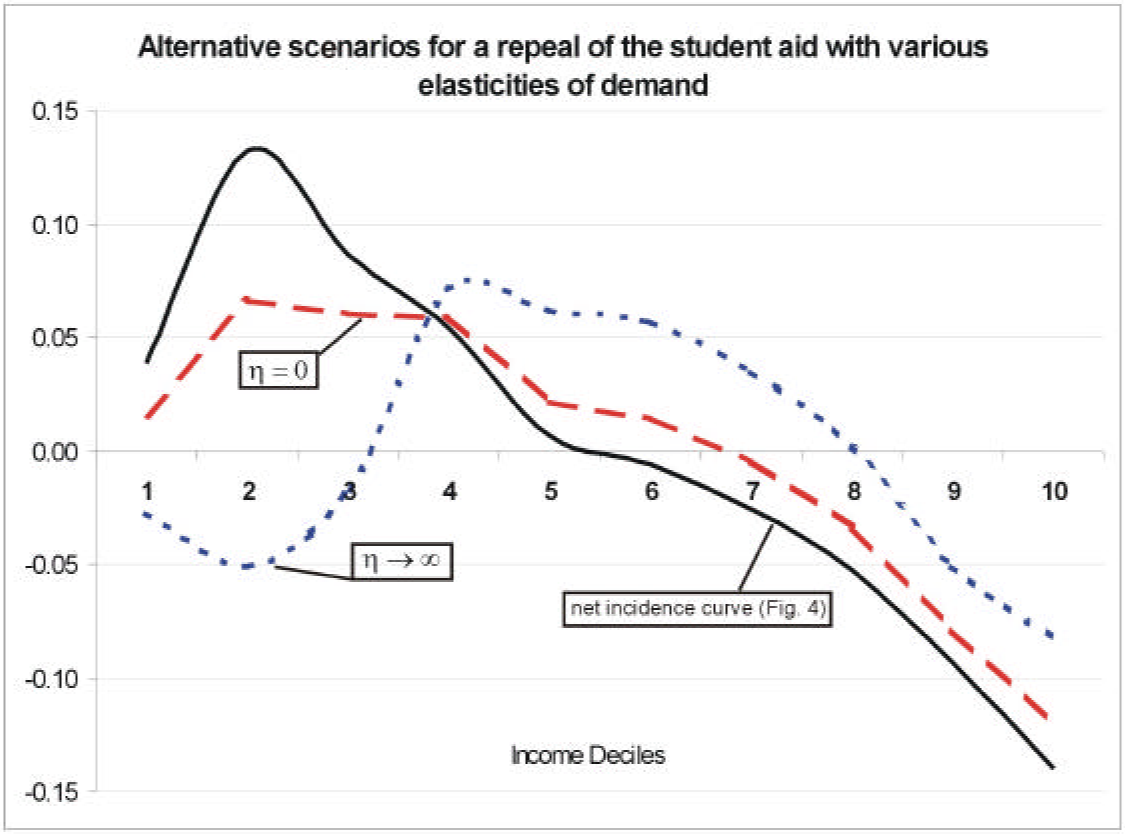

Figure 5. Source: own calculations, *h* indicates the elasticity of enrollment with respect to student aid.

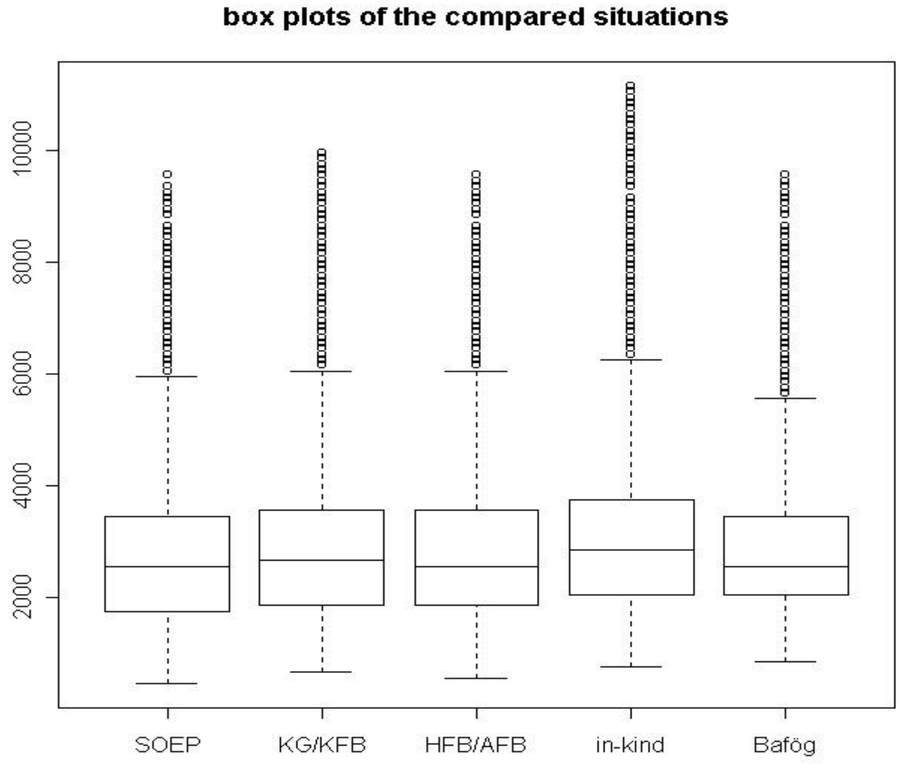

Figure 6. Source: bmbf, own calculations.

Sample estimators, Bootstrap estimators and BC$_a$-confidence intervals (1000 rep.)

	square root scale		modified OECD scale			square root scale		modified OECD scale	
	Q	**Y**	**Q**	**Y**		**Q**	**Y**	**Q**	**Y**
mean$_{Sample}$	2796.9	3414.4	2936.5	2405.7	gini$_{Sample}$	0.2739	0.2037	0.2103	0.2780
mean$_{Bootstrap}$	2796.8	3414.3	2935.9	2405.5	gini$_{Bootstrap}$	0.2738	0.2037	0.2102	0.2780
0.99 lb	2760.3	3379.0	2909.4	2376.6	0.99 lb	0.2690	0.1996	0.2067	0.2738
0.99 ub	2829.0	3443.4	2965.3	2435.1	0.99 ub	0.2792	0.2076	0.2144	0.2829
0.95 lb	2771.2	3387.4	2915.5	2382.6	0.95 lb	0.2703	0.2004	0.2075	0.2748
0.95 ub	2825.4	3436.3	2957.5	2427.7	0.95 ub	0.2777	0.2067	0.2135	0.2820
z_0	0.0778	0.0075	-0.0201	-0.0376	z_0	0.0426	-0.0301	0.1055	0.1282
acc	0.0023	0.0028	0.0025	0.0021	acc	0.0033	0.0049	0.0047	0.0032
sd$_{Sample}$	1466.5	1379.2	1195.4	1258.9	entropy$_{Sample}$	0.1233	0.0708	0.0734	0.1247
sd$_{Bootstrap}$	1466.2	1379.5	1195.4	1259.0	entropy$_{Bootstrap}$	0.1233	0.0708	0.0734	0.1247
0.99 lb	1428.4	1338.0	1166.0	1231.1	0.99 lb	0.1189	0.0679	0.0708	0.1205
0.99 ub	1511.1	1419.0	1229.0	1291.5	0.99 ub	0.1280	0.0738	0.0763	0.1289
0.95 lb	1439.6	1347.6	1172.5	1236.4	0.95 lb	0.1200	0.0685	0.0714	0.1218
0.95 ub	1498.0	1408.5	1221.2	1282.8	0.95 ub	0.1269	0.0730	0.0759	0.1282
z_0	0.0201	-0.0728	0.0728	0.0577	z_0	0.0451	0.0201	0.0904	0.0627
acc	0.0080	0.0085	0.0091	0.0084	acc	0.0047	0.0069	0.0071	0.0047
cv$_{Sample}$	0.5243	0.4039	0.4071	0.5233	$A(\varepsilon=0.5)_{Sample}$	0.0605	0.0337	0.0351	0.0614
cv$_{Bootstrap}$	0.5242	0.4038	0.4070	0.5233	$A(\varepsilon=0.5)_{Bootstrap}$	0.0604	0.0338	0.0351	0.0614
0.99 lb	0.5149	0.3948	0.3988	0.5136	0.99 lb	0.0585	0.0322	0.0339	0.0593
0.99 ub	0.5345	0.4136	0.4154	0.5324	0.99 ub	0.0626	0.0353	0.0364	0.0633
0.95 lb	0.5165	0.3970	0.4005	0.5158	0.95 lb	0.0590	0.0326	0.0341	0.0598
0.95 ub	0.5322	0.4111	0.4136	0.5304	0.95 ub	0.0621	0.0348	0.0361	0.0629
z_0	0.0075	0.0828	0.0201	0.0150	z_0	0.0451	0.0226	0.0075	-0.0201
acc	0.0064	0.0086	0.0092	0.0067	acc	0.0041	0.0063	0.0062	0.0040
vli$_{Sample}$	0.2716	0.1266	0.1359	0.2776	$A(\varepsilon=2.0)_{Sample}$	0.2264	0.1158	0.1229	0.2301
vli$_{Bootstrap}$	0.2716	0.1266	0.1360	0.2778	$A(\varepsilon=2.0)_{Bootstrap}$	0.2265	0.1157	0.1229	0.2300
0.99 lb	0.2619	0.1217	0.1316	0.2672	0.99 lb	0.2197	0.1122	0.1188	0.2235
0.99 ub	0.2820	0.1318	0.1411	0.2871	0.99 ub	0.2331	0.1195	0.1269	0.2366
0.95 lb	0.2638	0.1228	0.1322	0.2703	0.95 lb	0.2208	0.1129	0.1200	0.2253
0.95 ub	0.2793	0.1303	0.1396	0.2851	0.95 ub	0.2316	0.1187	0.1260	0.2356
z_0	-0.0552	0.0025	0.0000	-0.0326	z_0	-0.0326	0.0251	0.0351	0.0677
acc	0.0037	0.0047	0.0044	0.0039	acc	0.0042	0.0049	0.0046	0.0045

Table 1. Source: own calculations.

Sample estimators, Bootstrap estimators and BC_a-confidence intervals (1000 rep.) for the five situations compard (only square root scale)

	SOEP	KG/KFB	HFB/AFB	in-kind	Bafög
$\text{mean}_{\text{Sample}}$	2778.2	2908.9	2842.1	3087.1	2910.9
$\text{mean}_{\text{Bootstrap}}$	2777.5	2908.8	2841.2	3087.1	2911.1
0.99 lb	2741.7	2872.1	2805.3	3049.9	2876.2
0.99 ub	2811.9	2943.2	2876.1	3117.5	2938.6
0.95 lb	2752.6	2883.3	2816.4	3058.3	2884.7
0.95 ub	2806.5	2937.5	2870.6	3110.1	2932.4
z_0	0.0778	0.0828	0.0803	0.0025	0.0125
acc	0.0023	0.0023	0.0023	0.0023	0.0028
$\text{sd}_{\text{Sample}}$	1457.6	1472.2	1467.5	1460.7	1347.4
$\text{sd}_{\text{Bootstrap}}$	1458.1	1471.7	1468.2	1460.9	1347.1
0.99 lb	1419.8	1433.8	1429.3	1419.2	1306.5
0.99 ub	1502.0	1517.0	1512.1	1500.2	1386.7
0.95 lb	1430.8	1445.2	1440.6	1430.8	1316.6
0.95 ub	1488.9	1504.4	1499.0	1488.1	1376.1
z_0	0.0201	0.0226	0.0201	-0.0702	-0.0652
acc	0.0080	0.0080	0.0080	0.0081	0.0084
$\text{cv}_{\text{Sample}}$	0.5247	0.5061	0.5163	0.4732	0.4629
$\text{cv}_{\text{Bootstrap}}$	0.5249	0.5061	0.5162	0.4731	0.4628
0.99 lb	0.5152	0.4955	0.5071	0.4633	0.4527
0.99 ub	0.5348	0.5182	0.5263	0.4835	0.4735
0.95 lb	0.5169	0.4980	0.5086	0.4659	0.4552
0.95 ub	0.5326	0.5140	0.5241	0.4804	0.4709
z_0	0.0100	0.0175	0.0100	0.0702	0.0878
acc	0.0064	0.0066	0.0065	0.0070	0.0082
$\text{vli}_{\text{Sample}}$	0.2717	0.2442	0.2586	0.2063	0.1690
$\text{vli}_{\text{Bootstrap}}$	0.2717	0.2441	0.2583	0.2062	0.1690
0.99 lb	0.2620	0.2351	0.2496	0.1982	0.1623
0.99 ub	0.2822	0.2532	0.2685	0.2137	0.1754
0.95 lb	0.2639	0.2373	0.2514	0.2004	0.1638
0.95 ub	0.2795	0.2513	0.2659	0.2121	0.1739
z_0	-0.0577	0.0301	-0.0502	-0.0125	-0.0276
acc	0.0038	0.0036	0.0037	0.0037	0.0043
$\text{gini}_{\text{Sample}}$	0.2739	0.2640	0.2696	0.2468	0.2331
$\text{gini}_{\text{Bootstrap}}$	0.2738	0.2640	0.2695	0.2469	0.2331
0.99 lb	0.2691	0.2595	0.2648	0.2424	0.2287
0.99 ub	0.2792	0.2683	0.2748	0.2511	0.2373
0.95 lb	0.2703	0.2604	0.2661	0.2435	0.2295
0.95 ub	0.2777	0.2674	0.2733	0.2502	0.2364
z_0	0.0451	-0.0075	0.0376	0.0050	-0.0201
acc	0.0033	0.0035	0.0034	0.0037	0.0047

$\text{entropy}_{\text{Sample}}$	0.1234	0.1146	0.1194	0.1003	0.0920
$\text{entropy}_{\text{Bootstrap}}$	0.1235	0.1146	0.1195	0.1003	0.0920
0.99 lb	0.1190	0.1107	0.1151	0.0966	0.0883
0.99 ub	0.1282	0.1189	0.1240	0.1037	0.0955
0.95 lb	0.1201	0.1113	0.1162	0.0973	0.0891
0.95 ub	0.1270	0.1178	0.1229	0.1031	0.0947
z_0	-0.0326	-0.0577	0.0451	0.0175	0.0000
acc	0.0047	0.0049	0.0048	0.0053	0.0065
$A(\varepsilon=0.5)_{\text{Sample}}$	0.0605	0.0559	0.0584	0.0488	0.0438
$A(\varepsilon=0.5)_{\text{Bootstrap}}$	0.2268	0.0559	0.0584	0.0488	0.0438
0.99 lb	0.0585	0.0541	0.0566	0.0469	0.0420
0.99 ub	0.0626	0.0579	0.0605	0.0506	0.0458
0.95 lb	0.0590	0.0546	0.0570	0.0474	0.0424
0.95 ub	0.0621	0.0574	0.0600	0.0502	0.0451
z_0	0.0426	0.0401	0.0401	0.0100	0.0201
acc	0.0041	0.0043	0.0042	0.0046	0.0059
$A(\varepsilon=2.0)_{\text{Sample}}$	0.2265	0.2067	0.2171	0.1787	0.1499
$A(\varepsilon=2.0)_{\text{Bootstrap}}$	0.2268	0.2067	0.2170	0.1787	0.1499
0.99 lb	0.2198	0.2005	0.2106	0.1736	0.1454
0.99 ub	0.2333	0.2129	0.2235	0.1843	0.1547
0.95 lb	0.2209	0.2017	0.2118	0.1749	0.1464
0.95 ub	0.2318	0.2115	0.2221	0.1827	0.1536
z_0	0.0451	-0.0175	-0.0301	0.0376	0.0251
acc	0.0042	0.0040	0.0041	0.0040	0.0045

Table 2. Source: own calculations.