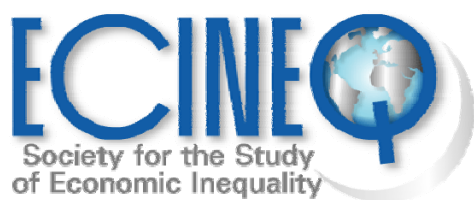# Regional Income Stratification in Unified Germany using a Gini Decomposition Approach

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Regional Income Stratification in Unified Germany using a Gini Decomposition Approach[*]

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Abstract

This paper delivers new insights into the development of income inequality and regional stratification in Germany after unification using a new method for detecting social stratification by a decomposition of the GINI index which yields the obligatory between- and within-group components as well as an "overlapping" index for the different sub-populations. We apply this method together with a jack-knife estimation of standard errors. We find that East Germany is still a stratum on its own when using post-government income, but since 2001 no longer is when using pre-government income. These results remain stable when using alternatively defined regional classifications. However, there are also indications of some regional variation within West Germany. Overall, these findings are important for the political discussion with respect to a potential regional concentration of future transfers from East to West Germany..

Keywords: Inequality Decomposition; Gini; Stratification; German Unification; Regional Disparities; SOEP
JEL Classification: C81; D31; D63

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Contents

1   Introduction

The motivation for this paper is twofold: first, it attempts to contribute to a fuller understanding of the persisting differences in economic performance between East and West Germany since the fall of the Berlin Wall. A second and equally important motivation is of a methodological nature: it employs a Gini decomposition as a means of analyzing stratification in German society as reflected in the income distribution.

The difference in economic performance between East and West Germany can be operationalized by various relevant indicators such as unemployment rates, labor productivity and the dependency on public transfers, all of which impact on the income distribution in terms of both market income (from labor and capital) and disposable income. Such cross-regional variation in living standards is a highly relevant policy issue. According to the German constitution, economic and social policy should be targeted at diminishing regional differences in living circumstances. Various instruments and agreements between the federal government and the state governments (*Bundesländer*) are attempting to deal with this issue. A very important financial instrument is the "*Länderfinanzausgleich*". However, one should keep in mind that even aside from the current inequalities between East and West, regional variation in economic performance had a long history within West Germany alone. Agriculture, for example, was a crucially important economic sector in the state of *Bayern* for several decades after WW II, until this state's successful industrial modernization got underway. In the state of *Nordrhein-Westfalen*, on the other hand, the decline of the formerly successful monostructure of the mining and metal industries began to generate huge adjustment costs. These developments spurred extensive discussion of differences in economic performance between the North and the South of Germany (cf. Friedrichs, Häußermann and Siebel 1986, Geppert 1999). This discussion has largely disappeared from the policy agenda since the fall of the Wall, and today, East-West comparisons dominate the debate on regional variation in Germany.[1]

From a micro-economic perspective, it is interesting to see the extent to which such regional variation is reflected in the personal distribution of income. This is why, for our empirical analysis, we apply a Gini decomposition for detecting stratification in a given society with respect to the distribution of income. In our case, we want to analyze whether the ob-

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[1]See Lammers (2003) for a discussion of an emerging North-South variation within East Germany.

servable regional differences in the income distribution in fact also mirror stratification of German society. Decomposing inequality in economic well-being requires additive inequality indices such as the Theil Index, but it has long been argued that one of the most commonly used indices for inequality analysis, the Gini index, cannot be adequately decomposed in an additive manner. However, using the covariance-based formula of the Gini coefficient, Yitzhaki & Lerman (1984, 1991) propose a decomposition approach which yields the obligatory between- and within-group components as well as an "overlapping" index for the different sup-populations. This is a very helpful tool for interpreting decomposition results with respect to income stratification. We apply this method (Yitzhaki, 1994) together with a jackknife estimation of confidence bands (Frick et al., 2005).

Welfare economists are interested mainly in the income distribution *after* government intervention, i.e. re-distribution after receipt of public transfers and after paying taxes and contributions to the social security system. However, given the massive monetary transfers from West to East Germany, it is important to find out the capacities for self-sustenance of the populations of East and West Germany, respectively. This also makes it important to look at the distribution of income *prior* to government intervention, i.e. market incomes stemming from both factor income (labor and capital) and private transfers (including private pensions).

One of our central findings is that the distribution of East German market incomes has changed drastically over the period under investigation, starting from a predictably low level in the early 1990s and rising in recent years to much higher levels of inequality compared to West Germany. The development of post-government income presents a different picture: here we find significantly lower and more equally distributed incomes in the East over the complete period. Between-group inequality decreased over the first years of transition, but this process came to a halt in the mid-1990s. Overall, there is no convincing evidence of increasing regional convergence in post-government income levels and inequality. The question arises whether the policy goal of equalizing regional differences in income levels and income distribution is a realistic one, or whether regional stratification should simply be accepted as a currently unavoidable byproduct of economic evolution.

The paper is structured as follows: After briefly discussing the literature on income distribution and regional income variation in Germany (Section 2) we sketch some relevant instruments of the rather complex system of public transfers targeted at financial equalization between federal states (*Bundesländer*) in Section 3. Section 4 describes the applied decomposition methodology and the data for our empirical analysis. The empirical appli-

cation is given in Section 5, and the final section draws methodological and substantive conclusions.

2   Income Distribution in West and East Germany

Macroeconomic data, such as national accounts statistics, may enable comparisons of regional differences in absolute or per capita welfare levels, and are often used to analyze processes of regional convergence or divergence (e.g. in 1991, per capita GDP in East Germany was 33% of Western per capita GDP, and rose to "only" 63% in 2003). Analyses along this line looking at the economic performance of various German regions have been conducted by Geppert (1999) and Lammers (2003). But macroeconomic data does not provide an adequate foundation for analyzing trends in the regional variation of income inequality, while micro-data does. German databases that provide the basis for this kind of study include the EVS ("Income and Expenditure survey") and the German Socio-Economic Panel Study (SOEP) which also form the empirical basis of a huge body of literature on the evolution and distribution of pre- and post-government income (and its components) in West and East Germany.[2] The following is a summary of central findings:

Krause (2003) examines trends in income inequality and poverty dynamics in East and West Germany up to the year 2000, and finds an increase in East German inequality in the first half of the 1990s, a more stable picture in the mid-1990s, and a trend towards increasing inequality in both parts of Germany at the end of the century. Frick et al. (2005a) show that disposable income inequality in East Germany is consistently lower, but that market incomes - starting from a predictably low level of inequality at the beginning of the transition process - have been more unequally distributed in the East than in the West since the mid-1990s. According to Goebel et al. (2005), this picture is consistent whether the analysis is based on equivalized household pre-government income or individual labor income; in any case, the increase in inequality is driven by both increasing unemployment and widening wage dispersion. Bird et al. (1998) find evidence that the former GDR elites fared well over the first years of transition, maintaining an income advantage of about 10%. Bishop et al. (2001) show that in West Germany, low-income households (below the median income level) bore an

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[2]See Becker et al. (2002) for a more detailed discussion of the impact of survey characteristics when comparing distribution results based on SOEP with those based on EVS due to the latter's quota sampling design, misrepresentation of foreigners, and non-coverage of top-income households.

above-average share of the costs of unification and the 1992-93 recession.

Focusing on market incomes and analyzing individual labor income, Hunt (2001) identifies rapid wage growth of more than 80% for East Germany over the period 1990-1996, with the biggest gainers being women and the better educated. According to Biewen (2001), the increase in income inequality in East Germany during the first half of the 1990s was due to rising unemployment, decreasing female labor market participation, and a widening income structure. Brenke (2005) stresses the relevance of differential changes in the demographic compositions of East and West German households since the fall of the Wall: East German households are, on average, shrinking faster with respect to household size due in particular to decreasing fertility and the consequentially declining share of families with dependent children. According to Brenke (2005), aging, together with increasing unemployment, is linked to the growing importance of (social) transfer income in East Germany.

Decomposing the Theil(0) inequality measure, Grabka et al. (1999) try to disentangle the effects which unification and migration exerted on the German pre- and post-government income distribution over the 1990s. They conclude that migration from East to West reduced overall German income inequality. Büchel & Frick (2001) analyze the participation of various population subgroups in the income redistribution process induced by the tax and transfer system during the mid-1990s. Comparing relative income positions before and after government intervention, they find that East Germans as a whole as well as specific immigrant groups significantly benefit from redistribution.

While nearly all these analyses focus on differences between East and West Germany, Berthoud (2004) uses ECHP data to look at regional variation of income inequality and poverty across and within EU member states and their regions. For the regional differentiation, he refers to the level of NUTS1[3], which for Germany is defined by the 16 federal states or *Bundesländer*. An important finding from a German point of view is the very low degree of inequality - in cross-national terms - between regions: only 2.2% of overall inequality in Germany is attributed to between-region inequality, while this share is approximately 3 to 5 times higher in France, Spain, and Italy. These findings are in line with those presented by Stewart (2002), who uses LIS data to show that variability of poverty rates at German NUTS1-level around 1990 (West Germany only) is much lower than in Italy, France, Spain and the UK. However, between-region variability clearly

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[3]NUTS is the acronym for Nomenclature des unités territoriales statistiques.

increases when including East German federal states in the mid-1990s[4], a result which is confirmed by the EUROMOD-based analysis using 1998 income data from Mercader-Prats & Levy (2004). The latter also find a negative correlation between market income inequality and regional economic performance and consequently, regions showing weak performance will reap above-average gains from re-distribution.[5] Obviously the definition of regions is significant here, and looking at income inequality the county level, for example, "produces" much more between-regional variation than is the case at higher aggregated regional levels.

The findings of Loikkanen et al (2003) for Finland demonstrate that redistribution by the welfare state induced by taxes and public transfers decreases regional variation and inequality. Surprisingly, the joint effect of the Finnish economic crisis of the early 1990s and the welfare state's redistribution did not become visible in the applied measures of regional differences. Förster et al (2002), who use LIS-data for four Central and Eastern European countries, reveal the extent to which intra-country inequality is masked by national-level analyses. This appears especially important for those transition economies where Socialist central planning had often created regional concentrations of certain industries, possibly producing lasting regional disparities in macro-economic performance. The transition into more market-oriented structures may have revealed or accentuated this variation.

To target this kind of within-country variation, our paper applies a new stratification method based on the decomposition of the Gini coefficient, which offers the advantage of producing three components: (1) the region-specific contribution to overall inequality in Germany, (2) the inter-regional contribution, and (3) overlapping information defined by the degree to which a given region's income distribution overlaps with the overall distribution (as well as with the distribution of any other region of interest). In order to give some indication of the sensitivity of inequality results with respect to the choice and number of regions, we first define only two regions, West and East Germany, (focusing on the current political debate) and compare the results with those obtained from a more diversified grouping of four

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[4]Based on log GDP per capita information for 110 regions in the EU-12 (applying a mix of NUTS-0, NUTS-1, and NUTS-2) Pittau (2005) identifies a convergence between poorer and richer European regions during the late 1970s and 1980s. In the mid-1990s however, a small group of very rich regions seems to have emerged, mostly large metropolitan areas including the German city-state of *Hamburg*.

[5]This is exemplified by the federal state of Sachsen-Anhalt in East Germany: this region occupies the 88th position (out of 100 regions) with respect to market income inequality, and is ranked 3rd after redistribution by the tax and transfer system (Mercader-Prats & Levy, 2004: 19).

regions by splitting West Germany into North, Central, and South (looking at the issue of a North-South divide). Certainly the choice of these regions is somewhat arbitrary, but it is driven by the interest in expanding public awareness in Germany beyond a purely West-East perspective to a broader view of regional variation in income levels and inequality (see also the recommendations by the SVR 2004: cipher 617).

3   Some stylized facts on the German federal system of financial equalization across regions

Since 1990, there has been an ongoing process of massive re-distribution from West to East through a complex system of government activities and the social security system (i.e., unemployment insurance, old age insurance, health insurance, nursing care insurance). There have been a wide variety of estimates of the amount of these transfers[6], ranging up to as much as - on average - 100 billion euro annually since 1990; Rode (2004) estimated the costs of unification to be about 4% of West German GDP, inducing a slow-down in economic growth (see also the paper by the Dohnany Commission, quoted in *Der Spiegel*, April 5, 2004, p. 26). Statistics Germany (*Arbeitskreis VGR der Länder*) has estimated the volume of these West-East transfers on the basis of national account data disaggregated for East and West Germany: subtracting private and state consumption as well as gross investment in plants and equipment in East Germany from East German GDP yields an implicit West-East "transfer" of approximately 90 billion euro per year for the period 1991 through 2002. This amount has been declining since the mid-1990s, however, from about 110 billion euro in 1995 to "only" 72 billion euro in 2002 (Appendix Table A-1). Data on the most important instrument for (horizontal) financial equalization between the federal states, the *Länderfinanzausgleich*, shows a consistent pattern of transfers from West to East Germany, mostly financed by the federal states in the southern part of West Germany. states.

Starting immediately after unification, various new instruments began to be developed and existing ones adjusted to meet the extraordinary financial needs of East Germany, all with the aim of ensuring rapid equalization of living conditions in East Germany and preventing a consolidation of regional stratification. In the early years of transition (i.e., 1990 - 1994) transfers to East Germany were financed via the fund "*Deutsche*

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[6]See SVR (2004: cipher 628 et seqq.).

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"Länderfinanzausgleich" by Region (EURO, nominal)
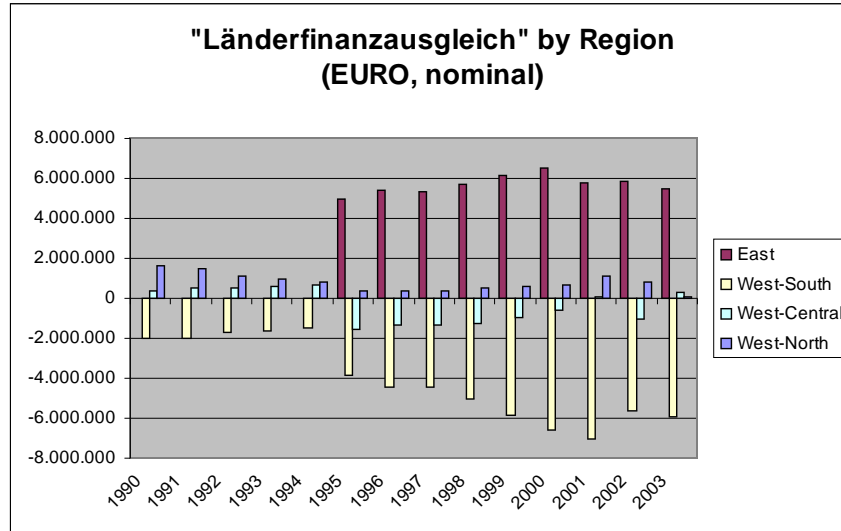
Source: Bundesfinanzministerium; Statistisches Bundesamt; authors' calculations.

Figure 1: Financial Equalization across Regions

Einheit" which contained approximately 82.2 billion euro (25.4 billion of which was financed by the federal government, 8.2 billion by the western states, and 48.6 billion through credit, Bundesfinanzministerium 2002). In 1993, federal and state governments agreed on a federal consolidation program including the so-called *Solidarity Pact* (intended to run from 1995 to 2004) which included a wide range of instruments targeted at solving labor market issues, promoting goods produced in East Germany, implementing industrial policy, undertaking the ecological treatment of brownfields, etc. One important financial instrument went into effect in January 1995: the solidarity tax (*Solidaritätsabgabe*, at time of introduction calculated as 7.5% of income tax). In the same year, the East German federal states (including the state of Berlin) were fully incorporated into the existing system of financial equalization between the federal and the state governments (*Bund-Länderfinanzausgleich* or vertical equalization) as well as among the federal states themselves (*Länderfinanzausgleich* or horizontal equalization).[7] This

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[7]The basis for this regulation is laid down in articles 106 and 107 of the constitutional law. See Der-Laenderfinanzausgleich-und.htm for more details on the Länderfinanzausgleich.

rather complex system proceeds in two stages: first, there is a redistribution of sales tax revenues between federal, state, and local authorities, and second, there a further correction is undertaken in such a way as to guarantee approximately equal per capita tax revenues across federal states. This process makes stronger federal states subsidize weaker ones in order to match factual tax revenues with financial needs. Finally, various types of federal funding (*Bundesergänzungszuweisungen*) focus on meeting specific needs caused, for example, by higher fixed costs of governmental authorities in smaller federal

It is clearly very difficult to derive a *true* measure of all West-East transfers. Such a measure would have to take into consideration implicit subsidization within the social security system as well, for example, payments received by East Germans that may not be fully financed by contributions from the East German population. This applies in particular to the old age pensions that East Germans are entitled to even when they were not able to pay into the system during GDR times; such deficits in the old age pension system are partly corrected through federal subsidies, which also must be

Table 1: Grouping of federal states, population size and GDP

	East	West		
Grouping 1	Berlin, Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt, Thüringen	Baden-Württemberg, Bayern, Hessen, Nordrhein-Westfalen, Rheinland-Pfalz, Saarland, Bremen, Hamburg, Niedersachsen, Schleswig-Holstein		
		South	Central	North
Extended Grouping 2	Berlin, Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt, Thüringen	Baden-Württemberg, Bayern, Hessen	Nordrhein-Westfalen, Rheinland-Pfalz, Saarland	Bremen, Hamburg, Niedersachsen, Schleswig-Holstein
Population size (%)				
1991	22,4	34,2	27,9	15,5
2003	20,5	35,4	28,1	16,0
Gross Domestic Product (%)				
1991	11,0	41,4	30,2	17,3
2003	14,8	41,3	27,5	16,4

Source: Statistisches Bundesamt; authors' calculations.

For more information on the Solidarity Pact see Solidarpakt.htm. Starting in 2005, regulations of the solidarity pact II will come into power, see Solidarpakt-II.htm. All documents can be found at the webpage www.bundesregierung.de.

considered a form of West-East transfers.

Nevertheless, figures on the horizontal fiscal equalization provide an important proxy of these West-East transfers after incorporating East Germany into the existing system. Figure 1 shows that in the first half of the 1990s, the federal states in the southern part of West Germany (here: *Baden-Württemberg, Bayern, Hessen*) on average were net contributors to the *Länderfinanzausgleich*, while the northern part of West Germany gained an above-average profit, and the states in the centre of West Germany benefited marginally. The inclusion of East Germany in 1995 drastically changed the overall turnover and also moved the states of central West Germany on average into the category of donors. In general, however, it is the southwestern states that move the bulk of funds to East Germany.[8]

For the regional differentiation, we sort the 16 federal states according to the grouping given in Table 1 - Berlin is treated here as part of East Germany due to problems of differentiating its eastern and western parts. As can be seen from the information on population and GDP, the population of the eastern part of the country shrank by about 2 percentage points from 1991 to 2003 to about one-fifth of the country's overall population. In the same period, production increased by almost 4 percentage points to almost 15%.

4   Emprical Analysis: methods and data

4.1   The ANOGI (Analysis of Gini) methodology

The ANOGI (ANalysis Of GIni) technique can be seen as the equivalent to ANOVA (ANalysis Of VAriance) performed with the Gini coefficient. To measure inequality, we use the Gini index as represented by the covariance formula according to Lerman and Yitzhaki (1984):

$$G = \frac{2cov(y, F(y))}{\mu} \tag{1}$$

Here, the Gini is twice the covariance between income y and rank $F(y)$ standardized by mean income μ.[9] The Gini of the entire population, G_u,

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[8]Accounting for differences in population size and inflation (as well as for West-East purchasing power differences) does not change, but rather accentuates this finding.

[9]Note that the relative version of Gini is used here, which is most commonly used in the income distribution literature.

can be decomposed as:

$$G_u = \sum_{i=1}^{n} s_i G_i O_i + G_b \tag{2}$$

where s_i denotes the share of income on overall income for group i, O_i is the overlapping index of the entire population by sub-population i (to be explained below), G_i represents the Gini of sub-population i, and G_b is the between-group inequality component.

The between-group inequality G_b as defined in Yitzhaki and Lerman (1991) is:

$$G_b = \frac{2cov(\mu_i, \bar{F}_{ui})}{\mu_u} \tag{3}$$

Hence G_b is twice the covariance between the mean income of each sub-population and the sub-populations' mean rank in the overall population, divided by overall expected income. That is, each sub-population is represented by its mean income, and the mean rank of its members in the overall distribution. The term G_b equals zero if either the mean incomes or the mean ranks are equal for all sub-populations. In extreme cases, G_b can be negative, which occurs when the mean income is negatively correlated with mean rank.[10]

The within-group inequality, $s_i G_i O_i$, therefore consists of three components (rather than only two, when decomposing other inequality measures or when applying ANOVA), of which the overlapping index is the most important for measuring stratification. The formal definition of the overlapping index is given by:

$$O_i = O_{ui} = \frac{cov_i(y, F_u(y))}{cov_i(y, F_i(y))} \tag{4}$$

where, for convenience, the index u is omitted and cov_i gives the covariance according to distribution i, i.e.

$$cov_i(y, F_u(y)) = \int (y - \mu)(F_u(y) - \bar{F}_{ui})f_i(y)dy \tag{5}$$

where $\bar{F}_{ui}$ is the expected rank of sub-population i in the overall population (all observations of sub-population i are assigned their ranks within the

[10]For a more detailed discussion of between-group inequality and the relation to the overlapping index as well as alternative specifications of G_b, see Frick et al. (2005). See Dickey (2001) for an empirical application to earnings inequality in the UK using an alternative decomposition of the Gini-coefficient following Pyatt (1976).

union and $\bar{F}_{ui}$ represents the expected value).[11] Note that the numerator in (4) is the covariance between y and its rank, had it been ranked within the entire population, while in the denominator, the ranking is within sub-population i itself. The overlap as defined in (4) can be further decomposed to identify the overlapping of sub-population i and all sub-populations that comprise the union. In other words, total overlapping of sub-population i, that is O_i, is composed by the overlapping of all sub-populations (including group i itself) by group i. This further decomposition of O_i is:

$$O_i = \sum_j p_j O_{ji} = p_i O_{ii} + \sum_{j \neq i} p_j O_{ji}$$
$$= p_i + \sum_{j \neq i} p_j O_{ji} \quad ,$$

(6)

where $O_{ji} = \frac{cov_i(y, F_j(y))}{cov_i(y, F_i(y))}$ is the overlapping of group j by group i. From this follows that O_{ji} is equal to zero if no member of distribution j lies within the range of distribution i, which means that group i is a perfect stratum. On the other hand, if over the range of distribution i, the shape of the distribution of group j is similar to the shape of distribution i, then O_{ji} is equal to 1, and of course by definition, O_{ii} in any case is equal to 1. O_{ji} is bounded from above by 2. This maximum value will be reached if all observations belonging to distribution j that are located in the range of i are concentrated at the mean of distribution i.[12] O_{ji} and O_{ij} are connected, in a way that, generally spoken[13], the higher the overlapping index O_{ji}, the lower O_{ij} will be. That is, the more group j is included in the range of distribution i, the less distribution i is expected to be included in the range of j. Therefore O_{ji} is an index that measures the extent to which population j is included in the range of group i.[14]

We interpret the overlapping index as the inverse of stratification. Stratification is a concept mostly used by sociologists, and we follow Lasswell's (1965: 10) definition:

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[11]It is worth noting that the O_i is a kind of a Gini correlation. See Schechtman and Yitzhaki (1987, 1999) for the properties of Gini correlations.

[12]Note, however, that for a given distribution i the upper limit can be lower than 2 (for details see Schechtman, 2000).

[13]Note that the indices O_{ji} and O_{ij} are not inter-related by a simple relationship. However, it is clear that the indices of overlapping are not independent.

[14]A discussion of the estimation with grouped and weighted data is given in Lerman and Yitzhaki (1989), and for a description of the jackknife estimation see Yitzhaki (1991) and Frick et al. (2005).

> "In its general meaning, a stratum is a horizontal layer, usually thought of as between, above or below other such layers or strata. Stratification is the process of forming observable layers, or the state of being comprised of layers. Social stratification suggests a model in which the mass of society is constructed of layer upon layer of congealed population qualities."

According to Lasswell, perfect stratification is achieved when all observations of each population (in our case the population living in different German regions) are found in a specific range of income, and the ranges of the income distribution of the various sub-populations do not overlap. Yitzhaki (1982) links stratification to the concept of relative deprivation, arguing that more stratified societies can tolerate even greater inequalities than non-stratified ones.

One rarely finds perfect stratification in real life, and for this reason an index describing the degree of stratification is required. The index of overlapping is actually an index describing the extent to which the different sub-populations are stratified. In our case, this property plays an important role because it tells us whether East and West Germany (according to different groupings) represent different income strata even 14 years after unification.

4.2   The data

In our empirical application we make use of representative micro-data for private households from the German Socio-Economic Panel Study (SOEP, cf. Wagner et al., 1993, and Haisken-DeNew and Frick, 2003). We analyze annual pre- and post-government income (previous calendar year) available for all years between 1992-2003 (actually representing the income distribution in the period 1991-2002 as gathered from the population living in the period 1992-2003).[15] Following the recommendations by the Canberra Group (2001), our income measures include imputed rental values for owner-occupied housing (cf. Frick & Grabka 2003). Given the multitude of income components incorporated in the aggregated pre- and post-government income measures (factor income from labor and capital, public and private transfers, public and private pensions, etc.) these income constructs are both rather complex to generate; this is especially true for the simulation of

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[15]Income measures for 1990 and 1991 are not included in this analysis due to the introduction of the common currency in 1990 and comparability problems of East and West German incomes immediately after unification (cf. Hauser et al. 1994).

direct taxes and social security contributions. All income measures are corrected for missing data due to item-non-response by means of longitudinal and cross-sectional imputation (cf. Frick & Grabka 2005).

In order to adjust income for differences in household size and age composition, we apply a common international equivalence scale, the modified OECD scale (which gives a weight of 1 to the household head, a weight of 0.5 to other adult household members above age 14, and a weight of 0.3 to all children up to 14 years of age). All income measures are deflated to prices of 2000 including a correction for purchasing power differences between West and East Germany.

5   Empirical Results

This section provides empirical results on the decomposition of the Gini coefficient for annual pre- and post-government income measures for different German regions (East and West Germany, the latter also being split into North, Central and South).

With reference to the theoretical considerations in Section 4.1 on the ANOGI methodology, we can interpret any significant variation between regions (here: West and East Germany) as an indication of stratification. In other words, no regional stratification is given if all parameters of interest were the same for all regions (i.e. no statistically significant differences apply):

Mean income:	$\mu_{West} = \mu_{East}$
Mean rank:	$F_{West} = F_{East} = 0.5$
Gini coefficient:	$G_{West} = G_{East}$
Overlapping index:	$O_{West} = O_{East} = 1$
Between-group inequality:	$G_b = G_{bp} = 0$

Based on the heavy transfers from West to East Germany, the baseline hypothesis must be that income distribution differentials which may have existed when the Berlin Wall fell diminish over time and eventually disappear. Our analysis will show that this is not true at all for post-government income and that it is only true for the overlapping of the pre-government income, because the shape of this income distribution in East Germany developed in a rather specific way.

For the sake of illustration[16], the results of our Gini-decomposition (ANOGI) are presented as time series by groups in graphical form using separate figures for

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[16]All results are available in tabulated form on request.

(a) Mean income (μ_i),

(b) Gini index (G_i) with between and within inequality shares ($\frac{G_b}{G_u}$) and ($\frac{1-G_b}{G_u}$), respectively,

(c) Overlapping component (O_i), and

(d) Mean rank (F_i)

Confidence bands[17] are also indicated for the group-specific Gini, the shares of between and within inequality as well as for the overlapping index.

## 5.1 Income inequality decomposition by region: West and East Germany

5.1.1 Pre-government income

Pre-government income levels in West Germany generally mirror the development of the business cycle[18] (see Figure 2(a)). Over the whole period, inequality, G_i, increases at a moderate pace, but again in line with the business cycle; i.e. there are years that even show a minor decrease in inequality. As is to be expected, pre-government income inequality in East Germany in the early years of transition was significantly lower than in the West, however, inequality steadily increased and passed the West German level as early as the mid-1990s (see also Biewen 2001, Hunt 2001). Market income inequality in the East is still rising at a clearly higher pace in more recent years (see Figure 2(b))[19]. This process is mainly driven by massive (increasingly long-term) unemployment (see Frick et al. 2005a). East German pre-government income *levels* (as measured by mean and ranks) cannot close the gap to West Germany; again the process of catching up had already stopped in 1995 and mean ranks, F_i, (see Figure 2(d)) have remained very stable at about 0.41 for almost 10 years.

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[17]The confidence bands shown are defined by two times the respective standard errors, based on a jack-knife procedure.

[18]Burkhauser et al (1999) argue that when comparing time trends on inequality measures, one needs to properly consider the state of the business cycle, i.e., one should compare "peak to peak" and "trough to trough" years.
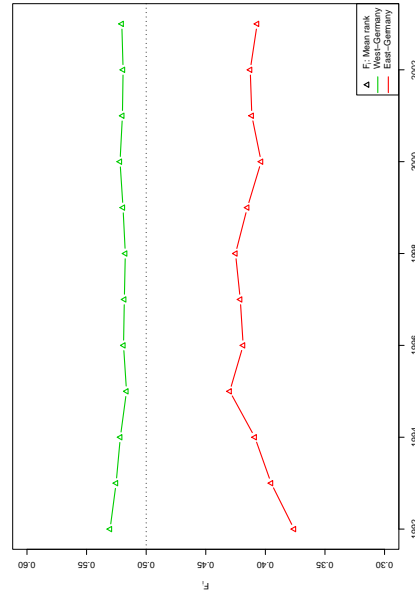
[19]In 1992, the East German Gini was .3711 as compared to .4129 in West Germany. In 2003, the corresponding values were .5227 and .4584, respectively.
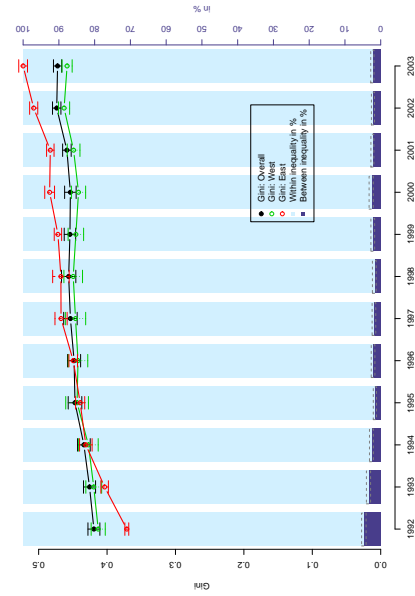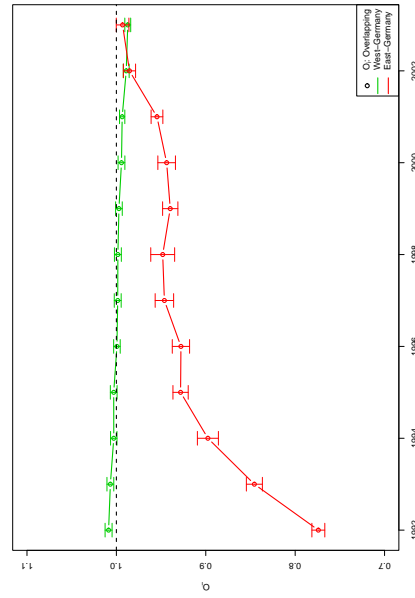
(a) Means

(b) Within and Between-Inequality
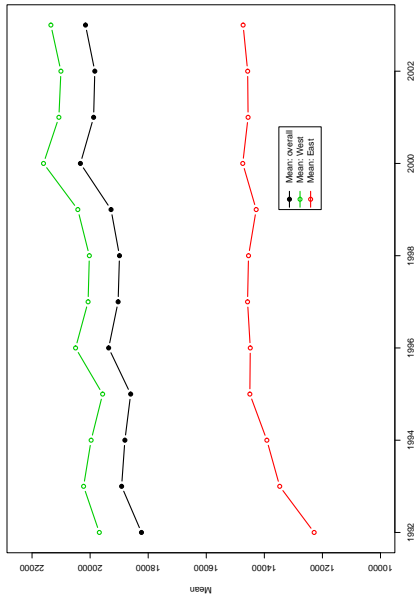
(c) Overlapping

(d) Mean rank

Figure 2: ANOGI-Results on pre-government income: East vs. West Germany, 1992-2003

The contribution of between-region *inequality*, G_b, was significantly reduced in those early years (1992: 4.7%) and reached its minimum in the mid-90s (1995: 2.0%) when pre-government income inequality in the East matched that in the Western part of the country. However, the between-group contribution has increased slightly in more recent years in line with East Germany's skyrocketing inequality (2000: 2.7%). According to the overlapping indicator, O_i, East Germany was clearly a pre-government income stratum on its own over the first 10 years of the unification process. In 1992, the O_i for East Germany was as low as 0.7741 but rapidly developed to 0.9282 in 1995. Since then, although at a lower pace, this measure further approached the value of one, and in 2003, the pre-government income distribution in both parts of Germany overlapped almost perfectly ($O_{West} \approx .9873$ versus $O_{East} \approx .9930$, see Figure 2(c)).[20] This result, however, must be interpreted together with the consistently lower income levels and increasing income inequality in East Germany: i.e., those East Germans who do have a paid job (which is by far the most important source of pre-government income) "reach into" the West German distribution. However, a large group of East German individuals have very low or even zero market incomes[21] as well due to unemployment or early retirement schemes.

5.1.2   Post-government income

Post-government income levels in East Germany increased significantly over the first half of the 1990s, steadily closing the gap to the Western levels (see Figure 3). However, as could be observed for pre-government income, this process came to a halt around 1995. Inequality, as measured by the Gini coefficient, G_i, remained consistently and significantly lower in the East compared to the West. This process mirrored the development of the business cycle, although to a less pronounced degree than was the case for pre-government income. This merely reflects the fact that public transfers are effectively performing their stabilizing function, especially the unemployment assistance schemes which appear to be more important in East Germany given the extraordinarily high unemployment rates there (almost 20% and as such about twice as high as in the West). For West Germany, we

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[20]In this decomposition for only two groups, we abstain from presenting results for the group-by-group overlapping index, O_{ji}, given that O_i qualitatively resembles O_{ji}. Note that O_i is the weighted sum of the group-specific O_{ji} with O_{ii} being equal to one.

[21]See Figure A-1 (Appendix) for kernel density estimations of pre- and post-government income distributions by region for 1992, 1997 and 2003. For the case of pre-government income, we see clearly that the share of zero incomes in East Germany increases dramatically after unification.

find a mildly u-shaped trajectory in the inequality development since 1995 ($G_i = .2841$), with another local maximum reached in 2002 ($G_i = .2904$). The decrease found here in recent years does not appear in the East, resulting in a somewhat narrowed regional inequality gap in 2003, but the difference remains statistically significant ($G_{West} = .2847$ versus $G_{East} = .2416$).

In line with these results, mean ranks do not show any relevant changes since 1995 in West and East Germany ($F_{East} \approx .42$). The overlapping index identifies East Germany to remain significantly different throughout the period under investigation, i.e., the East still forms an income stratum on its own (2003: $O_{East} \approx .9184$).

Concluding from the findings in Section 5.1, one can derive that the German welfare state continuously and significantly reduces market-induced inequality in a very effective way. Although for pre-government income, the overlapping index indicates that the market-induced income distributions in East and West now overlap because of the high degree of inequality in East Germany, this is not at all true of disposable or post-government income.

5.2   Income inequality decomposition using an extended regional grouping

In a second step we extend our differentiation to allow for more regional variation within West Germany. One may argue that the differences between East and West Germany do not come as a surprise, since such differences also arise within West Germany alone if it is divided in an appropriate way.[22] Certainly any such regional grouping is based on some normative decisions. Given the federal organization of Germany on the one hand and the availability of data at the federal state level as well as the identification of these regional entities in our data on the other hand, the grouping chosen in this paper is based on federal states (NUTS1-level). In the context of the discussion about a "North-South divide" within West Germany, we group the federal states into northern, central, and southern states (see Table 1 above).
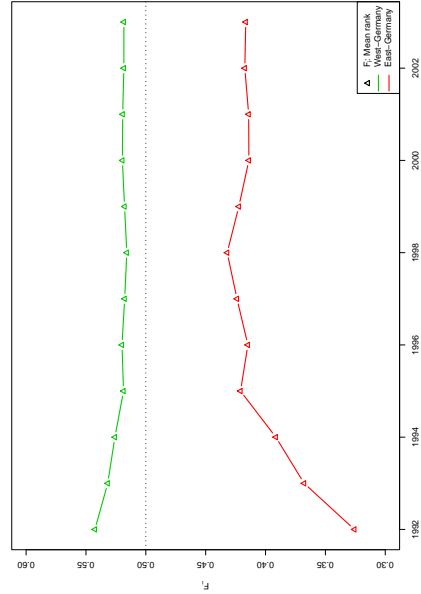
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[22]According to Stewart (2002) between-region variation of the poverty-rate in West-Germany as measured at NUTS1-level (federal states) is rather low, especially when compared to other large EU-countries.
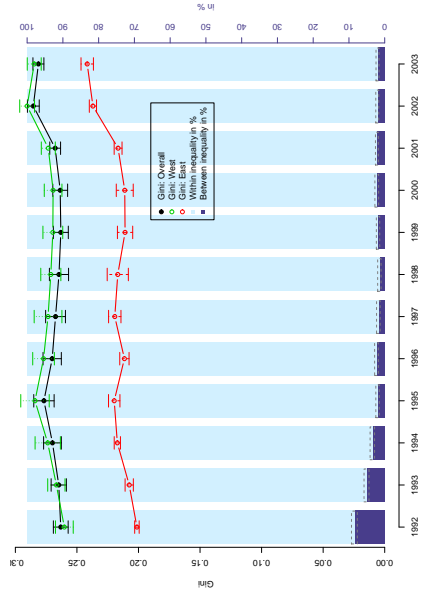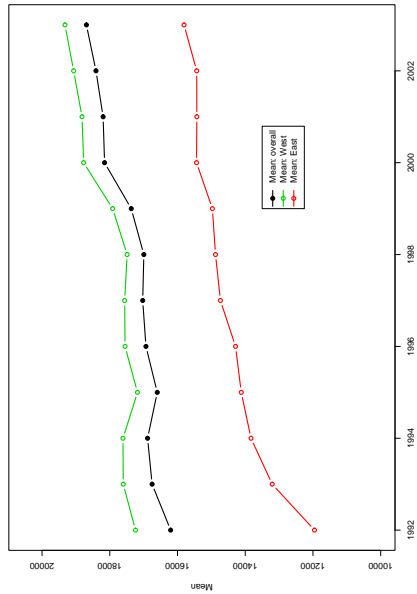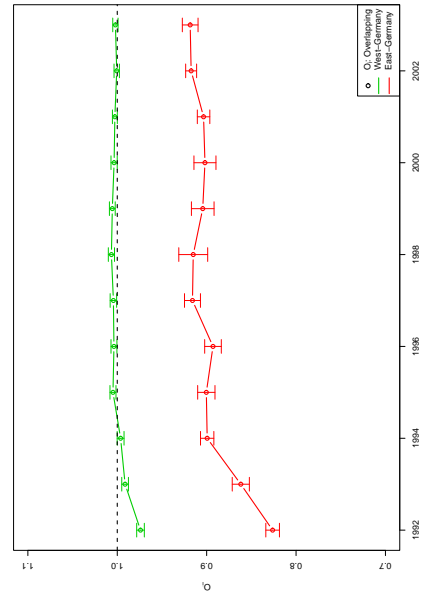
(a) Means

(b) Within and Between-Inequality

(c) Overlapping

(d) Mean rank

Figure 3: ANOGI-Results on post-government income: East vs. West Germany, 1992-2003

Using this extended grouping, the substantive group-specific results described in Section 5.1 above for East Germany (Gini G_i, mean income and rank F_i, and overlapping O_i) will remain unchanged, while the results for West Germany will now be derived from three measures: the northern, central, and southern parts of West Germany. However, the contribution of between-group inequality, G_b, as well as the group-by-group overlapping index, O_{ji}, may very well be subject to change. It is not only relevant to find out the degree to which these three West German regions deviate from each other, but also to see whether the East German results come closer to at least oney of the western regions.. If this were the case, then the hypothesis of East Germany forming an income stratum on its own would be falsified.[23]

5.2.1   Pre-government income

With only one exception in the year 2000, we find a consistent picture of pre-government incomes being higher on average in the southern part of West Germany than in the central and the northern federal states, which is perfectly in line with the discussion about the North-South divide (see Figure 4). According to mean rank, all three western regions show above-average values throughout the entire observation period, although in most recent years FSouth improved, while it clearly worsened for the northern and central groups. Despite of this development, the average East German income still falls far short of the lowest of these three reference values. It should be noted that this overall development at the micro-level perfectly matches the regionally disaggregated macro-information on GDP as given in Table 1.

There is no clear trend with respect to market income inequality across the West German groups - all of them remain rather close and it is only in the early 1990s and during the very recent years that the South has shown significantly lower inequality than the central and northern regions. But as was true when comparing the eastern result to West Germany overall, we find East German inequality in pre-government income to be lower in the early years of transition and significantly higher since the late 1990s. In 2003, G_{East} reached .5227 and the "closest" Western value was given by the northern region with $G_{North} = .4795$. This finding is confirmed by the fact that between-group inequality does not significantly change when using four rather than only two regions for the decomposition analysis.

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[23]For sake of clarity of the presentation, all figures in this section do not show results for Germany as a whole, which are given in Section 5.1 above. By definition, these do not change with the number of groups distinguished.

   With respect to the overlapping index, O_i, we conclude that, starting
in 2002, the distribution in East Germany began extending into the range
of the corresponding West German O_i. Nevertheless, the mean rank in
the East has remained significantly lower and the increase in inequality has
accelerated in recent years.

   Figure 5 presents the decomposition results with respect to the overlap-
ping indices for each group in terms of the respective other groups, namely
O_{ji}.[24] In contrast to the above mentioned results for O_i, where we compare
each group with the entire population, such a group-by-group comparison
is not affected by the relative size of the various groups.[25] Following this
consideration, Figure 5 includes for each of the regions considered in our
analysis (North, Central, South, East) the corresponding overlapping in-
dices with the respective three other regions.

   Throughout the entire period under investigation, East Germany (Figure
5(d)) formed a distinct income stratum with respect to all three western
regions, except for last year, when a significant deviation was found only
in comparison to the North. None of the other regions formed an income
group with respect to the East in the first years following unification. For
the South, this changed starting in 1996 (Figure 5(c)), for the Central part
in 1998 (Figure 5(b)), and finally for the Northern part as well in 2002
(Figure 5(a)). Since then each of the other regions has shown a distinctively
different distribution from the East German distribution. There is a more
heterogeneous picture within West Germany: While over the early 1990s,
only South Germany formed a group with respect to North and Central, we
observe a convergence during the mid-1990s, a period with less inequality
and more similar mean ranks among the three western regions. Starting in
1998, however, the overlapping results indicate that the South and Central
regions also form distinct income groups with respect to the northern part
of the country. This may be taken as an indication of a North-South divide.

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[24]Results for O_{ji} are presented as time series showing statistically significant deviations
   from 1 as solid dots, otherwise no annually value is depicted (broken line).
[25]Note that the overlapping index for two groups i and j may not be symmetrical (see Section
   4).

(a) Means

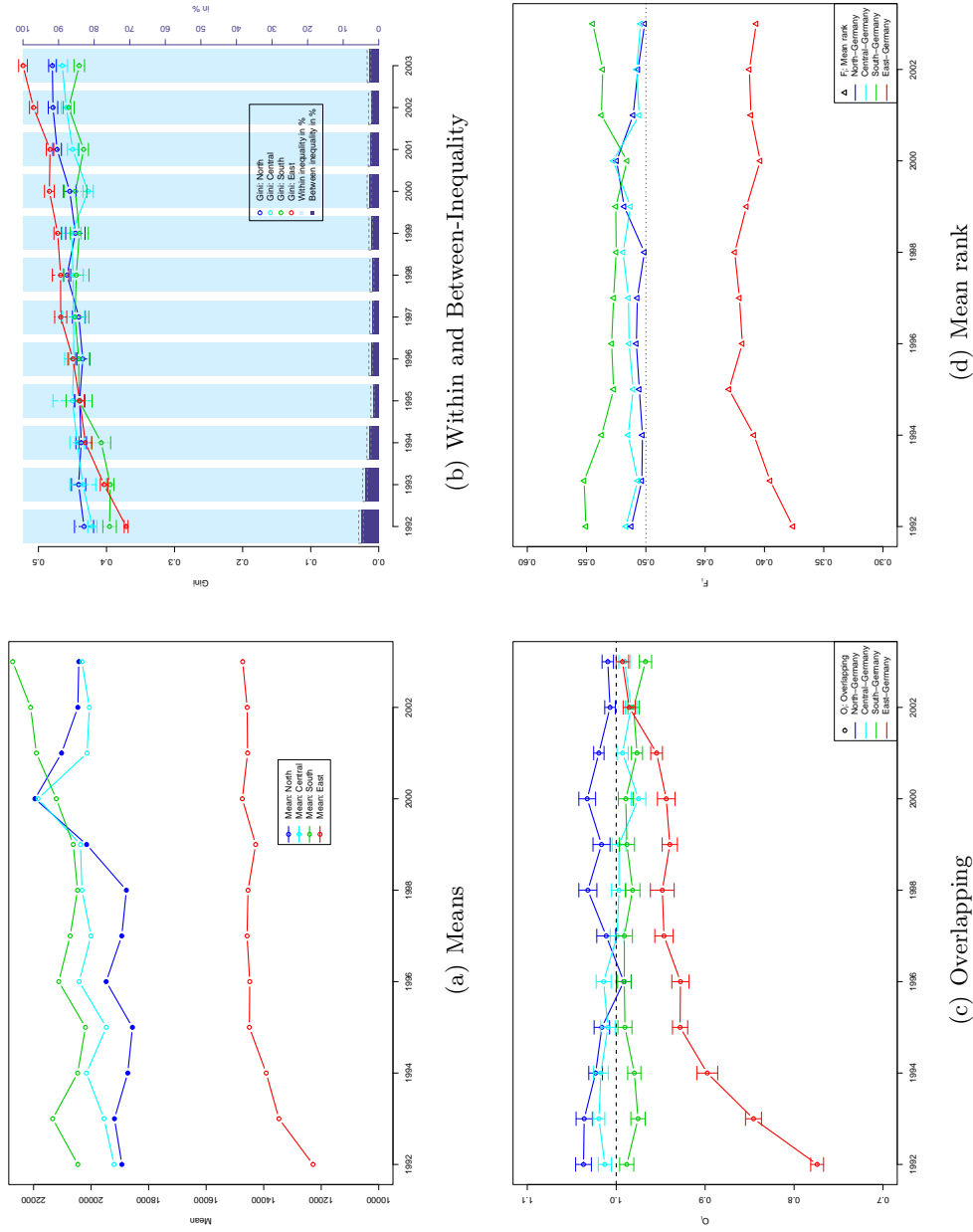(b) Within and Between-Inequality

(c) Overlapping

(d) Mean rank

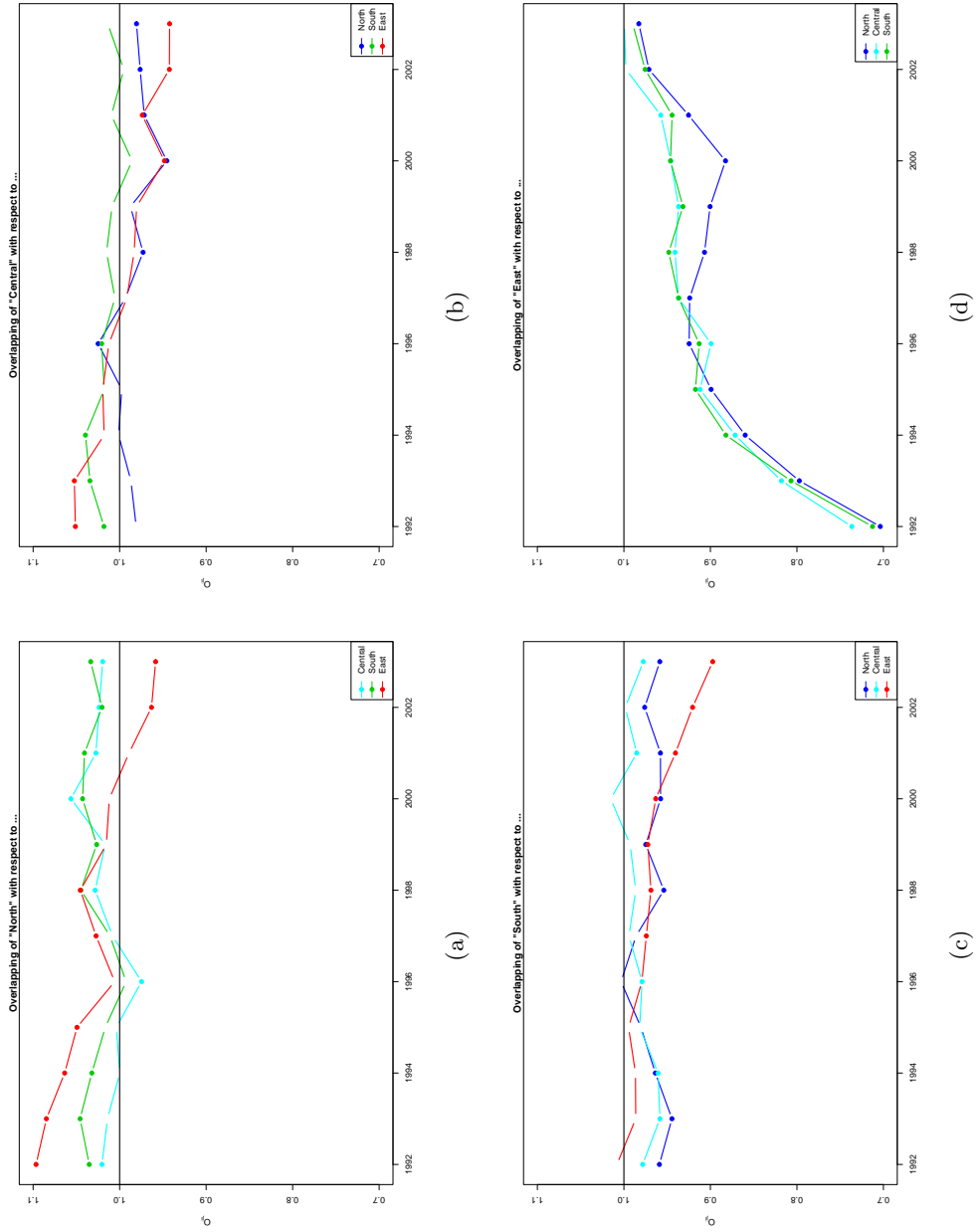Figure 4: ANOGI-Results on pre-government income: Extended regional grouping, 1992-2003

Figure 5: Overlapping for each group with each other group (O_{ji}): Pre-Government Income, 1992-2003

5.2.2   Post-government income

Given the results on pre-government income, it comes as no surprise that a more diversified regional grouping in West Germany also does not yield significant changes (for the West-East comparison) when the dependent variable is post-government income (see Figure 6). Income levels in the southern part of West Germany are in principle higher than in the central and northern parts, and all of them are clearly above the average eastern income. This is also confirmed by the mean rank, F_i. The ordering of West German regions with respect to income inequality (G_i) changed in the late 1990s, when the North became the region with highest inequality after being below average for the first half of the period under investigation. The more important finding is again that all group-specific decomposition components - inequality, average income, mean ranks, overlapping - for the East German disposable income remains far below any of the three West German regions.

Even with the more differentiated grouping of West Germany, the overlapping index with the overall distribution, O_i (Figure 6(c)), as well as the group specific overlapping, O_{ji} (see Figure 7(d)) for East Germany remains significantly different from all three reference regions. And again, we can conclude that with respect to regional stratification, the East still forms an income stratum on its own.

The overlapping indices for each group in terms of the respective other groups (Figure 7) from a western point of view indicate that only in the very first years after unification did the western regions form distinct income strata with respect to the East. However, this changed rather soon and since 2000 only the South again forms a group with respect to the East. Within West Germany, there is a much more homogeneous picture when using the group specific overlapping indices. The central part does not form a group at all over the whole period, and the northern part was only a group with respect to Central Germany in the first half of the period under investigation. Solely the South seems to become more stratified with respect to the North in the more recent years after a process of assimilation during the mid-90s, in line with the pre-government income results presented in Section 5.2.1.

(a) Means

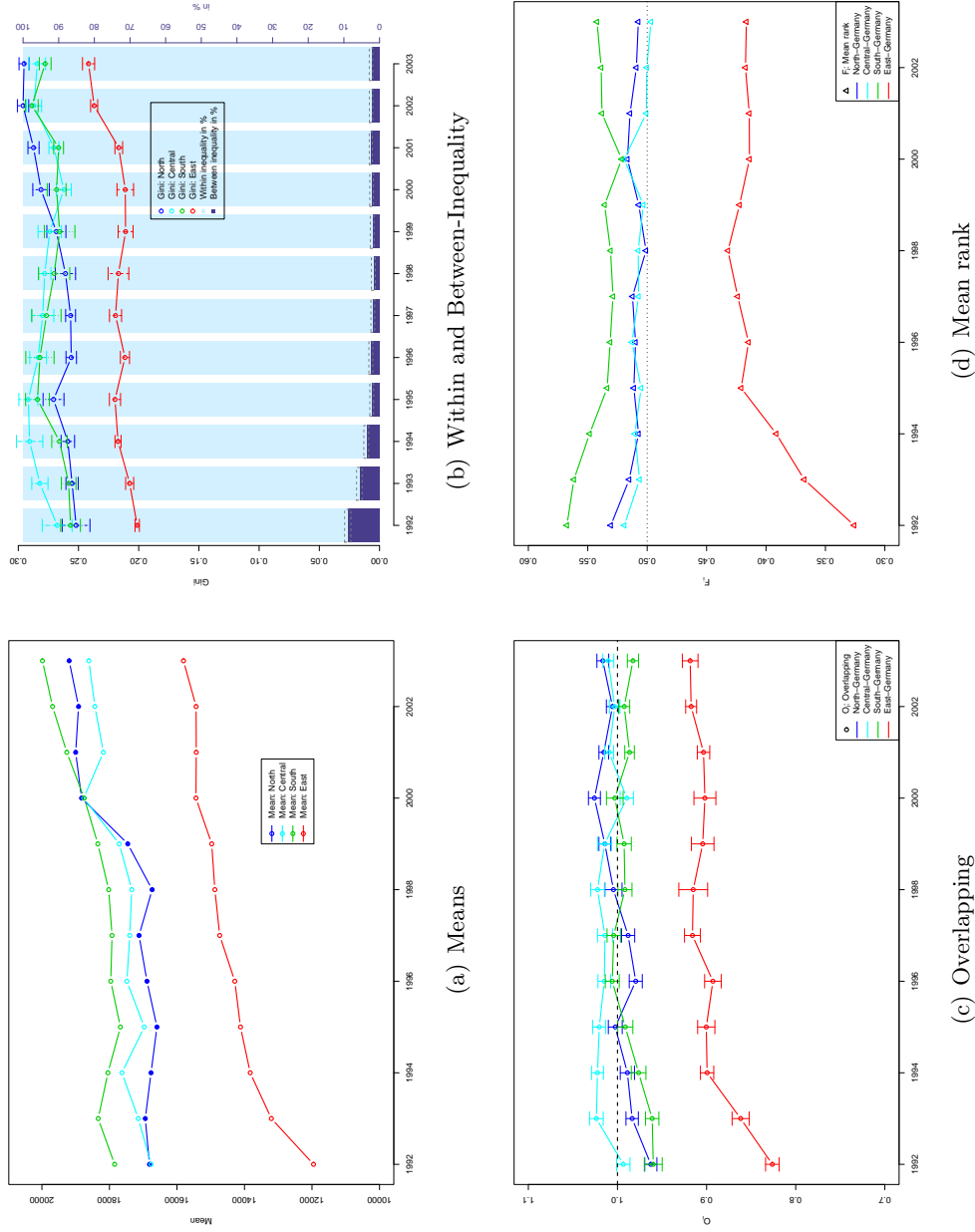(b) Within and Between-Inequality

(c) Overlapping

(d) Mean rank

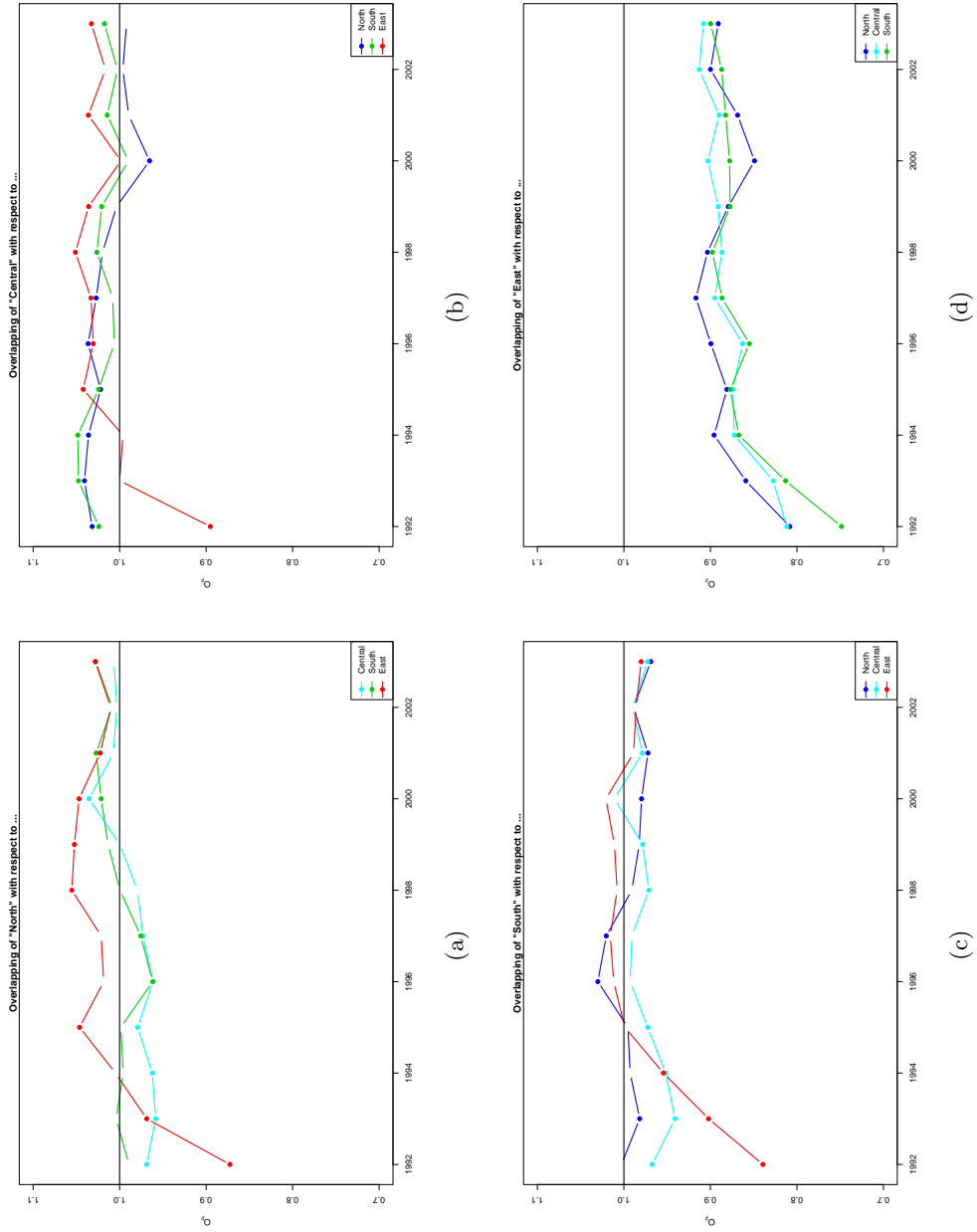Figure 6: ANOGI-Results on post-government income: Extended regional grouping, 1992-2003

Figure 7: Overlapping for each group with each other group (O_{ji}): Post–Government Income, 1992-2003

6   Conclusion

Using analysis of Gini (ANOGI) for an inequality decomposition, we empirically demonstrate the evolution of the income distribution after German unification. The unique advantage of this methodology is that it provides an additional term which reflects the overlap between the distributions of two or more interesting groups or strata formed by various German regions.

Concluding from our empirical results with respect to post-government income, we must reject the hypothesis that East and West Germany are moving towards a common income distribution.[26] After a "promising" start over the first half of the 1990s with increasing levels of income among East Germans, but accompanied by rising inequality, this process appears to have stopped in the mid-1990s without major changes since then. The picture is quite different for pre-government incomes, which are heavily dominated by labor income for East Germany, while for the West German population, capital gains are a more relevant issue. Mostly driven by massive unemployment and the lack of counteracting capital income, market-income inequality in East Germany already surpassed the Western level in the early 1990s and this difference has continuously increased. The huge inequality of market incomes in East Germany results in East Germany no longer being a stratum on its own with respect to the overlapping of pre-government incomes: very low (zero) as well as (some few) remarkably high market incomes yield an income distribution overlap with that in West Germany. However, the average East German market incomes (as well as the respective mean rank) are still far lower than in West Germany.

Enlarging the number and structure of the regions under consideration by splitting the western part into its northern, central and southern components also reveals a certain degree of regional variation *within* West Germany, with the South being in a somewhat more favorable position with respect to market and disposable income. If regions in West Germany (in particular the South) create income strata on their own at all, then only at a much smaller scale and not persistently over time. There is, however, a clear picture of East Germany still being quite different from the rest of the country, irrespective of any western regional grouping.[27]

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[26] As such, our results provide reason for disappointment among those who wish to see Willy Brandt's message come true: "*now what belongs together will grow together*" (Original quote: "*Jetzt wächst zusammen, was zusammen gehört.*") Commentary about the fall of the Berlin Wall by Willy Brandt, German chancellor 1969-1974 and mayor of Berlin, on November 10, 1989 .

[27] These findings are perfectly in line with Colavecchio et al. (2005) who analyze GDP

Overall, we find clear indications of post-government income stratification.[28] On the one hand, this may be taken as underlining the need for a continuation of transfers from West to East in the context of the new *Solidarity Pact II*, which just started in 2005. However, instead of arguing about the need to counter any existing differences with even more and higher transfers, politicians and the public may have to start discussing whether one should become more willing to accept regional differences which might become the basis for endogenous growth in the less advantaged regions. This process is not limited solely to the East-West discussion, since there has been a tendency in recent years toward pre-government income stratification in South (West) Germany as compared to both other Western regions, as well as of Central (West) Germany as compared to the Northern part.

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per capita at the county level ("Kreis", n=439) derived from aggregated statistics by the Arbeitskreis VGR. They are also able to identify variation within East Germany, however: in 2001 about 80% of Eastern counties still belonged to the poorest of three income categories, while only 8% could be found in the richest category. Our results are based on micro-data with a finite number of observations, which cannot deal with such a high level of regional disaggregation.

[28]It is not clear at this point to what extent these processes are influenced by regional mobility of East Germans moving to the western part of the country and vice versa - however, given tendency towards selective mobility, this issue may be taken up in future extension of this paper.

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A   Appendix

Table A-1: Macro data on production, consumption and investment in East Germany, 1991-2002

| Year	Gross domestic product	Private consumption	Public consumption	Gross investment in plant and equipment	Difference Consumption ./. Production
in billion EURO					
1991	105	100	40	46	82
1992	133	113	48	65	94
1993	163	127	55	79	99
1994	188	134	61	97	104
1995	201	144	64	99	107
1996	209	152	65	94	101
1997	214	156	64	89	94
1998	218	160	64	85	91
1999	225	168	65	82	90
2000	227	173	66	78	89
2001	230	176	66	70	82
2002	234	176	67	63	72

Source: Arbeitskreis VGR der Länder
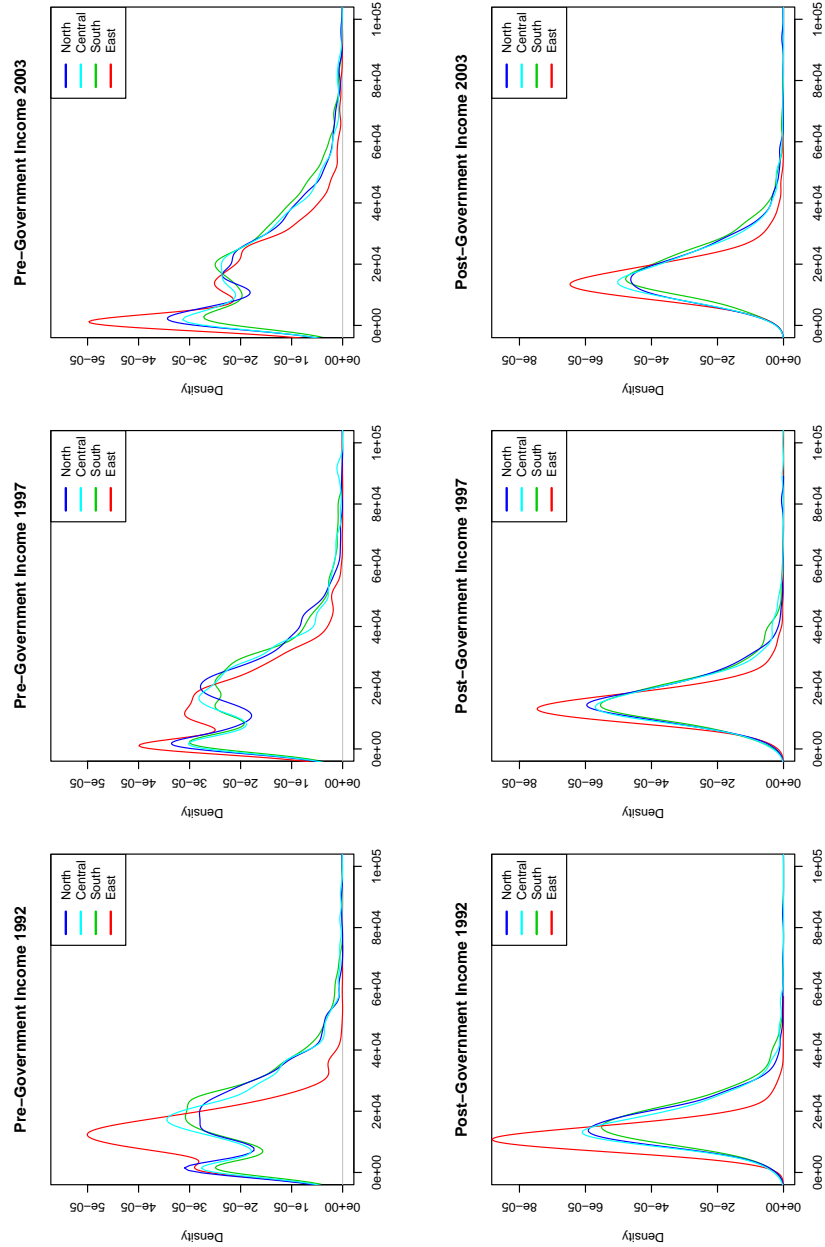
Figure A-1: Kernel Density Estimates by region and year (Bandwith=2500)