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ACCOUNTING FOR REGIONAL POVERTY DIFFERENCES IN CROATIA: EXPLORING THE ROLE OF DISPARITIES IN AVERAGE INCOME AND INEQUALITY

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Abstract

The prevalence of poverty in a given population is determined by both the level of average income and the shape of income distribution. Accordingly, the difference in poverty between two populations can be attributed to disparities in their average incomes and in the levels of income inequality. In this paper, we decompose the differences in relative poverty between each of the twenty-one Croatian counties and Croatia as a whole into the contributions of the mean income and income inequality, using the Household Budget Survey data for 2010. The decomposition framework that we utilize here is one usually applied for decompositions of intertemporal poverty changes, and is based on the concept of Shapley value from cooperative game theory. Poverty is measured by three conventional measures – the headcount ratio, the poverty gap, and the squared poverty gap – and robustness of the results to switching from one measure to another is discussed. The results of decompositions show that in most cases both the mean income and inequality differences contribute to poverty variation across the counties, relative to poverty in Croatia as a whole. When poverty is measured by the headcount ratio, the income contribution dominates the inequality contribution, while when we switch to the other two measures, which give more weight to poorer among the poor, the inequality contribution starts to dominate.

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1 Introduction

That the material standard of living in a given population is determined, in principle, by both the average income and income distribution is a well established fact. Although there is a strong negative correlation – both across space (countries, regions within countries) and over time – between the level of average income and the prevalence of low living standards, the fact that even in the developed world there still are people living in poverty suggests that how income is distributed is important as well. Thus, to maximize effectiveness of a poverty alleviation program – or, generally, any other policy measure aimed at improving the living standards – one should be concerned with both its efficiency and equity aspects. The efficiency aspect concerns increasing the average income, while the equity aspect is focused on distributive issues, that is, how the aggregate income is distributed over the individuals comprising the population. However, the two aspects are not always equally important for policy effectiveness, and knowing which of them should be given more attention at a given moment requires knowledge of how much poverty is due to low income and how much due to income inequality. In other words, for a given difference in poverty between two populations, one has to be able to measure the respective contributions of differences in the average income and inequality. In principle, the fact that one population enjoys higher average income than another does not guarantee that poverty is lower in the former population: the higher average income may be accompanied by more unequal income distribution, and the net outcome may be higher, rather than lower, poverty level.

In the existing literature, the exercise of decomposing the difference in poverty between two populations into the average income and inequality contributions[1] is usually performed in intertemporal settings; that is, for a given country (or some other spatial unit) over time (see, e.g.,

[1] Precise definitions of these two contributions will be given in section 3.

Kakwani and Subbarao 1990; Jain and Tendulkar 1990; Datt and Ravallion 1992; Kakwani 2000; Baye 2006; Verme 2006; Zhang and Wan 2006; Bresson and Labar 2007). Similar decomposition exercise can, however, as well be done in spatial settings, by decomposing cross-country or cross-regional (within a country) poverty differences. Indeed, there are no conceptual differences between applications in intertemporal and spatial settings; the only difference is in interpretation. Yet, in spite of this fact, there are surprisingly few spatial applications in the existing literature. To the best of our knowledge, the only two papers on the topic are Kolenikov and Shorrocks' (2005) and Dhondge's (2005) studies of regional poverty in Russia and India, respectively. In this paper, we aim at contributing to the empirical literature on this neglected topic by studying regional poverty differences in Croatia. We use the Household Budget Survey data for the year 2010 to compare the poverty level in each of twenty-one Croatian counties with that at the national level and decompose these differences into the contributions of the mean income and income inequality.

It should be stressed here that we do not deal with the absolute poverty, commonly understood as the lack of an absolute amount of material resources (generally, income) required to satisfy a set of basic human needs. Instead, we deal with poverty in a relative sense. In particular, we are concerned with people who may not be truly, genuinely poor, but rather with those who are said to be *at risk of poverty*.[2] Being at risk of poverty does not necessarily imply being seriously materially deprived in the sense of lacking income required to be, say, well nourished. According to Eurostat's glossary[3], for an individual to be tagged as at-risk-of-poverty, it suffices that (s)he commands income "below the at-risk-of-poverty threshold, which is set at 60% of the national median equivalized disposable income after social transfers". The European

[2] These, of course, include the genuinly poor as well, if any.
[3] Statistics Explained (http://epp.eurostat.ec.europa.eu/statistics_explained/).

Commission uses the so-called *at-risk-of-poverty rate*, defined as the share of total population that is at risk of poverty, as one of its social indicators (see, e.g., Atkinson and Marlier 2010). So defined, this indicator is obviously equivalent to the poverty rate, also known as the *headcount poverty ratio* or *poverty incidence*, with the poverty line is relative,[4] equal to 60 percent of the equivalized median income. In our empirical analysis, we decompose the regional differences in the at-risk-of-poverty incidence into the portions attributed to the differences in the mean equivalized income and inequality of its distribution.

Selecting one poverty[5] measure instead of another is a normative choice which can, in principle, affect the results of the analysis. In order to check the robustness of our results, we also consider two measures other than the poverty headcount ratio, namely the *poverty gap* (also known as *poverty depth*) and the *squared poverty gap* (also known as *poverty severity*). All three indicators belong to the so-called FGT class of poverty measures introduced by Foster, Greer and Thorbecke (1984) and are commonly used in the poverty decomposition literature.[6]

The rest of this paper is structured as follows. The decomposition framework is presented in section 2. Then, in section 3, the three poverty measures we use are described. In section 4, we describe the Household Budget Survey data. Section 5 contains some descriptive evidence on poverty, the mean income and inequality across the twenty-one Croatian counties. In section 6 we give the results of decompositions and discuss them. Section 7 concludes.

[4] Unlike an absolute poverty line, whose real value is fixed over time and as such independent of distributional changes, a relative poverty line is dependent upon the income distribution, for it is usually set equal to a proportion of the mean or the median income.
[5] For expositional simplicity, throughout the rest of the paper we will drop the prefix "at-risk-of-" and refer just to "poverty". This does not entail any conceptual changes.
[6] Exact formal definitions of these measures will be given later.

2 Decomposition framework

We use the decomposition framework pioneered by Kakwani and Subbarao (1990) and Jain and Tendulkar (1990), and afterwards more rigorously analyzed by Datt and Ravallion (1992), Kakwani (2000) and Shorrocks (2011). They all used it in intertemporal settings, namely to decompose the poverty change between two years into what they call the “growth” and “redistribution” contributions. The framework can, however, be equally well used in spatial settings, that is, to decompose the difference in poverty between two countries or regions[7] at a given year (see Kolenikov and Shorrocks 2005; Dhondge 2005). For spatial applications, the growth and redistribution contributions should be appropriately renamed. Kolenikov and Shorrocks (2005) use the terms "income" instead of "growth" and "inequality" instead of "redistribution", and in this paper we will use this terminology as well. The renaming seems obvious enough: while the terms "growth" and "redistribution" are suggestive of a dynamic nature of applications in intertemporal settings, the terms "income" and "inequality" reflect on the other hand a static nature of spatial applications.

Consider two regions, indexed by $r \in \{1,2\}$. The poverty level in region r, denoted by P_r, is a function of the income vector $\mathbf{y}^r = (y_1^r, ..., y_i^r, ..., y_n^r) \in \mathbb{R}^{n^r}$, and the fixed[8] poverty line $z \in \mathbb{R}_{++}$:

$$P_r = P(\mathbf{y}^r, z). \tag{1}$$

Since our aim is to decompose the difference in poverty between two regions into the contributions of the differences in mean incomes and inequality levels, it is useful to rewrite (1) as

[7] Or any other spatial units that one finds appropriate.

[8] That is, the poverty line is te same for both regions, $z_1 = z_2 = z$.

$$P_r = P(\mu_r, \boldsymbol{\pi}_r), \tag{2}$$

where we use the fact that any income distribution $\mathbf{y}^r$ is fully characterized by its mean μ_r and the parameters of the Lorenz curve, denoted by the vector $\boldsymbol{\pi}_r$. Also, since the poverty line is the same for both regions, we drop it for the sake of notational simplicity. Poverty difference between the two regions is then expressed as

$$\Delta P = P_2 - P_1 = P(\mu_2, \boldsymbol{\pi}_2) - P(\mu_1, \boldsymbol{\pi}_1). \tag{3}$$

Since the poverty line is fixed, a given difference in poverty can be only due to the difference in the mean income, $\Delta\mu = \mu_2 - \mu_1$, or due to the difference in the level of inequality, $\Delta\boldsymbol{\pi} = \boldsymbol{\pi}_2 - \boldsymbol{\pi}_1$. The portion of ΔP that comes from the difference in mean incomes, with inequality fixed at the level in the reference region (either of the two)[9], is called the *pure income effect (contribution)*, and the portion that is due to the difference in the level of inequality, with the mean income fixed at the reference region's level, is the *pure inequality effect (contribution)*.[10]

If we take region 1 as the reference region, that is, if we fix inequality at its level in region 1, the corresponding income effect, G_1, is formally defined as follows:

$$G_1 = P(\mu_2, \boldsymbol{\pi}_1) - P(\mu_1, \boldsymbol{\pi}_1). \tag{4}$$

By the same token, fixing the mean income at the level of region 1, the inequality effect, I_1, is given by

$$I_1 = P(\mu_1, \boldsymbol{\pi}_2) - P(\mu_1, \boldsymbol{\pi}_1). \tag{5}$$

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[9] To be precise, the reference can be chosen completely arbitrarily, meaning that it can be any region other than the two being compared. Indeed, the reference need not be observed in reality; that is, it can be fully artificial. However. the latter possibility, although logically perfectly legitimate does not seem to be defensible on intuitive grounds.

[10] The adjective "pure" is to be understood as "*ceteris paribus*". In the remainder of the paper, we will drop it and call the effects "income effect" and "inequality effect". We will also use the words "effect" and "contribution" interchangeably throughout the paper.

Choosing region 2 instead of region 2 as the reference is, however, no less legitimate. The corresponding income and inequality effects are, respectively,

$$G_2 = P(\mu_2, \boldsymbol{\pi}_2) - P(\mu_1, \boldsymbol{\pi}_2), \tag{6}$$

and

$$I_2 = P(\mu_2, \boldsymbol{\pi}_2) - P(\mu_2, \boldsymbol{\pi}_1). \tag{7}$$

Generally, there is no a priori reason why choosing one region as the reference would be better than choosing the other, and the choice is therefore fully arbitrary. Datt and Ravallion (1992) noticed that if the function *P* is not additively separable[11] in the mean income and the level of inequality, the income and inequality effects computed with one region as the reference are not equal to those computed with the other region as the reference. And since poverty measures generally are not additively separable, the implication is that whichever region is chosen as the reference, the resulting decomposition will be inexact in the sense that, besides the income and inequality effects, there will also be a residual, *R*, equal to the difference between the income (or inequality) effects computed for different choices of the reference region. For example, taking $r = 1$, one gets the decomposition

$$\Delta P = G_1 + I_1 + R_1, \tag{8}$$

where $R_1 = G_2 - G_1 = I_2 - I_1$. It is easy to check that for $r = 2$ the corresponding residual is $R_2 = -R_1$. In their empirical application, Datt and Ravallion (1992) found that the residual is not negligible: indeed, in some cases it accounted for even 50 percent of ΔP.

It is important to realize at this point that the existence of the residual, irrespective of its size, is not a consequence of leaving out some components other than the differences in the mean

[11] A function is additively separable in its arguments if its first order derivative with respect to any of the arguments is not a function of any of its other arguments; in other words, if all its cross partial derivatives are zero. For example, the function $f(u,v)$ is additively separable in u and v if $\partial^2 f / \partial u \partial v = 0$.

incomes and inequality levels, but rather a pure accounting failure. In other words, the residual must be fully comprised of those parts of the true income and inequality effects that are not properly accounted for by choosing either region as the reference. This is implied by the fact that, once we fix the poverty line, the differences in the mean incomes and levels of inequality must be the only sources of the difference in poverty between two regions.[12]

That said, in order to solve the issue of residual, one may proceed in one of two different ways. One involves trying to better approximate the income and inequality effects. This is done in Bresson (2008a, 2008b) who used a decomposition procedure based on integral calculus, proposed recently by Müller (2008). Alternatively, one may decide to apportion the residual between the income and inequality effects in a certain way. It is a common practice in the decomposition literature that the residual be divided between the two effects so that each of them gets one half of it. In the present paper, we will also pursue this common practice.

There are two justifications for such "fifty-fifty" division rule. Kakwani (2000) proposed an axiomatic decomposition framework based on the following axioms: (i) if one of the effects is zero, the total poverty difference must be equal to the other effect; (ii) if both effects are (weakly) positive/negative, the total poverty difference must be (weakly) positive/negative; (iii) the income and inequality effects obtained in the decomposition of $\Delta P = P_2 - P_1$, must be of the same absolute magnitude, but of the opposite sign, as those obtained in the decomposition of $-\Delta P = P_1 - P_2$. These axioms are shown to imply that the two effects should be calculated by averaging their values obtained with different reference regions. Therefore, the income and inequality effects are, respectively,

[12] For decompositions where the poverty line is also allowed to vary, and thus can be an additional source of poverty differences, see, for example, Kolenikov and Shorrocks (2000, 2005) and Deutsch and Silber (2011).

$$G = \frac{1}{2}G_1 + \frac{1}{2}G_2 = \frac{1}{2}[P(\mu_2, \boldsymbol{\pi}_1) - P(\mu_1, \boldsymbol{\pi}_1)] + \frac{1}{2}[P(\mu_2, \boldsymbol{\pi}_2) - P(\mu_1, \boldsymbol{\pi}_2)] \tag{9}$$

and

$$I = \frac{1}{2}I_1 + \frac{1}{2}I_2 = \frac{1}{2}[P(\mu_1, \boldsymbol{\pi}_2) - P(\mu_1, \boldsymbol{\pi}_1)] + \frac{1}{2}[P(\mu_2, \boldsymbol{\pi}_2) - P(\mu_2, \boldsymbol{\pi}_1)]. \tag{10}$$

By rearranging (9) and (10), one can show that G and I contain a half of the residual each, so that the following equalities hold:

$$G = G_1 + \frac{1}{2}R_1 = G_2 + \frac{1}{2}R_2, \tag{11}$$

$$I = I_1 + \frac{1}{2}R_1 = I_2 + \frac{1}{2}R_2. \tag{12}$$

The expressions (9) and (10) are also derived by Shorrocks (2011) in a decomposition framework based on the Shapley value. The Shapley value is a concept imported from cooperative game theory, and it indicates the portion of total output that each player in a cooperative game is to be given. It is equal to the average marginal contribution of a player to all possible coalitions (s)he can form with other players (Shapley 1953).[13] In a "decomposition game", there are two "players", namely the effects of income and inequality, and the "output" is the total poverty difference. It turns out that the Shapley values of the income and inequality effects are given by (9) and (10), respectively.

In the expressions (9) and (10), four different poverty levels appear. Two of them are always observed from the data: $P(\mu_1, \boldsymbol{\pi}_1)$ is the level of poverty in region 1, and $P(\mu_2, \boldsymbol{\pi}_2)$ in region 2. The remaining two, $P(\mu_1, \boldsymbol{\pi}_2)$ and $P(\mu_2, \boldsymbol{\pi}_1)$, are unobserved. The former corresponds to the counterfactual income distribution whose mean is equal to that in the income distribution of region 1, $\mathbf{y}^1$, and whose Lorenz curve is identical to that in the income distribution of region 2,

[13] For an overview of the Shapley value, see Hart (2008).

$\mathbf{y}^2$. For the latter poverty level, it is exactly the other way around: it measures poverty corresponding to the distribution with the mean income and the Lorenz curve equal to those in the distributions $\mathbf{y}^2$ and $\mathbf{y}^1$, respectively.

The two counterfactual distributions are easily constructed using the fact that the inequality level in a given income distribution is scale invariant, that is, it does not change when all incomes get multiplied by the same number. It follows then that the counterfactual distribution with mean μ_1 and the Lorenz curve parameters $\boldsymbol{\pi}_2$ is the distribution $\left(\frac{1}{1+g}\right)\cdot\mathbf{y}^2$, where $g = \frac{\mu_2-\mu_1}{\mu_1}$ is the relative difference between the two regions' mean incomes. Similarly, the counterfactual distribution characterized by μ_2 and $\boldsymbol{\pi}_1$ is the distribution $(1+g)\cdot\mathbf{y}^1$. Using the notation for the poverty measure as in (1), the Shapley income and inequality effects are expressed as, respectively,

$$G = \frac{1}{2}\left[P((1+g)\cdot\mathbf{y}^1, z) - P(\mathbf{y}^1, z)\right] + \frac{1}{2}\left[P(\mathbf{y}^2, z) - P\left(\left(\frac{1}{1+g}\right)\cdot\mathbf{y}^2\right)\right] \tag{13}$$

and

$$I = \frac{1}{2}\left[P\left(\left(\frac{1}{1+g}\right)\cdot\mathbf{y}^2, z\right) - P(\mathbf{y}^1, z)\right] + \frac{1}{2}\left[P(\mathbf{y}^2, z) - P((1+g)\cdot\mathbf{y}^1, z)\right]. \tag{14}$$

These two formulas will be used in the decomposition exercise that we perform in the remainder of the paper.

3 Poverty measures

As mentioned in the introduction, we use three poverty measures that are commonly used in the decomposition literature, as well as in the empirical literature on poverty measurement in general.

They all belong to the so-called FGT class of measures, introduced by Foster, Greer and Thorbecke (1984). In this section we define them formally.

For a discreste income distribution **y** of size n,[14] a poverty measure from the FGT class is given by

$$FGT_{\alpha}(\mathbf{y},z)=\frac{1}{n}\sum_{i=1}^{n}\left(\max\left\{\frac{z-y_i}{z},0\right\}\right)^{\alpha}, \tag{15}$$

where α is a non-negative parameter, usually interpreted as indicating the degree of "poverty aversion". By changing the value of α, one obtains different poverty measures which capture different aspects of poverty. The three measures that we use correspond to $\alpha=0$, $\alpha=1$ and $\alpha=2$.

For $\alpha=0$, (15) *headcount poverty ratio* or *poverty incidence* – the percentage (hence multiplication by 100) of total population below the poverty line:

$$FGT_{0}(\mathbf{y},z)=\frac{1}{n}\sum_{i=1}^{n}\left(\max\left\{\frac{z-y_i}{z},0\right\}\right)^{0}. \tag{16}$$

With $\alpha=1$, (15) gives another common poverty measure – the *poverty gap* or *poverty depth*:

$$FGT_{1}(\mathbf{y},z)=\frac{1}{n}\sum_{i=1}^{n}\max\left\{\frac{z-y_i}{z},0\right\}. \tag{17}$$

It measures the average shortfall of the poor people's incomes from the poverty line, expressed as a percentage of the poverty line, where the average is taken over the whole population of the region, not just over the population below the poverty line. Alternatively, one may understand it as a "weighted headcount ratio", where the relative gap $(z-y_i)/z$ is the weight assigned to

[14] For the sake of notational simplicity, in this section we drop the superscript r, indicating region, from the income vector $\mathbf{y}^r$ and its size n_r.

individual *i*. This interpretation makes clear that, in comparison with the headcount ratio, the poverty gap gives more weight to poorer people. In other words, not all individuals below the poverty line contribute equally to the aggregate poverty: the poorer the person, the more it contributes to the aggregate poverty. It can also be shown that the functional relation between the poverty gap and the headcount ratio is $FGT_1(\mathbf{y},z) = FGT_0(\mathbf{y},z)\cdot(z-\mu_z)/z$, where μ_z is the average income of people below the poverty line z in distribution $\mathbf{y}$. It follows that for two distributions with the same headcount ratio, the one in which the average of the poor is higher, and therefore closer to the poverty line, will have lower poverty measured by the poverty gap.

The last poverty measure that we use is obtained by setting $\alpha = 2$, which gives us the *squared poverty gap* or *poverty severity*:

$$FGT_2(\mathbf{y},z) = \frac{1}{n}\sum_{i=1}^{n}\left(\max\left\{\frac{z-y_i}{z},0\right\}\right)^2 . \tag{18}$$

In comparison with the poverty gap, relative shortfalls of individual incomes from the poverty line are here squared, meaning that these shortfalls are weighted by themselves. Unlike the headcount ratio and the poverty gap, this measure is sensitive to income inequality among the poor. This can be seen from the fact that it can be expressed as $FGT_2(\mathbf{y},z) = FGT_0(\mathbf{y},z)\cdot\left[\left(\frac{z-\mu_z}{z}\right)^2 + \left(1-\frac{z-\mu_z}{z}\right)^2\cdot\rho\right]$, where ρ is the coefficient of variation of incomes below the poverty line, measuring thus inequality among the poor (Foster, Greer and Thorbecke 1984; Ravallion 1994).[15] So, if two regions have the same poverty gap, the one with more unequal incomes among the poor will have more poverty according to this measure. This

[15] Later on, when we present decomposition results for the squared poverty gap, we report inequality below the poverty line across the twenty-one counties (Figure 8), but we use a more conventional measure of inequality, the Gini coeffeicient, instead of the coefficient of variation. The former can be shown to be an increasing function of the latter (Milanović 1997): $Gini = \rho \cdot corr(y, r_y)/\sqrt{3}$, where r_y is the rank of income y when incomes are ordered from the lowest to the highest, and $corr(\cdot,\cdot)$ is the coefficient of correlation.

does not mean that the headcount ratio and the poverty gap are not sensitive to overall inequality; they are sensitive to the measure of inequality for the whole population, but not to inequality of incomes below the poverty line. Just like the poverty gap, the squared poverty gap can also be understood as a "weighted headcount ratio", with the squared gap, $((z - y_i)/z)^2$, being used as the weight of person *i*. Thus, this measure gives greater weight to the poorest among the poor.[16]

4 Data

The empirical analysis in this paper is based upon the household micro data from the nationally representative Household Budget Survey (HBS) for 2010. The survey is conducted on a yearly basis by the Croatian Bureau of Statistics (in Croatian: Državni zavod za statistiku) in accordance with methodological recommendations of the Eurostat. It contains data on household expenditures, income sources and various socioeconomic characteristics.

The unit of observation in our empirical analysis is an individual. His or her individual living standard is measured by the household income per adult equivalent. Total household income is adjusted using the modified OECD equivalence scale (Hagenaars, De Vos, and Zaidi 1994). This equivalence scale accounts for household composition by assigning the following weights to household members: 1 to the household head, 0.5 to each additional adult, and 0.3 to each child, where a person is considered to be a child if (s)he is aged 14 or less.

Regarding the sampling design of the HBS, it is a two-step stratified sample, the twenty-one counties being the strata. In total, there are 9,631 individuals living in 3,461 households,

[16] As α becomes bigger, the corresponding FGT measures get increasingly more sensitive to the incomes at the very bottom of the distribution. In the limit, as α approaches infinity, one obtains a "Rawlsian" poverty measure (Rawls 1971) which considers only the poorest person in the distribution. Comparing poverty levels between two distributions then amounts to comparing the income gap of the poorest person in one region with that of the poorest person in the other region or, equivalently, comparing incomes of the poorest persons in the respective distributions.

which is about 0.23 percent of the total population. The response rate at the household level is 61 percent.[17] Unfortunately, for confidentiality reasons, the Croatian Bureau of Statistics does not provide data users with information on which household belongs to which of the 650 clusters, so that we cannot account for clustering in computing the standard errors of our estimates. In all estimations we apply the set of individual weights.

5 Poverty, income and inequality across counties

Before turning to decomposition of regional poverty differences into the mean income and inequality components, here we first present some descriptive figures on poverty, average income and inequality for the twenty-one counties considered. These are given in Table 1.

-- TABLE 1 ABOUT HERE --

Let us start with the poverty measures. Panels A, B and C of Figure 1 show the headcount ratios (FGT_0), the poverty gaps (FGT_1) and the squared poverty gaps (FGT_2), respectively, from Table 1. The poverty line is set to 60 percent of the median equivalized annual income for Croatia as a whole and equals 25,260 Croatian kuna (about 3,420 euros).[18] The headcount ratio ranges from below 10 percent in Istria, City of Zagreb, Dubrovnik-Neretva, Primorje-Gorski Kotar and Krapina-Zagorje, to more than 45 percent in Karlovac and Virovitica-Podravina. The figure for Croatia as a whole is 17.7[19], with eight counties below that level and thirteen above it. The former comprise more than half of the total population (about 56 percent), a consequence of three biggest cities being located within these counties: Zagreb (coincides with City of Zagreb),

[17] For more details on the sampling design, see CBS (2012).
[18] According to the average EUR/HRK exchange rate in 2010.
[19] It should be said that this figure is lower than the official one, 20.6, published by the Croatian Bureau of Statistics (CBS 2012). The likely reason is that the official figure is based on different data, namely the Household Income Survey data, which are fully compatible with the European Union Statistics on Income and Living Conditions (EU-SILC). These data are still unavailable for research purposes outside the Croatian Bureau of Statistics.

Split (in Split-Dalmatia) and Rijeka (in Primorje-Gorski Kotar). Most other counties have headcount ratios between 10 and 30 percent.

-- FIGURE 1 ABOUT HERE --

As for the FGT_1, at the national level it is 6.1 percent, meaning that at the aggregate level the average[20] shortfall of poor people's incomes from the poverty line is 6.1 percent. Now that more weight is given to poorer among the poor, thirteen counties (comprising about 66 percent of total population) are below that figure. Of these thirteen counties, seven are those that also have the headcount ratio below the national level. This indicates that in five counties that have higher share of the poor than Croatia as a whole, the poverty gap is higher income compared to that for Croatia as a whole. Or, in other words, the average poor person's income in each of these five counties is closer to the poverty line than income of the average poor person in the whole country. Similarly, using the FGT_2 to measure poverty, one can give even more weight to poorer among the poor. In this case, in comparison to what we had when the FGT_1 was used, one additional county becomes better ranked than Croatia as a whole.

Besides the rerankings of counties relative to the whole Croatia, induced by switching from one poverty measure to another, there are also many rerankings among counties relative to each other. These are shown in Table 2, where the rankings are made so that lower ranks mean lower poverty. We see that no county is equally ranked by all three poverty measures. Although a number of rerankings, especially small ones, are likely due to imprecision of the estimates, some of them are certainly too big to be explained this way. For instance, Dubrovnik-Neretva is ranked third by the FGT_0, eighth by the FGT_1 and eighteenth by the FGT_2. An opposite example is Požega-Slavonija whose rank, upon switching from the FGT_0 to the FGT_1, declines from

[20] Recall from section 3 that the average is taken over the whole population, not just over those below the poverty line.

eighteenth to sixth place. This non-robustness of poverty rankings to switching from one poverty measure to another suggests that the character of poverty is different across counties: the fact that one county has higher poverty than another when poverty is measured by the FGT_0 does not necessarily mean that this is so when the other two measures are used. As we will see later on, this will also affect the results of decomposition of poverty differences into the mean income and inequality components.

-- TABLE 2 ABOUT HERE --

Concerning the average equivalized income, it varies from 66 percent of the national average in Karlovac to 127 percent in Istra. In 15 counties, populated by about 57 percent of total population, the average income is below the national level. Expectedly, correlation with each of the poverty measures is negative, as shown on Figure 2. The correlation with the poverty headcount ratio (panel A) is stronger than with the other two measures (panels B and C), suggesting that the average income is better at predicting the share of people below the poverty line than at predicting the average shortfall of incomes from the poverty line, be it squared or not. To this point, note that of all the counties with the mean income below the national mean only two have their headcount ratios below the national level. And all the counties whose mean income is above the national level are also less poor, according to the headcount ratio, than the nation as a whole.

-- FIGURE 2 ABOUT HERE --

As regards income inequality, the Gini coefficient ranges from 20.4 in Požega-Slavonija to 42.1 in Karlovac. For Croatia as a whole, it is 29.3, with fifteen counties having less unequal income distribution. On Figure 3, we observe positive relationships between the Gini coefficient and all three poverty measures, indicating that counties with more unequal income distributions tend to have higher poverty as well. Contrary to what we had in the case of average income, the

Gini coefficient is correlated more strongly with FGT_1 and FGT_2 than with FGT_0. In other words, it is better at predicting the average shortfall of incomes from the poverty line than at predicting the share of individuals below the poverty line. The same can be concluded by observing that if poverty is measured by FGT_1 or FGT_2, almost all the counties with income distribution less unequal than the national distribution are also less poor than the nation as a whole, which is not the case when FGT_0 is used.

-- FIGURE 3 ABOUT HERE –

6 Decomposition results

In this section we present the results of decompositions of regional poverty differences. For the sake of expositional simplicity, regional decompositions are performed in the following way. Rather than computing the income and inequality effects of regional poverty differences for each pair of counties, which would be cumbersome given that there are 210 pairs, we take Croatia as a whole to be the benchmark "region" and compare each of the twenty-one counties with the national benchmark.[21] In all decompositions Croatia as a whole will be treated as region 1. Referring to the formulae (13) and (14) from the previous section, $\mathbf{y}^1$ is the income vector for Croatia as a whole, while $\mathbf{y}^2$ is the vector of incomes for any of the twenty-one counties.

Note that even if we chose to decompose the poverty differences between each pair of counties, it would nevertheless be warranted to complement such analysis with what we actually do here. The reason is that the approach we have chosen seems to be more policy relevant, for it provides one with evidence which may be of help while deciding on whether some region-

[21] The results of 210 pairwise decompositions are available upon request.

specific policies for poverty reduction would be more purposeful than policies designed for the whole country.

6.1 Results for the headcount poverty

We first present the results for the case where poverty is measured by the headcount ratio, FGT_0. The estimates of poverty differences, along with the income and inequality contributions are given in Table 3 and graphed on Figure 4.

-- TABLE 3 ABOUT HERE --

-- FIGURE 4 ABOUT HERE --

To illustrate how the estimated figures should be interpreted, let us take City of Zagreb as an example. City of Zagreb is the nation's capital and a county on its own. With the mean income 22 percent above the national level, it is one of the most affluent counties; there is only one county, namely Istra, with higher mean income. As far as income inequality is concerned, the Gini coefficient of 27.9 is below the one for Croatia as a whole, and in comparison to the Ginis for all the twenty-one counties, 27.9 is the median value. The figure -9.9 in Table 3 means that the headcount ratio is 9.9 percentage points lower in City of Zagreb than at the national level. This total difference in poverty is decomposed into the income and inequality contributions, equal to -6.6 and -3.3, respectively. In Table 4, we show exactly how these two figures are computed.

-- TABLE 4 ABOUT HERE --

If one takes the whole country as the reference (column (i)), applying formulas (4) and (5) gives, respectively, G_1 = -6.4 (income effect) and I_1 = -3.1 (inequality effect). G_1 = -6.4 (I_1 = -3.1) is interpreted as follows: if income inequality (the mean income) in City of Zagreb rose (fell) to the level for Croatia as a whole, holding at the same time the mean income (income inequality) unchanged, the headcount ratio would be 6.4 (3.1) percentage points lower for City of Zagreb than for the whole country. One can analogously interpret G_2 = -6.8 and I_2 = -3.5 (column (ii)), obtained using formulas (6) and (7), respectively. In column (iii), the Shapley value-based income effect G = -6.6 is obtained by averaging G_1 and G_2 (formula (9)), and the Shapley value-based inequality effect I = -3.3 by averaging I_1 and I_2 (formula (10)). The effects are of the same sign – both are negative – meaning that they reinforce one another in reducing the headcount ratio in City of Zagreb below that for the entire country. In a qualitative sense, this result was expected and could have been predicted on the base of Table 1: the mean income is notably higher and the Gini coefficient is lower in City of Zagreb than in Croatia as a whole.

Another example of a county where the two effects reinforce each other is Karlovac. Here, however, both the income and inequality effects are positive, equal to 19 and 9 percentage points, respectively, so that the total excess of the headcount ratio in Karlovac over the national one is 28 percentage points. Again, such result could have been guessed by referring to Table 1 which shows that Karlovac has lower mean income and more unequal income distribution than the nation as a whole.

Finally, take the example of Požega-Slavonija where the effects work against each other: the headcount ratio in this county would be 17.4 percentage points above the national level if there were no inequality effect of the opposite sign which partly offsets the income effect. On net, the two effects yield the headcount ratio for Požega-Slavonija which is 10.6 percentage points higher than that for Croatia as a whole. Again, since the mean income in this county is lower than the national mean income and that its income distribution is more unequal than that for the entire country (see Table 1), it comes as no surprise that the income and inequality effects work against one another.

In Table 3 and Figure 4, counties are ordered from the least poor to the poorest. The total poverty difference, relative to Croatia as a whole, ranges from -13.8 for Istra as the least poor county to 29.8 for the poorest county, Virovitica-Podravina. Only differences greater than 5 percentage points in absolute value – thirteen out of twenty-one – are statistically different from zero at the 5 percent level. Regarding the income and inequality effects, note first that in most decompositions (thirteen out of twenty-one) the two effects have the same sign. This is more pronounced if we consider only the cases in which both effects are statistically different from zero: out of eleven such cases, in eight the effects are of the same sign. Among these eight cases, four are the least poor counties (Istra, City of Zagreb, Dubrovnik-Neretva, Primorje-Gorski Kotar, Krapina-Zagorje), three are the poorest counties (Sisak-Moslavina, Karlovac, Virovitica-Podravina), with only one between the extremes (Koprivnica-Križevci). This indicates that the income and inequality effects tend to reinforce one another, rather than operating in opposite directions, especially in most and least poor counties. A reason for this pattern lies in negative correlation between the mean income and inequality: on average, poorer counties have also more unequal income distributions.[22] Counties where the two effects are of opposite signs tend to be those with poverty levels that are not significantly different from the national level (e.g., Split-Dalmacija, Zagreb, Bjelovar-Bilogora, Varaždin): obviously enough, statistically significant income and inequality effects must operate against each other to yield an insignificant total poverty difference.

Comparing the absolute values of the two effects, we observe that in most cases (fifteen out of twenty-one) the income effect dominates the inequality effect. Of the six counties for which the opposite holds, that is, where the inequality effect dominates, five of them are less poor

[22] Kolenikov and Shorrocks (2005), who decomposed poverty differences between Russian regions, found the opposite: poorer regions tend to have lower inequality.

than Croatia as a whole. In addition, among the fifteen counties where the income effect dominates, dominance is on average greater for poorer counties. This is in accordance with the fact that the negative correlation between FGT_0 and the average income (Figure 2, panel A) is stronger than the positive correlation between FGT_0 and the Gini coefficient (Figure 3, panel A). Another way to show this is by plotting total poverty change against the income and inequality contributions. Figure 5 shows that positive correlation with the total poverty change with the income contribution (panel A) is higher than with the inequality contribution (panel B). Thus, when poverty is measured by the headcount ratio, regional differences in the mean income are better than regional inequality differences at predicting poverty differences.

-- *FIGURE 5 ABOUT HERE* --

One can conclude that when poverty is measured by the headcount ratio, that is, by the proportion of population below the poverty line, the income contribution to total poverty differences generally dominates the inequality contribution. Although there are cases in which the inequality contribution is dominant, those are rather rare. This result seems to confirm to some extent the conventional intuition that the main determinant of poverty in a region within a country is that region's average income as an indicator of the average living standard. However, despite the domination of the income contribution, the size of the inequality contribution is not small enough to be neglected. In most of the twenty-one counties, the contribution of inequality to the difference in their poverty relative to national poverty is of a significant magnitude. Moreover, there seems to exist a clear pattern: counties with higher average income also tend to have more equal income distribution.

6.2 Results for the poverty gap

After decomposing differences in the headcount ratio (FGT_0), here we perform decomposition of the poverty gap (FGT_1). The estimates are displayed in Table 5 and Figure 6. Interpretation of the figures follows the logic explained in Table 4, the only difference being that here poverty is measured by FGT_1 instead of by FGT_0.

-- TABLE 5 ABOUT HERE --

-- FIGURE 6 ABOUT HERE --

As already noted in section 4, when we switch from FGT_0 to FGT_1, many counties change their poverty ranking relative to the national benchmark, as well as relative to one another. While in the case of FGT_0 eight counties were less poor than the nation as a whole, now that poverty is measured by FGT_1 there are thirteen such counties. Seven of them are the same counties as in the case of FGT_0 (Istra, Krapina-Zagorje, City of Zagreb, Primorje-Gorski Kotar, Međimurje, Zagreb, Dubrovnik-Neretva), while the remaining six are "newcomers" (Požega-Slavonija, Zadar, Varaždin, Osijek-Baranja, Lika-Senj, Koprivnica-Križevci). Of these six, five are only insignificantly poorer than the entire country, just as they were so in the case of FGT_0 (the only exception being Koprivnica-Križevci). The only newcomer county that is now significantly poorer than the national benchmark is Požega-Slavonija. It changes rank from eighteen to six, that is, advances from the group of poorest to the group of least poor counties. There is only one county, Split-Dalmacija, that becomes poorer than Croatia as a whole, though not significantly so.

Considering the estimates of the income and inequality effects, note first that income component for each of the counties is proportional to its value in the benchmark where poverty was measured by FGT_0. Indeed, in Figure 7 (panel A), where income contributions for FGT_0 are plotted against those for FGT_1, the coefficient of correlation is very high, 0.97. Regressing the income contribution for FGT_0 on the income contribution for FGT_1, the slope coefficient is slightly greater than three (3.07), and the intercept is very close to zero, showing that the factor of proportionality between the two income components is about three. In the case of the inequality component, correlation is lower, 0.80 (Figure 7, panel B). This suggests that upon switching from FGT_0 to FGT_1 the inequality contributions change on average relatively more than the income contributions, so much so that we now have more counties where the inequality contribution dominates in absolute value the income contribution. While in the case of FGT_0 there were only six such counties, now that we have switched to FGT_1 there are thirteen out of twenty-one. Thus, one can conclude that by using FGT_1 instead of FGT_0, that is, by giving more weight to poorer among the poor, the inequality contribution to regional poverty differences becomes on average more important than the income contribution. This is expected since, as we already showed, the Gini coefficient is correlated more strongly with FGT_0 (Figure 2, panel B) than with FGT_1 (Figure 3, panel B).

-- FIGURE 7 ABOUT HERE --

Regarding the signs of the income and inequality contributions, they are generally preserved. The sign of the income contribution must be preserved by definition, for if a county's mean income is below (above) the national mean income, the income component will be positive (negative), irrespective of the poverty measure used. This need not be so for the inequality contribution. However, in our case we observe sign reversals only in cases where the inequality contribution for FGT_0 or that for FGT_1 (or both) is not statistically different from zero.

6.3 Results for the squared poverty gap

The last poverty measure we consider is the squared poverty gap, FGT_2, which assigns even more weight to poorer among the poor than FGT_1. As we said in section 3, unlike FGT_0

which accounts only for the proportion of the population below the poverty line, and unlike FGT_1 for which only the average relative shortfall of incomes from the poverty line is important, FGT_2 is sensitive to inequality of incomes below the poverty line. On Figure 8, which shows the Gini coefficients among the poor, we see that inequality of incomes below the poverty line is lowest in Požega-Slavonija (6.4) and highest in Dubrovnik-Neretva (47.0). These values depart substantially from those for the whole distribution, displayed in the last column of Table 1. Given this fact, one can reasonably expect the poverty ranking of Požega-Slavonija to significantly improve and that of Dubrovnik-Neretva to worsen now that poverty is measured by FGT_2 as a measure which accounts for inequality among the poor.

-- *FIGURE 8 ABOUT HERE* --

The estimates of the total poverty differences and the income and inequality contributions are given in Table 6 and Figure 10. In comparison to what we had when poverty was measured by FGT_1, the number of counties that are less poor than Croatia as a whole does not change: there are again thirteen such counties, five more than when FGT_0 was used to measure poverty. However, while in the case of FGT_1 seven total poverty differences were statistically different from zero, now there are twelve of them. There are again many rerankings, and some of them are quite remarkable. For example, Dubrovnik-Neretva, which was less poor than the nation as a whole according to both FGT_0 and FGT_1, now becomes poorer than the total population, though not significantly so. The worse ranking is a direct consequence of the nature of poverty in this county: in comparison the whole country, it has a lower share of people below the poverty line, but incomes of the poor are much more unequally distributed. The example of Požega-Slavonija should be mentioned again. This county was the fourth poorest county according to FGT_0, then it became the sixth among least poor counties upon switching from FGT_0 to FGT_1, and now its ranking is improved even more: according to FGT_2, only Istra and Krapina-Zagorje are less poor.

This indicates that the nature of poverty in Požega-Slavonija is such that there are relatively many people below the poverty line, but their incomes do not fall very much short of the poverty line, and inequality among the poor is low.

-- *TABLE 6 ABOUT HERE* --

-- *FIGURE 9 ABOUT HERE* --

Turning to the estimates of the income and inequality contributions, the most notable result is that the inequality contribution gets even more dominant over the income contribution than it was the case with FGT_1. While the inequality contribution was dominant for thirteen counties when poverty was measured by FGT_1, here we have domination for fifteen counties. This unsurprising result stems from the already mentioned fact that in addition to inequality in the whole distribution, FGT_2 is sensitive to inequality of incomes below the poverty line. Correlation between the income contributions for FGT_2 and FGT_0 (Figure 10, panel A) is just a little weaker than between the income contributions for FGT_1 and FGT_0 (Figure 7, panel A): it falls from 0.97 to 0.93. However, if we compare the correlation between the inequality contributions for FGT_2 and FGT_0 (Figure 10, panel B) with the correlation between the inequality contributions for FGT_1 and FGT_0 (Figure 7, panel B), we observe a bigger decline: from 0.80 to 0.67. Thus, the switch from FGT_0 to FGT_2 induces strengthening of the inequality contribution, relative to the income contribution, more than the switch from FGT_0 to FGT_1.

In sum, comparing the results obtained in case where poverty is measured by FGT_0 with the results obtained by the two alternative poverty measures from the FGT class, a shift in dominance from the income toward inequality contribution is clearly observed. The results do not come as a surprise, given that the three measures capture different aspects of poverty.

7 Summary and concluding remarks

The existing literature on empirical poverty analysis abounds with decompositions of intertemporal poverty differences into the "growth" and "redistribution" components. Although the conceptual framework that is commonly used in those decomposition exercises can be equally well applied to decompositions of spatial poverty differences, that is, between countries or regions within a country, there are surprisingly few studies on this topic. In this paper, we aimed at contributing to this literature by studying differences in relative poverty between Croatian counties in the year 2010, using the standard decomposition framework based on the Shapley value.

Utilizing three poverty measures, where each accounts for a different aspect of poverty, we showed that the way one measures poverty affects significantly the results of decompositions of spatial differences in poverty. For the most common poverty measure, the headcount ratio, the results show that regional differences in the average income are the principal determinant of regional headcount poverty differences. This, however, does not mean that the inequality component should be neglected: although the income contribution is dominant for most of the counties, the inequality component is also significant and in some cases even dominates the income contribution. The results change substantially when we switch from the headcount ratio to the other two measures, namely the poverty gap and the squared poverty gap. First, there are many poverty rerankings of counties relative to each other, and some of them change their rank quite remarkably, suggesting that the nature of poverty varies across counties. Most importantly, unlike in the case of the headcount ratio, the inequality contributions become dominant over the income contribution, especially when the squared poverty gap is used to measure poverty. Thus, the results are not robust to the choice of poverty measure due to, as we already said, varying nature of poverty across counties.

This non-robustness of the results is the most important message regarding policy recommendations that could be drawn from the decomposition exercise performed in this paper. Before poverty-reduction measures are devised, policy makers should make clear what exactly their objective is. Do they aim at lowering the proportion of population below the poverty line (reducing the headcount ratio)? Or do they rather wish to bring the poor closer to the poverty line (reducing the poverty gap or the squared poverty gap, depending on how much weight is given to those at the bottom of distribution)? Once the objective is known, results such as those obtained in this paper could be used to see how much of the disparity between a region's and national poverty levels is due to the difference in average incomes and how much due to the difference in inequality. As can be seen from our results, the contributions of the average income and inequality depend to a large extent on the poverty measure used.

Regarding further research, two avenues are especially worth exploring. First, this paper's analysis is just an accounting exercise: we estimate the income and inequality contributions of regional poverty differences without going into deeper analyses aimed at understanding the economic and broader social forces underlying the results we obtain. More detailed analyses are needed if one wants to better grasp the pattern of regional poverty differences and the underlying mechanisms, especially so if the results are meant to be a guide for policy making. For example, it would be worth exploring sources of variations in the average income and income inequality across counties. Such analyses may help to reveal potential levers that poverty-reduction programs could rely on. Second, the poverty measures we use are scale-invariant, meaning that their values do not change when all incomes and the poverty line are multiplied by the same positive number. Alternatively, one may choose translation-invariant measures, whose values do not change when the same number is added to all incomes and the poverty line. By choosing scale-invariant poverty measures, we have also implicitly adopted the relative approach to inequality, according to which inequality does not change if all incomes are multiplied by the same number (i.e., if the ratios of incomes do not change). However, no less legitimate is the absolute approach to inequality, according to which inequality does not change if the same number is added to all incomes (i.e., if the absolute differences between incomes remain unchanged). Bresson and Labar (2007) show that the two approaches give different results which, in turn, lead to different recommendations when it comes to policy making.

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Tables and figures (ordered as they appear in the text)

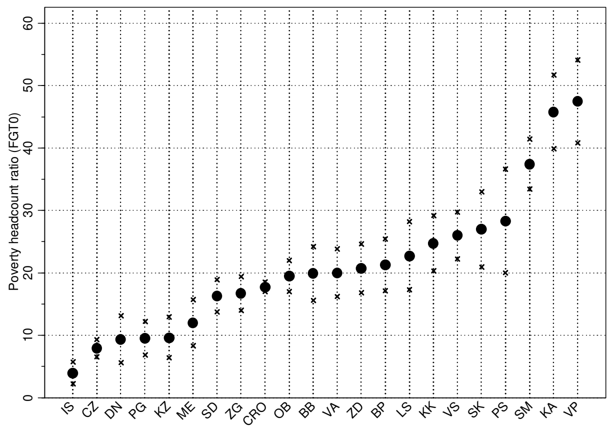
Table 1. Basic statistics for the twenty-one counties

	Population share	Headcount ratio (FGT_0)	Poverty gap (FGT_1)	Squared poverty gap (FGT_2)	Mean equivalized income (CRO=100)	Gini coefficient
Zagreb (ZG)	7.3	16.7	4.2	1.7	106	25.5
Krapina-Zagorje (KZ)	3.1	9.6	2.1	0.7	100	22.5
Sisak-Moslavina (SM)	4.1	37.4	19.0	13.2	73	35.9
Karlovac (KA)	3.0	45.8	25.7	18.6	66	42.1
Varaždin (VA)	4.1	20.0	5.4	2.4	88	24.9
Koprivnica-Križevci (KK)	2.8	24.7	6.0	2.2	95	29.1
Bjelovar-Bilogora (BB)	2.9	19.9	8.2	4.6	86	28.5
Primorje-Gorski Kotar (PG)	6.9	9.5	2.9	1.7	110	26.2
Lika-Senj (LS)	1.2	22.7	5.9	2.3	89	24.7
Virovitica-Podravina (VP)	2.1	47.5	14.7	6.8	69	30.7
Požega-Slavonija (PS)	1.8	28.3	4.0	0.9	77	20.4
Brod-Posavina (BP)	3.9	21.3	7.7	3.4	91	29.7
Zadar (ZD)	3.8	20.7	5.0	2.3	92	27.8
Osijek-Baranja (OB)	7.4	19.5	5.6	2.3	95	28.7
Šibenik-Knin (SK)	2.6	27.0	8.4	4.1	90	31.4
Vukovar-Srijem (VS)	4.4	26.0	7.7	3.3	85	29.5
Split-Dalmacija (SD)	10.7	16.3	6.4	4.2	96	29.2
Istra (IS)	4.8	3.9	1.2	0.8	127	24.7
Dubrovnik-Neretva (DN)	2.9	9.3	4.9	4.2	111	26.4
Međimurje (ME)	2.6	12.0	3.4	1.5	98	22.4
City of Zagreb (CZ)	17.7	7.9	2.8	1.6	122	27.9
Croatia (CRO)	100.0	17.7	6.1	3.4	100	29.3

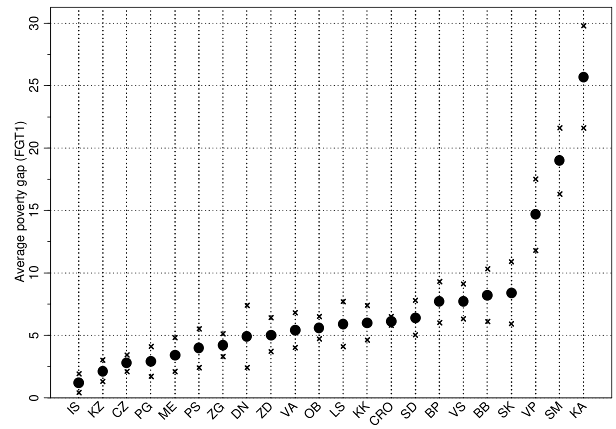
Source: Own calculation based on the Household Budget Survey data for 2010.
Note: Incomes are equivalized using the modified OECD equivalence scale.

Figure 1. Poverty across the twenty-one counties

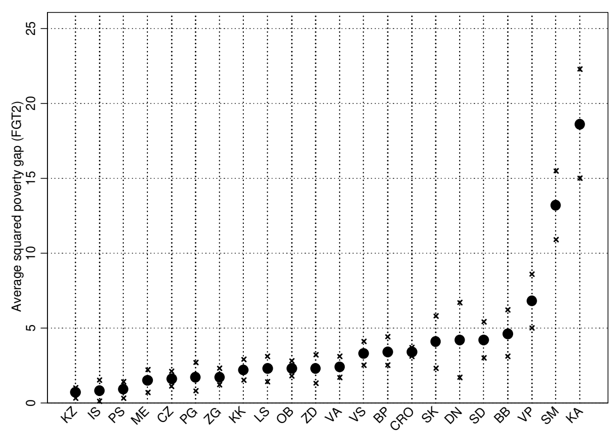
A. Poverty headcount ratios (FGT_0)



B. Poverty gaps (FGT_1)



C. Squared poverty gaps (FGT_2)

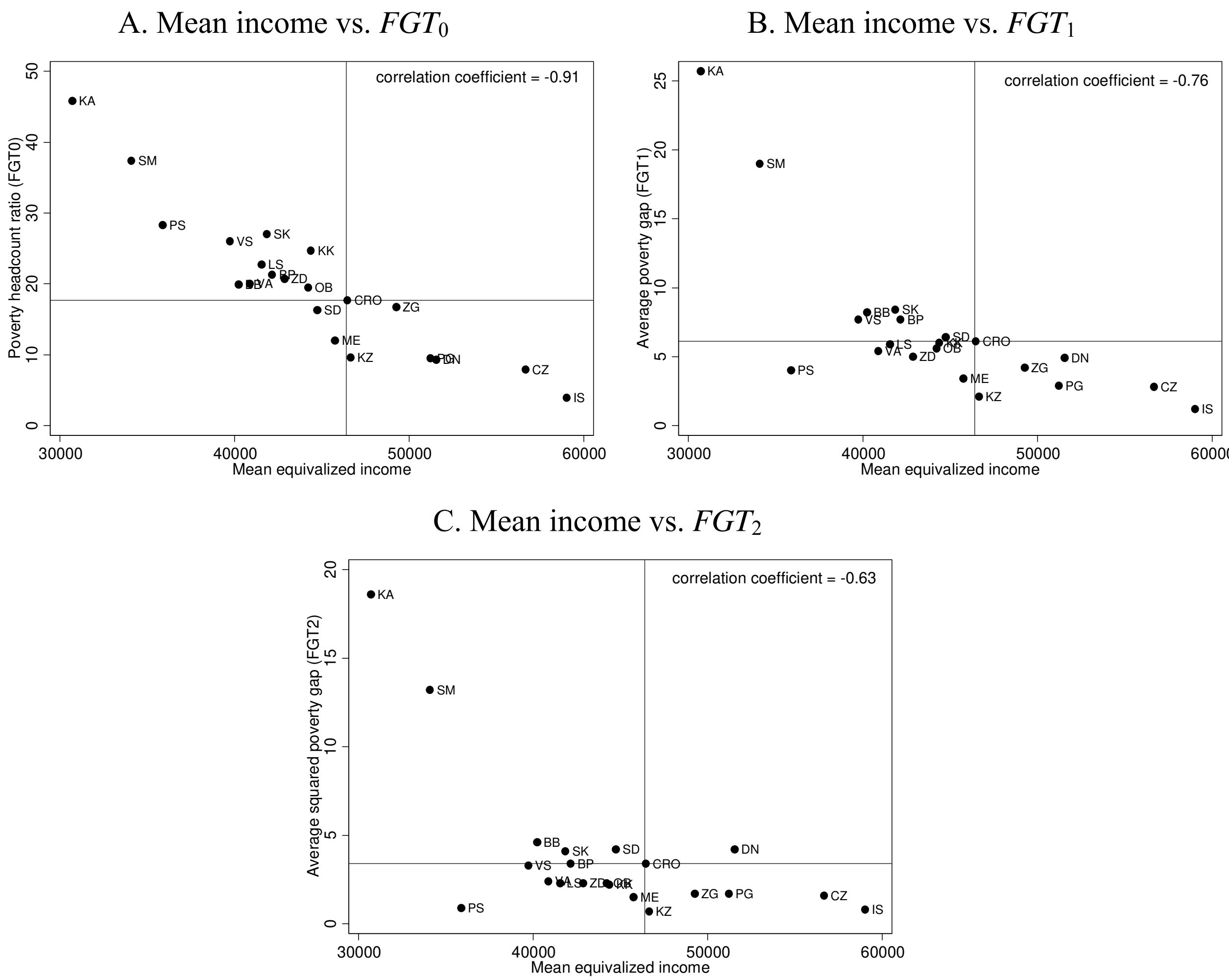


Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: On each panel, the estimates are shown as the heights of the circles. The little crosses above and below each of the estimates represent the bounds of a 95-percent confidence interval, based on asymptotic standard errors. Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Table 2. Poverty rankings for different poverty measures			
	Rank by FGT_0	Rank by FGT_1	Rank by FGT_2
IS	1	1	1
CZ	2	3	5
DN	3	8	18
PG	4	4	6
KZ	5	2	1
ME	6	5	4
SD	7	15	17
ZG	8	7	7
CRO	9	14	15
OB	10	11	10
BB	11	18	19
VA	12	10	12
ZD	13	9	9
BP	14	17	14
LS	15	12	11
KK	16	13	8
VS	17	16	13
SK	18	19	16
PS	19	6	3
SM	20	21	21
KA	21	22	22
VP	22	20	20

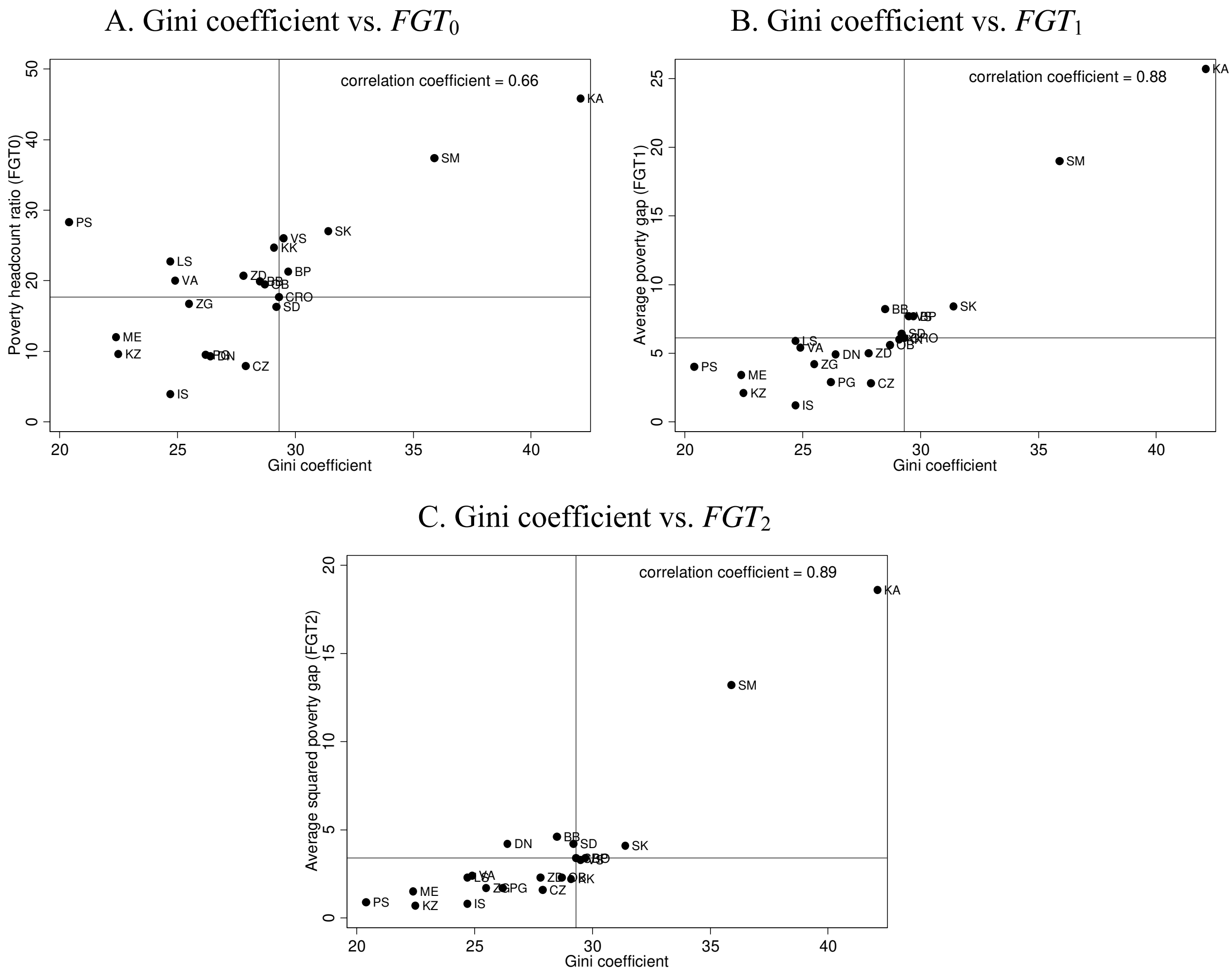
Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: For each of the three poverty measures, rankings are such that the county with the lowest value of the respective poverty measure is ranked as first (rank = 1). Rankings are based the values of the three poverty measures given in Table 1. The grey-colored cells in the table indicate equal ranking by different poverty measures. For full names of the counties, see Table 1.

Figure 2. Correlation between the mean income and the three poverty measures



Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. The horizontal (vertical) reference line indicates the value of the statistic on the vertical (horizontal) axis for Croatia as a whole. For full names of the counties, see Table 1.

Figure 3. Correlation between the Gini coefficient and the three poverty measures



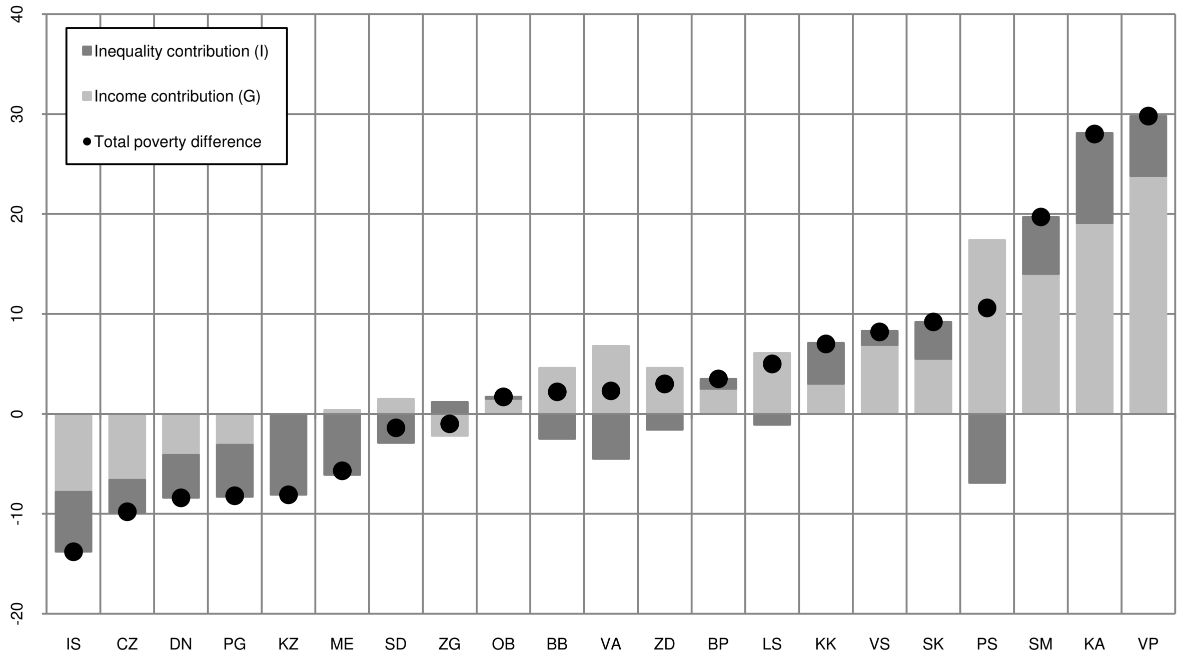
Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. The horizontal (vertical) reference line indicates the value of the statistic on the vertical (horizontal) axis for Croatia as a whole. For full names of the counties, see Table 1.

Table 3. Decomposition results for the headcount ratio

	Total poverty difference (ΔP)	Income contribution (G)	Inequality contribution (I)
Istra (IS)	**-13.8**	**-7.8**	**-6.0**
City of Zagreb (CZ)	**-9.9**	**-6.6**	**-3.3**
Dubrovnik-Neretva (DN)	**-8.4**	**-4.1**	**-4.3**
Primorje-Gorski Kotar (PG)	**-8.2**	**-3.1**	**-5.1**
Krapina-Zagorje (KZ)	**-8.1**	-0.1	**-8.0**
Međimurje (ME)	**-5.7**	0.4	**-6.1**
Split-Dalmacija (SD)	-1.4	**1.5**	**-2.9**
Zagreb (ZG)	-1.0	**-2.2**	1.2
Osijek-Baranja (OB)	1.7	**1.5**	0.2
Bjelovar-Bilogora (BB)	2.2	**4.6**	-2.4
Varaždin (VA)	2.3	**6.8**	**-4.5**
Zadar (ZD)	3.0	**4.6**	-1.6
Brod-Posavina (BP)	3.5	**2.5**	1.0
Lika-Senj (LS)	5.0	**6.1**	-1.1
Koprivnica-Križevci (KK)	**7.0**	**3.0**	**4.0**
Vukovar-Srijem (VS)	**8.2**	**6.9**	1.3
Šibenik-Knin (SK)	**9.2**	**5.5**	3.7
Požega-Slavonija (PS)	**10.6**	**17.4**	**-6.8**
Sisak-Moslavina (SM)	**19.7**	**14.0**	**5.7**
Karlovac (KA)	**28.0**	**19.0**	**9.0**
Virovitica-Podravina (VP)	**29.8**	**23.8**	**6.0**

Source: Own calculation based on the HBS data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure P is the headcount ratio (FGT_0). Incomes are equivalized using the modified OECD equivalence scale. Boldface figures are statistically different from zero at the 5 percent level; statistical significance is assessed based on asymptotic standard errors.

Figure 4. Decomposition results for the headcount ratio



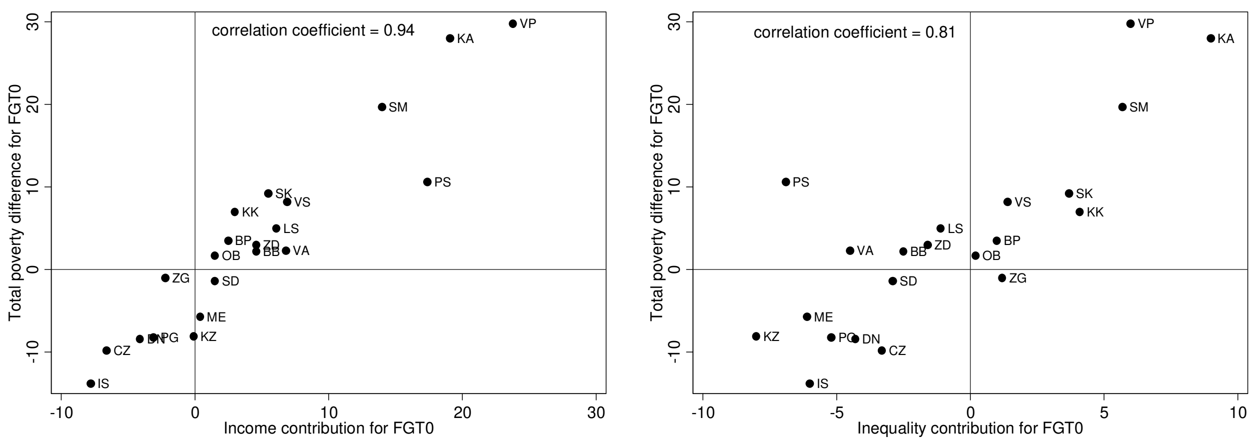
Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure P is the headcount ratio (FGT_0). Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Table 4. Calculating the income and inequality contributions			
	Reference: Croatia as a whole	Reference: City of Zagreb	Shapley value approach
	(i)	(ii)	(iii)
Total poverty difference	ΔP = -9.9	ΔP = -9.9	ΔP = -9.9
Income contribution	G_1 = -6.4	G_2 = -6.8	$G = 0.5 \cdot (-6.4) + 0.5 \cdot (-6.8) = -6.6$
Inequality contribution	I_1 = -3.1	I_2 = -3.5	$I = 0.5 \cdot (-3.1) + 0.5 \cdot (-3.5) = -3.3$
Source: Own calculation based on the Household Budget survey data for 2010.			

Figure 5. Correlation between the total difference in the headcount ratio and the income and inequality contributions

A. Total poverty change vs. income contribution

B. Total poverty change vs. inequality contribution



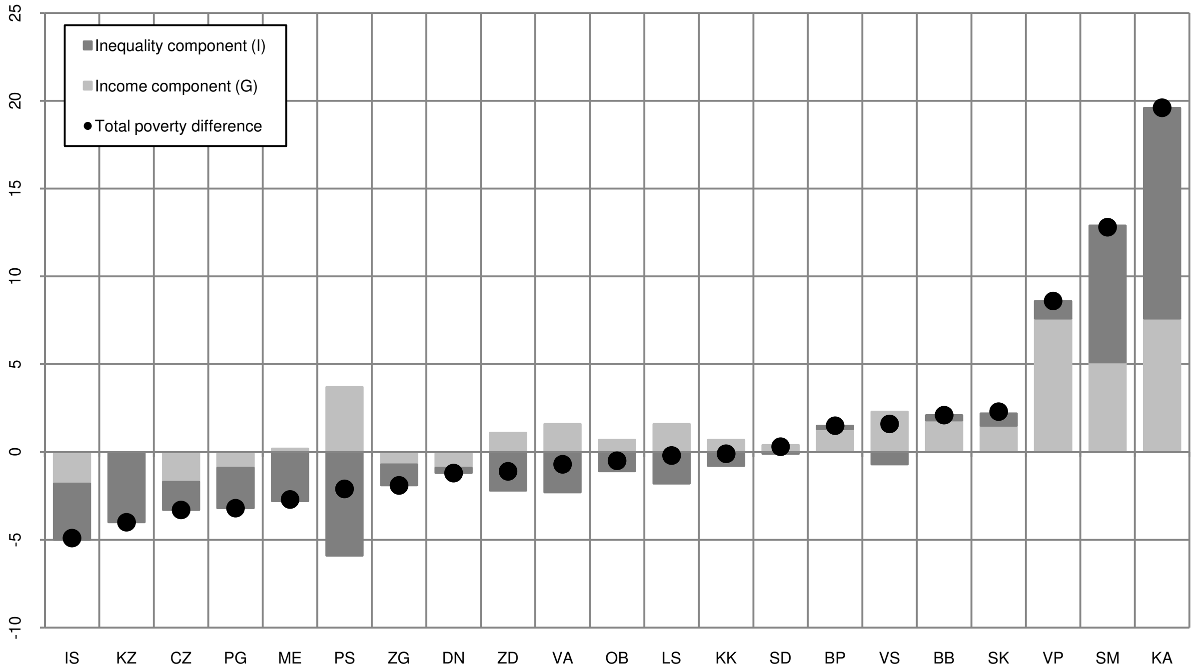
Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Table 5. Decomposition results for the poverty gap

	Total poverty difference (ΔP)	Income contribution (G)	Inequality contribution (I)
Istra (IS)	**-4.9**	**-1.8**	**-3.2**
Krapina-Zagorje (KZ)	**-4.0**	0.0	**-4.0**
City of Zagreb (CZ)	**-3.3**	**-1.7**	**-1.6**
Primorje-Gorski Kotar (PG)	**-3.2**	**-0.9**	**-2.3**
Međimurje (ME)	**-2.7**	**0.2**	**-2.8**
Požega-Slavonija (PS)	**-2.1**	**3.7**	**-5.9**
Zagreb (ZG)	**-1.9**	**-0.7**	**-1.2**
Dubrovnik-Neretva (DN)	-1.2	**-0.9**	-0.3
Zadar (ZD)	-1.1	**1.1**	**-2.2**
Varaždin (VA)	-0.7	**1.6**	**-2.3**
Osijek-Baranja (OB)	-0.5	**0.7**	-1.2
Lika-Senj (LS)	-0.2	**1.6**	**-1.8**
Koprivnica-Križevci (KK)	-0.1	**0.7**	-0.8
Split-Dalmacija (SD)	0.3	**0.4**	-0.1
Brod-Posavina (BP)	1.5	**1.3**	0.2
Vukovar-Srijem (VS)	1.6	**2.3**	-0.7
Bjelovar-Bilogora (BB)	2.1	**1.8**	0.3
Šibenik-Knin (SK)	2.3	**1.5**	0.8
Virovitica-Podravina (VP)	**8.6**	**7.6**	1.0
Sisak-Moslavina (SM)	**12.8**	**5.1**	**7.7**
Karlovac (KA)	**19.6**	**7.6**	**12.0**

Source: Own calculation based on the HBS data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure P is the poverty gap (FGT_1). Incomes are equivalized using the modified OECD equivalence scale. Boldface figures are statistically different from zero at the 5 percent level; statistical significance is assessed based on asymptotic standard errors.

Figure 6. Decomposition results for the poverty gap

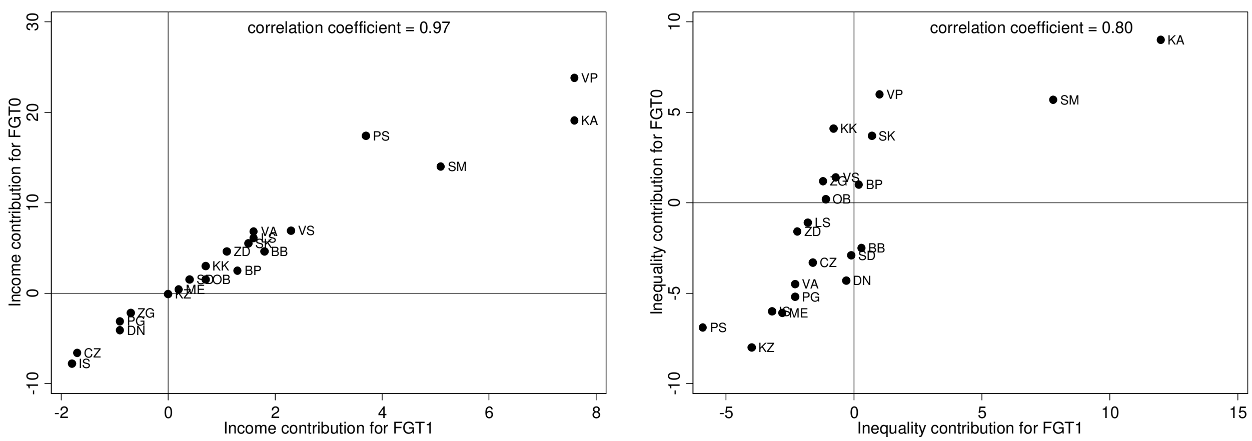


Source: Own calculation based on the HBS data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure P is the poverty gap (FGT_1). Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Figure 7. Correlation between the income contributions and between the inequality contributions for FGT_0 and FGT_1

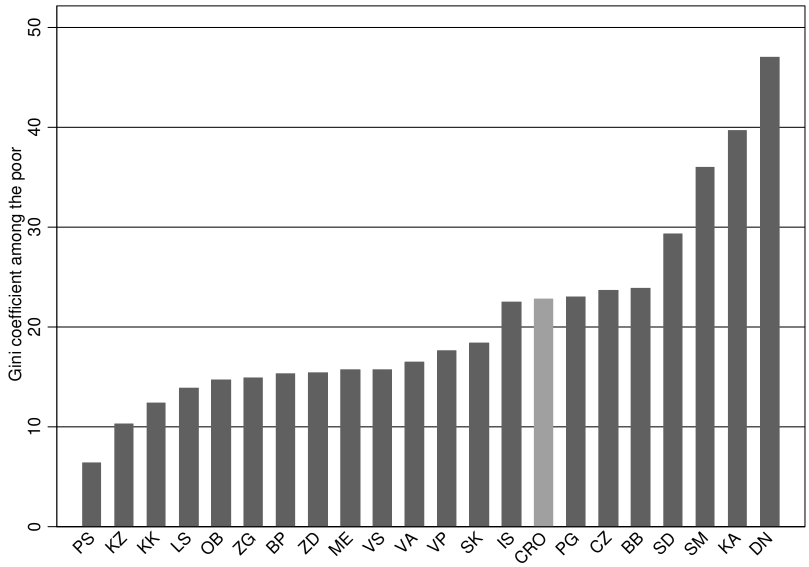
A. Income contribution for FGT0 vs. income contribution for FGT1

B. Inequality contribution for FGT0 vs. inequality contribution for FGT1



Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Figure 8. Inequality of incomes below the poverty line



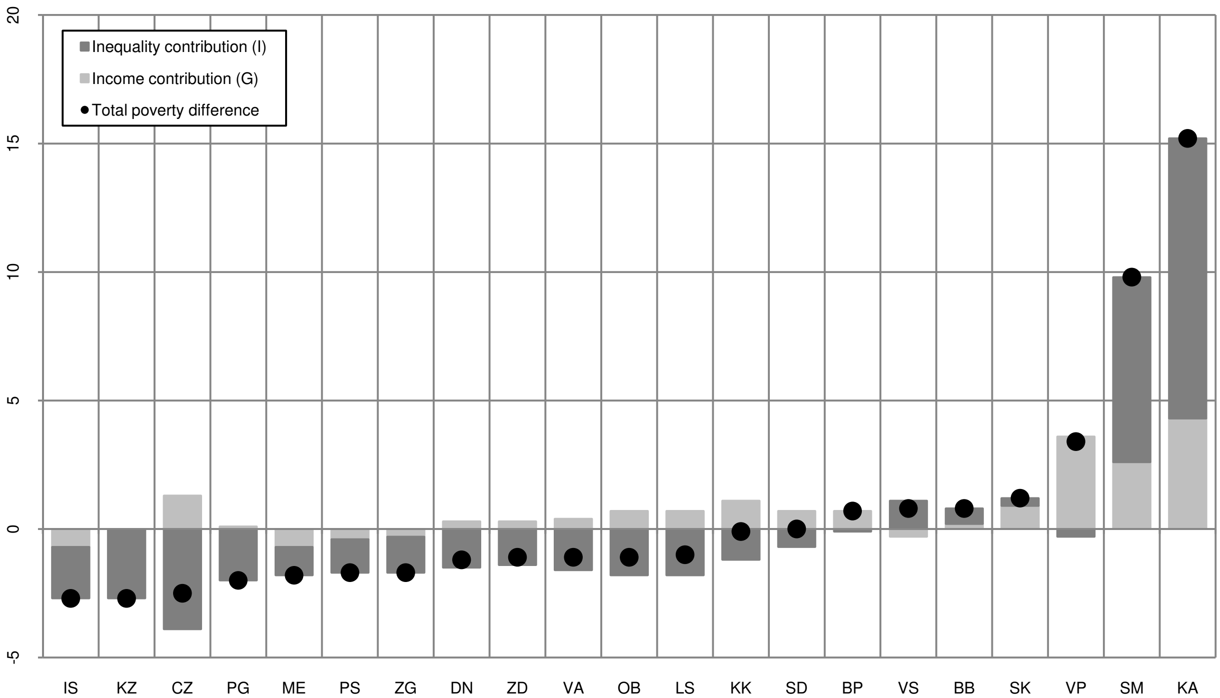
Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Table 6. Decomposition results for the squared poverty gap

	Total poverty difference (ΔP)	Income contribution (G)	Inequality contribution (I)
Istra (IS)	**-2.7**	**-0.7**	**-2.0**
Krapina-Zagorje (KZ)	**-2.7**	0.0	**-2.7**
Požega-Slavonija (PS)	**-2.5**	**1.3**	**-3.9**
Međimurje (ME)	**-2.0**	**0.1**	**-2.0**
City of Zagreb (CZ)	**-1.8**	**-0.7**	**-1.1**
Primorje-Gorski Kotar (PG)	**-1.7**	**-0.4**	**-1.3**
Zagreb (ZG)	**-1.7**	**-0.3**	**-1.4**
Koprivnica-Križevci (KK)	**-1.2**	**0.3**	**-1.5**
Zadar (ZD)	**-1.1**	**0.4**	**-1.6**
Osijek-Baranja (OB)	**-1.1**	**0.3**	**-1.4**
Lika-Senj (LS)	**-1.1**	**0.7**	**-1.8**
Varaždin (VA)	**-1.0**	**0.7**	**-1.8**
Vukovar-Srijem (VS)	-0.1	**1.1**	**-1.2**
Brod-Posavina (BP)	0.0	**0.7**	-0.7
Šibenik-Knin (SK)	0.7	**0.7**	-0.1
Dubrovnik-Neretva (DN)	0.8	**-0.3**	1.1
Split-Dalmacija (SD)	0.8	**0.2**	0.6
Bjelovar-Bilogora (BB)	1.2	**0.9**	0.3
Virovitica-Podravina (VP)	**3.4**	**3.6**	-0.3
Sisak-Moslavina (SM)	**9.8**	**2.6**	**7.2**
Karlovac (KA)	**15.2**	**4.3**	**10.9**

Source: Own calculation based on the HBS data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure P is the squared poverty gap (FGT_2). Incomes are equivalized using the modified OECD equivalence scale. Boldface figures are statistically different from zero at the 5 percent level; statistical significance is assessed based on asymptotic standard errors.

Figure 9. Decomposition results for the squared poverty gap

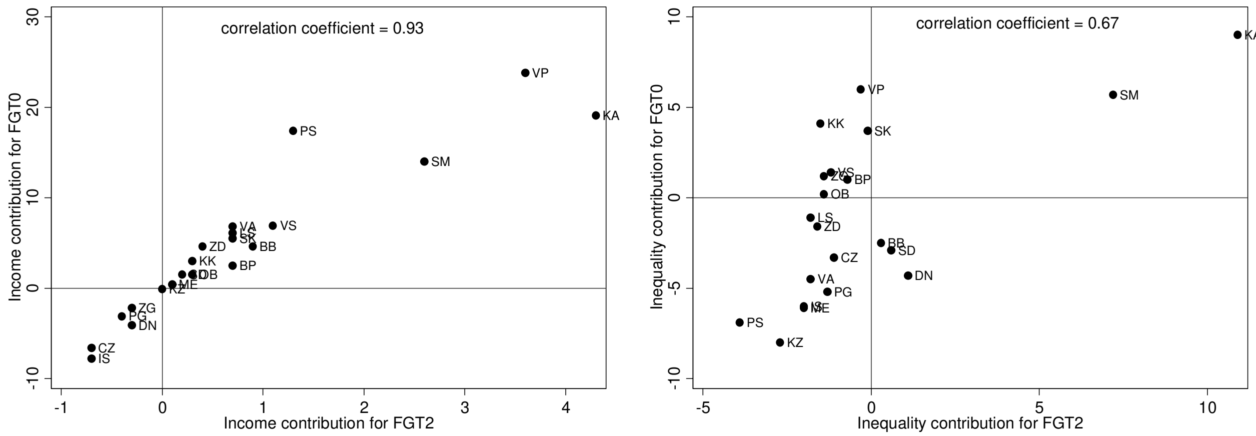


Source: Own calculation based on the HBS data for 2010.
Notes: Decomposition is based on the Shapley value approach, using formulas (13) and (14), where the poverty measure *P* is the squared poverty gap (FGT_2). Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.

Figure 10. Correlation between the income contributions and between the inequality contributions for FGT_0 and FGT_2

A. Income contribution for FGT_2 vs. income contribution for FGT_0

B. Inequality contribution for FGT_2 vs. inequality contribution for FGT_0



Source: Own calculation based on the Household Budget Survey data for 2010.
Notes: Incomes are equivalized using the modified OECD equivalence scale. For full names of the counties, see Table 1.