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# Regional Income Inequality lowers Life Satisfaction: Evidence from OECD Countries\*

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## Abstract

This paper analyzes the effect of regional income inequality within countries on individual life satisfaction. We use data from the World Values Survey (WVS) and the European Values Survey (EVS) containing approximately 97,000 observations from 1981–2008. Regional income inequality is measured by the coefficient of variation of regional GDP per capita. We find that higher regional income inequality leads to lower life satisfaction in OECD countries. In non-OECD countries, we find no significant effect. This may be related to the higher dynamics of regional inequality in middle and low income countries, where people still hope to participate in income increases in the future, while regional inequality is persistent in high income countries.

*JEL classification:* D6; H3; I3; O1; O2

*Keywords:* European Values Survey; Gini coefficient; Happiness; Income Inequality; regional Income Inequality; Life satisfaction; Subjective well-being; World Values Survey

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# 1 Introduction

The European cohesion policy aims at reducing disparities between regions, in order to achieve a balanced and sustainable development.<sup>1</sup> Different measures of income redistribution are used to decrease regional income inequality. In the current budgetary period of the European Union (2007–2013), the EU spends 348 billion Euro, or roughly 35% of its entire budget, on cohesion policies. One argument that justifies the large redistribution programs is that regional inequality between regions increases interpersonal inequality between individuals. Similarly, estimations by Yemtsov (2005) for Russia and Elbers et al. (2005) for Ecuador, Madagascar, and Mozambique and Lessmann (2013) for a cross section of countries show that spatial inequality explains about one-third of interpersonal income inequality. Regional inequality also matters since it may lead to political instability and conflict. Regional inequality often goes hand in hand with political and ethnic tensions, which undermine social cohesion and political stability [Kanbur and Venables (2005)]. In very extreme cases, this may increase the risk of internal conflicts and civil wars [see, e.g., Deiwiks et al. (2012), Buhaug et al. (2011), and Lessmann (2013)].

While the effect of income inequality on life satisfaction has been studied extensively in the literature [see e.g. Haller and Hadler (2006), Alesina et al. (2004) and Fahey and Smyth (2004)], the role of regions in the inequality–satisfaction nexus has not been studied yet. Oshio and Kobayashi (2009) are the first looking at the impact of income inequality, calculated on a regional level, on life satisfaction. In the political sciences literature, the distinction between *vertical* and *horizontal* inequalities has become very popular [see, e.g., Stewart (2000, 2002)]. Vertical inequality refers to the inequalities within a group, for example a group of individuals or households. Those inequalities can be measured by the Gini coefficient of the income distribution or alternative concentration measures, which are widely used in the empirical literature. By contrast, horizontal inequality refers to inequalities between groups: ethnic groups, religious groups, races, or the inhabitants of different regions. These inequalities have been neglected in the literature, since they are quite difficult to measure, although they may be very important in this context. Stewart (2000) argues that horizontal inequalities create identity, which binds the group, and are a breeding ground for grievance. Therefore, horizontal inequality between different groups of individuals - where groups are formed based on the regional boundaries - might explain, while in some countries vertical inequality does not affect life satisfaction significantly. This research question is at the heart of this analysis.

In the present paper we empirically estimate the effect of regional inequality on

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<sup>1</sup> See Treaty on European Union Art. 2. The example of Germany shows an additional concentration on a fair balance between the Länder to ensure the uniformity of the living standards [see Basic Law for the Federal Republic of Germany Art. 106 3(2)].

individual life satisfaction. For this purpose we use WVS data and EVS data from 1981–2008. In addition to that, we use the regional data provided by Lessmann (2014) to measure regional income inequality. We find that regional income inequality has a negative and significant impact on life satisfaction in OECD countries. Moreover the impact of regional income inequality is higher, meaning a higher coefficient, than the one of personal income inequality. For non-OECD countries we do not find a significant impact of regional income inequality on life satisfaction. We ascribe the result to the higher dynamics of regional income inequality in middle and low income countries, that go along with the perceived possibility of participating in income increases [Hirschman and Rothschild (1973)].

This paper is organized as follows. In section 2 we discuss the existing theoretical and empirical literature on the impact of income and income inequality on life satisfaction. In section 3 we present our data, methodology and the regression results. In section 4 we sum up our results and conclude.

## 2 Literature

The literature on the influence of regional income inequality on life satisfaction is in the early stages. For this purpose we look at the theoretical [section 2.1], as well as the empirical literature [see section 2.2], in the field of the impact of personal income inequality on life satisfaction. This field of research is linked to the research on the preferences for redistribution. That is why we look at the literature dealing with the preferences for redistribution, too.

### 2.1 The theoretical link between income inequality and life satisfaction

The impact of income inequality on life satisfaction can be negative [see e.g. Meltzer and Richard (1981), Clark et al. (2008)] as well as a positive [see the tunnel effect by Hirschman and Rothschild (1973)]. Hirschman and Rothschild (1973) assume that people have little information about their future. For this purpose people use the income of others to build their expectations. However, if expectations are not met, rising income inequality makes people more dissatisfied. Accordingly, the tunnel effect is only a short-run effect.

Romer (1975) argues that rising income inequality leads to a higher preference for redistribution. In this model decisions about the level of redistribution are made by majority voting. Income inequality is measured by the gap between the median pre-tax income and the average income. People with a below-average income prefer a high level of redistribution, vice versa. If the gap rises, income inequality rises.

Hence rising income inequality leads to a higher preference for redistribution [see also Roberts (1977)].

Meltzer and Richard (1981) take the general equilibrium model to explain the impact of reference income on the preference for redistribution. Voters with an income lower than the income of the median voter have a preference for more redistribution, vice versa. Meltzer and Richard (1981) refer to Kuznets (1955), who argues that economic growth may lead to rising income inequality. Accordingly, Meltzer and Richard (1981) conclude that economic growth leads to higher income inequality and therefore to a higher preference for redistribution. Clark et al. (2008) conclude that countries with higher income inequality have lower life satisfaction on average. Consequently does higher income inequality lead to a higher preference for redistribution as well as lower life satisfaction.

Income inequality can also have a positive impact on life satisfaction in countries without the experience of sustained growth. Hirschman and Rothschild (1973) introduce the tunnel effect: if the income of a group of people rises, the others expect that (1) they participate in growth, too, or (2) growth is unstable. In both cases inequalities would disappear after a while. Hirschman and Rothschild (1973) stress that the positive impact of income inequality is just a short-run effect. The impact of income inequality on life satisfaction is negative, if people recognize that their expectations are not met.

## **2.2 The empirical relationship between income inequality and life satisfaction**

The theory mainly shows that income inequality has a negative impact on life satisfaction. This relationship can also be proved in the empirical literature [see e.g. Alesina et al. (2004), Fahey and Smyth (2004) and Oshio and Kobayashi (2011)]. However, the impact of income inequality on life satisfaction depends, e.g., on the countries included [see Dolan et al. (2008) and Ferrer-i-Carbonell and Ramos (2013)] and the evaluation of fairness of the income distribution [see Bjørnskov et al. (2013)]. Bjørnskov (2003) and Haller and Hadler (2006) find that the comprehension of Latin America involves in highly significant and positive effects of inequality on satisfaction.<sup>2</sup> Another exception are the transition countries, where the impact can also be positive. This derives from uncertainty about the future and income volatility [see Senik (2004)]. Oshio and Kobayashi (2009) are the first ones who deal with the impact of regional income inequality on life satisfaction. They find that higher income inequality leads to lower life satisfaction.

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<sup>2</sup> However, Graham and Felton (2005) show for Latin American countries that rising inequality makes people with above average income happier and people with below average income unhappier.

The reminder of this section is structured as follows: we look at empirical work that uses microdata of (1) a worldwide database, (2) a European database, (3) a database for either transition or Latin-American countries and (4) a database for a single country.

### 2.2.1 Worldwide database

Morawetz et al. (1977) find that income inequality has a negative impact on life satisfaction. They use data for two Israeli communities in 1976. The income inequality measure is a dummy variable. If people live in the region with higher income inequality, the value of the dummy is 1 and 0 otherwise. Morawetz et al. (1977) use an Ordered Probit regression. This empirical work is the starting point for the research in the field of income inequality and life satisfaction.

Haller and Hadler (2006) find a positive impact of personal income inequality, measured by the Gini coefficient, on life satisfaction. They use WVS data from 1995–1997 and use happiness as well as life satisfaction responses.<sup>3</sup> Haller and Hadler (2006) constitute their findings to the inclusion of Latin American countries, that have high levels of income inequality but high levels of life satisfaction anyway. They ascribe the positive effect to the high quality of social relations.

Bjørnskov et al. (2013) argue that the sign of the impact of income inequality on life satisfaction is influenced by the evaluation of the fairness of the income distribution. They use data from the WVS from 1990–2008 and measure happiness by using the responses to the life satisfaction question. Personal income inequality is measured by the Gini coefficients of the Standardized World Income Inequality Database by Solt (2009). Bjørnskov et al. (2013) conduct an OLS regression and find that personal income inequality does not necessarily lead to lower life satisfaction. The effect depends on the interdependency of perceived and actual fairness of the institutional framework.

### 2.2.2 European database

O’Connell (2004) analyzes the relationship between personal income equality and mean life satisfaction in wealthy countries. He does not include common control variables, but concludes that higher income equality makes people happier. O’Connell (2004) uses EU-15 data from 1995–1998 and performs Linear Regression Modeling. The responses to the life satisfaction question of the Eurobarometer Surveys<sup>4</sup> measure life satisfaction. The mean value is calculated per country and year. O’Connell

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<sup>3</sup> Happiness is measured on a 4-point scale with 1 "very happy" and 4 "not at all happy". Life satisfaction ranges from 1 "dissatisfied" to 10 "satisfied", i.e. measured on a 10-point scale.

<sup>4</sup> Life satisfaction is measured on a four-point scale with 1 "very satisfied" to 4 "not at all satisfied".

(2004) constructs an own measure for equality by taking income distribution data from Eurostat and calculating the ratio of the top quintile and the lowest quintile.

Alesina et al. (2004) conclude that Americans are less inequality averse than Europeans because of a better chance to climb the social ladder. They use micro data of the United States General Social Survey from 1981–1996 and of the Euro-barometer Survey Series from 1975–1992. Alesina et al. (2004) compute an Ordered Logit regression. Life satisfaction is measured by taking the responses to the life satisfaction questions<sup>5</sup>. Personal income inequality is measured by the per state per year Gini coefficients from Wu et al. (2002) for the US data and by the Gini coefficients from the Deininger and Squire (1996) dataset for Europe.

With data on 33 European countries, Fahey and Smyth (2004) show that personal income inequality has a negative impact on life satisfaction. They measure personal income inequality by using the Gini coefficient. Life satisfaction derives from the EVS.<sup>6</sup> Fahey and Smyth (2004) use a multi-level approach and sustain a highly significant negative impact of income inequality on mean life satisfaction by country. Additionally Ebert and Welsch (2009) find that people are more inequality averse than the proper inequality measures show. Consequently the impact of income inequality on life satisfaction may be higher than the estimated effect.

Heidenreich and Wunder (2008) analyze income inequality in Europe from 1995–2003. They find that regional inequalities within countries increased by 15%.<sup>7</sup> This findings highlights that regional income inequalities and their impact on life satisfaction should be examined. Especially, politicians should concentrate on lower regional income inequality, if regional income inequality has a negative impact on life satisfaction.

### 2.2.3 Transition or Latin-American countries

Graham and Felton (2005) look at 18 Latin-American data from 1997–2004. They find that income inequality has a negative significant impact on life satisfaction. Graham and Felton (2005) use data of the latinobarometer and measure income inequality by the Gini coefficient. They estimate an Ordered Logit model with country fixed effects. These results are contrary to the assumptions of Bjornskov (2003) and Haller and Hadler (2006).

Sanfey and Teksoz (2007) look at the relationship between income inequality and

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<sup>5</sup> Happiness in the US sample is measured on a three-point scale from "very happy" over "pretty happy" to "not too happy". In the EU sample the variable is measured by using the responses to the satisfaction question on a four-point scale. Alesina et al. (2004) recoded the satisfaction data into similar categories, to make them comparable

<sup>6</sup> Life satisfaction is measured on a ten-point scale with 1 meaning "dissatisfied" and 10 meaning "satisfied".

<sup>7</sup> Regional income inequality is measured by the Gini-coefficient and the mean logarithmic deviation from the GDP on NUTS 3 level.

life satisfaction in transition and non-transition countries separately. They find that income inequality has a negative and significant impact on life satisfaction in transition countries. This findings are contrary to the findings of Senik (2004). Sanfey and Teksoz (2007) find that income inequality has a positive and significant effect on life satisfaction in non-transition countries. They use data of the WVS and EVS from 1990–2002. Income inequality is measured by the Gini coefficient. Sanfey and Teksoz (2007) estimate a clustered linear regression with country and wave dummies.

Grosfeld and Senik (2010) do not find a significant impact of income inequality on life satisfaction in general. They use data for Poland of the Public Opinion Research Center from 1992–2005. The estimation shows that there is a break point. Before the end of 1996 they find a positive impact of income inequality on life satisfaction. Afterwards the impact is negative and significant. This empirical examination seems to prove the Tunnel effect by Hirschman and Rothschild (1973).

#### 2.2.4 Consideration of single countries

Tomes (1986) use data from the Canadian Quality of Life Survey from 1977. Income inequality is measured by mean income, the share of the upper 10% and the lower 40% on the aggregate income. Only the share of the lower 40% on the aggregate income has a significant negative impact on life satisfaction. The other measures do not have a significant impact.

Schwarze and Härpfer (2007) evaluate the role of redistribution by the state for life satisfaction in Germany. They use life satisfaction data from the German Socio-Economic Panel (GSOEP) from 1985–1998.<sup>8</sup> Inequality aversion is measured by three different indices on a regional basis: the Gini coefficient, the Theil index and the Atkinson measure. Schwarze and Härpfer (2007) compute an Ordered Probit regression. They find that people are inequality averse [see also Carlsson et al. (2005)] and redistribution leads to a lower level of inequality. But redistribution politics do not significantly result in higher life satisfaction.

Also Ferrer-i-Carbonell and Ramos (2010) find that income inequality has a significant negative impact on life satisfaction in Germany. They calculate the Gini coefficient from the income distribution of the NUTS1 regions. Ferrer-i-Carbonell and Ramos (2010) use the SOEP dataset from 1997–2007. They compute a FE and RE regression and include region and year fixed effects.

A first paper looking at regional income inequality and its impact on life satisfaction is Oshio and Kobayashi (2011). They estimate a Logit Model for Japan. Life

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<sup>8</sup> In the GSOEP life satisfaction is measured on an eleven-point scale from 0 "completely dissatisfied" to 10 "completely satisfied".



satisfaction data come from the Japanese General Social Survey from 2000–2006.<sup>9</sup> Oshio and Kobayashi (2011) calculate the Gini coefficient for every prefecture. The results show that unhappy people are more sensitive to regional inequality than happy people. Oshio and Kobayashi (2010) and Oshio and Kobayashi (2009) also find that regional income inequality has a negative impact on life satisfaction.

The examination of the impact of regional income inequality on life satisfaction is at the outset. The empirical literature mainly concentrates on the impact of vertical income inequality on life satisfaction. Oshio and Kobayashi (2009), Oshio and Kobayashi (2010) and Oshio and Kobayashi (2011) show that regional income inequality - meaning horizontal income inequality - has a negative impact on life satisfaction. However, they do not look at an international dataset.

### 3 Empirical analysis

In the following we employ an Ordered Response Model to measure the impact of regional income inequality<sup>10</sup> on subjective well-being. Firstly we discuss the data used. Secondly we present the econometric method. Finally we look at the regression results.

#### 3.1 Data

We use individual data from the longitudinal datasets of the WVS<sup>11</sup> and the EVS<sup>12</sup>. The data contain 96,884 observations from 1981–2008, with 49,895 observations from OECD countries and 46,989 from non-OECD countries.<sup>13</sup>

Life satisfaction measures are widely accepted as a proxy for utility [see Clark et al. (2008)]. We use the responses to the subjective life satisfaction question "All things considered, how satisfied are you with your life as a whole these days?". The answers range from 1 (dissatisfied) to 10 (satisfied).

We focus on the impact of *regional* income inequality on life satisfaction. For this purpose we use a new dataset [see Lessmann (2014)]. Most of the studies use the Gini coefficient to measure the impact of *personal* income inequality on life satisfaction. Though Stewart (2000) emphasizes the relevance of horizontal inequalities, e.g. regional income inequalities, for crisis prevention. Our measure for regional

<sup>9</sup> Life satisfaction ranges from 1 "happy" to 5 "not happy". The authors recode the scale into a binary variable. In model 1 they allocate the value 1 "happy" to people responding the upper two categories. But in model 2 they only allocate the value 1 to people responding the highest category.

<sup>10</sup> We want to avoid confusion and therefore do not switch between the terms regional and horizontal income inequality. We will mainly use the term regional income inequality.

<sup>11</sup> See [www.worldvaluessurvey.org](http://www.worldvaluessurvey.org) for details.

<sup>12</sup> See <http://www.gesis.org> for details.

<sup>13</sup> See table A.1 for all the variables and their sources.

income inequality is the coefficient of variation. This coefficient satisfies the requirements for concentration measures for cross-country analysis: (1) it is independent of the number of regions included, (2) it is not sensitive to changes of the average GDP level, and (3) it leads to higher equality when income is redistributed from rich to poor<sup>14</sup> [see Lessmann (2009)]. The calculation of the regional income inequality measure is carried out as follows:

$$REG\_INEQ = \frac{1}{\bar{y}} \left[ \frac{1}{n} \sum_{r=1}^n (\bar{y} - y_r)^2 \right]^{1/2}. \quad (1)$$

With the country's average GDP per capita,  $\bar{y}$ , and the number of sub-national units,  $n$ .  $y_r$  is the GDP per capita in region  $r$ . A country's regional income inequality equals the ratios of the standard deviation of the GDP p.c. of every region from the mean regional GDP p.c. in the country and the expected value of the regional GDP p.c.

The coefficient of variation has two advantages in comparison to other measures for regional income inequality: (1) it is not sensitive to the amplitude of the GDP p.c. and (2) it is independent of the number of regions considered [see Lessmann (2006), p. 12].

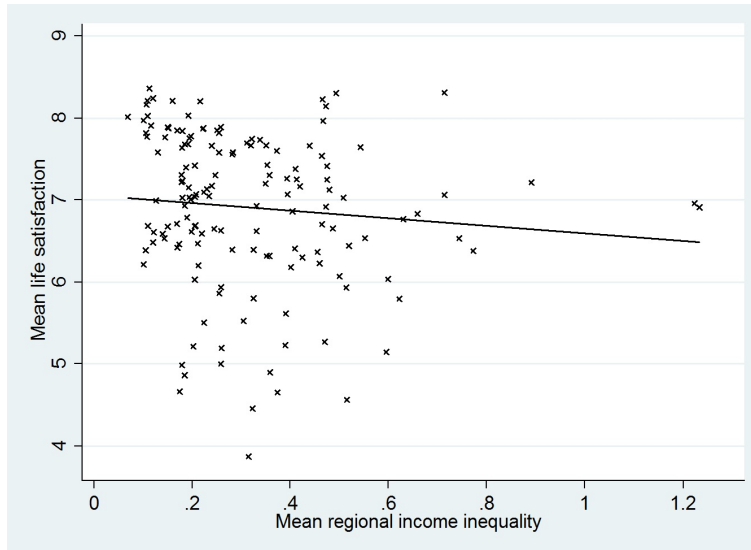


Figure 1: The relationship between regional income inequality and life satisfaction.

Figure 1 shows the relationship of mean life satisfaction and mean regional income inequality. Mean life satisfaction is the per country and per year average of the responses to the life satisfaction question. The mean value of regional income inequality is the per country and wave average of the coefficient of variation. The negative slope points out that higher regional income inequality leads to lower life

<sup>14</sup> For more details on the Pigou-Dalton transfer principle see Pigou (1912).

satisfaction. The outliers derive from Indonesia in the 4th and 5th wave, with a value of mean regional income inequality of 1.22 and 1.23, respectively. However the exclusion of these observations does not change the negative slope. Note that this figure only illustrates the relationship between these two variables but does not reveal anything about the direction of the effect.

In addition to our regional income inequality measure we control for the impact of personal income inequality as well as group income inequality. Group income inequality is the population-weighted coefficient of variation.<sup>15</sup> This measure quantifies the income inequality between people living in a country’s region and therefore belonging to the same group. Highly populated regions have a higher impact on the inequality measure. Therefore group income inequality also measures income inequality on a regional basis but does not measure the pure variation of regional income inequality. We use the Gini-coefficient of All the Ginis Dataset [see Milanovic (2013)] for the personal income inequality. It quantifies the impact of the deviation of the individual income distribution from perfect equity.

Table 1 contains the summary statistics for the basic regression. Table A.3 shows the data summary for the basic regressions. We build wave-means for the inequality measures. Since missing values in the personal income inequality measure would reduce our sample by about 14,900 observations.<sup>16</sup>

In order to make our findings comparable to other studies and to avoid an omitted variables bias, we integrate several control variables. We select the control variables from the existing empirical literature in the field of income inequality and life satisfaction [see section /refEmpLit]. We control for the personal parameters age, sex, self-rated health, income, the employment status, the marital status and the number of children. In addition to that we control for the macroeconomic variables GDP p.c. growth, the inflation rate and the unemployment rate.

Our last control variables are a dummy variable for EU member states as well as a dummy for transition countries. The reason, why a membership in the EU should not be unconsidered, is the EU cohesion policy. The EU invests €347 billion on regional politics between 2007–2013. The aim is to reduce economic, social and territorial disparities.<sup>17</sup> Obviously this policy should have an influence on life satisfaction and regressions without this dummy would lead to biased estimation

<sup>15</sup> Group income inequality is calculated as follows

$$GROUP\_INEQ = \frac{1}{\bar{y}} \left[ \sum_{r=1}^n p_r (\bar{y} - y_r)^2 \right]^{1/2},$$

with the population density of the region  $r$ ,  $p_r$ .

<sup>16</sup> This regards 1,379 observations from Austria, 1,665 observations from Belgium, 3,243 observations from Canada, 928 observations from the Czech Republic, 1,440 observations from Finland, 806 observations from France, 1,375 observations from Italy, 1,905 observations from Japan, 1,171 observations from South Korea and 922 observations from Switzerland.

<sup>17</sup> See [http://ec.europa.eu/regional\\_policy/what/index.en.cfm](http://ec.europa.eu/regional_policy/what/index.en.cfm) for more information on the EU regional policy.

Table 1: Summary statistics for the basic regression

	Observations	Mean	Std. Dev.	Maximum	Minimum
AGE	49,895	44.270	16.775	96	15
AGE <sup>2</sup>	49,895	2,241.229	1,614.244	9,216	225
CHILD1	49,895	0.162	0.369	1	0
CHILD2	49,895	0.307	0.461	1	0
CHILD3	49,895	0.253	0.435	1	0
COUPLE	49,895	0.669	0.471	1	0
GDPGROW	49,895	2.057	2.124	7.46	-4.02
GROUP_INEQ	49,895	0.191	0.077	0.375	0.064
HEALTH	49,895	3.882	0.906	5	1
INC	49,895	5.184	2.573	11	1
INFLATION	49,895	5.118	4.539	23.1	-0.653
REG_INEQ	49,895	0.229	0.094	0.501	0.069
RELIG	48,969	6.076	3.215	10	1
RETIRED	49,895	0.177	0.382	1	0
PERS_INEQ	49,895	32.717	6.157	47.2	22.525
SATIS	49,895	7.284	2.014	10	1
SELFEMPL	49,895	0.062	0.242	1	0
SEPARATE	49,895	0.065	0.247	1	0
SEX	49,895	0.518	0.500	1	0
UNEMPL	49,895	0.054	0.226	1	0
UNEMPLY	49,895	8.096	4.154	22.7	2.1
WIDOW	49,895	0.069	0.253	1	0

This summary statistics contains the moments of the OECD country sample only.

results. Furthermore we have to control for the impact of transition countries. Due to the transition process and social and economic disorder, this dummy might have an impact on life satisfaction in these countries [see Bjornskov et al. (2006)].

### 3.2 Econometric Methodology

Satisfaction as our independent variable is of ordinal type. Therefore we use an Ordered Response Model.<sup>18</sup> Ordered Logit Models and Ordered Probit models only differ in the assumed distribution of the error term. While the error term in Logit models follows the logistic distribution, the error term in Probit models is standard normally distributed [see Wooldridge (2010)].

Because of the fact that households are different despite the repeated cross-sectional nature of our data, we index individuals by  $i(t)$  [see Ligthart and van Oudheusden (2011)]. In Ordered Response Models the ordinal responses are based upon a latent variable that depends on the above mentioned influence variables. Individual  $i$  chooses category  $k$  following the principle:

<sup>18</sup> In the present section we follow the accomplishments of Ligthart and van Oudheusden (2011).

$$SATIS_{i(t)jt} = k \text{ if } \mu_{k-1} < SATIS_{i(t)jt}^* \leq \mu_k \text{ for } k = 1, \dots, K. \quad (2)$$

With individual  $i$ 's self rated satisfaction at wave  $t$ , living in country  $j$ , where the survey was carried out in  $t$ ,  $SATIS_{i(t)jt}$ . The respondent chooses category  $k$  if his real life satisfaction  $SATIS_{i(t)jt}^*$  lies in the range of the lower cut-point for category  $k$ ,  $\mu_{k-1}$ , and the upper cut-point for category  $k$ ,  $\mu_k$ . Satisfaction scores are corresponding to different utilities. The latent dependent variable is given by

$$SATIS_{i(t)jt}^* = \beta' \mathbf{x}_{i(t)} + \gamma' \mathbf{z}_{jt} + \delta REG\_INEQ_{jt} + \eta_j + \phi_t + \varepsilon_{i(t)jt}. \quad (3)$$

With the matrix of individual level variables,  $\mathbf{x}_{i(t)}$ , the matrix of macro level variables,  $\mathbf{z}_{jt}$  and the level of regional income inequality  $REG\_INEQ_{jt}$ . We use country and wave fixed effects to capture general influences.  $\beta$ , and  $\gamma$  are parameter vectors, and  $\delta$  is the coefficient of regional income inequality. The error term  $\varepsilon_{i(t)jt}$  is clustered at country level. This allows for correlations between the error terms of each individual belonging to the same country and does not lead to spurious regressions [see Moulton (1990)]. However a correlation between the error terms of individuals of different countries is not allowed.

For the interpretation of the regression results the probability of the individual to choose a certain category has to be calculated. This probability depends on the influence of the exogenous variables.

$$\begin{aligned} Prob(SATIS_{i(t)jt} = k \mid \mathbf{x}_{i(t)}, \mathbf{z}_{jt}, REG\_INEQ_{jt}) \\ = \Phi(\mu_k - \beta' \mathbf{x}_{i(t)} - \gamma' \mathbf{z}_{jt} - \delta REG\_INEQ_{jt} - \eta_j - \phi_t) \\ - \Phi(\mu_{k-1} - \beta' \mathbf{x}_{i(t)} - \gamma' \mathbf{z}_{jt} - \delta REG\_INEQ_{jt} - \eta_j - \phi_t) \end{aligned} \quad (4)$$

with  $\Phi$  as the standard normal cumulative density function of  $\varepsilon_{i(t)jt}$ .<sup>19</sup> When running the Ordered Response Model the coefficients are estimated by maximizing this log-likelihood function:

$$\begin{aligned} \ln L(\boldsymbol{\theta} \mid \mathbf{x}, \mathbf{z}, REG\_INEQ) = \sum_{i=1}^I \sum_{j=1}^J \sum_{t=1}^T \sum_{SATIS_{i(t)jt}=k} SATIS_{i(t)jt} * \\ \ln Prob(SATIS_{i(t)jt} = k \mid \boldsymbol{\theta}, \mathbf{x}, \mathbf{z}). \end{aligned} \quad (5)$$

$\boldsymbol{\theta}$  denotes a row vector with the parameters  $\beta, \gamma, \delta, \eta_j, \phi_t$  and the vector of cut-points,  $\boldsymbol{\mu}$ . Maximizing this log-likelihood function gives the estimates of the regression coefficients  $\beta, \gamma$  and  $\delta$ , as well as the estimate of the fixed effects  $\eta_j, \phi_t$  and the cut-points.

<sup>19</sup> In Ordered Logit models the density function is replaced by the logistic cumulative density function.

We include country and wave fixed effects, to control for unobserved heterogeneity. This causes multicollinearity between these dummies and the macro variables, that are also calculated on country and/or wave level. Verme (2011) reveals the trade-off between avoiding multicollinearity and controlling for unobserved heterogeneity. In order to make our paper comparable to other examinations, we include country and wave dummies and cluster the error terms on country level.

### 3.3 Baseline Results

Our aim is to evaluate the influence of regional income inequality on life satisfaction. The European cohesion policy and the German redistribution politics are only two examples that are aimed at achieving regional equality of income. But does regional income inequality lower life satisfaction? We can answer in the affirmative for OECD countries. But we cannot find a significant impact of regional income inequality on life satisfaction for non-OECD countries.

Table 2 shows the examples for OECD countries. It is constructed as follows: we look at the influence of (1) regional income inequality, (2) group income inequality, (3) personal income inequality on life satisfaction. We control for established additional variables. In table 2 we present Ordered Logit as well as Ordered Probit regression results for each regression equation. The difference between these two regression methods is the assumption of the logistic (Logit) versus the standard normal distribution (Probit) of the error term [see section 3.2].

The coefficients in table 2 have to be interpreted as ordered log-odds (logit) regression coefficients. The coefficient of regional income inequality on life satisfaction says, if regional income inequality rises at 1 unit, the ordered log odds of perceiving a higher life satisfaction is expected to decrease c.p. by 2.109 index points [see table 2, column 1]. Indeed the interpretation of the coefficients is not as intuitively as with OLS. But the sign of the coefficient is an indicator for the direction of the effect.

In addition to the ordered log-odds, we compute the predicted change in the proportion of people in the highest satisfaction category, due to a one standard deviation change in the regional income inequality, in italics. The results show that regional income inequality has a significant negative impact on life satisfaction in OECD countries.

Group income inequality - measured by the population weighted regional income inequality - has a negative significant impact on life satisfaction, as well. The impact of personal income inequality is not significant. But the effect becomes significant when regional income inequality is added to the regression. However, the impact of regional income inequality on life satisfaction stays negative and significant. In

Table 2: Basic regression results

	Dependent variable: Life Satisfaction							
	(1)	(2)	(3)	OECD countries		(6)	(7)	(8)
	Probit	Logit	Probit	Logit	Probit	Logit	Probit	Logit
Reg. Ineq.	-2.109*** (-5.44) <i>-0.393</i>	-3.779*** (-5.61) <i>-0.356</i>					-2.479*** (-4.90) <i>-0.462</i>	-4.511*** (-5.70) <i>-0.425</i>
Group Ineq.			-2.967*** (-3.96)	-5.206*** (-3.52)				
Pers. Ineq.					-0.008 (-0.57) <i>-0.001</i>	-0.019 (-0.84) <i>-0.002</i>	-0.019** (-2.63) <i>-0.004</i>	-0.039*** (-3.33) <i>-0.004</i>
<i>Personal characteristics</i>								
Age	-0.022*** (-5.50)	-0.042*** (-5.83)	-0.022*** (-5.48)	-0.042*** (-5.80)	-0.022*** (-5.51)	-0.042*** (-5.85)	-0.022*** (-5.52)	-0.042*** (-5.85)
Age <sup>2</sup>	0.000*** (6.86)	0.001*** (7.09)	0.000*** (6.84)	0.001*** (7.07)	0.000*** (6.88)	0.001*** (7.11)	0.000*** (6.87)	0.001*** (7.12)
Sex	0.076*** (5.01)	0.144*** (5.25)	0.075*** (5.03)	0.142*** (5.29)	0.074*** (5.02)	0.140*** (5.25)	0.075*** (4.98)	0.144*** (5.22)
Health	0.350*** (32.13)	0.632*** (29.71)	0.350*** (32.61)	0.633*** (30.16)	0.351*** (32.15)	0.634*** (29.66)	0.350*** (32.32)	0.632*** (29.87)
Income	0.061*** (3.91)	0.117*** (4.29)	0.062*** (3.99)	0.119*** (4.40)	0.063*** (3.90)	0.120*** (4.27)	0.062*** (3.93)	0.119*** (4.31)
Income <sup>2</sup>	-0.002** (-2.15)	-0.005** (-2.68)	-0.003** (-2.33)	-0.005** (-2.91)	-0.003** (-2.38)	-0.006** (-2.91)	-0.003** (-2.16)	-0.005** (-2.67)
Employment status								
Unemployed	-0.333*** (-8.06)	-0.602*** (-8.41)	-0.335*** (-8.12)	-0.605*** (-8.49)	-0.334*** (-8.23)	-0.603*** (-8.65)	-0.332*** (-8.07)	-0.598*** (-8.43)
Self-employed	0.013 (0.57)	0.023 (0.59)	0.012 (0.54)	0.022 (0.55)	0.011 (0.48)	0.021 (0.51)	0.013 (0.59)	0.022 (0.60)
Retired	0.085*** (3.49)	0.148*** (3.30)	0.085*** (3.51)	0.147*** (3.33)	0.085*** (3.53)	0.145*** (3.30)	0.086*** (3.51)	0.148*** (3.30)
Marital status								
Couple	0.250*** (9.68)	0.438*** (9.83)	0.252*** (9.72)	0.441*** (9.87)	0.253*** (9.79)	0.445*** (9.96)	0.251*** (9.70)	0.441*** (9.87)
Separated	-0.128*** (-4.38)	-0.221*** (-4.55)	-0.127*** (-4.32)	-0.220*** (-4.50)	-0.127*** (-4.37)	-0.220*** (-4.56)	-0.128*** (-4.37)	-0.221*** (-4.55)
Widow	-0.035 (-0.96)	-0.070 (-1.06)	-0.034 (-0.94)	-0.068 (-1.03)	-0.034 (-0.92)	-0.067 (-1.00)	-0.035 (-0.96)	-0.070 (-1.05)
Number of Children								
1	-0.017 (-0.87)	-0.026 (-0.75)	-0.019 (-0.95)	-0.029 (-0.83)	-0.019 (-0.96)	-0.029 (-0.85)	-0.017 (-0.85)	-0.025 (-0.73)
2	-0.022 (-0.88)	-0.037 (-0.85)	-0.023 (-0.91)	-0.038 (-0.88)	-0.025 (-1.00)	-0.041 (-0.97)	-0.021 (-0.86)	-0.035 (-0.82)
≥ 3	0.030 (0.99)	0.054 (1.02)	0.029 (0.96)	0.051 (0.98)	0.028 (0.93)	0.050 (0.95)	0.031 (1.00)	0.055 (1.03)
<i>Macro Variables</i>								
GDP p.c. growth in %	0.037** (2.91)	0.069** (2.99)	0.039** (3.24)	0.071*** (3.32)	0.027** (2.41)	0.053** (2.95)	0.046*** (4.80)	0.087*** (5.74)
Inflation rate	-0.046*** (-6.55)	-0.081*** (-6.24)	-0.038*** (-4.35)	-0.066*** (-4.13)	-0.022 (-1.31)	-0.035 (-1.14)	-0.044*** (-5.35)	-0.076*** (-5.19)
Unemployment rate	0.002 (0.18)	0.001 (0.06)	0.005 (0.43)	0.007 (0.29)	-0.005 (-0.47)	-0.011 (-0.54)	0.002 (0.26)	0.002 (0.11)
<i>Dummies</i>								
Postcommunism	-0.620*** (-5.93)	-1.152*** (-6.52)	-0.240** (-2.84)	-0.471** (-3.22)	-0.410 (-1.12)	-0.909 (-1.43)	-1.145*** (-3.79)	-2.227*** (-4.53)
EU	0.132 (1.60)	0.215 (1.37)	0.140 (1.34)	0.232 (1.21)	0.149 (1.03)	0.250 (1.00)	0.138** (2.12)	0.233** (2.04)
Country Dummies	✓	✓	✓	✓	✓	✓	✓	✓
Wave Dummies	✓	✓	✓	✓	✓	✓	✓	✓
Obs.	49,895	49,895	49,895	49,895	49,895	49,895	49,895	49,895
Pseudo R <sup>2</sup>	0.053	0.056	0.053	0.056	0.053	0.055	0.053	0.056

Note: Z test statistics are reported in parenthesis; standard errors are clustered at country level; \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10%, respectively. The value in italics below the z-test statistic of the regional income inequality and the personal income inequality coefficient displays the predicted change in the proportion of people in the highest satisfaction category originating from a one standard deviation change in regional respectively personal income inequality.

order to compare the effects, we also compute the predicted change in the highest satisfaction category for the last two regressions. Regional income inequality has a higher impact on the proportion of people in the highest life satisfaction category. The pseudo  $R^2$  are around 0.05 and correspond to the explanatory power found, e.g., by Bjørnskov et al. (2013).

Figures 2 and 3 illustrate the findings of the basic regression. They show the predicted probabilities of life satisfaction for countries with low and high regional income inequality. The solid line describes the predicted probabilities of life satisfaction for a country with mean regional income inequality. We use these predicted probabilities to compare the extreme cases<sup>20</sup> with the mean value. This mean regional income inequality equals 0.353 and similar levels accord to, e.g., the USA in 1999, Belgium in 1999 and Hungary in 2008. We chose the regional income inequality level of Indonesia in 2006 for figure 2.<sup>21</sup> Indonesia is the country with the highest level of income inequality in our sample. The bars illustrate the predicted probabilities of life satisfaction in a country with high income inequality. Figure 2 shows that the bars for low levels of life satisfaction are all above the solid line. This means, that the predicted probabilities of unhappy people in Indonesia are higher than the predicted probabilities for a country with mean income inequality.

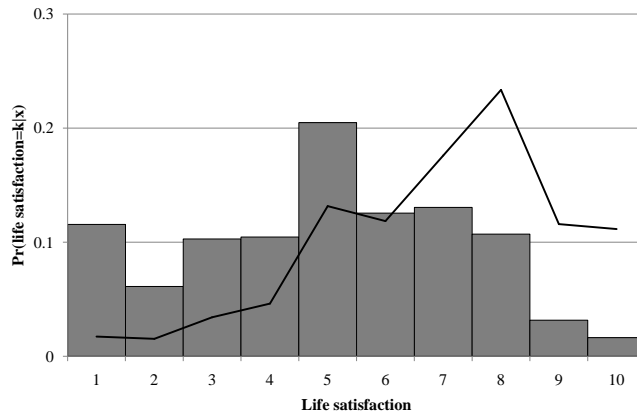


Figure 2: Predicted probabilities of life satisfaction in a country with high regional income inequality, compared to a country with mean regional income inequality.

In figure 3 we chose the level of regional income inequality of Sweden in 1982. This level corresponds to the lowest level of income inequality of our sample.<sup>22</sup> The bars illustrate the predicted probabilities of life satisfaction in a country with a low level

<sup>20</sup> The maximum and minimum income inequality cases.

<sup>21</sup> The level of regional income inequality of Indonesia in 2006 equals 1.232.

<sup>22</sup> The level of regional income inequality of Sweden in 1982 equals 0.069.



of income inequality. The bars for high levels of life satisfaction all correspond to higher predicted probabilities of life satisfaction in comparison to a country with a mean level of income inequality.

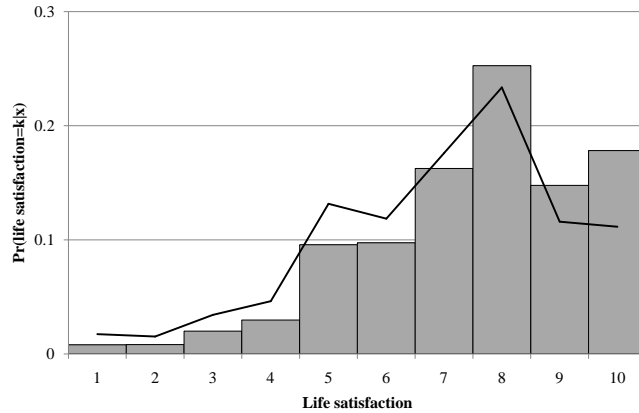


Figure 3: Predicted probability of life satisfaction for a country with low regional income inequality, compared to a country with mean regional income inequality.

The Logit and Probit regression results [see table 2] are nearly the same. In both cases the error term is symmetrically distributed about zero [see Wooldridge (2009)]. In order to concentrate on the relationship between regional income inequality and life satisfaction, we only display Probit regression results in the following examinations.

In all of the regressions, we include several control variables. To control for the influence of personal characteristics we include age and age squared. The coefficients correspond to the inverse u-shaped relationship between age and satisfaction found in the literature [see e.g. Ferrer-i-Carbonell and Gowdy (2007) and Dolan et al. (2008)]. Women are more satisfied than men which can be shown by the positive and significant influence of the sex coefficient [see e.g. Alesina et al. (2004)]. In addition to that self-rated health has a highly significant and positive effect on life satisfaction [see also Angeles (2011) and Caporale et al. (2009) for the same effect]. Furthermore we include personal income, measured by the level of income. Our results show that people’s life satisfaction rises with increasing personal income but with decreasing marginal rates.

The following personal controls are dummies for the employment and marital status as well as the number of children. Unemployment has a highly significant negative impact on life satisfaction and retirement has a positive effect, compared to people with another employment status than unemployed, self-employed or retired [see

Dolan et al. (2008)].<sup>23</sup> Self-employment does not have an impact on life satisfaction. People living in a partnership are more satisfied than singles or than people who answered they are 'divorced, separated or widow' or 'living apart but in a steady relation'. Separated people are significantly less satisfied than others. Being widowed has a non-significant impact on satisfaction.<sup>24</sup> Having children does not have a significant impact on life satisfaction.<sup>25</sup>

We add the macroeconomic control variables: the GDP p.c. growth in %, the annual inflation rate in consumer prices and the unemployment rate. Align to the findings of Di Tella et al. (2001a) the influence of the logarithm of the GDP per capita is positive. We include the GDP growth in order to control for relative changes in the GDP rather than the absolute value. This goes in line with the existing literature that says that relative changes are more crucial [see e.g. Ball and Chernova (2008)]. GDP growth has a significant positive impact on life satisfaction. The inflation rate has a negative effect on satisfaction. The effect becomes insignificant in the regressions that only include personal income inequality. According to the literature, national unemployment rates have a negative influence on happiness [see e.g. Di Tella et al. (2001b)]. We do not find a significant impact of unemployment rates on life satisfaction.

In the end we comprise a dummy for transition countries, the EU membership and country and wave dummies. In transition countries life satisfaction is significantly lower. Being a member of the EU does not have a robust and significant positive effect on life satisfaction.

### 3.4 Robustness analysis

To ensure that our regression results are not biased by omitted variables, we conduct a robustness analysis. Column 1 of table 3 contains the basic regression results [see column 1 of table 2]. In columns 7-11 of table 3 we split our sample into different subcategories. In column 7 we only look at male and in column 8 at female persons. We split the sample along three income levels and report the results in columns 9-11. The impact of regional income inequality on satisfaction is robust to the inclusion of the additional control variables [see columns 2-6] as well as in different subgroups of the sample. In every regression, regional income inequality has a negative and

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<sup>23</sup> The control group for the employment status dummies is others. This category includes full time employed, part time employed, housewives, students and others. These categories are defined by the WVS.

<sup>24</sup> We abut to the classification of Blanchflower and Oswald (2004) by building dummies for married, separated and widowed people. In addition to that, we expand the dummy for married people in the way that we also count people that live in a partnership.

<sup>25</sup> We do not control for the educational status like Alesina et al. (2004) did. The reason is that the education level was not part of every wave questionnaire in every country and established only in the last waves. If we integrated the education level in our regression, our sample would reduce by about 25,000 observations and regression results would be biased.

significant influence on life satisfaction.

In column 2 of table 3 we control for the impact of corruption, measured by the corruption perception index. The corruption measure used conveys the absence of perceived corruption. This means, the higher the Corruption Perception Index (CPI), the lower the corruption level. We expect a positive sign of corruption on satisfaction because the less corrupt a country is, meaning the higher the absence of corruption, the higher is life satisfaction. Hence the sign of the coefficient of corruption is strange but can be explained by multicollinearity between the macro variables and the country dummies [see Verme (2011)]. Besides the CPI is nearly constant over time [see Kalenborn and Lessmann (2013)]. Nevertheless the impact of regional income inequality on satisfaction does not change.

The next control variable is the general final government consumption expenditure in percent of the GDP, *Gov. Consumption*. Government Consumption can be used as a proxy for the government size, as well as the welfare state [see Rodríguez-Pose and Maslauskaite (2011)]. In column 3 of table 3 government consumption has a non-significant impact on life satisfaction.

Another variable measuring the institutional environment is *Democracy*, quantified by the mean value of the two dimensions of the Freedom in the World Index.<sup>26</sup> Note that a high index value corresponds to a low level of freedom. In column 4 the effect of democracy on satisfaction is not significant.

In column 5 we control for the robustness of the impact of regional income inequality on life satisfaction when *Religiosity* is added. This variable is measured at the micro level. It is the answer of the respondents to the question how important god is in their lives. The answers are in categories from 1 (not at all) to 10 (very important). People who are more religious are more happy [see also Inglehart (2010)].

Column 6 of table 3 contains the robustness regression results when adding all control variables. The impact of regional income inequality on life satisfaction is still negative and significant.

Dividing the sample into subgroups does not have any impact on the negative and significant influence of regional income inequality on life satisfaction. There are only little changes in the signs of the control variables.

Table 3: Robustness Results

	Dependent variable: Life Satisfaction										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	OECD countries										
	Probit										
Reg Ineq.	-2.109*** (-5.44)	-2.109*** (-5.44)	-1.793*** (-4.16)	-2.320*** (-5.89)	-2.008*** (-4.99)	-1.898*** (-3.72)	-2.111*** (-6.67)	-2.165*** (-4.47)	-1.962*** (-4.87)	-4.794*** (-12.22)	-4.426*** (-11.11)
<i>Personal characteristics</i>											
Age	-0.022*** (-5.50)	-0.022*** (-5.50)	-0.022*** (-5.54)	-0.022*** (-5.49)	-0.024*** (-5.95)	-0.024*** (-5.98)	-0.025*** (-6.69)	-0.020*** (-4.11)	-0.010 (-1.52)	-0.011** (-2.42)	-0.024*** (-4.01)
Age <sup>2</sup>	0.000*** (6.86)	0.000*** (6.86)	0.000*** (6.91)	0.000*** (6.85)	0.000*** (7.15)	0.000*** (7.19)	0.000*** (8.19)	0.000*** (5.25)	0.000*** (2.66)	0.000*** (3.13)	0.000*** (4.12)
Sex	0.076*** (5.01)	0.076*** (5.01)	0.076*** (5.03)	0.076*** (4.99)	0.035*** (2.05)	0.035*** (2.06)	0.035*** (2.00)	0.030 (1.17)	0.070*** (4.31)	0.030 (1.17)	0.070*** (2.41)
Health	0.350*** (32.13)	0.350*** (32.13)	0.350*** (31.83)	0.349*** (32.12)	0.353*** (31.44)	0.353*** (31.10)	0.358*** (22.00)	0.340*** (34.44)	0.334*** (22.40)	0.322*** (23.71)	0.344*** (17.83)
Income	0.061** (3.91)	0.061*** (3.91)	0.060*** (3.91)	0.061*** (3.93)	0.063*** (4.08)	0.062*** (4.11)	0.078*** (4.12)	0.047** (3.23)	0.034 (0.90)	-0.019 (-0.29)	0.036 (0.32)
Income <sup>2</sup>	-0.002** (-2.15)	-0.002** (-2.15)	-0.002** (-2.09)	-0.002** (-2.15)	-0.002** (-2.04)	-0.002** (-1.99)	-0.004** (-2.63)	-0.001 (-1.20)	0.001 (0.26)	0.003 (0.56)	0.001 (0.20)
<i>Employment status</i>											
Unemployed	-0.333*** (-8.06)	-0.333*** (-8.06)	-0.333*** (-8.09)	-0.333*** (-8.06)	-0.332*** (-8.33)	-0.331*** (-8.37)	-0.350*** (-7.89)	-0.316*** (-4.90)	-0.353*** (-4.82)	-0.317*** (-5.11)	-0.336*** (-3.12)
Self-employed	0.013 (0.57)	0.013 (0.57)	0.013 (0.59)	0.012 (0.54)	0.013 (0.59)	0.013 (0.57)	0.002 (0.10)	0.028 (0.69)	-0.035 (-0.55)	0.027 (0.48)	-0.011 (-0.25)
Retired	0.085*** (3.49)	0.085*** (3.49)	0.086*** (3.54)	0.085*** (3.50)	0.080*** (3.24)	0.081*** (3.31)	0.108*** (2.92)	0.054* (1.85)	0.066 (1.43)	0.159** (3.06)	0.111 (1.61)
<i>Marital status</i>											
Couple	0.250*** (9.68)	0.250*** (9.68)	0.250*** (9.64)	0.250*** (9.66)	0.253*** (9.70)	0.252*** (9.64)	0.245*** (9.64)	0.254*** (7.61)	0.211*** (4.76)	0.209*** (4.80)	0.252*** (5.88)
Separated	-0.128*** (-4.38)	-0.128*** (-4.38)	-0.129*** (-4.43)	-0.128*** (-4.39)	-0.109*** (-3.80)	-0.110*** (-3.86)	-0.185*** (-5.56)	-0.094** (-2.44)	-0.127** (-2.53)	-0.165** (-2.62)	-0.153 (-1.19)
Widow	-0.035 (-0.96)	-0.035 (-0.96)	-0.036 (-1.00)	-0.035 (-0.97)	-0.040 (-1.07)	-0.041 (-1.10)	-0.040 (-1.10)	-0.101* (-1.77)	-0.057 (-0.92)	-0.150** (-2.67)	-0.178** (-1.97)
<i>Number of Children</i>											
1	-0.017 (-0.87)	-0.017 (-0.87)	-0.016 (-0.82)	-0.017 (-0.85)	-0.017 (-0.83)	-0.016 (-0.77)	0.013 (0.74)	-0.044* (-1.67)	-0.008 (-0.29)	-0.030 (-0.92)	-0.010 (-0.22)
2	-0.022 (-0.88)	-0.022 (-0.88)	-0.021 (-0.85)	-0.022 (-0.87)	-0.026 (-0.99)	-0.024 (-0.96)	0.015 (0.60)	-0.056* (-1.87)	-0.012 (-0.36)	-0.018 (-0.82)	0.052 (1.39)
≥ 3	0.030 (0.99)	0.030 (0.99)	0.031 (1.03)	0.031 (1.00)	0.005 (0.17)	0.006 (0.21)	0.053* (1.85)	0.006 (0.17)	0.060 (1.62)	0.071** (2.17)	0.067 (1.22)
<i>Religiosity</i>											
<i>Macro Variables</i>											
GDP p.c. growth in %	0.037** (2.91)	0.037** (2.91)	0.046*** (4.04)	0.044*** (5.78)	0.037** (2.57)	0.052*** (4.88)	0.034** (2.36)	0.041*** (3.34)	0.084*** (7.25)	0.066*** (16.36)	0.066*** (6.25)
Inflation rate	-0.046*** (-6.55)	-0.046*** (-6.55)	-0.043*** (-5.33)	-0.045*** (-5.98)	-0.045*** (-5.85)	-0.049*** (-5.85)	-0.048*** (-6.90)	-0.045*** (-5.75)	-0.062*** (-11.77)	-0.117*** (-17.74)	-0.096*** (-5.36)
Unemployment rate	0.002 (0.18)	0.002 (0.18)	-0.008** (-2.27)	-0.000 (-0.04)	-0.001 (-0.12)	-0.013** (-3.65)	-0.006 (-0.21)	0.009 (0.88)	0.000 (0.03)	-0.030*** (-6.07)	-0.048*** (-4.46)
Corruption											
Gov. Consumption											
Democracy											
<i>Dummies</i>											
Postcommunism	-0.620*** (-5.93)	-0.620*** (-5.91)	-0.714*** (-5.01)	-0.685*** (-4.77)	-0.479*** (-4.24)	-1.129** (-3.14)	-0.654*** (-7.51)	-0.585*** (-4.66)	-	-	-
EU	0.132 (1.60)	0.132 (1.60)	0.204*** (6.17)	0.154** (2.94)	0.149 (1.62)	0.246*** (6.51)	0.219** (2.86)	0.042 (0.45)	-0.080*** (-7.90)	-0.171*** (-6.81)	-0.355*** (-5.80)
Country Dummies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wave Dummies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Obs.	49,895	49,895	49,895	49,895	48,969	48,969	24,055	25,840	9,177	11,170	8,564
Pseudo R <sup>2</sup>	0.053	0.053	0.053	0.053	0.056	0.056	0.056	0.052	0.045	0.039	0.042

Note: Z test statistics are reported in parenthesis; standard errors are clustered at country level; \*\*\*, \*\*, \* and \* indicate significance at 1%, 5% and 10%, respectively. The value in italics below the z-test statistic of the regional income inequality coefficient displays the predicted change in the proportion of people in the highest satisfaction category originating from a one standard deviation change in regional income inequality.

Table 4: The impact of regional income inequality on life satisfaction in OECD and non-OECD countries

	Dependent variable: Life Satisfaction							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OECD				non-OECD			
	Probit	Logit	Probit	Logit	Probit	Logit	Probit	Logit
Reg. Ineq.	-2.109*** (-5.44) <i>-0.393</i>	-3.779*** (-5.61) <i>-0.356</i>	-2.479*** (-4.90) <i>-0.462</i>	-4.511*** (-5.70) <i>-0.425</i>	0.698 (0.95) <i>0.143</i>	1.070 (0.77) <i>0.111</i>	1.063 (1.26) <i>0.218</i>	1.567 (0.93) <i>0.163</i>
Pers. Ineq.			-0.019** (-2.63) <i>-0.004</i>	-0.039*** (-3.33) <i>-0.004</i>			-0.008 (-0.66) <i>-0.002</i>	-0.011 (-0.47) <i>-0.001</i>
<i>Personal characteristics</i>								
Age	-0.022*** (-5.50)	-0.042*** (-5.83)	-0.022*** (-5.52)	-0.042*** (-5.85)	-0.027*** (-6.35)	-0.047*** (-6.41)	-0.027*** (-6.46)	-0.046*** (-6.52)
Age <sup>2</sup>	0.000*** (6.86)	0.001*** (7.09)	0.000*** (6.87)	0.001*** (7.12)	0.000*** (7.18)	0.001*** (7.28)	0.000*** (7.28)	0.001*** (7.39)
Sex	0.076*** (5.01)	0.144*** (5.25)	0.075*** (4.98)	0.144*** (5.22)	0.093*** (3.72)	0.161*** (3.91)	0.093*** (3.73)	0.161*** (3.92)
Health	0.350*** (32.13)	0.632*** (29.71)	0.350*** (32.32)	0.632*** (29.87)	0.289*** (17.27)	0.510*** (17.39)	0.288*** (17.37)	0.510*** (17.56)
Income	0.061*** (3.91)	0.117*** (4.29)	0.062*** (3.93)	0.119*** (4.31)	0.114*** (3.95)	0.202*** (4.04)	0.115*** (3.97)	0.203*** (4.05)
Income <sup>2</sup>	-0.002** (-2.15)	-0.005** (-2.68)	-0.003** (-2.16)	-0.005** (-2.67)	-0.004 (-1.49)	-0.007 (-1.56)	-0.004 (-1.52)	-0.007 (-1.59)
Employment status								
Unemployed	-0.333*** (-8.06)	-0.602*** (-8.41)	-0.332*** (-8.07)	-0.598*** (-8.43)	-0.186*** (-5.17)	-0.336*** (-5.48)	-0.186*** (-5.14)	-0.335*** (-5.44)
Self-employed	0.013 (0.57)	0.023 (0.59)	0.013 (0.59)	0.022 (0.60)	0.007 (0.30)	0.006 (0.16)	0.003 (0.15)	0.001 (0.04)
Retired	0.085*** (3.49)	0.148*** (3.30)	0.086*** (3.51)	0.148*** (3.30)	-0.044 (-1.32)	-0.090 (-1.49)	-0.045 (-1.35)	-0.091 (-1.50)
Marital status								
Couple	0.250*** (9.68)	0.438*** (9.83)	0.251*** (9.70)	0.441*** (9.87)	0.154*** (6.21)	0.260*** (6.00)	0.154*** (6.20)	0.260*** (6.00)
Separated	-0.128*** (-4.38)	-0.221*** (-4.55)	-0.128*** (-4.37)	-0.221*** (-4.55)	-0.050* (-1.88)	-0.099* (-1.94)	-0.050* (-1.88)	-0.099* (-1.94)
Widow	-0.035 (-0.96)	-0.070 (-1.06)	-0.035 (-0.96)	-0.070 (-1.05)	-0.012 (-0.61)	-0.046 (-1.37)	-0.012 (-0.62)	-0.046 (-1.38)
Number of Children								
1	0.037** (2.91)	0.069** (2.99)	0.046*** (4.80)	0.087*** (5.74)	0.013* (1.78)	0.025 (1.63)	0.011 (1.33)	0.022 (1.28)
2	-0.022 (-0.88)	-0.037 (-0.85)	-0.021 (-0.86)	-0.035 (-0.82)	-0.026 (-1.19)	-0.043 (-0.96)	-0.027 (-1.21)	-0.044 (-0.98)
≥ 3	0.030 (0.99)	0.054 (1.02)	0.031 (1.00)	0.055 (1.03)	0.041 (1.20)	0.080 (1.22)	0.040 (1.19)	0.079 (1.22)
<i>Macro Variables</i>								
GDP p.c. growth in %	0.037** (2.91)	0.069** (2.99)	0.046*** (4.80)	0.087*** (5.74)	0.013* (1.78)	0.025 (1.63)	0.011 (1.33)	0.022 (1.28)
Inflation rate	-0.046*** (-6.55)	-0.081*** (-6.24)	-0.044*** (-5.35)	-0.076*** (-5.19)	0.000 (0.77)	0.000 (0.88)	0.000 (1.14)	0.000 (1.00)
Unemployment rate	0.002 (0.18)	0.001 (0.06)	0.002 (0.26)	0.002 (0.11)	-0.008 (-0.34)	-0.014 (-0.33)	-0.014 (-0.67)	-0.023 (-0.56)
<i>Dummies</i>								
Transition	-0.620*** (-5.93)	-1.152*** (-6.52)	-1.145*** (-3.79)	-2.227*** (-4.53)	-0.624*** (-7.39)	-1.070*** (-7.13)	-0.794** (-2.87)	-1.302** (-2.47)
EU	0.132 (1.60)	0.215 (1.37)	0.138** (2.12)	0.233** (2.04)				
Country Dummies	✓	✓	✓	✓	✓	✓	✓	✓
Wave Dummies	✓	✓	✓	✓	✓	✓	✓	✓
Obs.	49,895	49,895	49,895	49,895	46,989	46,989	46,989	46,989
Pseudo R <sup>2</sup>	0.053	0.056	0.053	0.056	0.067	0.070	0.067	0.070

Note: Z test statistics are reported in parenthesis; standard errors are clustered at country level; \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10%, respectively. The value in italics below the z-test statistic of the regional income inequality and the personal income inequality coefficient displays the predicted change in the proportion of people in the highest satisfaction category originating from a one standard deviation change in regional respectively personal income inequality.

### 3.5 The impact of regional income inequality on life satisfaction in OECD and non-OECD countries

In the following we look at the impact of regional income inequality on life satisfaction in OECD and non-OECD countries. We have regional income inequality measures on NUTS 2 level for EU countries, TL2 level for the other OECD countries and on state or province level in non-OECD countries.<sup>27</sup>

Columns 1-4 of table 4 contain the basic regression results of table 2 for regional income inequality as well as regional and personal income inequality on life satisfaction. We compare these regression results to the results for non-OECD countries [see columns 5-8 of table 4]. Note that income inequality in non-OECD countries measures only the inequality between groups of regions. Regional income inequality has no significant impact on life satisfaction in non-OECD countries. We constitute this to the level on which regional income inequality is measured, rather than to a specialty of non-OECD countries.

Note that about 14,500 observations in the non-OECD regression are countries from Latin America and the Caribbean (LAC). The integration of these countries leads to a positive effect of inequality on life satisfaction, according to Bjornskov (2003). Nevertheless the significance of the impact of regional income inequality on life satisfaction in non-OECD countries does not change, when integrating a dummy variable for LAC countries.

## 4 Summary and conclusion

With data on life satisfaction as well as regional income inequality, we show that higher regional income inequality leads to lower life satisfaction. This goes along with the literature on the impact of reference income on life satisfaction [see, e.g., Ferrer-i-Carbonell (2005) and Boes et al. (2010)]. Additionally, we expand the findings of Oshio and Kobayashi (2009), Oshio and Kobayashi (2010) and Oshio and Kobayashi (2011). We use the coefficient of variation to measure inequality on a regional level.

We concentrate on the impact of regional income inequality in OECD countries, because we have more precise data for these countries. The impact of regional income inequality on life satisfaction is significant and negative. It is robust to the inclusion of additional control variables or the division of the sample into subsamples.

The basic regressions show that regional income inequality has a higher negative

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<sup>26</sup> The two dimensions are political rights and civil liberties. They both are scaled from 1 (highest degree of freedom) to 7 (lowest degree of freedom).

<sup>27</sup> See table A.4 for the data summary of the non-OECD country sample.

impact on life satisfaction than personal income inequality. That means horizontal inequalities have a negative impact on life satisfaction. The more equal incomes between regions are, the more satisfied are people with their lives. If Finland's regional income inequality (0.1936 in 2005) would rise to the level of Italy (0.2338 in 2005), the probability of people choosing the highest life satisfaction level would decrease by 16.82%.

As regional income inequality leads to more dissatisfaction, politicians should be more sensitive to regional income inequality. Especially because regional income inequality increased by 15% between 1995–2003 in the EU [see Heidenreich and Wunder (2008)]. Remarkably our findings underline, that financial adjustments in welfare states should assimilate regional income levels.

Our last regressions show the impact of regional income inequality looking at non-OECD countries. The effect of regional income inequality is not significant in these countries. One reason for this originates in the calculation of the measure of regional income inequality. For the measure of regional income inequality in OECD countries we use data based on the state/province level, instead of NUTS 2 or TL2 level for OECD countries. Another explanation is that in OECD countries the impact of regional income inequality is persistent, but in non-OECD countries perceived social mobility is more dynamic and people hope to participate in income increases [see the Tunnel effect by Hirschman and Rothschild (1973)]. Besides about one fourth of the non-OECD countries are Latin American and Caribbean countries, where people are generally more satisfied [see Bjørnskov (2003)].

Further research may comprise the interdependency of perceived and actual fairness of the institutional framework and its impact on the relationship between regional income inequality and life satisfaction, like Bjørnskov et al. (2013). We look at the impact of regional income inequality within a country, but do not comprise that income comparisons may take place on a lower regional level or decline with rising distance to the reference region. A spatial consideration of the impact of regional income inequality could give more insights on which regions are important for the classification of people's personal income.

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Table A.1: Data sources &amp; definitions

Variable	Definition	Source
AGE	Age of respondent in years.	World Values Survey Association (2009)
CHILD1	Dummy variable for people having exactly one child. Answer to the question "How many children do you have?"	World Values Survey Association (2009)
CHILD2	Dummy variable for people having exactly two children. Answer to the question "How many children do you have?"	World Values Survey Association (2009)
CHILD3	Dummy variable for people having at least three children. Answer to the question "How many children do you have?"	World Values Survey Association (2009)
CORRUPT	Corruption Perception Index (0 = highest corruption; 10 = absence of corruption), mean by each wave.	Transparency International
COUPLE	Dummy variable for people living in a relationship (1 = married or living together as married; 0 = other). Reference category for marital status are singles or never married people respectively, people who said they are 'divorced, separated or widow' and people living apart but in a steady relation (married, cohabitation).	World Values Survey Association (2009)
DEMO	Average of the components civil liberties and political rights of the Freedom in the World Index, mean by wave.	Freedom House
EU	Dummy for EU member states.	
HEALTH	Inverse self-rated state of health (1= very poor to 5=very good).	World Values Survey Association (2009)
INC	Scale of respondent's income (1=lower step; 10=tenth step).	World Values Survey Association (2009)
INFLATION	Inflation as measured by the consumer price index. Annual percentage change in the costs of a country's average consumer.	The World Bank Group (2011)
GDPPC_GROW	GDP p.c. growth in %.	The World Bank Group (2011)
GOVCONS	General government final consumption expenditure in percent of GDP.	The World Bank Group (2011)
GROUP_INEQ	Population-weighted coefficient of variation, mean by wave.	Lessmann (2006)
LAC	Latin American and the Caribbean, regional dummy.	The World Bank Group (2011)
PERS_INEQ	Gini coefficient as a measure for personal income inequality, mean by wave.	All the Ginis Dataset
TRANS	Dummy for the transition countries.	
REG_INEQ	Coefficient of variation based on regional GDP p.c. as a measure for regional income inequality, mean by wave.	Lessmann (2006)
RETIRED	Dummy variable for people being retired. Answer to the question "Are you employed now or not? IF YES: About how many hours a week? If more than one job: only for the main job."	World Values Survey Association (2009)
RELIG	Answer to the question "How important is God in your life?" (1 = not at all important to 10 = very important).	World Values Survey Association (2009)
SATIS	Life Satisfaction (1= Dissatisfied to 10=Satisfied). Answer to the question "All things considered, how satisfied are you with your life as a whole these days?"	World Values Survey Association (2009)
SELFEMPL	Dummy variable for self-employed respondents. Answer to the question "Are you employed now or not? IF YES: About how many hours a week? If more than one job: only for the main job."	World Values Survey Association (2009)
SEPARATE	Dummy variable for people being separated from the partner (1 = divorced or separated; 0 = other). Reference category for marital status are singles or never married people respectively, people who said they are 'divorced, separated or widow' and people living apart but in a steady relation (married, cohabitation).	World Values Survey Association (2009)
SEX	Dummy variable for respondent's sex (0=male; 1=female).	World Values Survey Association (2009)
UNEMPL	Dummy variable for unemployment (0=respondent is not unemployed; 1=respondent is unemployed). Answer to the question "Are you employed now or not? IF YES: About how many hours a week? If more than one job: only for the main job."	World Values Survey Association (2009)
UNEMPLY	Total unemployment rate as the share of the total labor force.	The World Bank Group (2011)
WIDOW	Dummy variable for widowed people (1 = widowed; 0 = other). Reference category for marital status are singles or never married people respectively, people who said they are 'divorced, separated or widow' and people living apart but in a steady relation (married, cohabitation).	World Values Survey Association (2009)

Table A.2: Summary statistics

	Observations	Mean	Std. Dev.	Maximum	Minimum
AGE	49,895	44.270	16.775	96	15
AGE <sup>2</sup>	49,895	2,241.229	1,614.244	9,216	225
CHILD1	49,895	0.162	0.369	1	0
CHILD2	49,895	0.307	0.461	1	0
CHILD3	49,895	0.253	0.435	1	0
CORRUPT	49,895	7.378	1.393	9.4	4.18
COUPLE	49,895	0.669	0.471	1	0
DEMO	49,895	1.187	0.282	2	1
GDPGROW	49,895	2.057	2.124	7.46	-4.02
GOVCONS	49,895	19.126	3.242	29.5	12.7
GROUP_INEQ	49,895	0.191	0.077	0.375	0.064
HEALTH	49,895	3.882	0.906	5	1
INC	49,895	5.184	2.573	11	1
INFLATION	49,895	5.118	4.539	23.1	-0.653
REG_INEQ	49,895	0.229	0.094	0.501	0.069
RELIG	48,969	6.076	3.215	10	1
RETIRED	49,895	0.177	0.382	1	0
PERS_INEQ	49,895	32.717	6.157	47.2	22.525
SATIS	49,895	7.284	2.014	10	1
SELFEMPL	49,895	0.062	0.242	1	0
SEPARATE	49,895	0.065	0.247	1	0
SEX	49,895	0.518	0.500	1	0
UNEMPL	49,895	0.054	0.226	1	0
UNEMPLY	49,895	8.096	4.154	22.7	2.1
WIDOW	49,895	0.069	0.253	1	0

This summary statistics contains the moments of the OECD country sample only.

Table A.3: Data summary for OECD countries

Country	Total	1981	1982	1990	1995	1996	1997	1998	1999	2000	2001	2005	2006
		Wave 1	Wave 2	Wave 2	Wave 2	Wave 3	Wave 3	Wave 3	Wave 4	Wave 4	Wave 4	Wave 5	Wave 5
Australia	1,792				1,792								
Austria	1,379			1,379									
Belgium	1,665			1,665									
Canada	5,922		1,000	1,451						1,679			1,792
Czech Republic	928							928					
Denmark	887			887									
Estonia	983					983							
Finland	2,358			540		900						918	
France	1,729		923	806									
Germany	1,659						1,659						
Italy	3,073		1,041	1,375								657	
Japan	3,481			651						1,077		925	1,194
Korea, Republic of	2,365										1,171		
Netherlands	762			762									
Norway	3,016		973	1,006		1,037							
Poland	919											919	
Portugal	1,109			1,109									
Slovakia	922							922					
Slovenia	980											980	
Spain	4,749			3,028		874				847			
Sweden	1,741		811						930				
United Kingdom	1,312			1,312									
United States	6,164		2,114	1,606	1,323				1,121				
Total	49,895	1,964	4,898	17,577	4,817	3,850	1,659	1,850	1,121	3,603	1,171	5,593	1,792
		6,862		17,577		12,176				5,895		7,385	

Table A.4: Data summary for non-OECD countries

Country	Total	1991	1995	1996	1997	1998	1999	2000	2001	2005	2006	2007	2008
		Wave 2	Wave 2	Wave 3	Wave 3	Wave 3	Wave 4	Wave 4	Wave 4	Wave 4	Wave 5	Wave 5	Wave 5
Argentina	2,655	537	869				1,249						
Brazil	1,451										1,451		
Bulgaria	1,766				880						886		
China	3,900		1,483						882			1,535	
Colombia	2,983					2,983							
Georgia	1,448												1,448
India	1,427		1,427										
Indonesia	2,573								862		1,711		
Latvia	1,116			1,116									
Lithuania	879				879								
Mexico	4,481			1,928				1,166		1,387			
Peru	2,844												1,371
Philippines	1,187								1,473				
Russian Federation	3,539		1,897						1,187		1,642		
South Africa	5,315								2,489			2,826	
Tanzania, United Republic of	998								998				
Thailand	1,459											1,459	
Turkey	6,025								3,089			1,313	
Ukraine	943			1,623							943		
Total	46,989	537	5,676	4,667	1,759	2,983	1,249	1,166	10,980	1,387	6,633	7,133	2,819
		537		15,085				13,395			17,972		