



# The individual (mis-)perception of wage inequality: measurement, correlates and implications

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## Abstract

This paper presents a simple conceptual framework specifically tailored to measure individual perceptions of wage inequality. Using internationally comparable survey data, the empirical part of the paper documents that there is huge variation in inequality perceptions both across and within countries as well as survey-years. Focusing on the association between aggregate-level inequality measures and individuals' subjective perception of wage inequality, it turns out that there are both a high correlation between the two measures and a considerable amount of misperception of the prevailing level of inequality. The final part of the analysis shows that subjective inequality perceptions appear to be more important, in a statistical sense, in explaining variation in individual-level attitudes toward social inequality than objective measures of inequality. This underlines the conceptual and practical importance of distinguishing between subjective perceptions of inequality and the true level of inequality.

**Keywords** Inequality perceptions · Inequality · (Mis-)perceptions of socioeconomic phenomena · Attitudes toward social inequality

**JEL Classification** D31 · D63 · J31

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## 1 Introduction

In a wide variety of contexts, individuals' subjective perception of socioeconomic phenomena might differ substantively from the "true" state—or, rather, the corresponding scientific representation—of the given object of interest.<sup>1</sup> From an economic point of view, probably one of the most interesting, and certainly one of the most relevant examples where reality and individuals' subjective perceptions may diverge from each other is the distribution of economic resources because a high level of inequality is expected to feed back into the political sphere by influencing individuals' attitudes toward social inequality, such as their beliefs about the determinants of individual pay. Individuals' attitudes toward social inequality, in turn, likely influence their attitudes toward marginal tax rates and other policy parameters which are ultimately crucial in determining the effective amount of (re-)distribution of economic resources (e.g., Alesina and Angeletos 2005; Bénabou and Tirole 2006).<sup>2</sup>

However, given the computational complexity and the large amount of information necessarily involved in obtaining a well-informed perception of the prevailing level of inequality in an individual's country of residence, it is likely that many, if not most, individuals have biased perceptions about the truly prevailing level of inequality. Indeed, the existing empirical evidence, primarily based on survey data, has consistently shown that there is huge variation in individuals' perceptions of occupational wages (e.g., Kelley and Evans 1993; Kluegel and Smith 1981; Kuhn 2017; Osberg and Smeeding 2006) and, consequently, in their overall assessment of the extent of wage inequality as well (e.g., Bavetta et al. 2019; Cruces et al. 2013; Engelhardt and Wagener 2014; Gimpelson and Treisman 2018; Knell and Stix 2017; Kuhn 2011). It appears more difficult to assess, however, whether people tend to under- or overestimate the true level of inequality—in part because the measured level of misperception appears to depend on the specific measurement framework used. For example, while Norton and Ariely (2011) find that Americans grossly underestimate the inequality in the distribution of wealth, both Eriksson and Simpson (2012) and Chambers et al. (2014) conclude that Americans tend to overestimate the existing extent of wage inequality. Clearly, the two results need not necessarily contradict each other, but part of the difference appears to be driven by the choice of the measurement framework (Eriksson and Simpson 2012).

Either way, however, potential discrepancies between the true level of inequality and individuals' subjective perceptions of inequality are relevant for the political-economic

<sup>1</sup> Such as the perception of inequality of opportunity (Brunori 2017), tax rates (Gemmill et al. 2004), the perception of corruption (Olken 2009), or individuals' self-assessment of how their own well-being would change as a result of various life events (Odermatt and Stutzer 2018). One persistent and well-known finding relates to individuals' (mis-)perception of probabilistic events (e.g., Dohmen et al. 2009).

<sup>2</sup> Consistent with this line of reasoning, evidence is accumulating on behavioral and attitudinal spillovers from inequality from a diversity of contexts and based on either experimental (e.g., Clark et al. 2010; Card et al. 2012; Kuziemko et al. 2015) or non-experimental data (e.g., Clark et al. 2010; Cornelissen et al. 2011; Dube et al. 2019; Kuhn 2019; Pfeifer 2015). Moreover, a related literature, focusing on the effect of inequality on subjective measures of satisfaction or happiness, generally finds that higher inequality is associated with less satisfaction and/or lower happiness (e.g., Senik 2005; Verme 2011). Clark and D'Ambrosio (2015) provide a comprehensive survey of both experimental and survey evidence on individuals' attitudes to income inequality.

implications of inequality because it appears obvious, *prima facie*, to assume that it is individual-level perceptions of inequality, rather than the objective level of inequality, which ultimately shape individuals' attitudes toward inequality (e.g., Gimpelson and Treisman 2018; Kuhn 2011, 2019; Schneider 2012). From an empirical point of view, then, one of the key challenges in approaching these questions empirically is the need for an empirical approximation to individual-level perceptions of wage inequality because, in contrast to the measurement of the objective level of wage inequality, there is no readily available measurement framework at hand.

In this paper, I use a simple and intuitive measurement framework suitable for constructing an empirical approximation of individual-level perceptions of wage inequality (Kuhn 2011).<sup>3</sup> As I will discuss in more detail below, as a by-product, the framework also yields estimates of individuals' perceptions of the overall wage level prevailing in their country of residence.<sup>4</sup> The intuitive nature of the framework derives from the fact that it is essentially based on a simple analogy with the measurement of the objective level of wage inequality using the well-known Gini coefficient, presumably one of the most often used measures of inequality in conventional applications (i.e., the measurement of inequality based on objective-level data on wages).

In the second empirical part of the paper, I apply the measurement framework using internationally comparable survey data from the International Social Survey Programme, covering about 81,000 individuals from 27 different countries and up to 4 different points in time, with the first surveys administered in 1987 and the most recent ones in 2009.<sup>5</sup> The relatively large number of 78 distinct aggregate cells (i.e., cells defined over country  $\times$  survey-year) offers the rare opportunity to study how inequality perceptions are associated with the objectively measured degree of inequality in a country, an issue which has, mainly due to data limitations, not yet received much attention in the literature—despite its obvious relevance from a political-economic perspective.

The empirical analysis of individual-level inequality perceptions, constructed according to the conceptual framework laid out in this paper, yields several interesting findings. First, and consistent with previous evidence on the subject, I find that there is huge variation in individual-level inequality perceptions, both within and across countries as well as survey-years. I also find that there is a strong correlation of individual-level inequality perceptions within aggregate cells; that is, individuals observed in the same country and the same survey-year tend to have more similar perceptions of wage inequality than randomly picked respondents, suggesting that respondents from the same country actually tend to form perceptions toward a common, though not necessarily the correct, economic phenomenon (i.e., the degree of

<sup>3</sup> Previous applications of the framework include a comparison of inequality perceptions and redistributive preferences between former East and West Germany (Kuhn 2013) as well as individuals' perceptions of executive compensation (Kuhn 2017).

<sup>4</sup> Moreover, considering the results from Eriksson and Simpson (2012) and Chambers et al. (2014) on the relevance of the measurement framework, the fact that the framework proposed here does not rely on individual estimates of relative frequencies may be another advantage.

<sup>5</sup> The same data, or parts thereof, were used with a similar purpose by several previous studies (e.g., Jasso 1999; Niehues 2014; Osberg and Smeeding 2006), but all of these studies used different frameworks to measure individuals' inequality perceptions. See also Knell and Stix (2017), who compare different conceptualizations of inequality perceptions.

inequality in their respective country of residence). The empirical analysis further shows that there is a substantial positive correlation between the objective level of inequality and mean inequality perceptions in a given country and year, but also that people often have (heavily) biased perceptions of the prevailing level of inequality, consistent with evidence from previous studies (e.g., Chambers et al. 2014; Eriksson and Simpson 2012; Gimpelson and Treisman 2018). The final part of the empirical analysis focuses on the question of whether the distinction between inequality and inequality perceptions has any bearing for the analysis of the potential spillovers on individuals' attitudes toward and beliefs about inequality. In this regard, regressions including both inequality perceptions and aggregate-level inequality measures show, for different attitudinal measures, that inequality perceptions are more important in predicting attitudes toward inequality than aggregate-level measures of the objective level of inequality.

The remainder of this paper proceeds as follows: The following section discusses the data used in the empirical part of the paper. Section 3 then sketches the conceptual framework used to measure individual-level inequality perceptions. Section 4 presents some basic descriptive evidence related to this measure, documenting systematic variation in inequality perceptions both across and within regions and over time. The main part of the paper is presented in Sect. 5, which focuses on the association between the objective level of inequality and subjective, individual-level perceptions of wage inequality. In a complementary analysis, Sect. 6 studies the predictive power of both aggregate-level inequality measures and individual-level inequality perceptions when both are used simultaneously to explain variation in individuals' attitudes to social inequality. Section 7 concludes.

## 2 Data

### 2.1 Survey data

The primary data source for the empirical analysis is the "Social Inequality" cumulation, a data file that combines several surveys on the causes and consequences of social inequality, administered and made available by the International Social Survey Programme (ISSP). The data combine four individual rounds of a survey designed to focus specifically on individuals' perceptions of the causes and consequences of social inequality. The four surveys were administered in 1987, 1992, 1999 and 2009, respectively (ISSP Research Group 2014a, b).<sup>6</sup>

The data from the "Social Inequality" cumulation cover a large number of survey items on individuals' attitudes toward social inequality, including, for example, their beliefs about the causes of individual economic success, their satisfaction with their own compensation from work, or their support of redistribution by the state as well as of progressive taxation (cf. Kuhn 2019). Moreover, the data cover a relatively long

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<sup>6</sup> The data are available to researchers from the GESIS data archive (<http://www.gesis.org>). More information about the ISSP is available from the organization's website (<http://www.issp.org>). Note that the cumulation file contains a harmonized list of variables, but that it does not cover all of the countries taking part in the separate waves of the survey.

period of time and, at least in the more recent waves of the survey, quite a large number of distinct countries from different parts of the world. (“Appendix” Table 6 shows the number of individual observations in the analysis sample by country and survey-year.) They thus provide the unique opportunity to assess the empirical association between subjective inequality perceptions and the objective level of inequality.

### 2.1.1 Subjective wage estimates for people working in specific occupations

As will be discussed in detail in Sect. 3 below, the conceptual framework used to measure individual-level inequality perceptions is essentially based on individuals’ subjective wage estimates for people working in different occupations. Specifically, respondents were asked in each round of the survey to give their best estimate of the wages actually paid in different occupations, such as a doctor in general practice for example. The exact wording of the question is as follows (see also footnote 7 below):

“We would like to know what you think people in these jobs actually earn. Please write how much you think they actually earn each month (before taxes, but after social security contributions). Many people are not exactly sure about this, but your best guess will be close enough.”

In some versions of the survey, respondents were asked to estimate wages for up to fifteen different occupations. Somewhat unfortunately, however, only four occupations appear consistently in all four rounds of the survey, namely (i) “an unskilled worker in a factory,” (ii) “a doctor in general practice,” (iii) “a cabinet minister in the national government” and (iv) “the chairman of a large national company.” For maximal comparability across the different waves of the survey, I will only use individuals’ wage estimates referring to these four occupations to construct the empirical approximation of inequality perceptions used in the main part of the empirical analysis (as discussed in detail in Sect. 3 below).

## 2.2 Aggregate statistics

I complement the individual-level survey data from the ISSP with objective measures of inequality from the Standardized World Income Inequality Database (SWIID), described in detail in Solt (2015, 2016). The SWIID uses the Luxemburg Income Study (LIS) as its main data source because it provides consistent and high-quality series of aggregate-level inequality for both market (before taxes, before transfers) and net (after taxes, after transfers) inequality. Data from several additional sources are then used to compute predictions for additional country  $\times$  year cells for which data from the LIS are not available. The SWIID has two features that make it attractive to use in empirical work (see Solt 2016, for details). First, the SWIID provides consistent series of aggregate-level inequality measures: It provides estimates of the Gini in both market and disposable equivalized household income. Second, it has broader coverage than other inequality databases because it combines data from several sources. Indeed, the SWIID covers almost all of the country  $\times$  year cells available in the “Social Inequality” cumulation by the ISSP.

Moreover, in some subset of the empirical analysis, I use a few additional aggregate statistics taken from published statistics of the World Bank. These include a country's per capita GDP (measured in constant 2005 US dollars), its annual growth rate, its unemployment rate, its labor force participation rate, and social expenditure as a percentage of GDP. These statistics are all taken from the World Bank's homepage (<http://www.worldbank.org>); the exception is social expenditure, which is from the OECD (<http://www.oecd.org>).

Obviously, the objective measures of aggregate-level inequality are of key interest when focusing on a direct comparison between perceptions of inequality and any objective measure of inequality. It is also obvious that such a comparison can only be meaningful if a relatively large number of aggregate units is available. Fortunately, this is the case for the ISSP cumulation data, which cover a relatively large number of distinct aggregate-level cells (i.e., cells defined at the country  $\times$  survey-year level). Due to restrictions related to the availability of some of the additional aggregate-level variables (e.g., the two objective-level Gini coefficients), it is not possible to use the full set of aggregate cells in most parts of the empirical analysis. Nonetheless, the main analysis below is still based on a comparatively large number of 78 distinct aggregate cells.

It is also worth emphasizing at this point, however, that a direct comparison must be interpreted with sufficient care because the two variables measure distinct phenomena in principle. While individual-level inequality perceptions are explicitly constructed to capture an individual's perception of wage differentials, aggregate-level Gini coefficients relate to the distribution of incomes, not wages.<sup>7</sup> We should therefore not expect the two measures to be perfectly correlated, even if all individuals had perfect information about the true extent of wage inequality.

### 3 Measuring inequality perceptions

In this section, I discuss how to construct subjective measures of inequality perceptions, drawing on a simple conceptual framework initially proposed by and discussed in more detail in Kuhn (2011).<sup>8</sup> The framework essentially tries to “mimic” the computation of the Gini coefficient in the case of objective data on wages, one of the most routinely used and best-known inequality measures.

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<sup>7</sup> Moreover, while most respondents were asked to estimate earnings before taxes, respondents in a few realizations of the survey were asked to estimate wages after taxes. This further complicates any simple comparison between the two measures. In the empirical analysis below, however, the inclusion of country and survey-year fixed effects will largely eliminate this issue. Another issue is that the questions in the ISSP module implicitly refer to full-time workers only, while objective inequality measures cover both full- and part-time workers.

<sup>8</sup> Kuhn (2013) provides kind of a validity check of the framework, showing that the framework is able to capture plausible differentials in inequality perceptions between (former) East and West Germany, consistent with evidence from other, independent sources of data (Alesina and Fuchs-Schündeln 2007).

### 3.1 Measuring individual-level inequality perceptions using subjective Gini coefficients

While the computation of the Gini coefficient in practice is usually based on individual-level data, it is well known that it is also possible to work with group-level data on wages (e.g., Gastwirth and Glauber 1976; Kakwani and Podder 1973).<sup>9</sup> In fact, in the simplest case, observing wage information for only two distinct groups of individuals is sufficient for approximating the underlying inequality of individual wages. I will focus on this special case in what follows because it most easily translates to the case of subjective wage data.

The main idea in applying the framework to the perceived, rather than the objective, level of wage inequality is to acknowledge that individuals, at least potentially, have imperfect or biased information about the existing wage levels for the two groups. At the conceptual level, this implies that the wage shares of the two groups will be considered as individual-specific quantities in principle.<sup>10</sup> Formally, let us assume that the following triplet of information is observed for each respondent:

$$y_i \equiv \left( \bar{y}_i^{\text{bottom}}, \bar{y}_i^{\text{top}}, f^{\text{bottom}} \right), \quad (1)$$

with  $\bar{y}_i^{\text{bottom}}$  and  $\bar{y}_i^{\text{top}}$ , respectively, denoting the wage share going to the bottom and the top group of wage earners as perceived by a given individual  $i$ , and with  $f^{\text{bottom}}$  denoting the relative size of the bottom group of wage earners. Because there are only two groups of wage earners, and because they are assumed to be exhaustive, the two population shares must add up to one. This in turn implies that  $f^{\text{top}} = (1 - f^{\text{bottom}})$ .

Further, starting from Eq. (1), an individual's subjective overall wage estimate is given by:

$$\bar{y}_i = f^{\text{bottom}} \cdot \bar{y}_i^{\text{bottom}} + (1 - f^{\text{bottom}}) \cdot \bar{y}_i^{\text{top}}, \quad (2)$$

which implies that the wage share earned by the bottom group, as perceived by individual  $i$ , is given by the following ratio:

$$q_i^{\text{bottom}} = \left( f^{\text{bottom}} \cdot \bar{y}_i^{\text{bottom}} \right) / \bar{y}_i \quad (3)$$

<sup>9</sup> However, because the Gini coefficient constructed from grouped data ignores within-group inequality, it tends to underestimate the true level of inequality (e.g., Fuller 1979; Olgwang 2003).

<sup>10</sup> The two population shares are treated as fixed parameters, even though it is easy to imagine that individuals have different (and potentially biased) perceptions of these quantities as well; see Evans and Kelley (2004), for example. This contrasts with other frameworks used in the literature which rely on individuals' estimates of relative group sizes (e.g., Engelhardt and Wagener 2014; Gimpelson and Treisman 2018; Niehues 2014). As mentioned in Introduction, the findings from Eriksson and Simpson (2012) and Chambers et al. (2014) suggest that the extent of inequality individuals perceive might differ, depending on whether the measurement is based on individuals' estimates of wages and/or relative group sizes.

Finally, when there are only two groups of wage earners, individual-level Gini coefficients can easily be computed as follows, as shown in Kuhn (2011):

$$G_i = f^{\text{bottom}} - q_i^{\text{bottom}} \quad (4)$$

Thus, the Gini coefficient is simply given by the difference between the population share of the bottom group and the wage share of the bottom group.<sup>11</sup>  $G_i$  is best thought of as a summary measure of an individual's perception of wage differentials across occupations, and it represents, in this sense, an individual's perception of inequality in market wages. Because individuals will tend to have different perceptions of group-specific wages, they will also differ regarding the perception of wage inequality. In contrast to the objective level of inequality, which can be described by a single Gini coefficient  $G$ , there will usually be a distribution of individual-level inequality perceptions,  $f(G_i)$ .

### 3.2 Subjectively perceived wage levels

A final issue that needs to be clarified is the construction of empirical counterparts of the three arguments on the right-hand side of Eq. (1), i.e., an individual's subjective perceptions of the wage level of the two groups of wage earners along with the relative size of the bottom group of wage earners. Remember that there are only four occupations for which respondents were asked to give wage estimates in each of the four waves of the survey, and I will thus only use data referring to these occupations.

Specifically, I calculate subjective wage estimates of a given individual  $i$  for the two groups of wage earners as:

$$\bar{y}_i^{\text{bottom}} = y_i^{\text{unskilled}}, \quad \text{and} \quad (5a)$$

$$\bar{y}_i^{\text{top}} = \frac{1}{3} \cdot \left( y_i^{\text{doctor}} + y_i^{\text{minister}} + y_i^{\text{chairman}} \right), \quad (5b)$$

respectively. That is, I simply use an individual's estimate of an unskilled worker's wage as his or her perception of the wage earned by the bottom group and, analogously, the average estimate of the wage of a doctor, a minister, and a chairman as a given individual's perception of the mean wage paid to the top group of wage earners.

The fraction of individuals belonging to the bottom group,  $f^{\text{bottom}}$ , is estimated from the observable distribution of individuals across different occupations in the following way:

$$f^{\text{bottom}} = \frac{1}{n} \sum_{i=1}^n \mathbf{1}(\text{isco}_i \in [3, 9]) = 1 - f^{\text{top}} = 1 - \frac{1}{n} \sum_{i=1}^n \mathbf{1}(\text{isco}_i \in [1, 2]), \quad (6)$$

<sup>11</sup> In principle, and in contrast to the Gini coefficient describing the objective distribution of wages, the subjective Gini coefficient given by Eq. (4) can take on negative values because some individuals may believe that  $\bar{y}_i^{\text{bottom}} > \bar{y}$ , which would imply that the perceived wage share of the bottom group is larger than their actual population share. (That is,  $q_i^{\text{bottom}}$  can take on any value between zero and one.) Empirically, as shown in Table 1, this is true for a small fraction of the overall sample (less than 0.4% of the overall sample).



with  $\mathbf{1}(\cdot)$  denoting the indicator function, and with  $\text{isco}_i$  denoting an individual's major occupational code according to the International Standard Classification of Occupations (ISCO). According to this classification, major group 1 (i.e.,  $\text{isco} = 1$ ) consists of "legislators, senior officials and managers" and major group 2 (i.e.,  $\text{isco} = 2$ ) of "professionals." Even though  $f^{\text{bottom}}$  is assumed not to vary across individuals, note that I estimate a different  $f^{\text{bottom}}$  for each aggregate cell.<sup>12</sup>

### 3.3 Strengths and weaknesses of the framework

The main strength of the framework presented above, and the feature that sets it apart from other frameworks used in previous studies, such as measures based on log ratios of wages (e.g., Jasso 1999; Schneider and Castillo 2015), is that it "mimics" the Gini coefficient—without doubt the best-known measure of inequality, even though it is not the best inequality measure from a theoretical point of view (e.g., Cowell 2000). Beyond that, there is a potential advantage for the Gini coefficient in terms of comparisons between perceptions and objective level of inequality because internationally comparable data on the Gini are more easily available than data on objective wage ratios. Another, more practical, advantage of the measure is that it combines several subjective wage estimates into a single statistic, which is efficient in the sense that it uses more information than, say, a simpler ratio measure. Moreover, the averaging across different wage estimates for the top group [cf. Eq. (5b) above] as well as the implicit downweighting [best evident in Eq. (2)] are expected to make the measure relatively robust to outliers.

The framework also has a couple of potential shortcomings, however, one being that the framework combines subjective wage estimates with objective relative group sizes (which essentially amounts to assuming that all individuals have correct knowledge about the relative size of the two groups of wage earners). While this may make the measure more transparent (in the sense that all differences in the subjective Gini across individuals are solely driven by differences in the underlying wage estimates), it ignores evidence suggesting that individuals have biased perceptions of these parameters as well (Evans and Kelley 2004). Another issue is that, so far, the ISSP does not use a comprehensive list of occupations when asking the respondents to estimate wage levels. Finally, there remain a couple of conceptual differences between subjective and objective Gini coefficients that complicate the comparison between the two (an issue that is further discussed in Sect. 5 below).

### 3.4 Tolerance of inequality

Finally, using an argument analogous to that used in constructing individual-level inequality perceptions, and because respondents in the ISSP surveys were not only asked about actual, but also about fair wages paid for in different occupations, it is possible to compute an empirical measure of individuals' tolerance of inequality as

<sup>12</sup> Estimated group shares do not change much over time, and thus, the results would hardly change if I only were to allow the population shares to vary across countries (but not over time within a given country). There are, however, substantial differences in  $f_{\text{bottom}}$  across countries.

well. The only difference compared to the construction of inequality perceptions is that it uses individuals' estimates of just, instead of actual, wages for people working in different occupations (which implies that tolerance of inequality is measured as a Gini coefficient as well). Individual-level tolerance of inequality thus reflects an individual's desired distribution of market wages, expressed in terms of a hypothetical level of inequality which is judged as just (see Kuhn 2011, for additional details).

Besides being of interest on its own, tolerance of inequality has been shown to be highly correlated with an individual's perception of the degree of wage inequality (Kuhn 2011; Mijs 2019; Trump 2018). More specifically, these studies find that a high level of perceived inequality tends to go hand in hand with a high level of tolerated inequality (and vice versa). Moreover, if individuals' perceptions of inequality are correlated with the prevailing level of inequality, then objective-level inequality will be correlated with tolerance of inequality as well. This implies individuals' tolerance of inequality may be an important control variable, both when estimating the association between inequality perceptions and the objective level of inequality (see Sect. 5 below) and when estimating the association between attitudes to inequality and inequality perceptions (cf. Sect. 6).

## 4 Descriptives

Table 1 presents a few overall descriptives (i.e., descriptives referring to the overall sample) for the variables of interest. Panel (a) first focuses on individuals' subjective perceptions of wage inequality. Individual inequality perceptions average 0.424 across all available countries and years. (Remember that inequality perceptions are measured in Gini points.) Clearly, there is a lot of variation in the perception of wage inequality across individuals, as indicated by the corresponding standard deviation of about 0.161 (see also "Online Appendix B.4" for further evidence on (residual) variation in inequality perceptions). Further note that there are only few individuals who do not perceive any wage differentials across the different occupations at all (only about 1 percent of the overall sample). Another obvious, yet somewhat counterintuitive feature, is that there is a small fraction of individuals with negative inequality perceptions (cf. footnote 11).

Panel (b) of Table 1 in turn shows descriptives for the two aggregate-level Gini coefficients describing the objective distribution of income in a given country and year. (Note that the descriptives in this case are based on variation across distinct aggregate-level cells only, not on individual-level data.) The mean Gini coefficient before taxes and transfer payments equals 0.453, while the Gini after taxes and transfers averages 0.304.

Panel (c) presents summary statistics for the variables used as controls in the regression analysis below, namely age (in years), a female dummy, an individual's self-positioning on a top-bottom scale, and his/her tolerance of inequality; and, at the aggregate level: a country's GDP per capita, its growth rate, its unemployment rate, its labor force participation rate, and social expenditure (as a percentage of GDP). The most notable finding here is the comparison of the average of tolerance of inequality with the mean of inequality perceptions. (Note that a direct comparison is possible

**Table 1** Descriptives

Variable	Mean	Standard deviation	Intraclass correlation
<i>(a) Individual-level perceptions of wage inequality</i>			
Inequality perceptions	0.424	0.161	0.366
<b>1</b> (inequality perception < 0)	0.004	0.067	
<b>1</b> (inequality perception = 0)	0.001	0.032	
<b>1</b> (inequality perception > 0)	0.994	0.074	
<i>(b) Aggregate-level statistics on inequality</i>			
Gini coefficient, before taxes/transfers	0.453	0.052	
Gini coefficient, after taxes/transfers	0.304	0.061	
<i>(c) Other individual- and aggregate-level controls</i>			
Age (in years)	44.793	16.256	0.035
Female (yes = 1)	0.517	0.500	0.006
Top-bottom self-positioning (1–10, 10 = highest)	5.150	1.788	0.143
Tolerance of inequality	0.291	0.152	0.230
Per capita GDP (in constant 2005 US dollars)	23,266.459	14,673.997	
Growth rate	−0.205	4.668	
Unemployment rate	8.444	3.397	
Labor force participation rate	70.914	5.605	
Social expenditure (as percentage of GDP)	20.845	4.989	

The table shows descriptives for the overall sample ( $n = 81,049$  in the case of individual-level variables; aggregate-level variables are available for at most 78 distinct aggregate cells at the country  $\times$  survey-year level). Variable definitions and data sources are given in the main text. **1**( $\cdot$ ) denotes the indicator function

because the two measures are constructed in the same way, and thus both variables use the same scaling.) The comparison suggests that the distribution of wages considered fair is considerably more equal than the perceived distribution of wages (0.291 vs 0.424 Gini points).

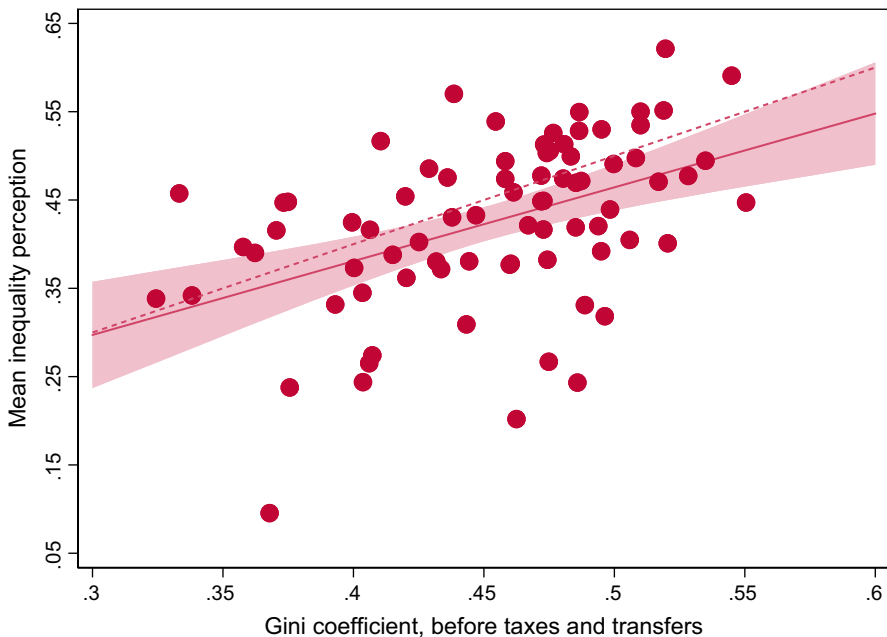
## 5 Inequality and inequality perceptions

The next section focuses on the empirical relation between the effective level of inequality (i.e., the level of inequality measured in an objective sense) in a given country and survey-year on the one hand, and individual-level, subjective perceptions of wage inequality on the other hand.

Because inequality perceptions are conceptualized as subjective Gini coefficients, it is obvious to perform such a comparison. However, before turning to the results, let me point out some issues that are important to keep in mind when comparing the two different measures. A first difference is that the two measures do not use

exactly the same income/earnings concept. While the ISSP asks for earnings, the Gini from the SWIID relates to incomes (i.e., wages plus income from other sources). Moreover, the two variables do also differ with respect to the population they relate to. The ISSP implicitly asks for full-time earnings of the working population only; the SWIID focuses on the distribution of equivalized household income among the total population. Finally, the two variables are also constructed in a different way; the SWIID is generally based on individual-level data, while the subjective Gini coefficients are calculated using grouped earnings data (as explained above). Moreover, in the case of the ISSP, there is only a small list of occupations for which subjective wage estimates are available.

Thus, there are a couple of reasons why the two measures might differ from each other empirically, even if individuals had perfectly unbiased perceptions of occupational wages. This implies that we should probably refrain from directly comparing the levels of the two measures. At the same time, those parts of the empirical analysis that essentially net out differences in the levels of the two variables, by including country and survey-year fixed effects in the regressions, should be much less, if at all, be affected by these issues (such as the results presented in Sect. 5.3 or in Sect. 6).



**Fig. 1** Mean subjective inequality perceptions and aggregate-level inequality at the country  $\times$  survey-year level. *Notes* The figure shows mean inequality perceptions, by country  $\times$  survey-year, against the corresponding Gini coefficient before taxes and transfer payments. The line and the shaded area, respectively, show the estimated regression function and its associated 95% confidence band. The dashed line corresponds to the 45° line

## 5.1 Graphical evidence

I start with some simple graphical evidence to illustrate the strength of the empirical association between inequality and inequality perceptions. Specifically, Fig. 1 plots the aggregate-level means of subjective inequality perceptions against the corresponding aggregate-level Gini coefficient, before taxes and transfer payments. Evidently, there is a strong and positive correlation between mean perceptions of wage inequality and the objectively measured level of inequality.

While it is not surprising to find that the two measures are correlated with each other, it is nonetheless notable how strong the correlation at the aggregate level actually is, given that the two measures are based on entirely independent sources of data. The estimated correlation coefficient equals 0.457 (with a  $p$  value  $< 0.01$ ). The figure also shows the estimated regression function, along with its associated 95% confidence band.

## 5.2 Estimation framework

To quantify the strength of the empirical association between the objective level of inequality and subjective inequality perceptions, I will estimate a series of regression models which all use individual-level inequality perceptions as the dependent variable and objective measures of the aggregate level of inequality as the main regressor(s). Specifically, these regression models will take on the following basic form:

$$G_{it}^* = \beta_0 + \beta_1 G_{j[i]t}^{\text{before}} + \beta_2 G_{j[i]t}^{\text{after}} + \beta_3 x_{it} + \beta_4 z_{j[i]t} + \phi_t + \psi_{j[i]} + \epsilon_{it}, \quad (7)$$

with the dependent variable  $G_{it}^*$  representing normalized individual-level inequality perceptions of individual  $i$  who participated in the survey in year  $t$ , as defined in Eq. (4) above. The regressor of key interest is either the Gini coefficient before and/or after taxes and transfer payments in country  $j$  and year  $t$ , denoted by  $G_{j[i]t}^{\text{before}}$  and  $G_{j[i]t}^{\text{after}}$ , respectively. The partial effect of inequality perceptions with respect to the objective level of inequality in a given country and year is of key interest in this context, and thus,  $\beta_1$  and/or  $\beta_2$  is of primary interest in what follows. Both  $\beta_1$  and  $\beta_2$  are expected to be positive, but the size of the parameters is mainly an empirical issue. Most importantly perhaps, it is not obvious, *ex ante*, whether the two parameters are smaller or larger than one. A coefficient about equal to one would indicate that the true level of inequality is reflected one-to-one in mean inequality perceptions, while a coefficient smaller (larger) than one would suggest that the effect of inequality on subjective perception is attenuated (amplified), due to, for example, biased coverage of the topic in the media (Petrova 2008). The comparison between  $\beta_1$  and  $\beta_2$  is interesting as well, showing whether individuals' perceptions of wage inequality are shaped by the distribution before and/or after government intervention.

Most of the regression models will also include survey-year fixed effects, denoted by  $\phi_t$ , as well as a full set of country fixed effects, denoted by  $\psi_{j[i]}$ . The fixed effects are important because they will absorb all systematic differences in inequality perceptions across countries and across years, independent of whether these differences are due

to observable or unobservable factors.<sup>13</sup> Finally, some of the more elaborated specifications will also include a few individual- and/or aggregate-level controls, denoted by  $x_{it}$  and  $z_{j[i]t}$  in Eq. (7) above, respectively. At the individual level, additional controls are age (in years), a female dummy, self-positioning on a top-bottom scale (cf. Knell and Stix 2017) and an individual's tolerance of inequality (cf. Sect. 3.4 above). Additional aggregate-level controls are a country's GDP per capita (in constant 2005 US dollars), its unemployment and labor force participation rate, social expenditure (as a percentage of GDP) and its growth rate (cf. Sect. 2.2 above).

A final estimation issue relates to the fact that the regressor of interest varies at the aggregate level only, while the dependent variable varies at the individual level. This might yield biased standard errors when the different levels of aggregation are neglected (e.g., Cameron and Miller 2015; Moulton 1990). To take this issue into account, I report standard errors that are clustered by country  $\times$  survey-year, instead of conventional standard errors, throughout the empirical analysis. (In the present context, this yields standard errors that are considerably larger than conventional standard errors.)

### 5.3 Main results

Table 2 presents the main estimates describing the association between perceptions of wage inequality and a country's aggregate-level inequality (focusing on market inequality in this step). The first column shows the resulting point estimate when the Gini coefficient before taxes and transfers is the only regressor in the model. This simple specification yields a large and statistically significant point estimate of  $\hat{\beta}_1 = 1.000$  (with a cluster-robust standard error of 0.239), resulting in a highly significant estimate. Moreover, also note that this simple model has a comparatively high fit, with a resulting R-squared of about 10%. This estimate, of course, mirrors the pattern shown in Fig. 1, and it underlines the fact that mean subjective inequality perceptions are strongly correlated with the effective level of inequality (which in turn implies that individual-level perceptions of inequality are correlated with each other within aggregate cells). At the same time, it is also immediately evident that there is a potentially high degree of individual misperceptions, because the by far larger fraction of the overall variation in inequality perceptions remains unexplained by the variation in aggregate-level inequality.

The second column adds country- as well as survey-year fixed effects. This yields a point of  $\hat{\beta}_1 = 1.059$  (with a cluster-robust standard error of about 0.263), which is about the same as the point estimate from the first specification. Interestingly, this specification confirms that there have been significant shifts in inequality perceptions over time (i.e., two of the three coefficients on the survey-year dummies are statistically significant, and a  $F$  test on the joint significance of all 3-year dummies yields a  $p$  value of 0.011), even conditional on the effective level of income inequality before taxes

<sup>13</sup> While it is possible to include a full set of country  $\times$  survey-year fixed effects, note that the fixed effects will fully pick up any potential effect of aggregate-level inequality on inequality perceptions (i.e., it is not possible to estimate both a full set of fixed effects and the effect of any aggregate-level variable). Nonetheless, estimating such a specification is useful as a robustness check, as discussed in Sect. 5.4 below.

**Table 2** Objective-level inequality and subjective inequality perceptions

	Inequality perception			
	(1)	(2)	(3)	(4)
Gini before taxes/transfers	1.000*** (0.239)	1.059*** (0.263)	1.068*** (0.260)	0.829*** (0.178)
Year = 1992		0.025 (0.026)	0.023 (0.026)	0.014 (0.018)
Year = 1999		0.054* (0.030)	0.051* (0.030)	0.027 (0.020)
Year = 2009		0.067** (0.030)	0.062** (0.030)	0.041** (0.020)
Age (in years)			0.001*** (0.000)	0.000*** (0.000)
Female (yes = 1)			-0.012*** (0.002)	-0.002 (0.001)
Top-bottom self-positioning			-0.001** (0.001)	-0.006*** (0.001)
Tolerance of inequality				0.529*** (0.017)
Country FEs	No	Yes	Yes	Yes
$p$ value ( $H_0 : \beta_1 = 1$ )	0.999	0.824	0.794	0.338
Number of observations	81,049	81,049	81,049	81,049
$R$ -squared	0.100	0.327	0.337	0.528

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country  $\times$  year, are shown in parentheses. The base year is 1987

and transfers. This is an interesting finding because it suggests that there have been shifts in the mean perception of inequality unrelated to changes in the effective level of inequality (potentially reflecting, for example, an increased public awareness toward issues of economic inequality and/or an increased coverage of such issues in the media). Alternatively, it may also be the case that there have been changes in earnings differentials not reflected in the Gini before taxes and transfers, but that show up in individuals' inequality perceptions. Moreover, this specification also nets out any other existing (and time-invariant) differences across the different countries such as any existing and persistent differences in market beliefs and other ideological factors.

Adding further individual-level controls has virtually no impact the estimated coefficient on the Gini before taxes and transfers, as shown in the third column of Table 2. The resulting estimate of  $\hat{\beta}_1 = 1.068$  remains highly statistically significant (with a cluster-robust standard error of about 0.260). The individual-level controls have the expected sign, and all three reach statistical significance. As expected, there is also a strong positive, and highly significant, association between tolerance of inequality and inequality perceptions (cf. Sect. 3.4), as shown in the final column of Table 2. The inclusion of this variables reduces the point estimate of  $\beta_1$  to about 0.829, which

remains statistically significant, however (robust standard error of 0.178). Also note that the inclusion of tolerance of inequality as a control substantively increases the overall fit of the model ( $R^2 = 0.528$  in the fourth column versus  $R^2 = 0.338$  in the third column).

Taken together, the estimates presented in Table 2 yield several interesting insights. First, subjective perceptions of wage inequality and aggregate-level inequality are quite strongly correlated with each other. Second, additional explanatory variables pick up a substantive part of the overall variation in inequality perceptions, but the association between subjective inequality perceptions and aggregate-level inequality remains robust to the inclusion of these additional controls. Third, and finally, note that all specifications from Table 2 yield point estimates that are consistently larger than zero. At the same time, and again across all specifications, the null hypothesis that the partial effect of aggregate-level market inequality is equal to one cannot be rejected (as shown at the bottom of Table 2).

## 5.4 Robustness

Table 3 presents a few robustness checks, documenting that the main estimates are robust to a variety of alternative model specifications. (For the ease of comparison, the first column of Table 3 simply replicates the baseline estimates from column 4 of Table 2.)

First, columns 2 and 3 of Table 3 present estimates that use a slightly different or an expanded set of control variables. More specifically, column 3 uses a more flexible specification with respect to the individual-level controls than the baseline model, including age-squared as well as interaction terms between the female dummy and age, age-squared, and tolerance of inequality. This yields an estimate very close to the baseline estimate. Column 4 also uses the baseline specification, but adds a couple of aggregate-level controls. (Note that this reduces the sample size by about 32.6%, compared to the baseline specification.) Again, however, this does not change the point estimate associated with the Gini coefficient before taxes and transfers by much ( $\hat{\beta}_1 = 0.837$  with a robust standard error of 0.272). Because of the large reduction in the sample size when including country-level controls, column 4 replicates the baseline specification using only the smaller sample of column 3. This yields a point estimate of  $\hat{\beta}_1 = 0.827$ , very close to both the estimate from column 3 and the baseline estimate from column 1.

In a next robustness check, column 5 reports estimates that use slightly different parameterizations of the objective level of inequality. Specifically, the estimates from the fifth column are from a regression which includes both the Gini after and the Gini before taxes and transfers as regressors. The estimated coefficient associated with the Gini before taxes and transfers remains positive and statistically significant ( $\hat{\beta}_1 = 0.835$ , robust standard error of 0.178), while the point estimate associated with the Gini after taxes and transfers is small and statistically insignificant ( $\hat{\beta}_2 = -0.039$ , robust standard error of 0.222). Similarly, column 6 includes both aggregate-level Gini coefficients, but also adds an indicator variable distinguishing between the earnings concept used in the survey (as mentioned in footnote 7 above) and the interaction



**Table 3** Robustness

	Inequality perception								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Gini before taxes and transfers	0.829*** (0.178)	0.833*** (0.178)	0.835*** (0.234)	0.827*** (0.274)	0.835*** (0.178)	0.690*** (0.234)	0.921*** (0.236)		
Gini after taxes and transfers					-0.039 (0.222)	-0.204 (0.250)		-0.375 (0.246)	
Age (in years)	0.000*** (0.000)	0.002*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Female (yes = 1)	-0.002 (0.001)	-0.011* (0.007)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.002)	-0.003 (0.002)	-0.003** (0.001)
Top-bottom self-positioning	-0.006*** (0.001)	-0.006*** (0.001)	-0.005*** (0.001)	-0.005*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.005*** (0.001)	-0.005*** (0.000)
Tolerance of inequality	0.529*** (0.017)	0.523*** (0.017)	0.496*** (0.013)	0.499*** (0.014)	0.529*** (0.017)	0.525*** (0.016)	0.541*** (0.019)	0.434*** (0.016)	0.490*** (0.014)
Survey-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	No	No	No	No	No	No

Table 3 continued

		Inequality perception								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Country-level controls	No	No	Yes	No	No	No	No	No	No	
I(income after) × Gini before/after	No	No	No	No	No	Yes	No	No	No	
Country × survey-year FEs	No	No	No	No	No	No	No	No	Yes	
Number of observations	81,049	81,049	54,626	54,626	81,049	81,049	56,858	24,191	81,049	
R-squared	0.528	0.530	0.537	0.535	0.528	0.532	0.506	0.590	0.559	

\*, \*\*, \*\*\* Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country × year, are shown in parentheses. Additional controls are: age-squared as well as interaction terms between the female dummy and age, age-squared, top-bottom self-positioning, and tolerance of inequality. Country-level controls are a country's per capita GDP (in constant 2005 US dollars), unemployment rate, labor force participation rate, growth rate and social expenditure (as a percentage of GDP). I(income after) is a dummy indicating that the questions on earnings in the different occupations used to construct the subjective Gini (cf. Sect. 3) in the survey referred to earnings after taxes and transfers

terms between this indicator variable and the two Gini coefficients. This specification yields estimates that are very similar to the ones from the preceding column.

The estimates in columns 7 and 8 split the sample according to the earnings concept used in the ISSP survey. Thus, column 7 (column 8) uses only the subset of the full sample where the earnings concept used was earnings before taxes (after taxes). Interestingly, the point estimate in column 7, where people were asked to estimate earnings before taxes, remains about the same size as in the baseline specification ( $\hat{\beta}_1 = 0.921$  with a robust standard error of 0.236). In the subset of the sample where the earnings concept was after taxes, the resulting point estimate is statistically insignificant ( $\hat{\beta}_1 = -0.375$  with a robust standard error of 0.246).

Finally, the specification in column 9 again uses the full sample, and it includes a full set of country  $\times$  survey-year fixed effects (i.e., the specification allows for time-variant country fixed effects). Because this specification absorbs all aggregate-level variation in inequality perceptions, a separate estimation of the coefficients on the two Gini coefficients is no longer possible. However, it is still informative to see that this model yields similar-sized estimates on the individual-level regressors as well as a model fit close to the baseline specification.

## 6 Attitudes to social inequality

A final issue that I want to address is whether the distinction between the objective level of inequality and individuals' subjective perception of inequality makes any difference when focusing on inequality as an explanatory variable, such as when thinking about the impact of inequality on attitudes (e.g., Kuhn 2011; Niehues 2014; Schneider 2012). Both Engelhardt and Wagener (2014) and Niehues (2014) have provided preliminary empirical evidence in favor of this argument. Both studies find that aggregate-level measures of inequality are not or even negatively associated with measures of redistribution, while subjective measures of inequality are positively associated. However, both studies use aggregate-level data in a small sample of countries only, and both estimate regression models that either include a subjective or a objective measure of inequality. A more recent study by Gründler and Köllner (2017), using a more sophisticated methodology, comes to similar conclusions, however. Another possibility to approach this question empirically is to use both individual-level subjective inequality perceptions and some objective, aggregate-level measure of inequality as regressors at the same time (cf. Gimpelson and Treisman 2018; Kuhn 2019).

In the following, I will thus estimate an additional series of regression models taking on the following common form:

$$a_{it} = \alpha_0 + \alpha_1 G_{it}^* + \alpha_2 G_{j[i]t}^{\text{before}} + \alpha_3 x_{it} + \phi_t + \psi_{j[i]} + \epsilon_{it}, \quad (8)$$

with the dependent variable  $a_{it}$  denoting attitudes toward social inequality of individual  $i$  in survey-year  $t$ .<sup>14</sup> More specifically, Table 4 reports estimates for three different measures of attitudes to inequality, namely (i) individuals' evaluation of

<sup>14</sup> "Online Appendix Table B.5" reports estimates using alternative measures of individual-level inequality perceptions in place of the baseline subjective Gini coefficient.

whether income inequality in their country of residence is too large, (ii) their stated support of government intervention to reduce income differences and (iii) their stated support of progressive taxation (see Kuhn 2019, for a more comprehensive analysis of the effect of inequality perceptions on natives' attitudes to inequality, using a much broader set of attitudinal measures).<sup>15</sup> All three dependent variables have been recoded such that higher values indicate, respectively, a more critical perception of the prevailing level of wage inequality or a stronger support of either government intervention or progressive taxation. I therefore expect both  $\alpha_1$  and  $\alpha_2$  to be positive throughout.<sup>16</sup> All the control variables appearing on the right-hand side of Eq. (8) were already defined earlier (see Sect. 5.2 above). Because the previous findings (cf. Table 3) suggest that inequality perceptions are mainly/only influenced by the distribution of economic resources before taxes and transfers, I only include  $G_{j|it}^{\text{before}}$  as regressor; however, I also checked that the results do not change when the Gini before taxes and transfers is included as regressor as well (see "Appendix" Table 8).

The first three columns of Table 4 show the corresponding estimates of individuals' normative evaluation of the perceived overall level of income inequality. The first column, which only considers individual-level inequality perceptions, yields a point estimate of  $\hat{\alpha}_1 = 1.253$ . With a cluster-robust standard error of about 0.099, this point estimate is significant at every conventional level of statistical significance. As expected, a higher perceived level of wage inequality is associated with respondents being more likely to think that the existing income difference in their country of residence is too large. The second column includes the aggregate-level Gini coefficient before taxes/transfers as key regressor instead of inequality perceptions. This specification yields a significant point estimate of  $\hat{\alpha}_2 = 1.377$  (with a cluster-robust standard error of 0.678), which appears to be consistent with the estimate from column 1. Column 3 includes both variables at once, yielding a positive coefficient for both inequality perceptions and the aggregate-level Gini coefficient. However, only the coefficient associated with individual-level inequality perceptions turns out to be statistically significant ( $\hat{\alpha}_1 = 1.245$ , with a robust standard error of 0.102).

Columns 4 to 6 report estimates for individuals' support of government intervention, using the same set of specifications as in the preceding three columns. The fourth column shows that there is again a positive, and highly significant, association between inequality perceptions and individuals' belief that the state should reduce income differences ( $\hat{\alpha}_1 = 1.183$  with a robust standard error of 0.096). The next column shows that there is also a positive, as well as significant, association with the aggregate-level Gini coefficient before taxes and transfers ( $\hat{\alpha}_2 = 2.551$ , with a robust standard error of about 0.876). The sixth column shows that, different to the first panel of Table 4, both individual-level perceptions of wage inequality and aggregate-level inequality have a

<sup>15</sup> The exact wording of the corresponding items is as follows: (i) "Income differences in (respondent's country) are too large" (five possible answer categories, ranging from "strongly agree" to "strongly disagree"), (ii) "Government should reduce income differences" (with the same possible answers as in (i)), and (iii) "Should people with high incomes pay more taxes" (five possible answers, ranging from "much larger share" to "much smaller share").

<sup>16</sup> As a simple robustness check, I also estimated similar regressions using binary variables (indicating a respondent's agreement with the underlying survey item) as dependent variables, yielding qualitatively identical results. Moreover, estimation by ordered probit also yields qualitatively identical results. These additional estimates are shown in "Appendix" Table 7.

**Table 4** Inequality perceptions and individuals' attitudes toward social inequality

	"Income differences are too large"			"Government should reduce income differences"			"People with high income should pay higher taxes"		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality perception	1.253*** (0.099)		1.245*** (0.102)	1.183*** (0.096)		1.143*** (0.104)	1.294*** (0.129)		1.245*** (0.129)
Gini before taxes/transfers		1.377** (0.678)	0.349 (0.586)		2.551*** (0.876)	1.608* (0.819)		3.395* (1.941)	2.280 (1.826)
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	79,878	79,878	79,878	78,999	78,999	78,999	49,874	49,874	49,874
R-squared	0.186	0.166	0.186	0.188	0.177	0.189	0.113	0.099	0.114

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country × year, are shown in parentheses. Individual-level controls are: age, female, top-bottom self-positioning and tolerance of inequality. See also Table 5 and "Appendix" Tables 8 and 9 for additional estimates

statistically significant effect when they are included as explanatory variables at the same time.

Finally, the remaining three columns of Table 4 report estimates with respect to individuals' support of progressive taxation (again using the same three specifications as above). Column 7 yields a positive and highly significant point estimate of  $\hat{\alpha}_1 = 1.294$  (robust standard error of 0.129), and, similar to the preceding panels, there is also a statistically significant association with the aggregate-level Gini coefficient, as shown in column 8. Finally, column 9 shows that only the coefficient on inequality perceptions remains statistically significant when both inequality perceptions and the aggregate level of inequality are included as regressors ( $\hat{\alpha}_1 = 1.245$ , robust standard error of 0.129).

It is also worth emphasizing that, for each of the three outcomes, the effect of inequality perceptions on attitudes is not only statistically significant, but also quantitatively important. Specifically, the estimates of column 3 (6, 9) imply an approximate elasticity of attitudes with respect to inequality perceptions, evaluated at mean values, of about 0.128 (0.130, 0.160).

One potential concern with the estimates from Table 4 is, however, that they are biased because of reverse causality, which would imply that the estimates potentially reflect that individuals with different attitudes toward inequality perceive a different level of inequality—rather than the other way around. Table 5 therefore presents two-stage least squares (2SLS) estimates of the effect of inequality perceptions on attitudes, using two different instruments. (The first column in each panel replicates the estimates from Table 4.) In the first case I use the logarithm of an individual's estimate of the overall wage level, i.e.,  $\ln(\bar{y}_i)$  (cf. Eq. (2)), as instrument for individual-level inequality perceptions. The main idea behind this instrument is that the perceived level of overall wages may be correlated with the perceived level of wage inequality, e.g., because of people having different reference groups (e.g., Knell and Stix 2017), but that there is no obvious reason for why this variable should influence his/her attitudes to social inequality, at least conditional on socio-demographic controls. The second instrument uses mean subjective inequality perceptions in regions-within-country  $\times$  survey-year, constructed directly from the survey data, as instrument for an individual's inequality perception (similar to Kuhn 2019).<sup>17</sup> Table 5 shows that the 2SLS estimates are generally consistent with the main estimates from Table 4, yielding essentially the same qualitative pattern of estimates. (In one case, however, the 2SLS estimate of  $\alpha_1$  using  $\bar{y}_i$  as instrument turns out insignificant.) Moreover, most 2SLS estimates for each of the three outcomes considered turn out to be larger than the simple estimates from Table 4, suggesting that the simple estimates are actually downward biased. (Also note that both instruments have a large first-stage effect, as indicated by the

<sup>17</sup> Mean inequality perceptions are only marginally influenced by individual inequality perceptions, but one might argue that a respondent's perception of wage inequality is influenced by the perceptions of people around him or her (for example his or her colleagues at work). One potential issue with this instrument is that there might be a direct (positive) effect on individuals' attitudes, which would bias the 2SLS estimates (upward). On the other hand, the results from "Online Appendix Table B.3" suggest that regional differences (within countries) in inequality perceptions do not appear to be especially relevant, conditional on country and survey-year fixed effects.

**Table 5** Inequality perceptions and individuals' attitudes toward social inequality—accounting for reverse causality

	Income differences are too large			Government should reduce income differences			People with high income should pay higher taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality perception	1.253*** (0.099)	2.388*** (0.493)	2.127*** (0.372)	1.183*** (0.096)	0.779 (0.506)	2.477*** (0.306)	1.294*** (0.129)	3.073*** (0.607)	2.636*** (0.720)
Estimation method	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Instrument	-	$\ln(\bar{y}_H^{actual})$	$\bar{G}_{k l}^{actual}$	-	$\ln(\bar{y}_H^{actual})$	$\bar{G}_{k l}^{actual}$	-	$\ln(\bar{y}_H^{actual})$	$\bar{G}_{k l}^{actual}$
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	79,878	79,878	79,878	78,999	78,999	78,999	49,874	49,874	49,874
R-squared	0.186	0.169	0.176	0.188	0.187	0.173	0.113	0.082	0.095

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country  $\times$  year, are shown in parentheses. Individual-level controls are: age, female, top-bottom self-positioning and tolerance of inequality. First-stage  $F$  values testing for instrument relevance are given in brackets. The first column in each panel is identical to the first column of the corresponding panel in Table 4. The second and third columns in each panel show 2SLS estimates, instrumenting for inequality perceptions. Instruments are the log perceived overall wage level of individual  $i$  (cf. Eq. (2)) in the second and mean inequality perceptions (by regions-within-country  $\times$  survey-year) in the third column of each panel, respectively. See also "Appendix" Tables 8 and 9 for additional estimates

corresponding first-stage F-statistic which tests for the strength of the instrument, at least in the case of the second instrument.)<sup>18</sup>

Taken together, these results yield the following insights. First, and consistent with previous evidence (e.g., Gimpelson and Treisman 2018; Kuhn 2019), I find that subjective inequality perceptions are more important—in a statistical sense—than aggregate-level measures of inequality for predicting the observed variation in individual attitudes to social inequality.<sup>19</sup> This finding that inequality perceptions affect individuals' attitudes toward social inequality is consistent across the different outcome measures, robust to different specification checks, and does not appear to be driven by reverse causality. Secondly, comparing the estimates for the same outcome across the different specifications suggests that the effect of aggregate-level inequality runs mainly through its effect on inequality perceptions, a finding which is highly intuitive and consistent with previous results (cf. Sect. 5).

## 7 Conclusions

In this paper I present a simple, yet intuitive conceptual framework suitable for measuring individual-level perceptions of wage inequality using a small set of simple survey questions asking individuals about their perception of wages paid for in different occupations. The framework is illustrated using internationally comparable survey data from the ISSP cumulation on social inequality, which covers a large number of different countries over a relatively long period of time with a total of about 81,000 individual observations from 27 different countries and from up to 4 different points in time.

The main part of the empirical analysis focuses on the association between aggregate-level measures of inequality and individual-level perceptions of wage inequality using a series of descriptive regression models. Not surprisingly, and in line with previous evidence on the subject (Gimpelson and Treisman 2018; Loveless and Whitefield 2011), I find that the true level of inequality is strongly and positively associated with subjective inequality perceptions.<sup>20</sup> This result turns out to be robust to a variety of specification checks (including, for example, alternative parameterizations of aggregate-level inequality). At the same time, there often is a large discrepancy between the effective level of inequality and an individual's subjective perception of inequality, a finding which is again consistent with previous results (e.g., Chambers et al. 2014; Eriksson and Simpson 2012; Gimpelson and Treisman 2018).

<sup>18</sup> I also estimated the models using both instruments at the same time and based on different estimation methods (see "Appendix" Table 9). Overall, the resulting point estimates are close to the 2SLS estimates from Table 5. Moreover, I cannot reject the null hypothesis that the overidentifying restrictions are valid in two out of three cases, supporting the credibility of the 2SLS estimates.

<sup>19</sup> For each of the three outcomes of Table 4, I also estimated a regression specification including a full set of country  $\times$  survey-year fixed effects (see, again, "Appendix" Table 8). In each case, the estimates turn out very similar to those from Table 4, further strengthening the case that attitudes toward inequality are primarily driven by the perception of inequality, rather than by the true level of inequality.

<sup>20</sup> Moreover, the finding of such a close association between inequality perceptions and aggregate-level inequality, using entirely independent sources of data, shows that simple survey items are sometimes surprisingly powerful indicators of even complex economic phenomena.



The final part of the empirical analysis shows that individuals' attitudes toward social inequality are strongly associated with both inequality perceptions and the objective level of inequality when considered separately, but only with inequality perceptions when the two variables are considered simultaneously—which is consistent with the intuition that the effect of aggregate-level inequality runs indirectly, through its impact on individuals' inequality perceptions. This effect turns out to be robust to a variety of specification checks, and it also holds when potential bias due to reverse causality is taken into account. It also confirms similar conclusions from several previous studies, using in part different and independent sources of data and alternative measurement frameworks (e.g., Kuhn 2019; Schneider 2012; Gimpelson and Treisman 2018). Further, the more general finding that the true level of inequality is strongly correlated with individuals' perceptions of wage inequality is in line with similar results from diverse contexts showing that the political-economic context partially shapes individuals' beliefs, perceptions and preferences (e.g., Di Tella et al. 2007; Giuliano and Spilimbergo 2014; Oto-Peralías 2015).

Finally, the research described in this paper also points out some open issues and interesting questions that future work could consider. First, there are two potentially important issues related to the conceptual framework laid out. The first issue is that the ISSP surveys do not really provide subjective wage estimates for a set of occupations that clearly represent the distribution of wage earners in its totality. However, such a comprehensive list of occupations may be crucial if one really wants to evaluate whether people under- or overestimate the prevailing level of inequality. Relatedly, while the empirical implementation of the framework presented in this paper used fixed proportions for the different groups of wage earners (which is equivalent to the assumption that individuals have correct knowledge about these parameters), evidence suggests that individuals have different perceptions of group sizes as well. It would be interesting to incorporate subjective group sizes into the construction of the subjective Gini coefficient and to see how the results differ from those reported in this paper. There are also substantive issues that may deserve to be addressed in more detail. One issue that became clearly apparent in the course of the analysis is that many people have severely biased perceptions of inequality. It would be interesting to further explore the individual- and contextual-level factors determining whether a person perceives a low or high degree of inequality. At the aggregate level, for example, it might be interesting to study whether the type of welfare state is associated with the mean level of inequality misperceptions.

## Compliance with ethical standards

**Conflict of interest** The author declares that he has no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by the author.

## A Additional tables

See Tables 6, 7, 8 and 9.

**Table 6** Number of valid observations, by country and survey-year

	Number of observations				Total
	1987	1992	1999	2009	
Australia	1318	1698	1401	1261	5678
Austria	859		859	971	2689
Bulgaria		880	802	496	2178
Canada		808	878		1686
Chile			981	1381	2362
Cyprus			920	929	1849
Czech Republic		643	1637	1150	3430
France			1631	2267	3898
Germany (former West)	1211	1923	727	778	4639
Germany (former East)		968	419	372	1759
Hungary	2165	1075	970	856	5066
Israel			1157	1012	2169
Italy			1157	1012	2169
Japan			588	568	1156
Latvia			1047	893	1940
New Zealand		1048	940	836	2824
Norway		1332	1148	1371	3851
Philippines		904	1075	1008	2987
Poland	1439	1333	892	967	4631
Portugal			990	640	1630
Russia		1655	1160	1421	4236
Slovak Republic		394	1055	1053	2502
Slovenia		859	846	815	2520
Spain			914	933	1847
Sweden		632	964	1013	2609
Switzerland				1087	1087
UK	985	895	623	806	3309
USA	1242	1108	899	1353	4602
Total	9219	19,132	25,523	27,175	81,049

The table shows the number of individual observations in the final analysis sample (i.e., the sample used for the main estimates shown in Table 2)

**Table 7** Attitudes to social inequality—alternative estimation approaches

	Income differences are too large			Government should reduce income differences			People with high income should pay higher taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality perception	1.253*** (0.099)	0.396*** (0.039)	1.853*** (0.133)	1.183*** (0.096)	0.393*** (0.036)	1.352*** (0.100)	1.294*** (0.129)	0.633*** (0.057)	1.392*** (0.142)
Estimation method	OLS	LPM	OProbit	OLS	LPM	OProbit	OLS	LPM	OProbit
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	79,878	79,878	79,878	78,999	78,999	78,999	49,874	49,874	49,874
(Pseudo-)R-squared	0.186	0.122	0.093	0.188	0.142	0.074	0.113	0.114	0.042

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country  $\times$  year, are shown in parentheses. The first column in each panel is identical to the third column of the corresponding panel in Table 4. The second column in each panel uses a dummy variable indicating a respondent's agreement with the corresponding statement in the survey item. Parameters in the second (third) column in each panel are estimated using a linear probability model (ordered probit)

**Table 8** Inequality perceptions and attitudes toward social inequality—additional estimates

	Income differences are too large			Government should reduce income differences			People with high income should pay higher taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality perception	1.245*** (0.102)	1.245*** (0.102)	1.175*** (0.100)	1.143*** (0.104)	1.142*** (0.105)	1.032*** (0.101)	1.245*** (0.129)	1.232*** (0.130)	1.150*** (0.118)
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey-year FEs	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Country FEs	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Gini before also included	No	Yes	No	No	Yes	No	No	Yes	No
Country × survey-year FEs	No	No	Yes	No	No	Yes	No	No	Yes
Number of observations	79,878	79,878	79,878	78,999	78,999	78,999	49,874	49,874	49,874
R-squared	0.186	0.186	0.196	0.189	0.189	0.198	0.114	0.119	0.136

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country × year, are shown in parentheses. The first column in each panel is identical to the third column of the corresponding panel in Table 4. In each panel, the second column further adds the Gini coefficient before taxes and transfer payments (on top of the Gini after taxes and transfers), while the third column adds a full set of country × survey-year fixed effects

**Table 9** Attitudes to social inequality—additional estimates based on overidentified models

	Income differences are too large			Government should reduce income differences			People with high income should pay higher taxes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inequality perception	2.198*** (0.280)	2.198*** (0.280)	2.252*** (0.267)	2.015** (0.267)	2.021*** (0.269)	1.890*** (0.268)	2.946*** (0.508)	2.948*** (0.508)	37.872 (526.529)
Estimation method	2SLS	LIML	GMM	2SLS	LIML	GMM	2SLS	LIML	GMM
Individual-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	79,878	79,878	79,878	78,999	78,999	78,999	49,874	49,874	49,874
<i>p</i> value (F-statistic)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>p</i> value (J-statistic)	–	–	0.640	–	–	0.000	–	–	1.000
<i>p</i> value (C-statistic)	–	–	0.000	–	–	0.000	–	–	0.367
<i>R</i> -squared	0.174	0.174	0.172	0.182	0.182	0.184	0.086	0.086	0.007

\*, \*\*, \*\*\*Denote statistical significance at the 10%, 5% and 1% levels, respectively. Robust standard errors, clustered by country  $\times$  year, are shown in parentheses. First-stage *F* values testing for instrument relevance are given in brackets. All estimates use both the log perceived overall wage level of individual *i* (using all occupational wages) and mean inequality perceptions (by regions-within-country  $\times$  survey-year) as instruments. Estimation by GMM allows testing for overidentifying restrictions (Hansen's J-statistic) and testing for exogeneity of the presumed endogenous variable (C-statistic)

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