OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

WORKING PAPER 211

Inequality, Perception Biases and Trust

Markus Knell, Helmut Stix

The *Working Paper series of the Oesterreichische Nationalbank* is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

The Working Papers are also available on our website (http://www.oenb.at) and they are indexed in RePEc (http://repec.org/).

Publisher and editor *Oesterreichische Nationalbank*
Otto-Wagner-Platz 3, 1090 Vienna, Austria
PO Box 61, 1011 Vienna, Austria
www.oenb.at
oenb.info@oenb.at
Phone (+43-1) 40420-6666
Fax (+43-1) 40420-046698

Coordinating editor Martin Summer

Design *Communications and Publications Division*

DVR 0031577

ISSN 2310-5321 (Print)
ISSN 2310-533X (Online)

Inequality, Perception Biases and Trust*

Markus Knell† and Helmut Stix‡
Oesterreichische Nationalbank

January 2017

Abstract

We present a theoretical framework that links trust, trustworthiness and inequality. It is assumed that an individual's level of interpersonal trust is related to expected trustworthiness among his reference group and that trustworthiness decreases when interpersonal income differences increase. As a consequence, inequality affects trust via the individual-specific perception of inequality which might not coincide with aggregate measures of inequality like the Gini coefficient. We work out the implications of our model for empirical estimations of the trust-inequality nexus and show that such regressions are very likely to understate the true effect of inequality. This might lead to the erroneous conclusion that inequality exerts no effect on trust. Survey data from Austria support the predictions of our framework. Individual-specific perceptions of inequality have a strong negative effect on trust while aggregate measures of inequality show no significant relation.

Keywords: Trust, Inequality, Perception
JEL-Classification: C23; D31; Z13

---

*The views expressed in this paper do not necessarily reflect those of the Oesterreichische Nationalbank. We thank Mathias Moser and Matthias Schnetzer for providing us with geographical data on income inequality in Austria from the TaxSim Project (Research Institute Economics of Inequality, Vienna University of Economics and Business). We are also grateful to an anonymous OeNB Working paper referee and for various conference participants for valuable comments and suggestions.

†OeNB, Economic Studies Division, Otto-Wagner-Platz 3, POB-61, A-1011 Vienna; Phone: (++43-1) 40420 7218, Fax: (++43-1) 40420 7299, Email: Markus.Knell@oenb.at.

‡OeNB, Economic Studies Division, Otto-Wagner-Platz 3, POB-61, A-1011 Vienna; Phone: (++43-1) 40420 7211, Fax: (++43-1) 40420 7299, Email: Helmut.Stix@oenb.at.

Non-Technical Summary

This paper is motivated by three observations: First, it is widely uncontested that a high level of trust is of great importance for economic and social development. Second, survey-based measures of trust have decreased over the recent decades for most countries. Third, economic inequality has considerably increased over the same time span. This paper investigates whether the latter two issues are related, i.e. whether rising inequality has an effect on trust. The answer provided in our paper is affirmative, although with a twist—it is not necessarily objectively measured inequality but rather the perception of inequality that lowers interpersonal trust.

We build a theoretical framework that formalizes the often vague notions of trust and trustworthiness and their relation to inequality. This framework is also a useful reference point for empirical estimations, i.e. for the derivation of testable hypotheses and for the organization of our empirical analysis. The framework rests on the view that trust is related to expected trustworthiness which in turn depends on expected relative income differences among members of a society. In other words, the likelihood that a randomly encountered person will behave in a trustworthy manner depends on how far away this person is from my socio-economic background. A very different income level, e.g., will result in a less trustworthy behavior. In deciding how much to trust, an individual has to evaluate pairwise income comparisons for all people that he or she considers.

The decisive issue in this trust evaluation is its scope. Are all people considered within a given region (and no other people from other regions)? In this case, we show that aggregate trust in a region is inversely related to the Gini coefficient. While this rationalizes the common empirical practice of regressing trust on the Gini coefficients we consider the underlying assumptions quite unrealistic: Individuals will typically only consider a socio-economic segment of the population and might also look across regions. Moreover, the breadth of this trust evaluation (how many other people to consider) will vary across agents. Under these more realistic assumptions, we show that a regression of trust on Gini coefficients could result in an underestimation of the true effect of inequality. The model shows that an unbiased estimate can be obtained if one uses a measures of perceived rather than objective inequality.

We confront the predictions of our model with Austrian survey data. We find that the income Gini coefficients of Austrian municipalities have no significant influence on individual trust. Subjective measures of the perception of inequality, however, exert a strong adverse effect on trust. Moreover, the crucial assumption that trust evaluations are based on pairwise income comparisons is confirmed by the data. Our main results hold for different trust measures and different empirical specifications. Overall, the paper demonstrates that inequality can exert a profoundly negative effect on trust even if the use of aggregate inequality measures does not suggest such a relation.

1 Introduction

Despite a substantial increase of interest in the multifaceted phenomenon of trust, there is still no consensus about the sources of trust. Some people see it primarily rooted in individuals' personalities (probably with a strong genetic base) while others explain it as the results of a history of bad or good experiences or point to the role of institutions and socio-economic conditions. One robust result of the empirical literature is that interpersonal trust depends on social distance. People from a similar socio-economic and socio-demographic background show more trusting behavior towards each other than people that differ along these dimensions.[1] Accordingly, one could conjecture that the increase in economic inequality over the recent decades has had a detrimental effect on trust. Joseph Stiglitz, for example, has expressed his worries that "trust is becoming yet another casualty of our country's staggering inequality. As the gap between Americans widens, the bonds that hold society together weaken" (Stiglitz 2013).

In light of this discussion, the paper deals with the relation between economic inequality and trust. We build a formal theoretical framework that is helpful in various respects. First, it lays out a conceptualization of the often vague notions of trust and trustworthiness and their relation to objective and perceived inequality. This allows us to state precisely under which conditions one can expect to find a close relation between average trust measures and measures of the Gini coefficient. Second, the theoretical framework is a useful reference point for empirical estimations, i.e. to derive testable hypotheses and to organize our empirical analysis. Third, the framework contributes to understanding conflicting results of the existing empirical literature. In particular, it offers an explanation why the effect of the Gini coefficient on trust is typically highly significant in one group of empirical studies (cross-country analyses) and often insignificant in another

[1] "In general, the more homogeneous a society, the more trust a (randomly selected) principal will place in a (randomly selected) agent" (Knack 2001, p. 7). "[A]nything that reduces the social distance between the citizens of a country could be expected to lead to more trust" (Bjørnskov 2007, p. 5).

group (within-country analyses).

Our starting point is the trust question that is commonly used in the literature: "Generally speaking, would you say that most people can be trusted?" Is has been widely discussed how survey respondents might interpret this rather general question and what might determine their answers. A common claim is that trust is associated with (or almost synonymous to) "expected trustworthiness" and we adopt this argument. Respondents will say that other people can be trusted if they think that other people behave in a trustworthy (i.e. cooperative, non-deceiving, non-opportunistic) manner. This, however, immediately raises two further questions. First, what determines trustworthiness and, second, what is the reference group that trusters (the survey respondents) have in mind when they answer a question about "most people"?

We stipulate that the trustworthiness of an arbitrary individual depends on personal traits (e.g. altruism), on socio-economic features (e.g. age, gender, employment status) and, importantly, on interpersonal differences for which economic inequality is the leading example. If the incomes of truster (Y_i) and trustee (Y_j) differ then this increases the likelihood that the trustee will not feel much common moral ground which decreases her willingness to cooperate. We assume that the strength of this feeling is related to the relative income difference $\nabla_{ji} = \frac{|Y_j - Y_i|}{E^j(Y)}$, where $E^j(Y)$ is the trustee's expectation of average income. The trust level of truster i will be influenced by his expectation about the income differences with all members j of his reference group, which we denote by $E^i(\nabla)$. The average trust level in a region will then be related to the mean of all individual perceptions of inequality ($E(E^i(\nabla))$).

The first important implication is that this mean of all individual perceptions of inequality corresponds exactly to the regional Gini coefficient under two crucial assumptions: (i) all individuals use identical reference groups when making income comparisons and (ii) these reference groups consist of all other persons from the own region but do not contain persons from other regions. The main specification of the empirical literature, regressing trust on Gini coefficients, can thus be rationalized within this conceptual framework if one believes that these "benchmark assumptions" are fulfilled.

We argue that these assumptions are highly unrealistic and that people typically have biased and heterogeneous reference groups. In particular, individuals tend to have closer and more frequent contact to people of a similar social and economic background and those similar people might be over-represented in respondents' reference groups. Also, reference groups are not necessarily region-centered, e.g. some individuals will give a higher weight to people that live in their own region or neighborhood while other persons might think about people living in remoter places.

The assumption of biased and heterogeneous reference groups has a number of implications for empirical estimation. First, analytical results and numerical simulations show that point estimates obtained from regressing trust on the Gini coefficient are likely to understate the true trust-decreasing effect of inequality. Equally problematic, such regressions might often lead to an acceptance of the false null hypothesis that there is no effect of inequality on trust. The simulations show that this erroneous result is more probable if the variation of the Gini coefficient is rather small which is typically the case for analyses based on difference across regions within a country.

The second important implication of the theoretical framework is that reliable estimates can be obtained if one employs direct measures of individual perceptions of income inequality rather than objective measures like the Gini coefficient to estimate the impact of inequality on trust. This conclusion holds irrespective of the way how individuals form reference groups.

The third important implication of the theoretical model concerns the individual perceptions of income inequality $E^i(\nabla)$. We show that under our assumption of pairwise income comparisons these perceptions will resemble a U-shape with respect to income.

Individuals at the tail ends of the distribution see a larger extent of income inequality than individuals in the middle which follows from the assumption that individuals base their perceptions of inequality on expected pairwise income comparisons. This implication, which holds both under homogenous and unbiased as well as under heterogenous and biased reference groups, can be tested empirically. Therefore, we can discriminate our trust framework against plausible alternative explanations, which imply a differently shaped relationship.

We utilize data from a survey that has been conducted among 2,000 Austrian residents, first, to test the predictions of our framework and, second, to inquire about the effect of inequality on trust. The survey elicits information on different aspects of trust and trustworthiness and on various social issues, including the respondents' subjective social standing, their perceptions about income inequality, the crime rate and the ethnic intermix. Moreover, we have collected measures of income inequality for all 181 municipalities that are covered in our sample, derived from tax register data. This information is used to investigate the determinants of trust and to study whether it is aggregate ("objective") measures of inequality or individual-specific ("subjective") perceptions of inequality that are more important for trust.

We find that the municipal Gini coefficients have no significant influence on individual trust. The same is true if one uses the 90/10 ratio as the inequality measure or alternative trust measures as the dependent variable. In line with the theoretical framework, however, subjective measures of the perception of inequality exert a strong adverse effect on trust. We provide evidence suggesting that this effect is causal. On the one hand, we conduct a number of robustness tests for sub-samples for which reverse causality should be less of an issue. On the other hand, we show that "objective" inequality exerts a significant effect if we control for the type of reference groups as predicted by our model. An additional empirical result lends supports to our key assumption that people perceive income inequality as the expectation of pairwise income differences. As predicted by the theoretical framework, we find that the relation between subjective perceptions of inequality and the rank in the income distribution is U-shaped. Finally, we get parallel results for other perception variables. In particular, the perception of the ethic intermix and the prevalence of crime in the own region are strongly related to individual trust, while this is not true for the corresponding objective measures.

The paper builds upon the literature that studies the connection between trust and socio-economic heterogeneity (including income inequality and ethnic fragmentation). Important papers in this wide literature are Knack (2001), Alesina & La Ferrara (2002), Uslaner (2002), Leigh (2006*a*), Leigh (2006*b*), Bjørnskov (2007), Gustavsson & Jordahl (2008), Hooghe et al. (2009) and the survey by Nannestad (2008). Our paper is also related to the literature that studies the perception of income and wealth inequality (Slemrod 2006, Norton & Ariely 2011, Kuziemko et al. 2015, Cruces et al. 2013, Gimpelson & Treisman 2015) and the influence of biased perceptions on social attitudes (Clark & D'Ambrosio 2015). A closely related paper is Butler et al. (2016). While our model implies (under certain assumptions) a hump-shaped pattern of trust with respect to income, Butler et al. (2016) document a hump-shaped relation of income with respect to trust for a sample of 32 countries. Their explanation of this pattern is based on the argument that for individuals with too little or too much trust, income will be lower than for individuals that have an intermediate level of trust. The level of trust of an individual itself is to a large extent predetermined by an inherited component. In contrast, we focus on the reverse direction of causation. In our model, trust is affected by the perception of inequality which itself depends on income. We will further discuss the differences between these two approaches in a later section.

Beyond providing a formal framework and new estimation results, our paper helps reconciling conflicting findings of the empirical literature. Specifically, our findings suggest that the formation of reference groups might place a veil between objective measures of inequality and trust which calls for caution when interpreting respective empirical results. For example, the estimated impact of the Gini coefficient on trust is typically weaker (and less often significant) in empirical studies that are based on small and rather homogeneous cross-country data or on within-country data (Alesina & La Ferrara 2002, Gustavsson & Jordahl 2008, Leigh 2006*b*) than on large, rather heterogeneous cross-country data (Bjørnskov 2007, Hooghe et al. 2009, Leigh 2006*a*).[2] Our model implies that these incongruent results reflect the fact that in cross-regional samples the variation in Gini coefficients is smaller and the likelihood of reference group heterogeneity higher than in cross-country samples.

The paper is structured as follows. In the next section we present our framework on the relation between inequality and trust and we derive various implications. In section 3 we use our dataset to study the empirical relation between trust and inequality. Section 4 concludes.

2 Theoretical Framework

2.1 Trustworthiness

There are $i \in [0, N]$ individuals living in some geographical area. For the moment one can think of this area as a specific country. Later we will discuss the choice of the geographical unit in more detail.

Individuals differ along various dimensions including their personality traits, their ethnicity, their income, their employment status, etc. Each person has random encounters

[2] For example: "The Gini coefficient, the measure used exclusively in previous studies, is more weakly related to Trust in our sample" (Gustavsson & Jordahl 2008, p.355), using a study based on Swedish regions. "Income inequality is among the most robust cross-country determinants of trust" (Bjørnskov 2007, p.5), referring to a sample of 64 heterogeneous countries.

with strangers where the own payoff depends on the level of cooperation of the other person. In a prisoners' dilemma situation, e.g., the vis-à-vis might play "cooperate" or "defect", in a public goods situation the other might contribute to a common good or not and in a trust game the opponent might return an investment or keep the advances for himself. The latter, sequential framework is the background of many experiments on the issue of trust (see e.g. Glaeser et al. 2000, Gächter et al. 2004) and we use it in the following to describe the trust situation. When individual i (the (male) truster) meets a randomly chosen individual j (the (female) trustee) he will face a specific level of cooperation (or "trustworthiness") TW_{ji} of the latter. This level of trustworthiness will depend on the personality traits of the trustee but also on how she sees the differences (in gender, socio-economic background variables, ethnicity etc.) between herself and individual i. We will primarily focus on economic differences. The related literature (see, e.g., Bjørnskov 2007) emphasizes that cooperative, trustworthy behaviour increases in the degree of homogeneity between truster and trustee. Possible reasons for this phenomenon are, e.g., that a person feels more empathy for a similar other, that she can step more easily in the shoes of the other person or that her self-image will be damaged to a larger degree if she disappoints a kindred spirit by defective behaviour. These arguments are captured in the following expression:

$$TW_{ji} = \tilde{\alpha} + \tilde{\gamma} X_j - \tilde{\delta} \nabla_{ji}, \tag{1}$$

where $\tilde{\alpha}$ is a constant, X_j a column vector of person-specific variables (gender, age, education, personality characteristics, ...) and $\tilde{\gamma}$ the corresponding row vector of coefficients. ∇_{ji}, on the other hand, measures the socio-economic difference between the truster i and the trustee j with $\tilde{\delta}$ the corresponding coefficient. In general the difference ∇_{ji} will be related to social differences in a broad sense that might depend on differences in income, wealth, status and human and social capital. In the following we will, however, often refer to the narrower concept of "income differences" since this corresponds to our empirical measures.

In line with the psychological literature equation (1) assumes that person-related factors are not influenced by the specific social situation and therefore the vector X_j is independent of the identity of individual i. This, however, is not true for ∇_{ji} that captures the argument that "unfamiliarity breeds contempt" and "familiarity breeds sympathy". According to this line of reasoning, individual j will show less cooperative or trustworthy behaviour if the other side of the random encounter is not considered to be part of the same moral community. We thus expect $\tilde{\delta} > 0$.

2.2 Perception of interpersonal inequality

There exist various possibilities to specify the trustee's measure of interpersonal income differences ∇_{ji}. We choose by intention a measure that implies a relation between average trust and the Gini coefficient (as will be shown below). We are, however, going to use our empirical data to test for the validity of the chosen specification and we will also briefly touch upon the implications of the use of alternative assumptions about ∇_{ji} in the following. Our measure of interpersonal income differences is based on the assumption that the trustee j assesses the pairwise income heterogeneity as the relative difference between the two incomes Y_i and Y_j. The strength with which the income difference affects her trustworthy behavior might depend on whether the other's income is higher or lower than the own income. In particular:

Assumption 1 (Perception of pairwise income inequality)

$$\nabla_{ji} = \begin{cases} (1-z)\frac{Y_i - Y_j}{E^j(Y)} & \textit{if}\; Y_i > Y_j, \\ z\frac{Y_j - Y_i}{E^j(Y)} & \textit{if}\; Y_j \geq Y_i, \end{cases} \tag{2}$$

where $E^j(Y)$ is individual j's expectation of mean income.

Assumption 1 implies that individual j is less cooperative if she sees her random opponent as either poorer ($Y_i < Y_j$) or richer ($Y_i > Y_j$) and that the magnitude of the effect depends on the sign of the income difference as measured by z.[3] It might be the case that individuals feel less empathy and less common moral ground with richer individuals and they will therefore show relatively less trustworthy behaviour in these encounters (i.e. $z < 1/2$). Individuals might as well identify themselves to a larger extent with richer and high-status peers (cf. Butler 2014) and the emulation of upward behaviour induces them to behave more cooperatively in these situations (i.e. $z > 1/2$). Finally, one could assume as a benchmark case that upward and downward comparisons are equally important and that deviations on both sides decrease the strength of social bonds (i.e. $z = 1/2$). Later, we will show that the average measure of perceived inequality in a society is independent of z and given by the Gini coefficient.[4]

2.3 Trust

When individual i is asked about his "general level of trust" he will think about a situation where he is in the role of the truster (e.g. by extending a favour, making an upfront investment, lending money etc.). Under the assumption that individual i knows the

[3]Note that there exists an alternative justification for the weights z and $(1-z)$. In particular, one can start with the assumption that income differences have a different impact on trustworthiness as expressed in (1) depending on the sign of the difference. In particular, $TW_{ji} = \tilde{\alpha} + \tilde{\gamma} X_j - \tilde{\delta}^H \frac{Y_i - Y_j}{E^j(Y)}$ if $Y_i > Y_j$ and $TW_{ji} = \tilde{\alpha} + \tilde{\gamma} X_j - \tilde{\delta}^L \frac{Y_j - Y_i}{E^j(Y)}$ if $Y_i \leq Y_j$. If one defines $z = \frac{\tilde{\delta}^L}{\tilde{\delta}^H + \tilde{\delta}^L}$, $(1-z) = \frac{\tilde{\delta}^H}{\tilde{\delta}^H + \tilde{\delta}^L}$ and $\tilde{\delta} = \tilde{\delta}^H + \tilde{\delta}^L$ then this formulation is equivalent to equations (1) and (2).

[4]The relative income difference has also been proposed to measure the extent of relative deprivation (or relative satisfaction) and is frequently used in the literature on income comparisons, inequality and poverty (see Runciman 1966, Yitzhaki 1979, Hey & Lambert 1980, Clark & D'Ambrosio 2015). In this context the fraction $\frac{Y_i - Y_j}{E^j(Y)}$ is seen as the feeling of (relative) deprivation experienced by the individual with income Y_j toward the individual with income $Y_i > Y_j$ (Hey & Lambert 1980, 567). On the other hand the individual might obtain (relative) satisfaction if $Y_j > Y_i$ although in the literature this case is mostly neglected. In other words, in the context of relative deprivation it is assumed that only (disadvantageous) upward comparisons are important which amounts to $z = 0$.

determinants of trustworthiness (1) he has to form an opinion about the expected level of trustworthiness of a randomly chosen individual j. In other words, the level of trust of individual i (and thus his answer to the general trust question) will be related to his expectation of average trustworthiness $E^i(TW_{ji})$, where the expectations parameter $E^i = E(\cdot \mid \Omega^i)$ refers to the information set Ω^i of individual i that might not contain all available data. In particular, we assume that trust can be written as:

$$T_i = \breve{\alpha} + \beta Z_i + \kappa E^i(TW_{ji}). \tag{3}$$

Interpersonal differences in trust can have various reasons. First, personal traits Z_i might again be important factors with associated coefficients β. Second, an individual might have biased perceptions of the world and might not refer to the universe of all individuals j when thinking about possible random encounters and the corresponding levels of trustworthiness TW_{ji}. Put differently, the information set Ω^i might only contain the incomes of all individuals $j \in \mathbb{S}_i$, where $\mathbb{S}_i$ denotes the reference group of individual i. It is, e.g., quite likely that individuals from the own geographical region and the own social class are over-represented in this reference groups.

Using equation (1) in (3) one can then write:

$$T_i = \breve{\alpha} + \beta Z_i + \kappa E^i \left(\tilde{\alpha} + \tilde{\gamma} X_j - \tilde{\delta} \nabla_{ji} \right) \tag{4}$$

or more compact:

$$T_i = \alpha + \beta Z_i + \gamma E^i \left(X \right) - \delta E^i \left(\nabla \right), \tag{5}$$

where $\alpha \equiv \kappa\tilde{\alpha} + \breve{\alpha}$, $\gamma \equiv \kappa\tilde{\gamma}$, $\delta \equiv \kappa\tilde{\delta}$, $E^i \left(X \right) \equiv E^i \left(X_j \right)$ and $E^i \left(\nabla \right) \equiv E^i \left(\nabla_{ji} \right)$. Trust—the answer to the trust question—will thus depend on own person-specific factors Z_i of the truster i, on his expectations about person-specific factors $E^i \left(X \right)$ in his reference group and on $E^i(\nabla)$, i.e. individual i's perception of income inequality conditional on his reference group.

We regard equation (5) as our benchmark specification to organize the empirical estimations and interpret the results. The specification is based on the three crucial assumptions that: (i) trust is related to expected trustworthiness (equation (3)), (ii) trustworthiness is influenced by pairwise income differences ∇_{ji} (equation (1)) and (iii) these pairwise income differences are assessed by the relative income differences as specified in equation (2). Alternatively one could also use a more direct approach and start with the assumption that trust is related to individual perceptions of aggregate income inequality, e.g.:

$$T_i = \alpha + \beta Z_i + \gamma E^i(X) - \delta E^i(\mathbb{G}), \tag{6}$$

where $\mathbb{G}$ stands for the Gini coefficient in the region. There are various ways to justify the alternative formulation (6). On the one hand it can be seen as a short-cut that simply postulates the impact of aggregate inequality perceptions on trust. This could be related to unspecified environmental or psychological factors, e.g. to a general culture of distrust that is nourished in an unequal society. On the other hand, the dependence of trust on the aggregate Gini coefficient might also be related to the behavior of the trustees. One might, e.g., argue that trustworthiness itself is not related to interpersonal income differences between truster and trustee but rather be given be the trustee's assessment of aggregate inequality, i.e. $TW_{ji} = \tilde{\alpha} + \tilde{\gamma} X_j - \tilde{\delta} E^j(\mathbb{G})$. We will discuss below the different implications of specification (6) and our benchmark specification (5) and we will present evidence that supports the latter formulation.

2.4 Average trust

Equations (3) and (5) refer to the level of individual trust T_i in a specific region. The average (aggregate) trust level in this region is given by:

$$\overline{T} = E(T_i) = \breve{\alpha} + \int_0^\infty \beta Z_i f(Y_i)\,\mathrm{d}Y_i + \kappa \int_0^\infty E^i(TW_{ji}) f(Y_i)\,\mathrm{d}Y_i, \tag{7}$$

where $f(Y_i)$ stands for the density function of incomes in the region with the corresponding distribution function $F(Y_i)$. Using equation (5), average trust thus depends on $E\left(E^i\left(\nabla\right)\right)$, i.e. the average value of all individual perceptions of inequality $E^i\left(\nabla\right)$.

2.5 Benchmark reference groups

So far the general specification of trust allowed for an arbitrary formation of reference groups $\mathbb{S}_i$. Now we look at the implications of this conceptual framework under a set of specific assumptions concerning reference groups. In particular, it is assumed that (i) all inhabitants of a region r have identical reference groups and (ii) this identical reference group consists of all inhabitants of region r and no member of a different region $r' \neq r$. We refer to this constellation of assumptions as “homogeneous, unbiased reference groups” or—for short—as “benchmark reference groups”.

2.5.1 Average trust

In the following proposition we state the average trust equation that follows from the assumption of benchmark reference groups.

Proposition 1 *For benchmark (homogenous and unbiased) reference groups the average trust level $\overline{T}_r$ in region r is given by:*

$$\overline{T}_r = \alpha + \beta \overline{Z}_r + \gamma \overline{X}_r - \delta \mathbb{G}_r, \tag{8}$$

where $\mathbb{G}_r$ stands for the Gini coefficient in region r.

Proof: See appendix A.1. For the case with $z = 1/2$ the proof is straightforward. In particular, note that for $z = 1/2$ equation (2) can be written as $\nabla_{ji} = \frac{|Y_i - Y_j|}{2\overline{Y}}$. The average perception of inequality in a region is then given by $\int_0^\infty E^i(\nabla) f(Y_i)\,\mathrm{d}Y_i = \int_0^\infty \int_0^\infty \frac{|Y_i - Y_j|}{2\overline{Y}} f(Y_j) f(Y_i)\,\mathrm{d}Y_j \mathrm{d}Y_i$. It is well-known (see Yitzhaki & Schechtman 2013) that this corresponds to the Gini-coefficient which can be defined as half the expected relative difference between two randomly drawn members from the population. Note, however, that the relation between average trust and the Gini coefficient is independent of the value z (i.e. whether people's trustworthiness is more strongly affected in the case of positive or negative income comparisons).[5]

Proposition 1 contains the average trust equation that is implied by our theoretical framework under the assumption of benchmark reference groups. If we look at one country then the country-specific Gini coefficient $\mathbb{G}_r$ has a negative effect on average trust and in a sample of countries one can obtain information on δ by regressing the average trust levels on the Gini coefficients. In fact, equation (8) corresponds to empirical estimations in cross-country regression (Leigh 2006*a*, Bjørnskov 2007) where average country-specific trust levels $\overline{T}_r$ are regressed on country-specific Gini coefficients. Our conceptual framework thus offers a straightforward justification for this popular empirical strategy.

2.5.2 Perception of average income inequality

Using the assumption of benchmark reference groups we can derive for each individual i the extent of perceived average income inequality $E^i(\nabla) = \int_0^\infty \nabla_{ji} f(Y_j)\,\mathrm{d}Y_j$ (where we leave out again the region indicator r).

[5] In fact, we show in appendix A.1 that this even holds for the case with individual-specific weights z_i as long as z_i and Y_i are uncorrelated.

Proposition 2 *For benchmark reference groups the extent of perceived average income inequality is given by:*

$$\begin{aligned} E^i(\nabla) &= \frac{1}{\overline{Y}}\left[(1-z)\int_0^{Y_i} F(Y_j)\,\mathrm{d}Y_j + z\int_{Y_i}^{\infty}(1-F(Y_j))\,\mathrm{d}Y_j\right] \\ &\approx \theta_0 + \theta_1(F(Y_i)-z)^2, \end{aligned} \tag{9}$$

where the approximation is around $F(Y_i) = z$ *and* θ_0 *and* θ_1 *are parameters stated in the appendix.*

Proof: See appendix A.1.

Proposition 2 shows that in the benchmark situation there exists a U-shaped pattern of the perception of inequality with respect to income. In order to capture this possible non-linear relationship, empirical trust regressions should thus include higher-order (at least quadratic) terms of the true income rank. Income inequality is perceived as most severe for the lower and higher ends of the distribution with a minimum for the individual with $F(Y_i) = z$. For the case with $z = \frac{1}{2}$ (where trustworthy behaviour is equally diminished by favourable and unfavourable income comparisons) this is just the median income.

Figure 1 illustrates the pattern of $E^i(\nabla)$ under the assumption of a log-normal income distribution for three values of z. The shape and the minimum of the average individual perceptions of income inequality depend on z. For higher values of z individuals are less trustworthy towards poorer individuals than towards richer individuals. For a person with a high Y_i this means that he will expect on average a higher degree of cooperation from strangers and he will thus also perceive a lower degree of trust-related inequality.

The U-shaped pattern is a consequence of the assumption that inequality is perceived as the expectation of pairwise income differences $E^i(\nabla)$. It is interesting to contrast this result to the alternative assumption that trust is related to individuals' expectations of the Gini coefficient $E^i(\mathbb{G})$ as stated in equation (6). In as far as average trust is

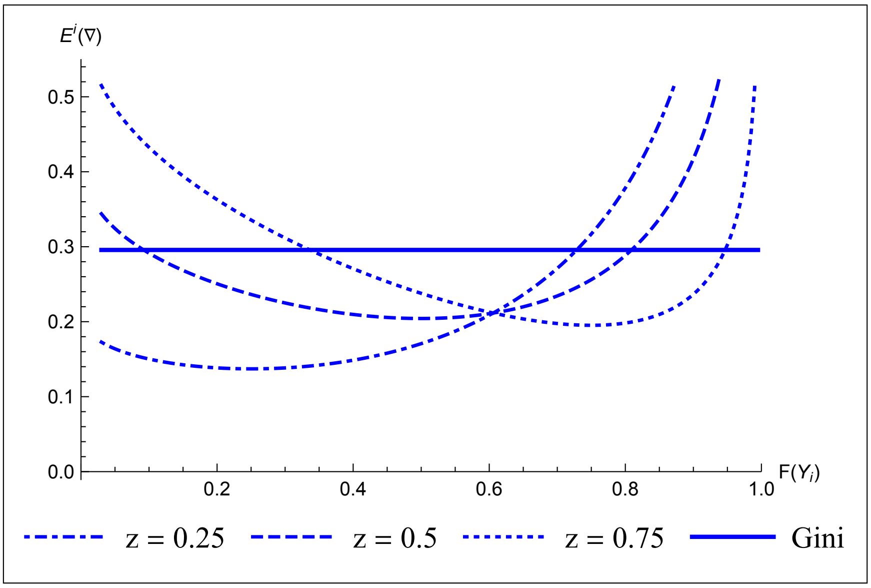


Figure 1: The figure shows the perceived inequality $E^i(\nabla)$ under the assumption that incomes are log-normally distributed with a mean income of 2,250, a standard deviation of 1,300 and an implied Gini coefficient of $\mathbb{G} = 0.3$. This corresponds to the values in our survey data (for monthly household incomes). We show three values of z together with the Gini coefficient.

concerned one gets the same result as in proposition 1, i.e. average trust is related to the Gini coefficient. In as far as the pattern of inequality perception is concerned, however, one arrives at a different conclusion. In particular, in the case of benchmark reference groups each individual has an unbiased perception of the Gini coefficient ($E^i(\mathbb{G}) = \mathbb{G}$) and thus the alternative formulation (6) implies identical perceptions of inequality for all individuals. This is shown by the flat line in figure 1 that corresponds to the Gini coefficient.

There are two noteworthy aspects of figure 1. First, an increase in the extent of income inequality will shift the Gini coefficient and all lines in figure 1 upwards. Second, one can observe that the average value of the curves for $E^i(\nabla)$ is exactly given by the Gini coefficient. In fact, this is the graphical illustration of the result that *average* trust is related to the Gini coefficient independent of the value of z as expressed in proposition 1. As an implication of this a regression of individual trust levels on regional Gini coefficients will lead to an accurate estimate of δ (at least as long as the assumption of benchmark reference groups is fulfilled).

2.5.3 Individual trust

Individual trust is related to the perception of average inequality as expressed in equation (5). If individual income does not have a direct impact on trust then the U-shape pattern of $E^i(\nabla)$ will translate into a hump-shape (an inverted U-shape) pattern of trust with respect to income. Trust, however, is also influenced by other personal characteristics Z_i that likely contain income Y_i. If the direct impact of income on trust is large then it will dominate the relation between the two variables and trust might be consistently increasing in income.

The possibility of a non-linear relation of income and trust is connected to a recent paper by Butler et al. (2016). They focus, however, at the reverse direction and argue that too little and too much trust have detrimental effects on individual incomes. When discussing the issue of reverse causality (i.e. the possibility that incomes have an influence on trust rather than the other way round) they argue that "insofar as this reverse causality argument is true, the rising portion of the documented trust-performance relationship may reflect it; however it cannot explain the declining part of the relationship" (p.1172). Our model that is based on the assumption that trust is influenced by pairwise income comparisons offers an explanation for the rising *and* the declining part of the income-trust relationship. It has to be stressed, however, that the hump-shape pattern of trust with respect to income does not necessarily imply a hump-shape pattern of income with respect to trust or the other way round. The outcome will depend on the distribution of exogenous factors (e.g. inherited trust or earnings abilities) and on the exact specification of the income-trust-nexus. In general, it is most reasonable to assume a bi-directional causation between trust and income: income depends on individual ability *and* on inherited trust (as argued by Butler et al, 2016) while observed trust itself reflects personal traits (including inherited trust) *and* the position in the income distribution and the corresponding perception of income inequality (as stressed in our framework). The outcome of this interdependent framework will be shaped by the various channels of influence in which all variables are determined in a simultaneous fashion. A thorough treatment of this set-up is an interesting topic for further research.

2.6 Non-benchmark reference groups

The benchmark assumption of homogeneous and unbiased reference groups as made in section 2.5 is highly restrictive. One would normally suspect that people have heterogeneous and biased reference groups that differ among each other both with respect to their "social" and to their "local" composition. First, people typically have closer contact with members of their own social group and these individuals will thus also get a larger weight when they form their expectations. Put differently, individuals do not know the correct distribution of income and they just draw "random samples" via their normal encounters with other individuals. The society, however, is stratified and so people meet predominately other people from their own or a similar income bracket. Second, the benchmark specification has assumed that the local radius of trust corresponds to the local dimension of income differences. For cross-country studies this might be a reasonable assumption. For within-country studies, however, this can be doubted. In fact, the general trust question refers to "most people" and one would expect that many respondents will use a perception span that is wider than the own region.

In order to study the implications of heterogeneous reference groups on our two important results (about average trust and the shape of individual inequality perceptions) one has to make specific assumptions. To do so in an appropriate manner one would ideally revert to empirical data on the formation of reference groups. Unfortunately, our data-set does not contain information on this issue and in general the evidence on the composition of individual reference groups is still rather scarce (cf. Clark & D'Ambrosio 2015). Therefore we have used a number of stylized examples to sketch the impact of biased perceptions on the results.

2.6.1 Average trust

In appendices A.2 and A.3 we use a number of simplifying assumptions about the income distribution and perception biases to derive analytical solutions of the average trust equation (8). We show that under these assumptions the equation can be written as:

$$\overline{T}_r = \alpha + \beta\overline{Z}_r + \gamma\overline{X}_r - \delta\phi(\cdot)\mathbb{G}_r, \tag{10}$$

where $0 \leq \phi(\cdot) \leq 1$ is a coefficient that depends on the size of the social or geographical perception bias. The larger the bias (i.e. the more reference group formation deviates from the benchmark assumption) the smaller the coefficient $\phi(\cdot)$. A regression of the average trust level on a regional Gini coefficient would thus lead to an underestimation of the true effect δ of income inequality on trust.

2.6.2 Perception of average income inequality

One can also use the stylized examples to study the impact of biased reference groups on the relation between income and inequality perceptions. This is done in a supplementary appendix S and we only want to report the final results. In particular, we focus on social perception biases and assume that an individual with income Y_i and a true income rank $F(Y_i)$ will only observe people within the percentiles $Max(0, F(Y_i)-p)$ and $Min(1, F(Y_i)+p)$ where p is the perception span. This means that for $p = 1$ individuals observe the entire income distribution while for small p they will only see a narrow segment of the

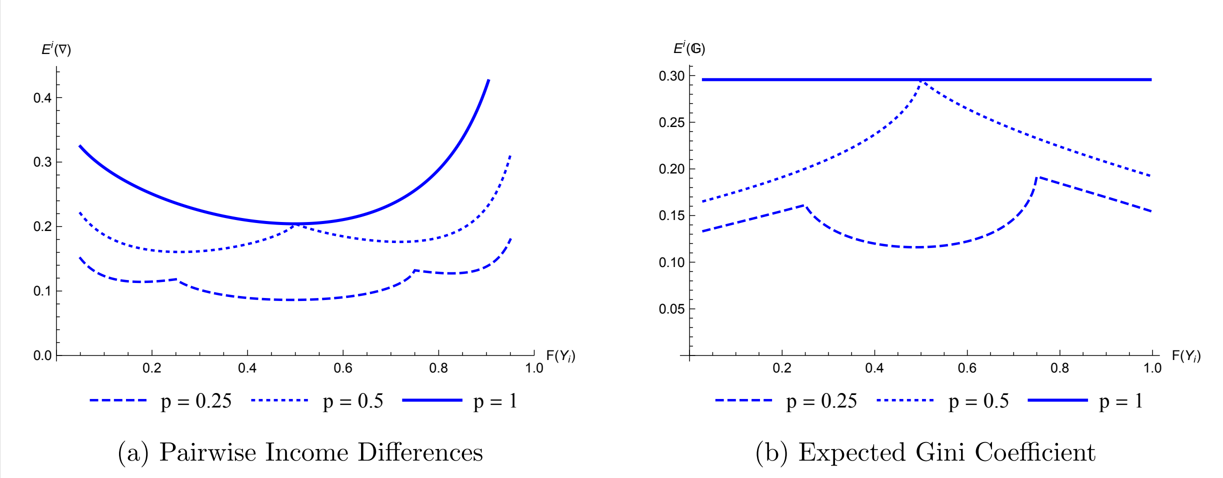


Figure 2: Panel (a) shows perceived inequality $E^i(\nabla)$ based on the expectation of pairwise income differences. We assume $z = 1/2$ and show three values of p. Panel (b) shows the case where the measure of perceived inequality is given by $E^i(\mathbb{G})$ as assumed in specification (6). In both cases it is assumed that incomes are log-normally distributed with a mean income of 2,250, a standard deviation of 1,300 and a Gini coefficient of $\mathbb{G} = 0.3$.

distribution.

In panel (a) of figure 2 we illustrate the pattern of $E^i(\nabla)$ for three values of p (assuming again a log-normal income distribution). On the one hand, the perception of inequality is universally lower for smaller values of p. A large perception bias will thus induce people to underestimate the true extent of income inequality. Using the Gini coefficient in a trust regression will thus also lead to an underestimation of the true effect δ of inequality on trust as reflected in equation (10). On the other hand, the U-shaped pattern of the perception of inequality with respect to income is also present for socially biased reference groups. Low-income and high-income individuals perceive a larger degree of inequality than individuals with average incomes.

It is interesting to contrast these results with the ones that emerge for the assumption that individual are not using pairwise income comparisons to assess inequality but rather to use a direct assessment of *aggregate* inequality $E^i(\mathbb{G})$ as specified in the alternative trust equation (6). The pattern of $E^i(\mathbb{G})$ is shown in panel (b) of figure 2 for various assumptions about p. The patterns differ considerably from the ones that come out for $E^i(\nabla)$ as shown in panel (a). For the case of benchmark reference groups each individual would have the same perception of the Gini coefficient as is shown by the flat line for $p = 1$. For biased reference groups, on the other hand, the alternative measure implies a situation where the perception of inequality is smallest for individuals that are located at the tail ends of the distribution. This is the exact opposite pattern to the one that comes out by using our standard income comparison measure $E^i(\nabla)$. The difference matters if one is interested in the question of who is losing trust when the income distribution changes or how inequality is perceived in different segments of society.

2.6.3 Heterogeneous reference groups

In section 2.6 we have so far referred to biased but still homogeneous reference groups. For a discussion of heterogeneous reference groups one has to resort to simulations. In appendix A.4 we report the results of various simulations that can be used to gauge the likely effect of heterogeneous reference groups on the size and the precision of the estimated coefficients of the Gini coefficient in empirical regressions. The results of the simulations can be summarized as follows. First, empirical regressions that use the Gini coefficient will underestimate the true effect δ of inequality perceptions except if the assumption of benchmark reference groups is fulfilled. In particular, for larger biases and more heterogeneous reference groups the hypothesis that the estimated effect $\hat{\delta}$ equals the true effect δ is rejected for a large share of simulations. Second, and more importantly, in these cases of large heterogeneity the wrong hypothesis of no effect of inequality on trust cannot be rejected for a considerable share of simulations. Third, this erroneous inference is more likely if the sample size is small and if the cross-sectional variation in Gini coefficients is low. Both of these features (and especially the latter) are characteristic for cross-regional estimations. The presence of biased and heterogeneous reference groups thus offers an explanation for the fact that these kinds of empirical studies often fail to find a significant impact of the Gini coefficient on trust. Finally, the simulations also show that the use of subjective perceptions of inequality in trust regressions will give rise to accurate estimations of the true effect δ of inequality on trust, irrespective of the sample size or the size of the cross-sectional variation of Gini coefficients.

3 Empirical Results

In the following we empirically investigate the trust model by combining survey data from Austria with data on income inequality across Austrian municipalities. In the literature, the relation between trust and inequality is typically tested in cross-country settings. According to the theoretical framework the relation should also be present across regions within a country, although the existing empirical evidence has been more mixed in these cases (Alesina & La Ferrara 2002, Gustavsson & Jordahl 2008, Leigh 2006*b*). This, however, makes within-country studies particularly interesting to analyse the interplay between trust, perceptions and inequality.

The survey has been conducted in 2011 among 2000 Austrian residents. Details on the data including variable descriptions and descriptive statistics are presented in appendix B.

3.1 Trust and inequality

Our empirical specification is based on equations (5). The dependent variable is given by answers to the general trust question (a 0/1 variable). The key explanatory variable is the Gini-coefficient $\mathbb{G}_r$ which has been computed from tax register data on gross individual incomes at the level of 181 municipalities. The explanatory variables comprise a set of socio-demographic variables Z_i and municipality-level variables $\overline{X}_r$ (average income, the number of inhabitants). The choice of respective variables is in line with the literature.

All results are based on linear probability models. Table 1 summarizes the regression results for the inequality-related variables. The full table, shown in the supplementary appendix (table S.1), reveals that results for household control variables are in line with respective findings from the literature, i.e., higher educated and well-informed individuals (the ones who read quality newspapers) have higher trust while unemployed, retirees and people with children as well as foreigners show less trust. The rank in the household income distribution is found to enter significantly. The implied pattern between trust and income trust is an inverted U-shape (with the peak for the seventh decile) and is thus in line with our theoretical framework's prediction of a non-monotonic relation between income and trust.

Table 1: Trust and Inequality

Dependent variable	Trust in people			Trust in people alternative def. (0/1)	(4 cat.)	(4 cat.)
	(1)	(2)	(3)	(4)	(5)	(6)
Municipality Gini	-0.982	—	—	-2.059	-0.968	—
	(1.271)			(1.294)	(0.674)	
Municipality 90/10 inequality	—	-0.001	—	—	—	-0.005
		(0.031)				(0.018)
Regional Gini	—	—	0.469	—	—	—
			(2.217)			
Objective rank	0.626***	0.623***	0.626***	0.468**	0.229**	0.227**
	(0.210)	(0.211)	(0.210)	(0.205)	(0.103)	(0.104)
Objective rank (squared)	-0.455**	-0.454**	-0.457**	-0.256	-0.114	-0.113
	(0.203)	(0.203)	(0.202)	(0.187)	(0.092)	(0.092)
Household controls	yes	yes	yes	yes	yes	yes
Municipality controls	yes	yes	yes	yes	yes	yes
Adj. R-squared	0.07	0.06	0.06	0.07	0.06	0.05
Observations	1272	1272	1272	1257	1257	1257

Dependent variables: In columns (1) to (3) the dependent variable is *trust in people*. In column (4) we use *trust in people alternative definition (0/1)*, in column (5) and (6) *trust in people alternative definition (4 cat.)*, i.e., the same variable recoded to 4 categories (0/0.33/0.66/1). All models report estimates from a linear probability model and include the following household control variables: Age and age squared, education, marital status, household size, children in household, labour market status (5 dummy variables), foreigner and quality news. All models include the following municipality control variables: Municipality avg. income (ln), Municipality population (ln). Since the objective rank is unavailable for many respondents estimations are based on 162 (instead of 181) municipalities. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

Column 1 of table 1 shows that the municipal Gini coefficient exerts no statistically significant effect on individual trust. This contradicts the implication of the framework presented in section 2.5 where it has been assumed that individuals have socially and locally unbiased perceptions. Under this assumption the regional Gini coefficient should affect general trust.

Various explanations could be put forward for the statistical insignificance of the Gini coefficient. First, the empirical measure of the Gini coefficient might not capture the concept that individuals use to assess income inequality. Individuals might, e.g., refer to net instead of gross income, to household instead of individual units or to wealth instead of income. We do not have such alternative measures available at the municipal level. We do have, however, municipal data on the 90/10 ratio of the income distribution. Column (2) reveals that this alternative measure is also insignificant.

Second, some municipalities are rather small and respondents could look at a coarser geographical aggregation. We account for this by utilizing Gini coefficients for regions (a total of nine) and find that this has no effect (column 3).

Third, it might be that our trust measure does not adequately reflect the attitude of respondents. In columns (4) to (6) we use answers on a different trust questions as the dependent variable: "How high is your trust in people in general?". For this question, respondents could give four answers. In column (4) we have recoded responses to a binary variables and in column (5) and (6) we use all four categories. In neither specification does the regional Gini coefficient or the 90/10 ratio have a significant effect on trust.

Fourth, there might not be enough variation in the regional Gini coefficient. In fact, the data show that in 90% of the municipalities the Gini coefficient is between 0.31 and 0.40. While this is a rather narrow range it should be noted that if one takes the theoretical framework at face value then this should not play a role if people have benchmark reference groups.

This brings us to the fifth, and our preferred, explanation for the insignificance of the objective inequality measure in table 1. People might not have homogeneous and unbiased perceptions of inequality as maintained in the benchmark assumption. In light of a small cross-regional standard deviation of Gini coefficients and heterogeneous perceptions, the simulation results of section 2.6.3 alert us that it is very likely that we (erroneously) fail to reject the null hypothesis of no effect of inequality on trust. In such a situation, both the theoretical framework and the simulation results imply that the use of *perceptions* of inequality should allow us to accurately establish the effect of inequality on trust.

3.2 Trust and the perception of inequality

To construct a measure for individual perceptions of inequality $E^i(\nabla)$ we use two survey questions. In particular, respondents have been asked about their assessment of how income and wealth are distributed in Austria: "What is your assessment about how income—the total sum of annual earnings—is distributed in Austria?" Answers comprise "extremely unequally distributed", "very unequally distributed", "rather unequally distributed" and "rather equally distributed" and we construct three dummy variables (the last two answers are collated into one category because of the low number of respondents answering "rather equally distributed"). A similar question was asked for wealth, making respondents aware that wealth comprises money, bonds, stocks, real estate and other assets.

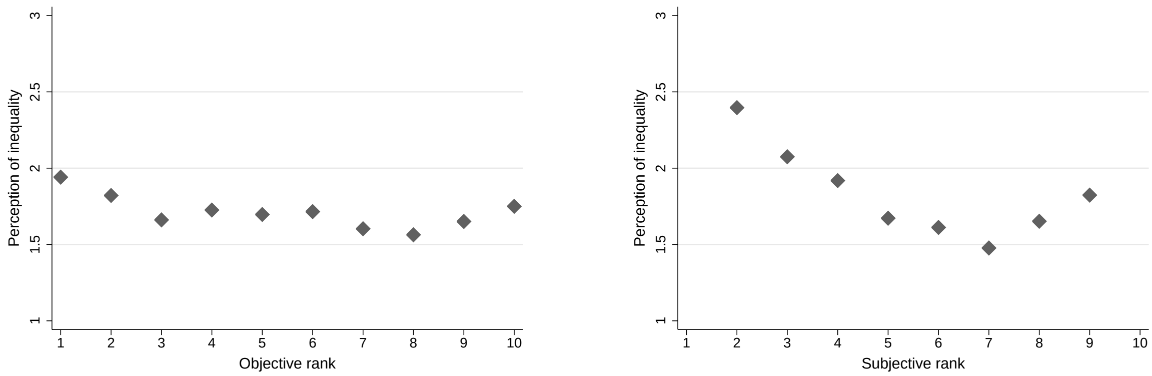
Answers to these questions are closely related to our theoretical measure $E^i(\nabla)$. When people are asked about their assessment of the income distribution they have to think about all incomes they can come up with (i.e. the incomes of the members of their reference group). One straightforward way to judge how unequal the distribution is, is to form pairwise comparisons of their own income with all these reference incomes and to calculate the average. This is exactly the measure $E^i(\nabla) = \int_{j \in \mathbb{S}_i} \nabla_{ji} f(Y_j)\,\mathrm{d}Y_j$.[6]

Proposition 2 stresses that $E^i(\nabla)$ should be U-shaped in the rank in the income distribution. Theoretically, we have shown that this pattern prevails both for homogenous and heterogeneous perceptions (figure 1 and figure 2a). The U-shape arises as people assess income inequality by building averages over pairwise income differences. In contrast, if they try to directly form an estimate of the Gini coefficient, one would expect a flat line in the case of homogenous perceptions or a hump-shaped pattern in the case of heterogenous perceptions (see figure 2b).

Therefore, an important identifying test of our framework is whether the predicted U-shaped pattern is confirmed by the data. Figure 3 reproduces figure 1 with our survey data. The left panel shows the average perceptions of inequality for each decile of the household income distribution of survey respondents (objective rank). As predicted by the theoretical framework we find a (weak) U-shape pattern. In fact, the pattern is rather similar to the theoretical shape that is obtained with a rather narrow perception span (i.e. a low value of p, see figure 2a).

The survey also elicits respondents self-assessed position in society on a 10-step ladder (subjective rank). The right panel of figure 3 shows the average perceptions of inequality for each subjective rank. In this case, the U-shape is more pronounced. There are several arguments why we prefer the subjective rank over the objective rank. First, the subjective rank is likely to reflect a broader assessment of respondents wealth status whereas the objective rank refers only to reported household income. Second, the income variable refers to per period income and not to life-time income. This can be problematic for respondents with larger income fluctuations, like business owners. Also, it is not clear whether one should consider personal or household income. Finally, the income variable

[6] In order to translate the outcome into answer categories like "extremely" or "rather" unequally distributed respondents might fix the benchmark cases of complete equality (all individuals have the same income, $E^i(\nabla) = 0$) and complete inequality (one person has the total income, $E^i(\nabla) = z$) and compare their actual assessment with these benchmark cases.



(a) Objective Rank vs. Inequality Perceptions (b) Subjective Rank vs. Inequality Perceptions

Figure 3: The figure shows the mean of the perception of inequality for a given objective rank (left panel) and subjective rank (right panel). The perception of inequality is coded as 1="the income distribution is somewhat or rather unequal", 2="very unequal", 3="extremely unequal". As the number of observations is very low for subjective ranks 1 and 10, we have aggregated them into rank 2 and 9.

from the survey is top-coded which might conceal relevant variation.

Regardless of which measure better reflects survey respondents rank in society, it is reassuring that in both cases the perception of inequality is largest for low and high income individuals and that the U-shaped pattern is also confirmed in regressions that correct for other explanatory variables (not shown). Summing up, the patterns shown in figure 3 confirm our framework of pairwise income comparisons while they contradict the assumption that people form direct estimates of the Gini coefficient.

In line with these findings, we estimate equation (5) by including the subjective perceptions of income inequality as an additional explanatory variable. In all specifications of table 2, these perceptions turn out to be highly significant and quantitatively important. The column (1) results show that the probability to trust decreases by 19 percentage points (10 pp.) for someone who sees incomes as extremely (very) unequally distributed while the objective inequality measures remains statistically insignificant. In the remaining columns of table 2 we perform various robustness tests that leave this main conclusion

Table 2: Trust and the Perception of Inequality

Dependent variable	Trust in people					Trust in people alternative def.
	(1)	(2)	(3)	(4)	(5)	(6)
Municipality Gini	-0.129	—	—	—	—	—
	(0.989)	—	—	—	—	—
Income very unequal	-0.103***	-0.058*	-0.050	—	—	-0.011
	(0.032)	(0.032)	(0.032)	—	—	(0.025)
Income extremely unequal	-0.188***	-0.151***	-0.138***	—	—	-0.130***
	(0.043)	(0.047)	(0.048)	—	—	(0.037)
Fin. sit. bad or very bad	—	—	-0.093***	—	-0.092***	-0.064**
	—	—	(0.034)	—	(0.035)	(0.026)
Wealth very unequal	—	—	—	-0.079**	-0.069**	—
	—	—	—	(0.032)	(0.033)	—
Wealth extremely unequal	—	—	—	-0.159***	-0.148***	—
	—	—	—	(0.049)	(0.050)	—
Subjective rank	0.718*	0.910**	0.783	0.943**	0.814	0.367
	(0.418)	(0.460)	(0.490)	(0.477)	(0.510)	(0.422)
Subjective rank (squared)	-0.245	-0.496	-0.449	-0.528	-0.477	-0.215
	(0.379)	(0.405)	(0.424)	(0.422)	(0.444)	(0.356)
Household controls	yes	yes	yes	yes	yes	yes
Municipality controls	yes	—	—	—	—	—
Municipality fixed-effects	—	yes	yes	yes	yes	yes
Adj.R-squared	0.09	0.23	0.23	0.22	0.23	0.19
Observations	1847	1847	1822	1826	1805	1784

The dependent variable is *trust in people* in columns (1) to (5) and *trust in people alternative definition (4 cat.)* in column (6). All models include the same control variables as in Table 1. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

qualitatively unaffected. In column (2), we replace the municipality Gini coefficients with municipality fixed effects which controls for unobserved variables at the municipal level. In column (3) we add a variable that captures the subjective assessment of the own financial situation which is found to be important for trust. In columns (4) and (5) we use the perception of wealth instead of income inequality. Column (6) employs the alternative trust measure as the dependent variable which results in qualitatively similar results.[7]

[7]Table 2 includes the subjective rank instead of the objective rank. The point estimates for table 2 show no hump-shaped pattern for this variable. Note that this is not in contrast with the non-linearities of figure 3 because part of the non-linearity is already captured by inequality perceptions. Moreover, equation (5) shows that income affects trust both directly and indirectly, via the perception of inequality. As the regressions control for inequality perceptions, the subjective rank variables thus measure the "remaining" (direct) effect which need not affect trust non-linearly. The use of the subjective rank conforms with the use of subjective variables for inequality perceptions. A side effect is that this also increases the number observations. However, we note that all subsequent main results are qualitatively

3.3 Other perception variables

Beside inequality there exist two other aggregate variables that are often considered as determinants of individual trust: the share of foreigners and the prevalence of crime in a region. Trust regressions typically allow for these influences by including objective measure of the crime rate and ethnic fragmentation. Following the line of reasoning above one would argue, however, that it is again only the *perception* of these factors that should have an impact on interpersonal trust. For this reason, the survey also elicited the subjective assessments of the share of foreigners and the crime rate. We include these variables along their objective counterparts.

The results in Table 3 show, in line with our previous results, that the perceptions of crime and of ethnic fragmentation matter while the corresponding objective variables do not matter. Specifically, the perception of the prevalence of theft has a statistically significant and quantitatively important negative impact on trust while this is not true for the corresponding objective crime measure. A similar picture emerges if we compare the effect of the perceptions of the share of foreigners in a region with the objective numbers. If both variables are added jointly (column 3), we find that one of the two additional perception variables looses importance which we ascribe to their correlation. Specification (4) contains municipality fixed effects which leaves results unaffected. Finally, we note that neither of these specifications affects the qualitative importance of the perception of inequality.

3.4 Robustness tests

The results in tables 2 and 3 support the conclusion that individual perceptions and subjective measures have more explanatory power for trust than the corresponding objective measures. However, this does not provide conclusive evidence that the relation is truly

unaffected if we (additionally) included the objective rank.

Table 3: Determinants of trust in people, ethnic heterogeneity and crime.

Dependent variable	Trust in people			
	(1)	(2)	(3)	(4)
Objective variables				
Municipality Gini	-0.289	-0.489	-0.441	—
	(0.961)	(0.937)	(0.962)	
Municipality share Austrians	0.134	0.213	0.098	—
	(0.411)	(0.414)	(0.412)	
Crime per 1,000 inhabitants (ln)	0.051	0.051	0.049	—
	(0.051)	(0.052)	(0.054)	
Perception variables				
Income very unequal	-0.099***	-0.093***	-0.096***	-0.051
	(0.033)	(0.032)	(0.033)	(0.032)
Income extremely unequal	-0.167***	-0.168***	-0.165***	-0.133***
	(0.042)	(0.042)	(0.042)	(0.046)
Foreigners few	-0.073*	—	-0.037	-0.012
	(0.042)		(0.042)	(0.051)
Foreigners many	-0.174***	—	-0.081*	-0.059
	(0.043)		(0.048)	(0.058)
Theft rare	—	-0.123***	-0.109***	-0.111***
		(0.034)	(0.035)	(0.041)
Theft frequent	—	-0.237***	-0.211***	-0.207***
		(0.037)	(0.043)	(0.048)
Fin. sit. bad or very bad	-0.136***	-0.127***	-0.123***	-0.075**
	(0.030)	(0.030)	(0.030)	(0.032)
Household controls	yes	yes	yes	yes
Municipality controls	yes	yes	yes	—
Municipality fixed-effects	—	—	—	yes
Adj. R-squared	0.12	0.13	0.13	0.25
Observations	1799	1740	1725	1725

The dependent variable is *trust in people*. All models include the same household control variables as in Table 2. The omitted base categories for the perception of ethnic heterogeneity and of crime are *Foreigners very few* and *Theft very rare*. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

causal. A number of alternative hypothesis could be responsible for the relation.

The most plausible objection against a causal interpretation is that the relation between the perception of inequality and trust is driven by an unobserved third factor that has an impact on both. It has, for example, been argued that trust is significantly influenced by a person's general "mood" and in particular by his or her outlook of the future (Uslaner 2002).[8] In column (1) of table 4 we control for this sense of optimism

[8] "Trusting intentions reflect a basic sense of optimism and control. [...] A view that the future will

by excluding individuals that indicate that they expect their economic situation in three years to be worse than today. For the sub-sample of optimistic individuals the impact of perceived inequality is similar than for the entire sample.

In columns (2) to (6) we focus on other sub-samples of individuals to control for potential confounding factors. We disregard individuals who state that they never do any voluntary work (column 2), individuals with below-median income (column 3) and those that indicate to have low trust in the judicial system (column 4). These three specifications exclude individuals with characteristics that are likely to reduce trust and that could also have an impact on reference group formation and perceptions. The effect of perceived inequality remains unaffected in the first two of these specifications. In the last specification, the effect of inequality perceptions is only weakly significant.[9]

It might also be the case that the perception of inequality is influenced by the normative assessment of inequality. Put differently, individuals that show less acceptance for income inequality might evaluate the extent of inequality differently and might also show a systematically different trusting behaviour. In column (5) we disregard respondents who very much agree to the statement that the difference between poor and rich is too large in Austria.

It has been argued that trust is formed in early childhood and not much affected by day-to-day experiences (Uslaner 2002, Butler et al. 2016). According to this view trust is mainly inherited from earlier generations and will only adjust very slowly (if at all) to the socio-economic environment over time. Taking this argument to the extremes implies that trust will not depend on current inequality (unless the extent of inequality is itself very persistent across generations). A more moderate interpretation is that trust is not

be better than the past and the belief that we can control our environment so as to *make it better*" (Uslaner 2002, 112, 81). In contrast, optimistic individuals could also have specific reference groups and more dampened perceptions of income inequality.

[9]Using the perception of wealth inequality (instead of that of income inequality), we find a strongly significant effect for this subsample of individuals.

completely unalterable but that the updating occurs only slowly over the course of a lifetime. To check for this possibility, we split the sample by the median age in columns (6) and (7). The results indeed show that the effect of inequality perceptions is weaker for younger than for older respondents, indicating that the inherited component of trust plays some role.

Table 4: Unobserved heterogeneity: Different subsamples.

Dependent variable	Trust in people						
Subsample	Optimism (1)	Civic involvement (2)	High income (3)	Trust courts (4)	Normative judgement (5)	Age below median (6)	Age above median (7)
Income very unequal	-0.061*	-0.019	-0.040	-0.057	-0.065*	-0.057	-0.055
	(0.037)	(0.052)	(0.037)	(0.038)	(0.037)	(0.052)	(0.052)
Income extremely unequal	-0.146***	-0.128**	-0.110**	-0.096*	-0.146**	-0.117*	-0.186***
	(0.052)	(0.063)	(0.052)	(0.053)	(0.058)	(0.065)	(0.064)
Theft rare	-0.112**	-0.074	-0.119**	-0.088**	-0.104**	-0.117*	-0.103*
	(0.044)	(0.073)	(0.051)	(0.042)	(0.051)	(0.065)	(0.058)
Theft frequent	-0.206***	-0.176**	-0.192***	-0.190***	-0.199***	-0.134*	-0.303***
	(0.048)	(0.073)	(0.058)	(0.053)	(0.054)	(0.072)	(0.063)
Fin. sit. bad or very bad	-0.065*	-0.020	-0.050	-0.123***	-0.077*	-0.127**	-0.037
	(0.036)	(0.055)	(0.044)	(0.041)	(0.046)	(0.054)	(0.054)
Household controls	yes	yes	yes	yes	yes	yes	yes
Municipality fixed-effects	yes	yes	yes	yes	yes	yes	yes
Adj. R-squared	0.25	0.28	0.24	0.24	0.25	0.29	0.22
Observations	1441	814	1180	1043	1275	836	904

The dependent variable is *trust in people.* Column 1 disregards all respondents who expect their financial situation to worsen over the next 3 years. Column 2 disregards respondents who state that they never do any voluntary work. Column 3 disregards respondents with below median household income. Column 4 disregards respondents who do not trust the courts (i.e., the judicial system). Column 5 disregards respondents who very much agree to the statement that the difference between poor and rich is too large in Austria. Columns 6 and 7 focus on respondents with an age below and above the median age. All models report estimates from a linear probability model. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

3.5 Biased perceptions and heterogeneous reference groups

We have shown that subjective perceptions of inequality are significantly and robustly related to individual trust while the municipal Gini coefficients show no significant relation. This result is in contrast to the large cross-country regressions where the Gini coefficient is typically found to have a large and highly significant impact on trust. On the other hand, the results are in line with the existing literature based on cross-region regressions (e.g. Alesina & La Ferrara 2002, Gustavsson & Jordahl 2008).

Following the simulation results summarized in section 2.6.3 we would argue that these conflicting results can be attributed to the fact that—contrary to the benchmark assumption—people have heterogeneous rather than identical reference groups. In this case the simulations have shown that the size and the precisions of the estimated Gini coefficient decreases and that the likelihood of erroneous non-rejection of the null hypothesis of no effect of the Gini coefficient on trust will increase. Moreover, this is more probable if the variation of the Gini coefficient is rather small which is typically the case for cross-region studies.

An implication of these insights is that the effect of objective inequality should be detectable in our sample first, if the standard deviation of the Gini coefficients across regional entities was larger and/or second, if one could control for local and social perception spans of individuals.

To test the first implication, we increase the standard deviation of Gini coefficients across municipalities by weighting observations with the squared distance between the municipality Gini and the Austria average. This artificially doubles the standard deviation of Gini coefficients (from 0.03 to 0.06). Column (1) of table 5 shows that the Gini coefficient enters negatively and significantly in this weighted regression (column (1) of table 5).

A significant effect of the Gini can also be expected if one could control for individual reference groups or perception biases. Unfortunately, the survey does not contain direct information on individual (socially or geographically biased) reference groups. However, the survey provides information on where people grew up and whether they have moved. A reasonable proxy variable for regional perception spans can be constructed if we assume that individuals who have never moved ("Not moved") have reference groups that are more local than individuals who have moved, after controlling for other confounding factors like media consumption and education. This provides useful information because the regional Gini coefficient should affect trust for those people who have a more local perception span, i.e. who have not moved (see equation (18) of appendix A.3). The column (2) results of table 5 support this theoretical finding. The Gini coefficient significantly affects individuals who did not move whereas no effect is found for respondents who moved. This result is also apparent in column (3), where we repeat this exercise with weighted regressions. In this case the respective point estimate is again considerably lower in column (3) than in column (1),

These attempts to control for local perception biases are certainly only indicative. Nevertheless, the results convey the important message that an adverse effect of objective inequality can be detected empirically if one controls for individuals' reference groups and/or if the standard deviation of Gini coefficients is "large".

4 Conclusions

A higher perception of inequality lowers interpersonal trust. We demonstrate that this conclusion holds regardless of whether objective measures of inequality, like the Gini coefficient, are found to exert a significant effect in empirical regressions.

We develop a formal framework which improves our understanding of the trust-inequality nexus and which helps us to develop estimation strategies for identifying the effect of inequality on trust. Trust is modelled as expected trustworthiness which in turn depends on expected relative income differences among members of a society. We show that restrictive assumptions need to be fulfilled within this framework to warrant the common practice of regressing trust on the Gini coefficient: all individuals use identical

Table 5: Controlling for perception spans.

Dependent variable	Trust in people		
Subsample	Weighted regression	Unweighted regression	Weighted regression
Municipality Gini	-3.827***	—	—
	(1.261)		
Munic. Gini x Not moved	—	-2.726**	-5.881***
		(1.294)	(1.612)
Munic. Gini x Moved	—	-0.167	-2.398**
		(1.254)	(1.151)
Not moved	—	0.922**	1.294***
		(0.371)	(0.432)
Fin. sit. bad or very bad	-0.214***	-0.215***	-0.211***
	(0.055)	(0.038)	(0.054)
Household controls	yes	yes	yes
Perception variables	—	—	—
Adj. R-squared	0.27	0.10	0.28
Observations	1262	1262	1262

The dependent variable is *Trust in people*. In columns 1, the standard deviation of the Gini coefficients across municipalities is increased by weighting the regression with the squared distance of *Municipality Gini* from the Austrian average. In column 2, the effect of the Gini coefficient is separated between respondents that have moved and respondents that have not moved. Column 3 applies the specification of column 2 with the weighting scheme of column 1. The control variables are the same as in table 1. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

reference groups when making income comparisons and these reference groups consist of all other inhabitants of a region and do not contain inhabitants of other regions.

We stipulate that these assumptions are unrealistic as individuals have heterogeneous as well as socially or geographically biased perceptions. Under these more realistic assumptions, it can be shown that regressions of trust on the Gini coefficient will yield point estimates that understate the effect of inequality. Equally problematic, such regressions are likely to fail to detect a significant effect of the Gini coefficient at all. In simulations we quantify this effect of underestimation under stylized scenarios and demonstrate that one needs a considerable cross-regional (or cross-country) variation in inequality to detect a significant (albeit still biased) effect of the Gini coefficient.

These results rationalize the findings from the literature that regressions based on a wide range of countries typically show a rather large and significantly negative effect of the Gini coefficient on average trust, while more homogeneous cross-country samples or within-country studies often fail to find a significant relation between trust and the Gini coefficient. Some scholars have concluded from these results that the relation between inequality and trust is weak or non-existent. Our conceptual framework offers a straightforward explanation for this pattern of results and suggests that such a conclusion might be premature. Instead, our model shows that the effect of inequality can be reliably estimated by an individual-specific measure of the perception of inequality. In addition, however, the model also suggests that trust and inequality might not move in locksteps. If individuals on average enlarge their reference groups (e.g. due to the influence of mass media) then average trust might change even if objective inequality stays constant. If, on the other hand, incomes gets more unequally distributed but the society becomes at the same time more stratified with narrower reference groups it might well be that average trust stays the same despite the increase in inequality.

We test our framework with data from an Austrian survey. Importantly, we can utilize theoretical predictions about the shape of the non-linear relation between inequality perceptions and income to identify the underlying trust model. The data are in line with our framework of pairwise income comparisons whereas alternative explanations are refuted. In line with our theoretical results, we find no indication that regional Gini coefficients are related to trust while individual-specific measures of the perception of inequality exert a strong adverse effect. This result is robust to a number of different specifications and to employing different trust measures.

Our data did not allow us to answer all open questions in a conclusive manner and some of our results can only be regarded as indicative. Future work should try to elicit further information concerning interpersonal trust, trustworthiness, perceptions and reference groups in order to corroborate and extend the findings. First, it would be desirable to collect information on how individuals form reference groups in order to provide direct evidence on the link between heterogeneous inequality perceptions and heterogeneous reference groups. Second, our basic assumption has been that individuals show less trustworthy behavior to individuals that are richer or poorer than they are themselves. The U-shaped pattern of inequality perceptions with respect to the rank in the income distribution is in line with this assumption. Although this is valuable indirect evidence, the relation should also be tested directly, for which one would need additional information concerning interpersonal and income-specific trustworthy (i.e. cooperative) behavior. The availability of detailed information along the suggested lines would help to further disentangle the causal interdependencies and mutual influences between trust, income and inequality.

References

Alesina, A. & La Ferrara, E. (2002), 'Who Trusts Others?', *Journal of Public Economics* **85**(2), 207–234.

Bjørnskov, C. (2007), 'Determinants of Generalized Trust: A Cross-Country Comparison', *Public Choice* **130**(1), 1–21.

Butler, J., Giuliano, P. & Guiso, L. (2016), 'The Right Amount of Trust', *Journal of the European Economic Association* **14**(5), 1155–1180.

Butler, J. V. (2014), 'Trust, Truth, Status and Identity: An Experimental Inquiry', *The BE Journal of Theoretical Economics* **14**(1), 293–338.

Clark, A. E. & D'Ambrosio, C. (2015), Chapter 13 - Attitudes to Income Inequality: Experimental and Survey Evidence, *in* A. B. Atkinson & F. Bourguignon, eds, 'Handbook of Income Distribution', Vol. 2 of *Handbook of Income Distribution*, Elsevier, pp. 1147 – 1208.

Cruces, G., Perez-Truglia, R. & Tetaz, M. (2013), 'Biased Perceptions of Income Distribution and Preferences for Redistribution: Evidence from a Survey Experiment', *Journal of Public Economics* **98**(C), 100–112.

Gächter, S., Herrmann, B. & Thöni, C. (2004), 'Trust, Voluntary Cooperation, and Socio-economic Background: Survey and Experimental Evidence', *Journal of Economic Behavior & Organization* **55**(4), 505–531.

Gimpelson, V. & Treisman, D. (2015), Misperceiving Inequality, NBER Working Papers 21174, National Bureau of Economic Research.

Glaeser, E. L., Laibson, D. I., Scheinkman, J. A. & Soutter, C. L. (2000), 'Measuring Trust', *The Quarterly Journal of Economics* **115**(3), 811–846.

Gustavsson, M. & Jordahl, H. (2008), 'Inequality and Trust in Sweden: Some Inequalities are More Harmful than Others', *Journal of Public Economics* **92**(1-2), 348–365.

Hey, J. D. & Lambert, P. J. (1980), 'Relative Deprivation and the Gini Coefficient: Comment', *The Quarterly Journal of Economics* **95**(3), 567–73.

Hooghe, M., Reeskens, T., Stolle, D. & Trappers, A. (2009), 'Ethnic Diversity and Generalized Trust in Europe: A Cross-National Multilevel Study', *Comparative Political Studies* **42**(2), 198–223.

Knack, S. (2001), Trust, Associational Life and Economic Performance, *in* 'In John F. Helliwell (ed), The Contribution of Human and Social Capital to Sustained Economic Growth and Well-Being. Quebec: Human Resources Development'.

Knack, S. & Keefer, P. (1997), 'Does Social Capital Have an Economic Payoff? A Cross-Country Investigation', *The Quarterly Journal of Economics* **112**(4), 1251–88.

Knack, S. & Zak, P. J. (2003), 'Building Trust: Public Policy, Interpersonal Trust, and Economic Development', *Supreme Court Economic Review* **10**, 91–107.

Kuziemko, I., Norton, M. I., Saez, E. & Stantcheva, S. (2015), 'How Elastic Are Preferences for Redistribution? Evidence from Randomized Survey Experiments', *American Economic Review* **105**(4), 1478–1508.

Leigh, A. (2006*a*), 'Does Equality Lead to Fraternity?', *Economics Letters* **93**(1), 121–125.

Leigh, A. (2006*b*), 'Trust, Inequality and Ethnic Heterogeneity', *The Economic Record* **82**(258), 268–280.

Moser, M. & Schnetzer, M. (2016), 'The Income-Inequality Nexus in a Developed Country. Small-scale Regional Evidence from Austria', *forthcoming Regional Studies* .

Nannestad, P. (2008), 'What Have We Learned About Generalized Trust, If Anything?', *Annual Review of Political Science* **11**(1), 413–436.

Norton, M. I. & Ariely, D. (2011), 'Building a Better America - One Wealth Quintile at a Time', *Perspectives on Psychological Science* **6**(1), 9–12.

Runciman, W. G. (1966), *Relative Deprivation and Social Justice: a Study of Attitudes to Social Inequality in Twentieth-Century Britain* , Routledge & Kegan Paul, London.

Slemrod, J. (2006), 'The Role of Misconceptions in Support for Regressive Tax Reform', *National Tax Journal* **59**(1), 57–75.

Stiglitz, J. E. (2013), In No One We Trust. The New York Times, 21st December, http://opinionator.blogs.nytimes.com/2013/12/21/in-no-one-we-trust/?_r=0 (accessed 10 March 2015).

Uslaner, E. M. (2002), *The Moral Foundations of Trust*, Cambridge University Press, UK: Cambridge.

Yitzhaki, S. (1979), 'Relative Deprivation and the Gini Coefficient', *The Quarterly Journal of Economics* **93**(2), 321–24.

Yitzhaki, S. & Schechtman, E. (2013), More Than a Dozen Alternative Ways of Spelling Gini, *in* 'The Gini Methodology', Vol. 272 of *Springer Series in Statistics*, Springer New York, pp. 11–31.

Zak, P. J. & Knack, S. (2001), 'Trust and Growth', *Economic Journal* **111**(470), 295–321.

Appendices

A Proofs and Results

In this appendix and in the supplementary appendix S we collect the proofs and results for different assumptions concerning the formation of reference groups and the presence of perception biases. The benchmark assumption is based on homogenous, region-centered reference groups and has been studied in section 2.5. In this appendix we also discuss the case of non-benchmark (i.e. biased and/or heterogeneous) reference groups by allowing for both social and geographical perception biases that furthermore might differ across individuals.

We model these two perception biases in the following way. We assume that there exists a continuum of regions $r \in [0, R]$ with an identical number of inhabitants N. The indicator $i_r \in [0, N]$ refers to an individual living in region r. The income of this individual is denoted by Y_{i_r} while the distribution of incomes in region r is described by the cumulative distribution function $F_r(Y_{i_r})$. We capture the social perception bias by the following assumption:

Assumption 2 (Socially Biased Reference Groups)
An individual with income Y_{i_r} and a true income rank $F_r(Y_{i_r})$ will only observe people within the percentiles $Max(0, F_r(Y_{i_r}) - p_{i_r})$ and $Min(1, F_r(Y_{i_r}) + p_{i_r})$ where p_{i_r} is the individual perception span.

For $p_{i_r} = 1$ an individual has unbiased perceptions (within his own region) while for $p_{i_r} = 0$ he would act as a solitaire that only cares about exactly identical others. We do not claim that assumption 2 is the most accurate description of peoples actual reference groups. It allows, however, for closed-form solutions and it matches some stylized facts of the data. Assumption 2 is, e.g., in line with a common finding from the literature (Cruces et al. 2013, Gimpelson & Treisman 2015) that low-income (high-income) people overestimate (underestimate) their true rank in the income distribution, a pattern that is also clearly present in our own data (not shown, available upon request).

As regards heterogeneity in the local perception span, we assume that the reference group of individual i_r consists of a share s_{i_r} of own-region individuals and a share $1 - s_{i_r}$ of individuals that are random draws from *all* other regions.

The various cases of reference group formation can thus be summarized by using the two perception parameters p_{i_r} and s_{i_r} that characterize the perception spans of individual i living in region r. The first case refers to the benchmark specification (section 2.5) with $p_{i_r} = p_r = 1$ and $s_{i_r} = s_r = 1$, i.e. no social perception biases and a local perception of inequality that corresponds to the radius of the trust question. This is shown below in appendix A.1. In the second case one has $0 \leq p_{i_r} < 1$ and $s_{i_r} = s_r = 1$ (only a social perception bias) while the third case is characterized by $p_{i_r} = p_r = 1$ and $0 \leq s_{i_r} \leq 1$ (a local perception bias but no social perception bias). These cases are discussed in sections A.2 and A.3, respectively, and the proofs are collected in the supplementary appendices S.1 and S.2. For the general case with $0 \leq p_{i_r} \leq 1$ and $0 \leq s_{i_r} \leq 1$ we have used numerical simulations as reported in section A.4.

A.1 Benchmark reference groups

This is the benchmark case that is—at least implicitly—often used in empirical trust studies. It is assumed that all individuals living in a region r have the same reference group that consists of all other inhabitants of this region and no member of a different region. In the following we leave out the region-specific index r in order not to clutter the notation.

For unbiased perceptions it follows from (2) that:

$$E^i(\nabla) = \int_0^\infty \nabla_{ji} f(Y_j)\, \mathrm{d}Y_j = (1-z)\int_0^{Y_i} \frac{Y_i - Y_j}{E^j(Y_x)} f(Y_j)\, \mathrm{d}Y_j + z\int_{Y_i}^\infty \frac{Y_j - Y_i}{E^j(Y_x)} f(Y_j)\, \mathrm{d}Y_j.$$

Since we assume that all individuals have the same unbiased regional perception it follows that $E^j(Y_x)$ is just given by the average regional income $\overline{Y}$. Similarly, $E^i(X_j) = \overline{X}$. We can then write:

$$E^i(\nabla) = \frac{1}{\overline{\overline{Y}}}\left[(1-z)\int_0^{Y_i}(Y_i - Y_j)f(Y_j)\,\mathrm{d}Y_j + z\int_{Y_i}^{\infty}(Y_j - Y_i)f(Y_j)\,\mathrm{d}Y_j\right] \tag{11}$$

and

$$T_i = \alpha + \beta Z_i + \gamma\overline{X} - \frac{\delta}{\overline{\overline{Y}}}\left[(1-z)\int_0^{Y_i}(Y_i - Y_j)f(Y_j)\,\mathrm{d}Y_j + z\int_{Y_i}^{\infty}(Y_j - Y_i)f(Y_j)\,\mathrm{d}Y_j\right].$$

Equation (11) can be written as:

$$E^i(\nabla) = \frac{1}{\overline{\overline{Y}}}\left[(1-z)\left(Y_iF(Y_i) - \int_0^{Y_i}Y_jf(Y_j)\,\mathrm{d}Y_j\right) + z\left(Y_i(F(Y_i)-1) + \int_{Y_i}^{\infty}Y_jf(Y_j)\,\mathrm{d}Y_j\right)\right]. \tag{12}$$

One can use integration by parts (by defining $v = F(Y_j)$ and $u = Y_j$) to derive that:

$$\int_0^{Y_i}Y_jf(Y_j)\,\mathrm{d}Y_j = F(Y_i)Y_i - \int_0^{Y_i}F(Y_j)\,\mathrm{d}Y_j$$

and (by defining $v = 1 - F(Y_j)$ and $u = Y_j$):

$$\int_{Y_i}^{\infty}Y_jf(Y_j)\,\mathrm{d}Y_j = (1 - F(Y_i))Y_i + \int_{Y_i}^{\infty}(1 - F(Y_j))\,\mathrm{d}Y_j.$$

Therefore $E^i(\nabla)$ can also be written as:

$$E^i(\nabla) = \frac{1}{\overline{\overline{Y}}}\left[(1-z)\int_0^{Y_i}F(Y_j)\,\mathrm{d}Y_j + z\int_{Y_i}^{\infty}(1 - F(Y_j))\,\mathrm{d}Y_j\right]. \tag{13}$$

This is also stated in proposition 2.

For the approximation we can rewrite (13) as:

$$E^i(\nabla) = \frac{1}{\overline{Y}}\left[(1-z)\int_0^{F(Y_i)} F(Y_j)\frac{1}{f(Y_j)}\,\mathrm{d}F(Y_j) + z\int_{F(Y_i)}^{1}(1-F(Y_j))\frac{1}{f(Y_j)}\,\mathrm{d}F(Y_j)\right].$$

The first two derivatives are:

$$\frac{\partial E^i(\nabla)}{\partial F(Y_i)} = \frac{F(Y_i)-z}{\overline{Y}f(Y_i)},$$

$$\frac{\partial^2 E^i(\nabla)}{\partial^2 F(Y_i)} = \frac{f(Y_i)-(F(Y_i)-z)f'(Y_i)(F^{-1}(Y_i))'F(Y_i)}{\overline{Y}(f(Y_i))^2}.$$

Evaluating these two derivatives at $F(Y_i) = z$ gives 0 and $\frac{1}{\overline{Y}f(Y_\mathrm{z})}$, respectively, where z stands for the individual with income Y_z for whom $F(Y_\mathrm{z}) = z$. A second-order Taylor approximation (around $F(Y_i) = z$) gives the result stated in proposition 2, where $\theta_0 \equiv E^\mathrm{z}(\nabla)$ and $\theta_1 \equiv \frac{1}{2\overline{Y}f(Y_\mathrm{z})}$.

Most cross-country studies are based on average values for the different countries included. Average trust is given by $\overline{T} = \int_0^\infty T_i(Y_i)f(Y_i)\,\mathrm{d}Y_i$. For this measure we need to calculate $\int_0^\infty E^i(\nabla)f(Y_i)\,\mathrm{d}Y_i$. Note that we can start with equation (12) to rewrite $E^i(\nabla)$ as:

$$\begin{aligned} E^i(\nabla) &= \frac{1}{\overline{Y}}\left[Y_iF(Y_i) - zY_i + z\int_0^\infty Y_jf(Y_j)\,\mathrm{d}Y_j - \int_0^{Y_i} Y_jf(Y_j)\,\mathrm{d}Y_j\right] \\ &= \frac{1}{\overline{Y}}\left[Y_iF(Y_i) - zY_i + z\overline{Y} - \int_0^{Y_i} Y_jf(Y_j)\,\mathrm{d}Y_j\right]. \end{aligned}$$

The overall perception of inequality is thus given by:

$$\int_0^\infty E^i(\nabla)f(Y_i)\,\mathrm{d}Y_i = \frac{1}{\overline{Y}}\left[\int_0^\infty Y_iF(Y_i)f(Y_i)\,\mathrm{d}Y_i - \int_0^\infty\int_0^{Y_i} Y_jf(Y_j)f(Y_i)\,\mathrm{d}Y_j\,\mathrm{d}Y_i\right]. \quad (14)$$

Note that this expression is independent of the weight z. In fact, this would even be true for the case where individuals have different weights z_i as long as z_i and Y_i were independently distributed.

In the following we want to show that $\int_0^\infty E^i(\nabla) f(Y_i)\,\mathrm{d}Y_i = \mathbb{G}$, where $\mathbb{G}$ stands for the Gini coefficient. In order to do so we start by observing that (14) holds for all values of z and thus also for the specific weight $z = \frac{1}{2}$. For this specific weight $z = \frac{1}{2}$, however, $E^i(\nabla)$ can be written as (from (11)):

$$\begin{aligned} E^i(\nabla) &= \frac{1}{2\overline{Y}} \left[\int_0^{Y_i} (Y_i - Y_j) f(Y_j)\,\mathrm{d}Y_j + \int_{Y_i}^\infty (Y_j - Y_i) f(Y_j)\,\mathrm{d}Y_j \right] \\ &= \frac{1}{2\overline{Y}} \left[\int_0^\infty |Y_j - Y_i|\, f(Y_j)\,\mathrm{d}Y_j \right]. \end{aligned}$$

From this it follows that:

$$\int_0^\infty E^i(\nabla) f(Y_i)\,\mathrm{d}Y_i = \frac{1}{2\overline{Y}} \left[\int_0^\infty \int_0^\infty |Y_j - Y_i|\, f(Y_j) f(Y_i)\,\mathrm{d}Y_j\,\mathrm{d}Y_i \right].$$

One has to note (see Yitzhaki & Schechtman 2013) that $\int_0^\infty \int_0^\infty |Y_j - Y_i|\, f(Y_j) f(Y_i)\,\mathrm{d}Y_j\,\mathrm{d}Y_i$ is equal to $2\overline{Y}\mathbb{G}$. It thus follows that:

$$\int_0^\infty E^i(\nabla) f(Y_i)\,\mathrm{d}Y_i = \mathbb{G}. \tag{15}$$

Combining (14) and (15) we can thus conclude that $\int_0^\infty E^i(\nabla) f(Y_i)\,\mathrm{d}Y_i = \mathbb{G}$ holds for all values of z not just for $z = \frac{1}{2}$. Using equation (13) one can then write:

$$\overline{T} = \alpha + \beta\overline{Z} + \gamma\overline{X} - \delta\mathbb{G}. \tag{16}$$

This is shown in proposition 1.

A.2 Non-benchmark reference groups: Social perception bias

In the supplementary appendix S we use a number of simplifying assumptions about the distribution of incomes both within regions and across regions in order to derive analytical results concerning the relation between inequality and trust.

First, in appendix S.1 we look at the case of only inward-looking individuals ($s_{i_r} = 1, \forall i_r$) that have identical social perception spans within each region ($p_{i_r} = p_r, \forall i_r$). For the assumption of a uniform income distribution we can show that in this case the average trust equation comes out as:

$$\overline{T}_r = \alpha + \beta \overline{Z}_r + \gamma \overline{X}_r - \delta \psi(p_r) \mathbb{G}_r, \tag{17}$$

where $0 \leq \psi(p_r) \leq 1$ is a coefficient that is specified in appendix S.1. For the assumption of unbiased social perceptions $p_r = 1$ it holds that $\psi(p_r) = 1$ and equation (17) collapses back to the average trust equation (8) of the benchmark case. A smaller perception span, however, reduces the coefficient and "weakens" the relation between the objective inequality measure $\mathbb{G}_r$ and average trust ($\frac{\partial \psi(p_r)}{\partial p_r} > 0$). In the case where the perceptions spans were also identical across regions ($p_{i_r} = p_r = p, \forall i_r$) then the relation between trust and the Gini coefficient would be given by $\delta \psi(p) < \delta$. A regression of average trust levels on regional Gini coefficients would thus lead to an underestimation of the true effect of pairwise income differences on trust.

A.3 Non-benchmark reference groups: Local perception bias

As a second example that allows for analytical solutions we look in the supplementary appendix S.2 at the reverse case where social perception biases are absent ($p_{i_r} = 1, \forall i_r$) but where individuals are also looking at incomes in other regions with identical local perception spans ($s_{i_r} = s_r, \forall i_r$). For the assumption that incomes are uniformly distributed across individuals and that the regional standard deviations of incomes are themselves uniformly distributed across regions we show that the average trust equation can be approximated as:

$$\overline{T}_r = \alpha + \beta \overline{Z}_r + \gamma \overline{X}_r - \delta \left(\frac{1}{4} \mathbb{G}_r \left(3 + s_r\right) + \frac{1}{4} \overline{\mathbb{G}} \left(1 - s_r\right) \left(1 - \frac{\lambda}{2}\right) \right), \qquad (18)$$

where $\mathbb{G}_r$ is the Gini coefficient of region r, $\overline{\mathbb{G}}$ the average Gini coefficient across all regions of the country and λ is a measure of the variation of income inequality across regions. Again we get a downward bias of the coefficient of the Gini coefficient for $s_r < 1$, similar to the case with $p_r < 1$ in equation (17). In particular, equation (18) implies that $\frac{\partial \overline{T}_r}{\partial \mathbb{G}_r} = -\delta \frac{3+s_r}{4}$. This means that the impact of the regional Gini on regional trust is less strong if there are more cross-region comparisons (i.e. if s_r is low). For $s_r = 1$, which corresponds to the situation analysed in section 2.5.1, one gets the benchmark slope of $\frac{\partial \overline{T}_r}{\partial \mathbb{G}_r} = -\delta$ while $\frac{\partial \overline{T}_r}{\overline{\mathbb{G}}} = 0$. In this case regional trust is only affected by regional inequality. For the other extreme case with $s_r = 0$ one gets a slope of $\frac{\partial \overline{T}_r}{\partial \mathbb{G}_r} = -\delta \frac{3}{4}$. The impact of the regional Gini $\mathbb{G}_r$ is not zero since, e.g., a more compressed regional income distribution in region r implies that the perception of inequality is lower, on average, for all region r individuals.

Summing up, the presence of social or local perception biases leads to the result that the true effect of pairwise income differences on trust (given by δ in equation (2)) is underestimated in regressions that use the Gini coefficient to assess this impact. This is captured by the coefficient $\phi(\cdot)$ in equation (10) in the paper.

A.4 Non-benchmark reference groups: Heterogeneity

For the case with heterogeneous reference groups and for a general income distribution analytical solutions are no longer available and we have to resort to numerical simulations.

To illustrate the basic mechanism we use a simplified version of the trust equation where individual trust T_{i_r} only depends on the individual perception of inequality $E^{i_r}(\nabla)$ (i.e., $\beta = \gamma = 0$). For the simulation we set $\alpha = 1$, $\delta = 0.5$—which is broadly in line with the estimated coefficients from cross-country regressions (see Bjørnskov 2007)—and we add an error term with mean 0 and a standard deviation of 0.5.

We simulate results for various cases that involve different assumptions about the size and distribution of the individual perception spans p_{i_r} and s_{i_r}. First, we look at the benchmark case of unbiased perceptions ($p_{i_r} = s_{i_r} = 1$). Next, we turn to three cases where the perception span deviates from this benchmark situation while it is still identical for all individuals: $p_r = p = 0.5$ (case 2), $s_r = s = 0.5$ (case 3) and $p_r = p = s_r = s = 0.5$ (case 4). In the last case we allow for the possibility of heterogeneous reference groups and assume that both p_{i_r} and s_{i_r} are uniformly and independently distributed random numbers which vary between 0 and 1. Individuals' incomes, on the other hand, are iid draws from lognormal distributions that have region-specific standard deviations (and thus region-specific Gini coefficients). For each simulation we run two regressions: first, we regress individual trust on the subjective perception of inequality $E^{i_r}(\nabla)$ which yields the point estimate $\hat{\delta}$ and second, we regress individual trust on the regional Gini coefficient $\mathbb{G}_r$ which yields the point estimate $\hat{\delta}_{GINI}$. This exercise is repeated 300 times and table A.1 summarizes the means and the standard deviations of $\hat{\delta}$ and $\hat{\delta}_{GINI}$ across all simulations. Furthermore, we report how often an empirical researcher who ran these 300 regressions would conclude that $\hat{\delta}$ or $\hat{\delta}_{GINI}$ differs from zero. This case is particularly relevant as it reflects the common test in empirical papers, given that the true coefficient is typically unknown. The last column reports how often an empirical researcher would conclude that $\hat{\delta}$ or $\hat{\delta}_{GINI}$ differs from the true value δ. The results of table A.1 can be summarized as follows:

- When the Gini coefficient is used as the independent variable (upper half of table A.1), the mean of estimated coefficients is very close to the true value only for the benchmark constellation with $p_{i_r} = s_{i_r} = 1$. In this case, the test that $\hat{\delta}_{GINI} = 0$ would be rejected in 96% of regressions and the test that $\hat{\delta}_{GINI} = \delta$ would be rejected in 6% of regressions.

- This picture is quite different if perception biases are introduced. First, values of $p_{i_r} < 1$ and $s_{i_r} < 1$ reduce the average size of the estimated point estimates as argued in appendices A.2 and A.3. The mean of the estimated coefficients $\hat{\delta}_{GINI}$ is 0.34 (for case 2 with $p_r = 0.5$), 0.38 (for case 3 with $s_r = 0.5$) and 0.3 (for case 4 with $p_r = s_r = 0.5$). If p_{i_r} and s_{i_r} are assumed to be random, the mean of the estimated coefficients is 0.28.

- In all cases with perception biases, the capability of the regressions to detect a significant effect of the Gini coefficient is sizeably reduced. With random p_{i_r} and s_{i_r} the null of $\hat{\delta}_{GINI} = 0$ is rejected in 58% of all estimations and the null of $\hat{\delta}_{GINI} = \delta$ in 42% of cases.

- When instead the subjective perception of inequality is used as the independent variable (lower half of table A.1), the mean of the estimated coefficients is very close to 0.50. This result does not come as a surprise since this specification corresponds to the assumed data-generating process with $\delta = 0.5$. More importantly, the test of $\hat{\delta} = 0$ is rejected in 100% of estimations and the test of $\hat{\delta} = \delta$ only in 4% of cases—both effects reflect a much lower standard deviation of point estimates. This demonstrates that it is much easier, in a statistical sense, to detect a significant impact of inequality if perceptions are used instead of the Gini coefficient. The occurrence of perception biases—social or local, homogeneous or heterogeneous—does not affect this conclusion.

Under what conditions will regressions that use the Gini coefficient as the explanatory variable deliver significant coefficients? One would suspect that this has to do with the sample size and with the variation in the explanatory variable. In order to investigate this conjecture we conduct further simulations where we change the baseline scenario along two dimensions. First, we randomly draw individuals in each region to obtain a smaller sample size and second we increase the cross-regional variation of the Gini coefficient. In particular, we draw them from a distribution with a mean of 0.45 and a SD of 0.16 (which mimics the sample statistics of the studies based on cross-country regressions) while in the baseline scenario we have used a distribution with a mean of 0.3 and a SD of 0.03 (which is close to the values in our cross-regional sample). The findings of the simulations are collected in table A.2 and can be summarized as follows:

- It is more likely to get significant results in samples with a high cross-regional variation of the Gini coefficients. This can be seen by comparing our benchmark results (panel A, large sample in table A.2) with the ones based on a high variation in the Gini coefficients (panel B, large sample). The coefficients of the explanatory variable are now estimated with a much higher precision (an average SD of 0.03 instead of 0.13) while the downward bias of the coefficient remains of course basically unchanged (an average value of 0.3 compared to 0.28 in the low-variation benchmark). The higher precision implies that one could always reject the Null of the estimated coefficient being equal to the true coefficient. On the other hand, however, one would also reject the Null of a zero coefficient in 100% of regressions.

- Smaller sample sizes make it more difficult to get significant results. This can be seen by comparing the results for small and large samples in panel A (low-variation scenario) and panel B (high-variation scenario), respectively. In the presence of heterogeneous perceptions the Null of no effect of the Gini coefficient is less often rejected (for the low-variation scenario). In particular, with a small sample size an empirical researcher would not reject the Null in 82% of regressions $(1 - 0.18)$ while with larger samples the non-rejection rate is reduced to 42% $(1-0.58)$.

Altogether, we conclude that the presence of perception biases leads to biased point estimates regarding the effect of the Gini coefficient. If, in addition, the cross-regional variation in inequality is low, then it is very likely that an empirical researcher will erroneously conclude that inequality has no effect on trust. In this case, a larger sample size does not help much. In order to detect a significant Gini coefficient one needs sizeable cross-regional variation while the sample size is of less importance. In contrast, the use of perceptions of inequality always leads to a correct inference about the impact of inequality on trust—regardless of the extent of cross-regional variation or the size of the sample.

Table A.1: Simulation results.

Regressor: GINI coefficient — $T_i = \hat{\alpha} - \hat{\delta}_{GINI}\mathbb{G}_r + \epsilon_i$					
		$\hat{\delta}_{GINI}$ mean	$\hat{\delta}_{GINI}$ std. dev.	% rejection of $H_0 : \hat{\delta}_{GINI} = 0$	% rejection of $H_0 : \hat{\delta}_{GINI} = \delta$
$p_i = 1$	$s_i = 1$	0.50	0.13	0.96	0.06
$p_i = 0.5$	$s_i = 1$	0.34	0.13	0.78	0.25
$p_i = 1$	$s_i = 0.5$	0.38	0.12	0.86	0.15
$p_i = 0.5$	$s_i = 0.5$	0.30	0.14	0.64	0.36
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.28	0.13	0.58	0.42
Regressor: perception of inequality — $T_i = \hat{\alpha} - \hat{\delta}E^i(\nabla) + \epsilon_i$					
		$\hat{\delta}$ mean	$\hat{\delta}$ std. dev.	% rejection of $H_0 : \hat{\delta} = 0$	% rejection of $H_0 : \hat{\delta} = \delta$
$p_i = 1$	$s_i = 1$	0.50	0.02	1.00	0.04
$p_i = 0.5$	$s_i = 1$	0.50	0.05	1.00	0.06
$p_i = 1$	$s_i = 0.5$	0.50	0.03	1.00	0.08
$p_i = 0.5$	$s_i = 0.5$	0.50	0.05	1.00	0.06
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.50	0.03	1.00	0.07

The table summarizes simulation results. We assume that there are 50 regions (r), each with 300 inhabitants i (for ease of readability, we omit subscript r). For each of 300 simulations we perform the following steps: Income for each i are randomly drawn with a pre-selected cross-regional variation. Individual i's perception of inequality $E^i(\nabla)$ is calculated as well as the true value for T_i that is randomized with ϵ_i. Given the income realizations, the sample Gini coefficient is calculated for each region r. The two types of regressions that are shown in the table are performed and parameter tests conducted. "Mean" and "std. dev." denote the sample means and standard deviations of the 300 point estimates of $\hat{\delta}$ and $\hat{\delta}_{GINI}$, respectively. "% rejection $H_0 : \hat{\delta} = 0$" ($H_0 : \hat{\delta} = \delta$) denotes the share of rejections of the Null hypothesis for a two sided t-test, applying a 95% confidence level. Results are shown for different parameter constellations of p_i and s_i. $U(0,1)$ denotes that p_i and s_i are uniform random values in the interval from 0 to 1. The region-specific Gini coefficients are assumed to have a mean of 0.3 with a SD of 0.03.

Table A.2: Simulation results—small samples versus large samples and low variance verses high variance

Regressor: GINI coefficient — $T_i = \hat{\alpha} - \hat{\delta}_{GINI}\mathbb{G}_r + \epsilon_i$					
		$\hat{\delta}_{GINI}$ mean	$\hat{\delta}_{GINI}$ std. dev.	% rejection of $H_0 : \hat{\delta}_{GINI} = 0$	% rejection of $H_0 : \hat{\delta}_{GINI} = \delta$
A. Low cross-regional variance					
Small Sample (2,500 obs)					
$p_i = 1$	$s_i = 1$	0.50	0.31	0.35	0.06
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.30	0.32	0.18	0.11
Large Sample (15,000 obs)					
$p_i = 1$	$s_i = 1$	0.50	0.13	0.96	0.06
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.28	0.13	0.58	0.42
B. High cross-regional variance (15,000 obs)					
Small Sample (2,500 obs)					
$p_i = 1$	$s_i = 1$	0.51	0.08	1.00	0.05
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.31	0.07	1.00	0.75
Large Sample (15,000 obs)					
$p_i = 1$	$s_i = 1$	0.51	0.03	1.00	0.06
$p_i \sim U(0,1)$	$s_i \sim U(0,1)$	0.30	0.03	1.00	1.00

The table summarizes simulation results for $\hat{\delta}_{GINI}$. The simulations are described in table A.1. "Mean" and "std. dev." denote the sample means and standard deviations of the 300 point estimates of $\hat{\delta}_{GINI}$. "% rejection $H_0 : \hat{\delta}_{GINI} = 0$" ($H_0 : \hat{\delta}_{GINI} = \delta$) denotes the share of rejections of the Null hypothesis for a two sided t-test, applying a 95% confidence level. Results are shown for the case of unbiased perceptions ($p_i = 1$, $s_i = 1$) and for the case of heterogenous perceptions where p_i and s_i are uniformly distributed random numbers between 0 and 1. "Small sample" denotes a simulation setting in which 50 individuals are randomly drawn (out of 300 individuals) from each of the 50 region. "Large sample" denotes the full sample with 300 individuals from 50 regions. We show simulations for a "low cross-regional variance" scenario (Panel A) and for a "high cross-regional variance" scenarios (Panel B) – the latter impose a higher cross-regional variation in the Gini coefficient (a mean of 0.45 with a SD of 0.16).

B Data Description

The data are drawn from a survey which was commissioned by the Oesterreichische Nationalbank and conducted by "IFES", an Austrian based market and polls research institute. From end of January 2011 until the beginning of March 2011, about 2000 Austrian residents aged 16 or older were interviewed face-to-face by computer assisted personal interviews. The questionnaire, designed by the authors for the purpose of this study, was appended to a questionnaire which mainly focused on economic sentiments and expectations regarding inflation, the economy or the financial situation of survey respondents.

The sample was drawn on the basis of a stratified multistage clustered random sampling procedure with the strata being Austrian districts. Item non-response was rather low with the exception of household income which was not provided by about 36% of respondents. Variables are defined below and descriptive statistics of key variables are presented in table B.1.

For the purpose of this study we will not use sampling weights and have not imputed missing observations. Also, we have eliminated all respondents below the age of 18 years. Therefore, the sample size that is used in the estimations comprises about 1200 survey respondents.

B.1 Variable description

Trust variables:

trust in people: "Generally speaking, would you say that most people can be trusted - or you can't be too careful in dealing with people?". Dummy variable=1 if "most people can be trusted", =0 if "one can't be too careful" or "don't know".

trust in people alternative definition (0/1): "How high is your trust in people in general?" Dummy variable=1 if "very high" "high", =0 if "low" or "very low".

trust in people alternative definition (4 cat.): "How high is your trust in people in general?" Variable = 1 if "very high", =0.66 if "high", =0.33 if "low" and =0 if "very low".

Perception variables:

Income unequal: "What is your assessment about how income–the total sum of annual earnings–is distributed in Austria?" Answers comprise "extremely unequally distributed", "very unequally distributed", "rather unequally distributed", "rather equally distributed". Three dummy variables are constructed: "extremely unequal", "very unequal" and "rather unequal" with the last category combining "rather unequally distributed" and "rather equally distributed" into one category (because of a low number of respondents for "rather equally distributed").

Wealth unequal: "Wealth comprises money, bonds, stocks, real estate and other assets. What is your assessment about how total wealth is distributed in Austria?" Answers comprise "extremely unequally distributed", "very unequally distributed", "rather unequally distributed", "rather equally distributed". Three dummy variables are constructed: "wealth extremely unequal", "wealth very unequal" and "wealth rather unequal" with the last category combining "rather unequally distributed" and "rather equally distributed" into one category (because of a low number of respondents for "rather equally distributed").

Ethnic fragmentation: "How many foreigners are in your residential area?" Answers comprise "very many", "many", "a few", "almost none". Three dummy variables are constructed: "Foreigners many" for "very many" and "many", "Foreigners few" for "a few" and "Foreigners very few" for "almost none".

Crime: "How serious is the problem of theft and burglary in your residential area?" Answers comprise "very serious", "rather serious", "rather not serious", "not serious at all". Three dummy variables are constructed: "Theft frequent" for "very serious" and "rather serious", "Theft rare" for "rather not serious" and "Theft very rare" for "not serious at all".

Subjective rank: "In our society there are groups which tend to be towards the top and groups which tend to be toward the bottom. Below is a scale that runs from top to bottom. Where would you put yourself on this scale?". Respondents were provided with a showcard with a horizontal scale from 1 (bottom) to 10 (top).

Household-level control variables:

We only describe variables that are not self-explaining.

Objective rank: Based on net monthly income of household recorded in 20 categories. Converted to numeric values by taking the mid-point of each category. The top category was coded based on data from a comparable survey with richer income information. *Objective rank* refers to the district-specific rank in the income distribution. In order to have enough observations per district, we utilize data from similar surveys that have been undertaken in (almost) each quarter from 2004 to 2011.

Education: "edu high"=1 if high school or university, "edu med"=1 if apprenticeship or middle school, "edu low"=1 if only mandatory schooling (omitted).

Children in HH: Dummy variable=1 if children are living in the household, 0 otherwise.

Foreigner: Dummy variable=1 if father of respondent was not born in Austria, 0 otherwise.

Quality newspapers: Based on a question on print-media consumption that provides a list of nine newspapers and magazines. Dummy variable=1 if respondent reads quality newspapers/magazines, 0 otherwise (including the possibility that respondents read no newspapers and magazines).

Fin. sit. bad or very bad: "All in all, how would you judge the current financial situation of your household?" Dummy variable=1 if respondents answered "fin. sit. rather bad", "fin. sit. bad", =0 if "fin. sit. very good" or "fin. sit. good".

Variables which are observed at the municipality, district or regional level:
The data set comprises all 9 Austrian regions (Bundesländer), 114 districts and 181 municipalities. The following list describes variables which are observed at the municipality, district or regional level. Our measures of regional inequality draws on Moser & Schnetzer (2016) who construct measures of income inequality on the municipality/district/regional level based on administrative income statements data of all non-self employed residents of a given regional entity (Taxsim project of the Research Institute Economics of Inequality, Vienna University of Economics and Business). We use data for 2011. The geographical assignment is based on the home address of taxpayers.

Municipality (district, region) Gini, municiality (district, region) 90/10 inequality: The Gini coefficient and the ratio of the first and the 9-th income decile based on gross taxable incomes of all taxpayers in the respective regional entity. Source: Moser & Schnetzer (2016).

Municipality avg. income: The average annual gross taxable income of all taxpayers in a municipality. Source: Moser & Schnetzer (2016).

Municipality population: Number of inhabitants. Constructed from administrative data of the Austrian statistical agency. Source: Statistik Austria.

Municipality share Austrians: Share of inhabitants who are born in Austria. Data are based on the population census 2001. Source: Statistik Austria.

Crime per 1,000 inhabitants: Number of incidences of burgleries and pickpocketing (average over the years 2009 and 2010). This information was provided by the Austrian Ministry of Internal Affairs and is recorded per "police district" which mostly overlap with political districts. The number is scaled by the number of inhabitants in each "police district". Source: Polizeiliche Kriminalstatistik Österreichs.

Table B.1: Descriptive statistics

	N	mean	sd	min	max
Trust variables					
Trust in people	1847	0.45	0.50	0.00	1.00
Trust in people alternative definition (0/1)	1800	0.71	0.46	0.00	1.00
Trust in people alternative definition (4 cat.)	1800	0.60	0.22	0.00	1.00
Perceptions of inequality, ethnic fragmentation and crime					
Income rather unequal	1847	0.46	0.50	0.00	1.00
Income very unequal	1847	0.36	0.48	0.00	1.00
Income extremely unequal	1847	0.18	0.38	0.00	1.00
Wealth rather unequal	1812	0.47	0.50	0.00	1.00
Wealth very unequal	1812	0.35	0.48	0.00	1.00
Wealth extremely unequal	1812	0.18	0.38	0.00	1.00
Subjective rank	1847	0.53	0.15	0.10	1.00
Foreigners very few	1823	0.14	0.35	0.00	1.00
Foreigners few	1823	0.45	0.50	0.00	1.00
Foreigners many	1823	0.41	0.49	0.00	1.00
Theft very rare	1764	0.25	0.43	0.00	1.00
Theft rare	1764	0.50	0.50	0.00	1.00
Theft frequent	1764	0.25	0.43	0.00	1.00
Household-level control variables					
Objective rank	1220	0.49	0.28	0.00	0.99
Age	1847	47.35	16.51	18.00	96.00
Male	1847	0.46	0.50	0.00	1.00
Edu med	1847	0.15	0.36	0.00	1.00
Edu high	1847	0.28	0.45	0.00	1.00
Married	1847	0.55	0.50	0.00	1.00
Separated	1847	0.20	0.40	0.00	1.00
Children in HH	1847	0.21	0.41	0.00	1.00
HH size	1847	2.26	1.23	1.00	7.00
Unemployed	1847	0.05	0.22	0.00	1.00
Owner	1847	0.06	0.24	0.00	1.00
Public employees	1847	0.06	0.24	0.00	1.00
In education	1847	0.03	0.16	0.00	1.00
At home	1847	0.03	0.18	0.00	1.00
Retired	1847	0.26	0.44	0.00	1.00
Foreigner	1847	0.13	0.33	0.00	1.00
Quality newspapers	1847	0.48	0.50	0.00	1.00
Fin. sit. bad or very bad	1822	0.29	0.46	0.00	1.00

See continuation.

Table B.1: Descriptive statistics (cont'd)

	N	mean	sd	min	max
Regional variables					
Municipality Gini	181	0.34	0.03	0.28	0.52
Municipality 90/10 inequality	181	5.56	0.84	3.92	11.08
Municipality avg. income	181	35101.97	5190.95	26289.29	68030.20
Municipality population (ln)	181	8.72	1.44	6.51	12.48
Municipality share Austrians	181	0.89	0.08	0.65	1.00
Crime per 1,000 inhabitants (ln)	181	3.93	0.58	2.97	7.27

S Supplementary Appendix for "Inequality, Perception Biases and Trust"

In this supplementary appendix, we collect the proofs and results of two cases of non-benchmark reference groups (or "biased perceptions") that are discussed in section 2.6 and in appendices A.2 and A.3 of the paper. In part S.1 we look at the case of "socially biased perceptions" where $0 \leq p_{i_r} < 1$ and $s_{i_r} = s_r = 1$ while in part S.2 we deal with the case of "local perception biases" where $p_{i_r} = p_r = 1$ and $0 \leq s_{i_r} \leq 1$. Part S.3 presents the full set of results for table 1.

S.1 Socially biased perceptions

We assume that individuals form their reference groups by just looking at incomes from their own region (i.e. $s_{i_r} = 1, \forall r$). We look at the case of one specific region and we therefore again leave out the region-index r in the following. Individuals do not know the correct distribution of income in their region and just draw "random samples" via their normal encounters with other individuals. The society, however, is stratified and so people meet predominately other people from the same class or only a somewhat richer or poorer income bracket. We model this by making assumption 2, i.e. by assuming that an individual at the position $F(Y_i)$ in the income ladder only knows and observes people income ranks between $F(Y_i) - p_i$ and $F(Y_i) + p_i$, given that $F(Y_i) - p_i \geq 0$ and $F(Y_i) + p_i \leq 1$. If this is the case then the individual will observe incomes between $Y_{min,i} = F^{-1}(F(Y_i) - p_i)$ and $Y_{max,i} = F^{-1}(F(Y_i) + p_i)$.

S.1.1 Uniform income distribution

In this subsection we look at the case of uni-formally distributed incomes.

Assumption 3 (Uniform income distribution)

Incomes Y_j are uni-formally distributed between $Y^{min} = \overline{Y}(1-\mu)$ and $Y^{max} = \overline{Y}(1+\mu)$ where $0 \leq \mu \leq 1$. The density and distribution functions are given by $f(Y_j) = \frac{1}{2\overline{Y}\mu}$ and $F(Y_j) = \frac{Y_j - \overline{Y}(1-\mu)}{2\overline{Y}\mu}$, respectively. Mean income is given by $\overline{Y}$, the variance by $\frac{\overline{Y}^2\mu^2}{3}$ and the Gini coefficient by $\frac{\mu}{3}$.

In this case the limits of the perception span can be calculated as: $Y_{min,i} = Y_i - 2p_i\mu\overline{Y}$ and $Y_{max,i} = Y_i + 2p_i\mu\overline{Y}$. Two cut-off points Y_A and Y_B can be defined as the levels where $Y_{min,i}$ ($Y_{max,i}$) are just equal to the region-wide minimum Y_{min} (maximum Y_{max}). These values come out as $Y_A \equiv Y_{min} + 2p_i\mu\overline{Y}$ and $Y_B \equiv Y_{max} - 2p_i\mu\overline{Y}$, respectively. Note that $Y_A < Y_B$ for $p_i < \frac{1}{2}$ and $Y_A > Y_B$ for $p_i > \frac{1}{2}$.

Therefore one has to distinguish between six cases:

- For $0 \leq p_i \leq \frac{1}{2}$:
  - **Case A1**: $0 \leq F(Y_i) \leq p_i$: Incomes observed between Y_{min} and $Y_i + 2p_i\mu\overline{Y}$.
  - **Case A2**: $p_i \leq F(Y_i) \leq (1-p_i)$: Incomes observed between $Y_i - 2p_i\mu\overline{Y}$ and $Y_i + 2p_i\mu\overline{Y}$.
  - **Case A3**: $(1-p_i) \leq F(Y_i) \leq 1$: Incomes observed between $Y_i - 2p_i\mu\overline{Y}$ and Y_{max}.
- For $\frac{1}{2} < p_i \leq 1$:
  - **Case B1**: $0 \leq F(Y_i) \leq (1-p_i)$: Incomes observed between Y_{min} and $Y_i + 2p_i\mu\overline{Y}$.
  - **Case B2**: $(1-p_i) \leq F(Y_i) \leq p_i$: Incomes observed between Y_{min} and Y_{max}.
  - **Case B3**: $p_i \leq F(Y_i) \leq 1$: Incomes observed between $Y_i - 2p_i\mu\overline{Y}$ and Y_{max}.

Individuals differ with respect to the interval in which they are located. One can calculate the perceived expected average income $E^i(Y)$ and the subjective position in the perceived income distribution $F^i(Y_i)$.[10]

- **Cases A1 and B1**: $E^i(Y) = \frac{Y_i+Y_A}{2}$ and $F^i(Y_i) = \frac{Y_i-Y_{min}}{Y_i+2p_i\mu\overline{Y}-Y_{min}}$.

  First, note that individuals in this interval thus underestimate the (objective) average income ($E^i(Y) \leq \overline{Y}$). This follows from the fact that $E^i(Y)$ is largest in this interval for $Y_i = Y_A$ (for $p_i \leq \frac{1}{2}$) and $Y_i = Y_B$ (for $p_i \geq \frac{1}{2}$). For $Y_i = Y_A$ one gets that $E^i(Y) = Y_A = Y_{min} + 2p_i\mu\overline{Y}$ which is smaller than $\overline{Y}$ for $p_i < \frac{1}{2}$. For $Y_i = Y_B$, on the other hand, one gets that $E^i(Y) = \overline{Y}$.

  Second, individuals in this interval overestimate their own position in the income distribution ($F^i(Y_i) \geq F(Y_i)$). This follows from the fact that $F^i(Y_i) = \frac{Y_i-Y_{min}}{Y_i+2p_i\mu\overline{Y}-Y_{min}} \geq \frac{Y_i-Y_{min}}{2\mu\overline{Y}} = F(Y_i)$. This inequality holds for $Y_i + 2p_i\mu\overline{Y} < Y_{max} = \overline{Y}(1-\mu)$ or $Y_i \leq \overline{Y}(1+\mu(1-2p_i)) = Y_B$. This is true for case B1 (per assumption) and for case A1 (where $Y_i \leq Y_A \leq Y_B$).

- **Case A2**: $E^i(Y) = Y_i$ and $F^i(Y_i) = \frac{1}{2}$.

  Individuals in this segment think that they are the "centre of the universe". They view their position as the middle of the income spectrum and they will thus either underestimate average income and overestimate their own position (if $Y_i < \overline{Y}$) or overestimate average income and underestimate their own position (if $Y_i > \overline{Y}$).

- **Case B2**: $E^i(Y) = \overline{Y}$ and $F^i(Y_i) = \frac{Y_i-Y_{min}}{2\mu\overline{Y}} = F(Y_i)$.

  In this interval p_i is large enough such that individuals have accurate perceptions.

- **Cases A3 and B3**: $E^i(Y) = \frac{Y_i+Y_B}{2}$ and $F^i(Y_i) = \frac{Y_i-(Y_i-2p_i\mu\overline{Y})}{Y_{max}-(Y_i-2p_i\mu\overline{Y})}$.

  This is just the mirror image of cases A1 and B1. Individuals in these intervals overestimate the (objective) average income ($E^i(Y) \geq \overline{Y}$) and they underestimate their own position in the income distribution ($F^i(Y_i) \leq F(Y_i)$).

[10] For case A1, e.g., this comes from: $E^i(Y) = \frac{\int_{Y_{min}}^{Y_i+2p_i\mu\overline{Y}} Y_j \frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}{\int_{Y_{min}}^{Y_i+2p_i\mu\overline{Y}} \frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}$ and $F^i(Y_i) = \frac{\int_{Y_{min}}^{Y_i} \frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}{\int_{Y_{min}}^{Y_i+2p_i\mu\overline{Y}} \frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}$.

One can now also calculate the average subjective perception of average income. In general, this requires to make an assumption on the distribution of the p_i across the population (and in particular about the joint distribution of Y_i and p_i). We report here the result for the benchmark case where the perception span is identical across individuals, i.e. $p_i = p$. The average perception is given by the average values for $E^i(Y)$ in the intervals A1, A2 and A3 (for $p \leq \frac{1}{2}$) and the intervals B1, B2 and B3 (for $p \geq \frac{1}{2}$). For both cases it comes out as $E(E^i(Y)) = \overline{Y}$.[11] The average perception is thus unbiased although the mass of people either under- or overestimates themselves. This is illustrated in panels (a) and (b) of figure S.1.[12]

For the calculation of the measure for income heterogeneity $E^i(\nabla)$ we need the perceived expectations of relative difference (or short: relative mean difference) between two incomes ∇_{ji} (see assumption 1). We first look at the expression in the numerator, i.e at the expected mean absolute differences $E^i(\Psi) = (1-z)\int_{j\in\mathbb{S}_i \wedge Y_j<Y_i}(Y_i - Y_j)f(Y_j)\,\mathrm{d}Y_j + z\int_{j\in\mathbb{S}_i \wedge Y_j>Y_i}(Y_j - Y_i)f(Y_j)\,\mathrm{d}Y_j$. They come out as:[13]

- **Cases A1 and B1**: $E^i(\Psi) = \mu\overline{Y}\left(F(Y_i) + p_i - \frac{F(Y_i)p_i}{F(Y_i)(1-z)+p_i z}\right)$.
- **Case A2**: $E^i(\Psi) = p_i\mu\overline{Y}$.
- **Case B2**: $E^i(\Psi) = \mu\overline{Y}\left(\frac{F(Y_i)^2-2F(Y_i)z+z}{F(Y_i)(1-2z)+z}\right)$.
- **Cases A3 and B3**: $E^i(\Psi) = \mu\overline{Y}\left(\frac{(1-F(Y_i))^2 z+p_i^2(1-z)}{(1-F(Y_i)-p_i)z+p_i}\right)$.

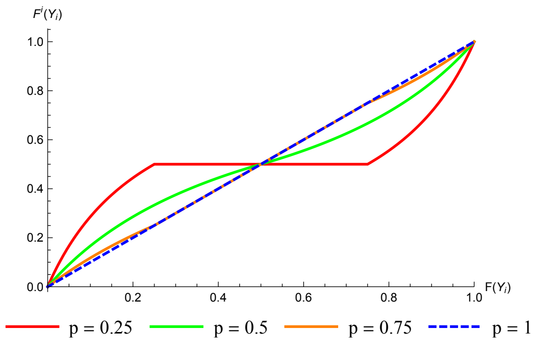
It can be shown again that in all cases except in case B2 (and A2 for $p_i = \frac{1}{2}$) individuals

---

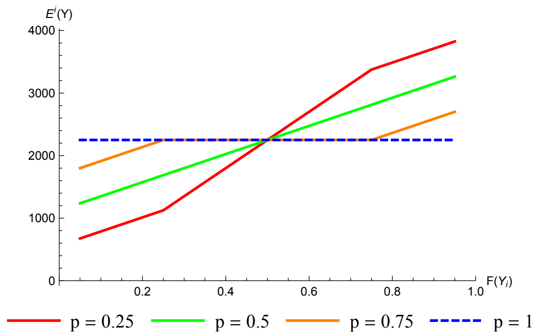
[11] For the case $p \leq \frac{1}{2}$, e.g., one can write:
$$E(E^i(Y)) = \int_{Y_{min}}^{Y_A} \frac{Y_i+Y_A}{2}\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_i + \int_{Y_A}^{Y_B} Y_i\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_i + \int_{Y_B}^{Y_{max}} \frac{Y_i+Y_B}{2}\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_i = \frac{(Y_A-Y_{min})(Y_A+4p\mu\overline{Y}+3Y_{min})}{4(2\mu\overline{Y})} + \frac{Y_B^2-Y_A^2}{2(2\mu\overline{Y})} + \frac{(Y_{max}-Y_B)(Y_B-4p\mu\overline{Y}+3Y_{max})}{4(2\mu\overline{Y})} = \overline{Y}.$$

[12] We use here $\overline{Y} = 2250$ and $\mu = 1$ which corresponds to a mean income of 2250 and a standard deviation of $SD(Y) = 1300$ which is in the neighbourhood of the values of our survey that we use in the empirical part of the paper.

[13] The formula for case A1 is:
$$E^i(\Psi) = \frac{(1-z)\int_{Y_{min}}^{Y_i}(Y_i-Y_j)\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j + z\int_{Y_i}^{Y_i+2p_i\mu\overline{Y}}(Y_j-Y_i)\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}{\int_{Y_{min}}^{Y_i+2p_i\mu\overline{Y}}\frac{1}{2\mu\overline{Y}}\,\mathrm{d}Y_j}.$$

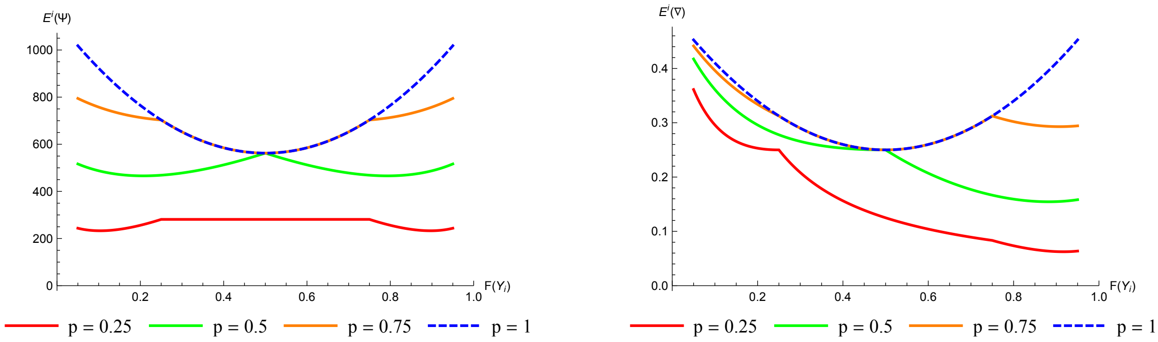


(a) Perceived Rank



(b) Perceived Average Income

Figure S.1: The figure shows the perceived income rank $F^i(Y_i)$ and perceived average income $E^i(Y)$ when income follows a uniform distribution with $\overline{Y} = 2250$ and $\mu = 1$ and when $p_i = p$. This is contrasted with the income rank if individuals had unbiased perceptions ($p = 1$).



(a) Mean Income Differences (b) Relative Mean Income Differences

Figure S.2: The figure shows individual perceptions of absolute and relative mean income differences, i.e. $E^i(\Psi)$ and $E^i(\nabla)$ when incomes follow a uniform distribution with $\overline{Y} = 2250$ and $\mu = 1$ and where $z = 1/2$.

underestimate the true value for the mean absolute differences that is given by: $E(\Psi) = \mu\overline{Y}\left(\frac{F(Y_i)^2 - 2F(Y_i)z + z}{F(Y_i)(1-2z)+z}\right)$.

Also note that the value of $E^i(\Psi)$ is the same for Y_{min} and Y_{max} and given by $p_i\mu\overline{Y}$. For $p_i < \frac{1}{2}$ this is just equal to the value of the middle segment. This is illustrated in panel (a) of figure S.2 for the case with $z = 1/2$.

In order to calculate the value for $E^i(\nabla)$ one also has to make an assumption about how individual i perceives individual j's estimation of average income $E^j(Y_x)$. We impose a law of iterated expectations and assume that $E^i(E^j(Y_x)) = E^i(Y_x)$. The solutions for perceived mean income have already been derived above. The resulting pattern of $E^i(\nabla)$ is shown in panel (b) of figure S.2.

Comparing panels (a) and (b) of figure S.2 one can see that it matters which concept of variability one uses in order to capture the perceived heterogeneity in incomes. While for the difference $E^i(\Psi)$ (see figure S.2a) the measure is U-shaped, it is more or less (at least for $p_i < \frac{1}{2}$) downward-sloping for the benchmark measure. For log-normally distributed incomes, however, this is not true as can be seen in figure 2a of the paper. This is another reason to use in empirical estimations a direct proxy for the perceived inequality (if such a measure is available).

One can calculate the average relative mean difference $E(E^i(\nabla))$ for the assumption $p_i = p$ (using again a similar expression as in footnote 11 for $E(E^i(Y))$). The resulting expression is rather lengthy but an approximation (around $\mu = 0$) gives:[14]

$$E(E^i(\nabla)) = \begin{cases} \frac{\mu}{3} \frac{3p(1+p(\ln(16)-3))}{2} & \text{for } 0 \leq p \leq \frac{1}{2}, \\ \frac{\mu}{3} \frac{1-6p+3p^2+4p^3-12p^2\ln(p)}{2} & \text{for } \frac{1}{2} < p \leq \frac{1}{2}. \end{cases} \tag{19}$$

This is the term that is referred to in equation (10) of appendix A.2 and in equation (17) of appendix A.2. Note that in the absence of biased perceptions (i.e. when $p = 1$) equation (19) implies that $E(E^i(\nabla)) = \frac{\mu}{3}$ which just corresponds to the true Gini coefficient for an unbiased perception given by: $\mathbb{G} = \frac{\mu}{3}$. For $p < 1$, however, the average measure $E(E^i(\nabla))$ for the subjective distribution based on the biased individual perceptions is lower than the true value. This is illustrated for the non-approximated values in figure S.3a. The functions appear almost linear (except for the case with $p = 0.25$). We have therefore also illustrated the dependence of $\frac{E(E^i(\nabla))}{\frac{\mu}{3}}$ for the expression in (19). This is just the value of $\psi(p)$ given in (17) of appendix A.2. It measures the "bias" of the true coefficient on the Gini if people have biased perceptions. This is shown in figure S.3b. For $p = 1$ one gets a value of 1.

S.1.2 Log-normal income distribution

The assumption of a uniform distribution of incomes is convenient since it allows us to derive results in explicit form and to get some intuition about the underlying mechanisms. In reality, however, incomes are unequally distributed and skewed to the right. We can capture this by using either the assumption of a triangular distribution (which still allows

[14] These expressions are exact if one calculates the average mean *absolute* (and not absolute relative) differences $E(E^i(\Psi))$ or if one sets $E^j(Y_x) = \overline{Y}$.

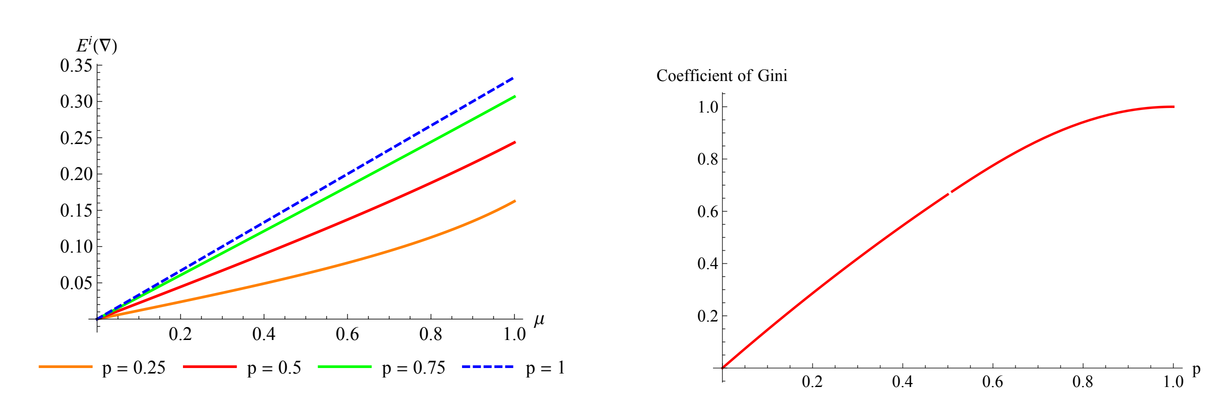


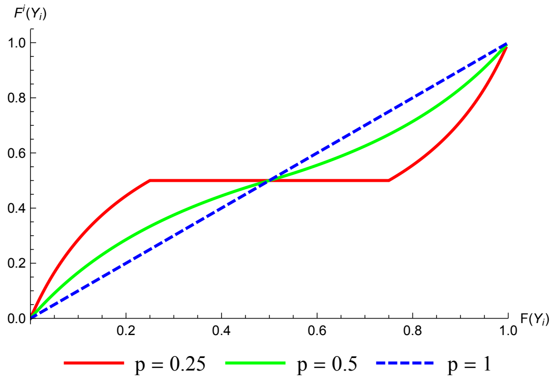
Figure S.3: Panel (a) of the figure shows the dependence of the average measure of perceived inequality $E(E^i(\nabla))$ on objective inequality μ for various values of p (and for the case where $z = 1/2$). At $p = 1$ it corresponds to the Gini coefficient given by $\frac{\mu}{3}$. Panel (b) shows the size of the term $\psi(p)$ in equation (17).

for some analytical results) or the assumption of a log-normal distribution which is often used to model the distribution of incomes. We have performed both exercises but report here only the one of a log-normal distribution.

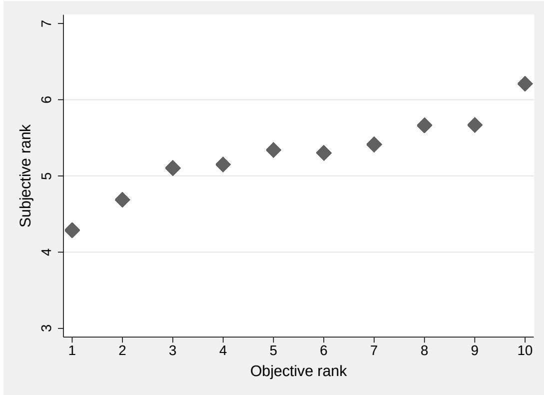
In particular, we first assume that incomes Y_i follow a log-normal distribution with $m = 7.575$ and $\sigma = 0.537$ such that $E(Y_i) = e^{m+\frac{\sigma^2}{2}} = 2250$ and $SD(Y_i) = E(Y_i)\sqrt{e^{\sigma^2} - 1} = 1300$, thereby again broadly conforming to the values in our dataset (and to the values used for the illustrations of the uniform distribution). We assume again that an individual with income Y_i just observes incomes in the range between $Max(0, F(Y_i) - p_i)$ and $Min(0, F(Y_i) + p_i)$.

Figure S.4a shows the pattern of the subjective rank $F^i(Y_i)$ for the case of the log-normal distribution and various values of p (assuming that $p_i = p$).

When comparing figure S.4a and figure S.1a we see that they are almost identical. Poorer households tend to overestimate themselves, richer households tend to see their relative position as lower than their objective rank and the range in-between views themselves as being exactly in the middle. The span of individuals that report to occupy the



(a) Perceived Rank (Theory)



(b) Perceived Rank (Data)

Figure S.4: Panel (a) shows the perceived income rank $F^i(Y_i)$ under the assumption that incomes are log-normally distributed with a mean income of 2250 and a standard deviation of 1300 (or $m = 7.575$ and $\sigma = 0.537$). This corresponds to the values in our survey data (for monthly household incomes). We assume $z = 1/2$, $p_i = p$ and show three values of p where $p = 1$ corresponds to the case with unbiased perceptions. Panel (b) contrasts the mean of the subjective rank in our dataset with the respondents' objective rank.

middle position seems to be rather large. This, however, is due to our assumption about the size and the nature of biased perceptions.

We can analyse the existence of socially biased perception by using our survey dataset. For this we need data on both the objective and the subjective rank in the income distribution. Our measure for the objective rank $F(Y_i)$ is based on the respondents' declaration of their net monthly household income.[15] In order to measure the subjective rank $F^i(Y_i)$ we use a question that has been employed by other researchers to capture the perception of the position in the income distribution: "In our society there are groups which tend to be towards the top and groups which tend to be toward the bottom. Below is a scale that runs from top to bottom [horizontal scale (10 top – 1 bottom)]. Where would you put yourself on this scale?" It is certainly true that this question refers to a concept of

[15]The answer is given as one of 20 income category. We use the midpoint of each interval as the income corresponding to each category and then use the cumulative distribution (in the region) of these values as our measure of the rank. Using the entire country gives a similar picture since the differences in regional distributions are rather modest.

"social standing" that is wider than just an assessment of the income position. On the other hand, social standing and income are closely related and we regard the answers to this question as a good proxy for social rank.

Figure S.4b lends strong support to the existence of socially biased perceptions. Individuals below the objective income rank $F(Y_i) = \frac{1}{2}$ on average overestimate their position while individuals above the median underestimate it. The crossing with the 45 degree line is exactly at the median. This result is in line with findings of the literature (Cruces et al. 2013, Gimpelson & Treisman 2015) and it is also confirmed in regressions that correct for a host of additional explanatory variables (not shown).

Figure 2a in the main text shows $E^i(\nabla)$ for the case of a log-normal income distribution. A comparison between figure 2a and figure S.2b reveals that the pattern of the perceived variability of incomes is qualitatively different for the case of a uniform and a log-normal income distribution. For the case of the uniform distribution, e.g., the perceived inequality has not been highest for the highest incomes but this is no longer true for the log-normal distribution.

S.2 Local perception bias

We assume now that individuals also look across the borders of their own regions. In this section we therefore have to use the region-index r. In particular, we assume that instead of assumption 2 the reference group of an individual i living in region r consists of a share s_{i_r} of own-region individuals and a share $1 - s_{i_r}$ of individuals that are random draws from *all* other regions in the total sample. In order to simplify notation we assume that this local perception span is the same for all individuals in a region, i.e. $s_{i_r} = s_r$.

Assumption 4 (Locally Biased Reference Groups)

All individuals have unbiased social perceptions, i.e. they observe all incomes in the range between $F_r^{-1}(0)$ and $F_r^{-1}(1)$. Individuals, however, also look across the borders of their *own region and they draw a random sample of all individuals that have incomes in their respective ranges. This sample consists of a share $s_{i_r} = s_r$ of members of the own region and a share $1 - s_r$ of members of the other regions.*

In order to derive closed-form solutions we furthermore employ assumptions 3 and 5, i.e. incomes are assumed to be uni-formally distributed within a region and the variance of incomes in a region is itself uni-formally distributed across regions.

Assumption 5 (Uniform cross-regional distribution)
Incomes are uni-formally distributed in each region $r \in [0, R]$ as specified in assumption 3, i.e. Y_{j_r} are between $\overline{Y}_r(1 - \mu_r)$ and $\overline{Y}_r(1 + \mu_r)$ with $0 \leq \mu_r \leq 1$. It is assumed that $\overline{Y}_r = \overline{Y}, \forall r$ and that μ_r is itself uni-formally distributed between $\mu_1 = \overline{\mu}(1 - \lambda)$ and $\mu_R = \overline{\mu}(1 + \lambda)$ where $\lambda \leq \frac{1-\overline{\mu}}{\overline{\mu}}$.

In order to derive the density function for the entire economy one has to consider the following. All income levels Y_i for which it holds that $\overline{Y}(1 - \mu_1) \leq Y_i \leq \overline{Y}(1 + \mu_1)$ can be observed in all regions. They are present in the region with the lowest income span μ_1 and therefore also in all other, more unequal societies. Since incomes are uni-formally distributed the mass of the income level Y_i in a region with a span μ_x will be just $\frac{1}{2\overline{Y}\mu_x}$. The spans μ_x themselves, on the other hand, have a density function given by $\frac{1}{2\lambda\overline{\mu}}$. For lower incomes levels, on the other hand, with $Y_i \leq \overline{Y}(1 - \mu_1)$ there will be regions where Y_i cannot be observed. The marginal region where it will be present is the one with a span μ_i^D for which the lowest income is just Y_i or $Y_i = \overline{Y}(1 - \mu_i^D)$. From this is follows that $\mu_i^D \equiv 1 - \frac{Y_i}{\overline{Y}}$. In a similar vein one can define a lower bound for high incomes with $Y_i \geq \overline{Y}(1 + \mu_1)$ where $Y_i = \overline{Y}(1 + \mu_i^E)$ and thus $\mu_i^E \equiv \frac{Y_i}{\overline{Y}} - 1$.

The density function for incomes in the entire country is then given by the following

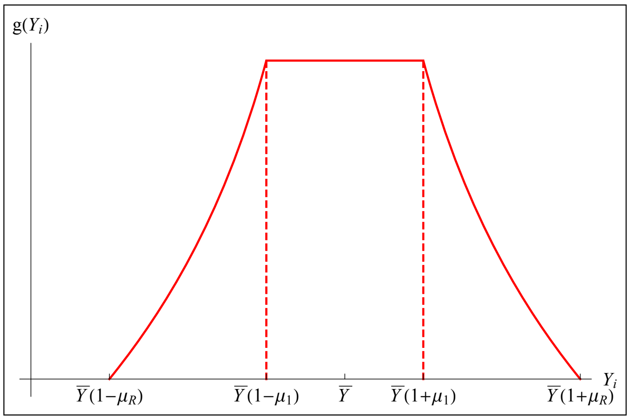


Figure S.5: The figure shows the density function $g(Y_i)$.

expression:

$$g(Y_i) = \begin{cases} \int_{\mu_i^D}^{\mu_R} \frac{1}{2\overline{Y}\mu_x} \frac{1}{2\lambda\overline{\mu}} \, \mathrm{d}\mu_x = \frac{\ln\left(\frac{\mu_R}{\mu_i^D}\right)}{2\overline{Y}} \frac{1}{2\lambda\overline{\mu}} & \text{for } \overline{Y}(1-\mu_R) \leq Y_i \leq \overline{Y}(1-\mu_1), \\ \int_{\mu_1}^{\mu_R} \frac{1}{2\overline{Y}\mu_x} \frac{1}{2\lambda\overline{\mu}} \, \mathrm{d}\mu_x = \frac{\ln\left(\frac{\mu_R}{\mu_1}\right)}{2\overline{Y}} \frac{1}{2\lambda\overline{\mu}} & \text{for } \overline{Y}(1-\mu_1) \leq Y_i \leq \overline{Y}(1+\mu_1), \\ \int_{\mu_i^E}^{\mu_R} \frac{1}{2\overline{Y}\mu_x} \frac{1}{2\lambda\overline{\mu}} \, \mathrm{d}\mu_x = \frac{\ln\left(\frac{\mu_R}{\mu_i^E}\right)}{2\overline{Y}} \frac{1}{2\lambda\overline{\mu}} & \text{for } \overline{Y}(1+\mu_1) \leq Y_i \leq \overline{Y}(1+\mu_R). \end{cases} \tag{20}$$

The density function is shown in figure S.5. Incomes between $\overline{Y}(1-\mu_1)$ and $\overline{Y}(1+\mu_1)$ are present in all regions and the density function in this segment is again uniform. Incomes below $\overline{Y}(1-\mu_1)$ and above $\overline{Y}(1+\mu_1)$, however, are only observed in a decreasing sub-sample of the regions. The lowest income $\overline{Y}(1-\mu_R)$ and the highest income $\overline{Y}(1+\mu_R)$ are only present in the top-inequality region μ_R and since there is a continuum of regions the mass of these extreme levels in the total population is zero.

We call the three segments of the density function $g^1(Y_i)$, $g^2(Y_i)$ and $g^3(Y_i)$. The distribution function then also consists of three segments that are given by: $\int_{\overline{Y}(1-\mu_R)}^{Y_i} g^1(Y_j)\,\mathrm{d}Y_j$, $\int_{\overline{Y}(1-\mu_R)}^{\overline{Y}(1-\mu_1)} g^1(Y_j)\,\mathrm{d}Y_j + \int_{\overline{Y}(1-\mu_1)}^{Y_i} g^2(Y_j)\,\mathrm{d}Y_j$ and $\int_{\overline{Y}(1-\mu_R)}^{\overline{Y}(1-\mu_1)} g^1(Y_j)\,\mathrm{d}Y_j + \int_{\overline{Y}(1-\mu_1)}^{\overline{Y}(1+\mu_1)} g^2(Y_j)\,\mathrm{d}Y_j +$

$\int_{\overline{Y}(1+\mu_1)}^{Y_i} g^3(Y_j)\,\mathrm{d}Y_j$, respectively. This can be solved to derive:

$$G(Y_i) = \begin{cases} \frac{Y_i-(1-(1+\lambda)\overline{\mu})\overline{Y}-(\overline{Y}-Y_i)\ln\left(\frac{(1+\lambda)\overline{\mu}\overline{Y}}{\overline{Y}-Y_i}\right)}{4\lambda\overline{\mu}\overline{Y}} & \text{for } \overline{Y}(1-\mu_R) \leq Y_i \leq \overline{Y}(1-\mu_1), \\ \frac{2\lambda\overline{\mu}\overline{Y}-(\overline{Y}-Y_i)\ln\left(\frac{1+\lambda}{1-\lambda}\right)}{4\lambda\overline{\mu}\overline{Y}} & \text{for } \overline{Y}(1-\mu_1) \leq Y_i \leq \overline{Y}(1+\mu_1), \\ \frac{Y_i-(1+(1-3\lambda)\overline{\mu})\overline{Y}+(Y_i-\overline{Y})\ln\left(\frac{(1+\lambda)\overline{\mu}\overline{Y}}{Y_i-\overline{Y}}\right)}{4\lambda\overline{\mu}\overline{Y}} & \text{for } \overline{Y}(1+\mu_1) \leq Y_i \leq \overline{Y}(1+\mu_R). \end{cases} \tag{21}$$

Note that $G(\overline{Y}(1-\mu_1)) = 0$, $G(\overline{Y}(1+\mu_R)) = 1$ and $\frac{\mathrm{d}G(Y_i)}{\mathrm{d}Y_i} > 0$, so $G(Y_i)$ is in fact a distribution function.

We are again interested in the perceived expectations of the mean relative difference between two incomes. To simplify the calculations we only look at the case where $z = 1/2$, i.e. $E^i(\nabla) = E^i(\frac{|Y_i-Y_j|}{2E^j(Y_x)})$ and we start with the case where $s_r = 0$. We first look at the expression in the numerator, which is given as: $E^i(|Y_i - Y_j|) = \int_{\overline{Y}(1-\mu_r)}^{Y_i} (Y_i - Y_j)\, g(Y_j)\,\mathrm{d}Y_j + \int_{Y_i}^{\overline{Y}(1+\mu_r)} (Y_i - Y_j)\, g(Y_j)\,\mathrm{d}Y_j$. This formulation follows from the assumption that also in other regions each individual will only observe incomes that are within the range of incomes that are present in his or her own regions, i.e. between $\overline{Y}(1-\mu_r)$ and $\overline{Y}(1+\mu_r)$. By calculating this expression one has again to distinguish between the three segments since the density function $g(Y_j)$ is different for $\overline{Y}(1-\mu_r) \leq Y_j \leq \overline{Y}(1-\mu_1)$ etc.

The three resulting expressions (call them $\Xi^1(Y_i)$, $\Xi^2(Y_i)$ and $\Xi^3(Y_i)$) are rather complicated and are not reported here. Note that due to the assumption of no social biases and symmetric distributions all individuals have an accurate perception of mean income $\overline{Y}$ that appears in the denominator of equation (2).

In order to calculate the average of the individual relative mean differences in a certain region r one has to integrate the expressions $\Xi^k(Y_i)$ over all individuals in a region. This means that:

$$E(E^{i_r}(\nabla)) = \int_{\overline{Y}(1-\mu_r)}^{\overline{Y}(1-\mu_1)} \frac{\Xi^1(Y_i)}{2\mu_r\overline{Y}}\,\mathrm{d}Y_j + \int_{\overline{Y}(1-\mu_1)}^{\overline{Y}(1+\mu_1)} \frac{\Xi^2(Y_i)}{2\mu_r\overline{Y}}\,\mathrm{d}Y_j + \int_{\overline{Y}(1+\mu_1)}^{\overline{Y}(1+\mu_r)} \frac{\Xi^3(Y_i)}{2\mu_r\overline{Y}}\,\mathrm{d}Y_j.$$

This can be solved to get:

$$E(E^{i_r}(\nabla)) = \frac{(1-\lambda)^3\overline{\mu}^3 + 9(1-\lambda)\overline{\mu}\mu_r^2 - \mu_r^3(10 + 12\ln\left(\frac{(1+\lambda)\overline{\mu}}{\mu_r}\right)}{36\mu_r\left((1-\lambda)\overline{\mu} - \mu_r\left(1+\ln\left(\frac{(1+\lambda)\overline{\mu}}{\mu_r}\right)\right)\right)}.$$

In the case where each individual has a share s_r of members of his own region in the reference group and a share of $1-s_r$ of members of other regions, all magnitudes have to be seen as a weighted average between the cases for reference group assumption 2 (with $p_{i_r} = p_r = 1$) and the formulas stated above e.g.:

$$E(E^{i_r}(\nabla)) = s_r\frac{\mu_r}{3} + (1-s_r)\frac{(1-\lambda)^3\overline{\mu}^3 + 9(1-\lambda)\overline{\mu}\mu_r^2 - \mu_r^3(10 + 12\ln\left(\frac{(1+\lambda)\overline{\mu}}{\mu_r}\right)}{36\mu_r\left((1-\lambda)\overline{\mu} - \mu_r\left(1+\ln\left(\frac{(1+\lambda)\overline{\mu}}{\mu_r}\right)\right)\right)}. \quad (22)$$

This can be linearized around $\mu_r = \overline{\mu}$ and $\lambda = 0$ to get:

$$E(E^{i_r}(\nabla)) = \left(\frac{1}{4}\mathbb{G}_r(3+s_r) + \frac{1}{4}\overline{\mathbb{G}}(1-s_r)\left(1-\frac{\lambda}{2}\right)\right).$$

This is stated in equation (18) where we use the fact that $\mathbb{G}_r = \frac{\mu_r}{3}$ and $\overline{\mathbb{G}} = \int_{\mu_1}^{\mu_r}\mathbb{G}_r\frac{1}{\lambda\overline{\mu}}\,\mathrm{d}\mu_r = \frac{\overline{\mu}}{3}$.

S.3 Additional estimation results

Table S.1: Trust and Inequality (Full Results)

Dependent variable	Trust in people			Trust in people alternative def. (0/1)	(4 cat.)	(4 cat.)
	(1)	(2)	(3)	(4)	(5)	(6)
Municipality Gini	-0.982	—	—	-2.059	-0.968	—
	(1.271)			(1.294)	(0.674)	
Municipality 90/10 inequality	—	-0.001	—	—	—	-0.005
		(0.031)				(0.018)
Regional Gini	—	—	0.469	—	—	—
			(2.217)			
Objective rank	0.626***	0.623***	0.626***	0.468**	0.229**	0.227**
	(0.210)	(0.211)	(0.210)	(0.205)	(0.103)	(0.104)
Objective rank (squared)	-0.455**	-0.454**	-0.457**	-0.256	-0.114	-0.113
	(0.203)	(0.203)	(0.202)	(0.187)	(0.092)	(0.092)
Age	-0.005	-0.005	-0.005	-0.010**	-0.004*	-0.004*
	(0.005)	(0.005)	(0.005)	(0.004)	(0.002)	(0.002)
Age sq. (x1e3)	0.044	0.047	0.048	0.126***	0.048**	0.050**
	(0.054)	(0.054)	(0.054)	(0.040)	(0.020)	(0.020)
Male	0.019	0.020	0.019	-0.040	-0.021	-0.022
	(0.031)	(0.031)	(0.031)	(0.026)	(0.013)	(0.013)
Edu med	-0.048	-0.046	-0.046	-0.068	-0.034*	-0.032
	(0.044)	(0.044)	(0.044)	(0.042)	(0.019)	(0.020)
Edu high	0.116***	0.116***	0.114***	0.095**	0.034*	0.034*
	(0.038)	(0.037)	(0.036)	(0.039)	(0.018)	(0.018)
Married	-0.032	-0.030	-0.030	0.029	-0.010	-0.008
	(0.047)	(0.047)	(0.046)	(0.044)	(0.022)	(0.022)
Separated	-0.055	-0.055	-0.055	0.026	-0.019	-0.019
	(0.048)	(0.048)	(0.048)	(0.045)	(0.024)	(0.024)
Children in HH	-0.116**	-0.114**	-0.113**	-0.077	-0.032	-0.030
	(0.055)	(0.055)	(0.055)	(0.048)	(0.023)	(0.023)
HH size	0.012	0.011	0.011	-0.018	-0.012	-0.013
	(0.022)	(0.022)	(0.022)	(0.019)	(0.009)	(0.009)
Unemployed	-0.160**	-0.160**	-0.161**	-0.144**	-0.103***	-0.105***
	(0.070)	(0.070)	(0.070)	(0.072)	(0.038)	(0.039)
Owner	-0.057	-0.056	-0.057	0.013	-0.019	-0.019
	(0.061)	(0.062)	(0.062)	(0.063)	(0.031)	(0.032)
Public employees	-0.073	-0.073	-0.074	-0.007	-0.030	-0.030
	(0.062)	(0.063)	(0.063)	(0.045)	(0.025)	(0.025)
In education	-0.035	-0.038	-0.038	0.235**	0.060	0.057
	(0.113)	(0.114)	(0.114)	(0.091)	(0.046)	(0.046)
At home	-0.018	-0.021	-0.023	-0.011	-0.016	-0.019
	(0.083)	(0.083)	(0.083)	(0.072)	(0.034)	(0.034)
Retired	-0.101*	-0.104*	-0.104*	-0.068	-0.028	-0.031
	(0.056)	(0.056)	(0.056)	(0.052)	(0.028)	(0.028)
Foreigner	-0.099**	-0.094**	-0.094**	-0.105**	-0.066***	-0.062***
	(0.044)	(0.044)	(0.044)	(0.047)	(0.023)	(0.024)
Quality newspapers	0.125***	0.124***	0.125***	0.064*	0.010	0.009
	(0.039)	(0.039)	(0.038)	(0.036)	(0.017)	(0.017)
Municipality avg. income (ln)	0.262	0.093	0.084	0.223	0.171	0.020
	(0.280)	(0.217)	(0.184)	(0.247)	(0.134)	(0.109)
Municipality population (ln)	0.008	0.006	0.005	0.002	-0.003	-0.005
	(0.014)	(0.014)	(0.016)	(0.015)	(0.008)	(0.008)
Adj. R-squared	0.07	0.06	0.06	0.07	0.06	0.05
Observations	1272	1272	1272	1257	1257	1257
Municipalities	162	162	162	162	162	162

Dependent variables: In columns (1) to (3) the dependent variable is *trust in people*. In column (4) we use *trust in people alternative definition (0/1)*, in column (5) and (6) *trust in people alternative definition (4 cat.)*, i.e., the same variable recoded to 4 categories (0/0.33/0.66/1). All models report estimates from a linear probability model. Standard errors in parentheses are adjusted for clustering at the municipality level. ***, **, * denote significance at the 0.01, 0.05 and 0.10-level. Variables are defined in appendix B.

Index of Working Papers:

March 29, 2010	Markus Knell	161	Nominal and Real Wage Rigidities. In Theory and in Europe
May 31, 2010	Zeno Enders Philip Jung Gernot J. Müller	162	Has the Euro changed the Business Cycle?
August 25, 2010	Marianna Cervená Martin Schneider	163	Short-term forecasting GDP with a DSGE model augmented by monthly indicators
September 8, 2010	Sylvia Kaufmann Johann Scharler	164	Bank-Lending Standards, the Cost Channel and Inflation Dynamics
September 15, 2010	Helmut Elsinger	165	Independence Tests based on Symbolic Dynamics
December 14, 2010	Claudia Kwapil	166	Firms' Reactions to the Crisis and their Consequences for the Labour Market. Results of a Company Survey conducted in Austria
May 10, 2011	Helmut Stix	167	Does the Broad Public Want to Consolidate Public Debt? – The Role of Fairness and of Policy Credibility
May 11, 2011	Burkhard Raunig, Johann Scharler	168	Stock Market Volatility, Consumption and Investment; An Evaluation of the Uncertainty Hypothesis Using Post-War U.S. Data
May 23, 2011	Steffen Osterloh	169	Can Regional Transfers Buy Public Support? Evidence from EU Structural Policy
May 23, 2011	Friederike Niepmann Tim Schmidt-Eisenlohr	170	Bank Bailouts, International Linkages and Cooperation
September 1, 2011	Jarko Fidrmuc, Mariya Hake, Helmut Stix	171	Households’ Foreign Currency Borrowing in Central and Eastern Europe
September 9, 2011	Jürgen Eichberger, Klaus Rheinberger, Martin Summer	172	Credit Risk in General Equilibrium

October 6, 2011	Peter Lindner	173	Decomposition of Wealth and Income using Micro Data from Austria
October 18, 2011	Stefan Kerbl	174	Regulatory Medicine Against Financial Market Instability: What Helps And What Hurts?
December 31, 2011	Konstantins Benkovskis Julia Wörz	175	How Does Quality Impact on Import Prices?
January 17, 2012	Nicolás Albacete	176	Multiple Imputation in the Austrian Household Survey on Housing Wealth
January 27, 2012	Gerhard Fenz, Lukas Reiss, Martin Schneider	177	A structural interpretation of the impact of the great recession on the Austrian economy using an estimated DSGE model
July 27, 2012	Helmut Stix	178	Why Do People Save in Cash? Distrust, Memories of Banking Crises, Weak Institutions and Dollarization
August 20, 2012	Markus Knell	179	Increasing Life Expectancy and Pay-As-You-Go Pension Systems
September 25, 2012	Fabio Rumler, Walter Waschiczek	180	Have Changes in the Financial Structure Affected Bank Protability? Evidence for Austria
November 9, 2012	Elisabeth Beckmann, Jarko Fidrmuc, Helmut Stix	181	Foreign Currency Loans and Loan Arrears of Households in Central and Eastern Europe
June 10, 2013	Luca Fornaro	182	International Debt Deleveraging
June 10, 2013	Jenny Simon, Justin Valasek	183	Efficient Fiscal Spending by Supranational Unions
July 24, 2013	Thomas Breuer, Hans-Joachim Vollbrecht, Martin Summer	184	Endogenous Leverage and Asset Pricing in Double Auctions
September 23, 2013	Martin Feldkircher	185	A Global Macro Model for Emerging Europe
September 25, 2013	Martin Gächter, Aleksandra Riedl	186	One Money, One Cycle? The EMU Experience

December 9, 2013	Stefan Niemann, Paul Pichler	187	Collateral, Liquidity and Debt Sustainability
March 6, 2014	Elisabeth Beckmann, Helmut Stix	188	Foreign currency borrowing and knowledge about exchange rate risk
March 10, 2014	Jesús Crespo Cuaresma, Martin Feldkircher, Florian Huber	189	Forecasting with Bayesian Global Vector Autoregressive Models: A Comparison of Priors
May 12, 2014	Claudia Steinwender	190	Information Frictions and the Law of One Price: “When the States and the Kingdom became United”
May 12, 2014	Saleem A. Bahaj	191	Systemic Sovereign Risk: Macroeconomic Implications in the Euro Area
May 16, 2014	John Bagnall, David Bounie, Kim P. Huynh, Anneke Kosse, Tobias Schmidt, Scott Schuh and Helmut Stix	192	Consumer Cash Usage: A Cross-Country Comparison with Payment Diary Survey Data
May 19, 2014	Konstantins Benkovskis Julia Wörz	193	“Made in China” - How Does it Affect Measures of Competitiveness?
June 25, 2014	Burkhard Raunig, Johann Scharler and Friedrich Sindermann	194	Do Banks Lend Less in Uncertain Times?
July 28, 2014	Martin Feldkircher and Florian Huber	195	The International Transmission of U.S. Structural Shocks – Evidence from Global Vector Autoregressions
September 16, 2014	Kim P. Huynh, Philipp Schmidt-Dengler, Helmut Stix	196	The Role of Card Acceptance in the Transaction; Demand for Money
October 10, 2014	Martin Brown, Helmut Stix	197	The Euroization of Bank Deposits in Eastern Europe
October 17, 2014	Ludmila Fadejeva, Martin Feldkircher, Thomas Reininger	198	Spillovers from Euro Area and U.S. Credit and Demand Shocks: Comparing Emerging Europe on the Basis of a GVAR Model

December 18, 2014	Esther Segalla	199	Shock Transmission through International Banks: Austria
March 5, 2015	Jonas Dovern, Martin Feldkircher, Florian Huber	200	Does Joint Modelling of the World Economy Pay Off? Evaluating Global Forecasts from a Bayesian GVAR
May 19, 2015	Markus Knell	201	The Return on Social Security with Increasing Longevity
June 15, 2015	Anil Ari	202	Sovereign Risk and Bank Risk-Taking
June 15, 2015	Matteo Crosignani	203	Why Are Banks Not Recapitalized During Crises?
February 19, 2016	Burkhard Raunig	204	Background Indicators
February 22, 2016	Jesús Crespo Cuaresma, Gernot Doppelhofer, Martin Feldkircher, Florian Huber	205	US Monetary Policy in a Globalized World
March 4, 2016	Helmut Elsinger, Philipp Schmidt-Dengler, Christine Zulehner	206	Competition in Treasury Auctions
May 14, 2016	Apostolos Thomadakis	207	Determinants of Credit Constrained Firms: Evidence from Central and Eastern Europe Region
July 1, 2016	Martin Feldkircher, Florian Huber	208	Unconventional US Monetary Policy: New Tools Same Channels?
November 24, 2016	François de Soyres	209	Value Added and Productivity Linkages Across Countries
November 25, 2016	Maria Coelho	210	Fiscal Stimulus in a Monetary Union: Evidence from Eurozone Regions
January 9, 2017	Markus Knell, Helmut Stix	211	Inequality, Perception Biases and Trust