Income Inequality and Incentives in Economies with Other-Regarding Preferences

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Abstract

We analyze model economies populated by individuals who care about their own income and wealth but also regard their position relative to the economy's average values of these variables. Furthermore, these individuals differ in their initial wealth. We consider inequality averse and competitive populations. Poor individuals are inferiority averse in both cases while rich individuals are superiority averse in the former but superiority seeking in the latter case. We investigate the impact of such preferences and wealth inequality on incentive contracts, output, and welfare. Unlike former agency models with inequality aversion within firms, we find that increasing inferiority aversion at the societal level tends to raise equilibrium effort and reduce wage costs. The same holds also for superiority seeking workers. By contrast, raising superiority aversion lowers effort and increases wage costs. A parameterized version of the model which roughly mimics some key features of the industrialized world shows that, even under inequality aversion, increased initial wealth differences lead to higher average output, entail distributional utility losses, and result in a more uneven income distribution.

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1 Introduction

There is plenty of evidence that people tend to compare themselves to others. The microeconomic literature has long recognized this fact and studied the impact of social preferences on labor relations, particularly in the context of income comparisons within firms (see the literature discussion below). The current paper extends the question to the aggregate economy. In the societal context, other-regarding preferences manifest themselves in the dependence of an individual's wellbeing on his or her relative position within the aggregate income and wealth distributions (see, e.g., Clark et al. 2008 and Clark and D'Ambrosio 2015). In this respect, and consistent with the evidence, income and wealth inequality directly affect individuals' welfare. However, the extent to which people care about inequality differs across societies and income levels (see, e.g., Lü and Scheve 2016, Osberg and Smeeding 2006 as well as Figures 5 and 6 and Table 4 in Appendix B). Reflecting this evidence and combining micro- and macroeconomic perspectives, we ask how different manifestations of societal other-regarding preferences affect incentive contracts at the microeconomic level and outcomes such as output, welfare, and the income distribution at the aggregate level.

For this purpose, we develop a static single-good general equilibrium model, in which labor relations are subject to moral hazard. The economy is populated by individuals who differ only in their initial wealth. These individuals care about their own income and wealth but also regard their position relative to the economy's average values of these variables (see, e.g., Clark and D'Ambrosio 2015). In this sense, their preferences are other-regarding in a self-centered manner. An economy can be populated by either *inequality averse* or *competitive* individuals. In both cases, those whose income and wealth fall short of the economy's average are inferiority averse, i.e., they incur disutility due to envy. If the population is inequality averse, individuals with above-average income and wealth are superiority averse, i.e., they too incur disutility due to empathy. However, in a competitive population such individuals are superiority seeking, that is, enjoy their advantage.[1] In both cases, a given income difference turns out to have a larger impact on a person whose wealth and income is below the societal average than it has on his 'rich' peer. This is consistent with our findings based on the European Social Survey of 2016, which indicate that the tolerance towards income inequality is rising in income (see Table 4 in Appendix B). Moreover, in our model, attitudes towards inequality are endogenously asymmetric. Under inequality aversion, this feature is in line with the literature, where envy is typically assumed to be the stronger emotion compared to empathy (see, e.g., Fehr and Schmidt 1999).

Our preference structure implies that, in the context of the labor market, workers consider their standing in the societal income and wealth distribution regardless of their employment status. Consequently, the income loss associated with becoming unemployed affects an individual's wellbeing not only directly but also through the associated deterioration in societal standing, thereby endogenizing the outside option. This feature differs from the standard approach to the

[1] Evidence indicates that people have a distaste for earning less than others. We allow for both attitudes towards advantageous inequality because the empirical results concerning advantageous inequality are inconclusive (see, e.g., Loewenstein et al. 1989, Lü and Scheve 2016, and Card et al. 2012).

outside option in studies investigating social comparison within firms. There, such comparisons are relevant only as long as workers are employed and hence the outside option is typically assumed exogenous. Consequently, in our model, the well-known inequality premium incurred by the employer due to their workers' other-regarding preferences tends to turn into a discount on wage costs.

In the economy, profit-maximizing firms operate a technology requiring only labor as an input. Due to the presence of moral hazard, incentives are aligned using an effort-related signal. Consequently, in addition to a fixed wage, employment contracts stipulate a bonus to be paid when the signal is detected by the employer. Due to the preference structure, the aforementioned incentive contracts depend on the economy's average income, which is in turn generated by the very same contracts. In equilibrium, both must coincide.

At the analytical level we derive some results that characterize the optimal incentive contracts and partial-equilibrium impacts of variations in the intensity and type of the other-regarding preference on them. For instance, we find that, in addition to the well-established incentive effect of variable pay, also the fixed wage impacts effort and that in a countervailing manner. This result follows because the fixed payment affects the other-regarding part of an individual's preferences through his societal standing. The latter is determined in the general equilibrium, which, due to the model's complexity, we analyze using a parameterized environment. The parameters are chosen to roughly mimic some key features of industrialized economies regarding the labor share, wealth distribution, and the ratio between wealth and income.

We numerically study several economies by varying the wealth distribution as well as the intensity and type of the workers' other-regarding preference. In an economy populated by inequality averse individuals, we find that the presence of envy strengthens incentives for the poor while empathy reduces incentives for the rich. This is in line with former agency models with inequity aversion. In our model, these effects manifest themselves when comparing an economy with an equitable initial wealth distribution to one with an inequitable distribution with the same average wealth. It turns out that inequality in the initial wealth distribution makes it easier (cheaper) to incentivize the initially poorer workers. In fact, because of the disadvantageous social standing, they are induced to exert more effort than that induced under equitable wealth distribution for a lower bonus. By contrast, the initially rich inequality averse workers reduce their effort relative to that of the equitable economy, but nevertheless obtain a higher bonus. As a result, the expected wage income of the rich is higher than that of the poor. Thus, despite the empathy arising from the preference structure, ex-post the wealth and income distribution becomes even less equitable. On the other hand, since the number of the poor outweighs that of the rich, output in the inequitable economy is higher than that of the equitable one. Naturally, net of initial wealth, the presence of wealth inequality causes both the poor and the rich to incur utility losses. However, for the rich these are not sufficient to outweigh the direct utility obtained from their higher initial wealth. It is worth noting that, in our model, inequality aversion may be beneficial for the firm when the initial wealth distribution is inequitable. This is in contrast to most of the agency literature, where employing inequality averse workers typically raises agency costs and hence lowers expected profits.[2]

In a competitive economy, under an inequitable initial wealth distribution, both the poor and the rich earn lower expected wages but nevertheless exert higher effort levels compared to the analogous outcomes with equitable initial wealth. Consequently, larger wealth inequality entails higher output. Not surprisingly, with competitive preferences, the rich earn more than the poor. The latter again incur utility losses whereas the rich enjoy the inequitable wealth distribution per se. Nevertheless, in a utilitarian sense, raising wealth inequality reduces welfare.

Comparing both types of economies, surprisingly, the difference between the equilibrium wages of the rich and the poor is larger with inequality aversion. That is, in our model, the presence of societal other-regarding preferences does not entail a more even distribution of total income. Finally, as expected, we find that increasing the intensity of the other-regarding preference increases all of the foregoing effects.

The structure of the paper is as follows. The next section discusses the related literature. Section 3 presents the various features of the model. Section 4 discusses the optimization problems of the players, defines the equilibrium, and discusses some general comparative-statics results. The parametric specification of the model and graphical presentations of its implications are the subject of Section 5. Section 6 presents our numerical experiments and their results while Section 7 discusses the results and concludes.

2 Related Literature

With our findings, we contribute to the literature on other-regarding preferences and that on income inequality. The former literature provides empirical evidence from the lab and the field suggesting that individuals not only care about their absolute but also about their relative economic position (see, e.g., Goranson and Berkowitz 1966, Berg et al. 1995, Fehr et al. 1998, Fehr and Schmidt 1999, or Charness and Rabin 2002). Akerlof and Yellen (1990) provide an early overview of the extensive literature on the effects of relative pay comparisons. A more recent overview of the experimental literature on other-regarding preferences is provided by, e.g., Camerer (2003) or Fehr and Schmidt (2006). The foregoing findings have clear implications for standard incentive theory since incentive pay is likely to affect an individual's relative income position. In this context, the ensuing work has revisited the effectiveness of different types of performance pay in the presence of other-regarding preferences, in particular envy or inequity aversion as formulated by Fehr and Schmidt (1999) (see, e.g., Grund and Sliwka 2005, Demougin et al. 2006, Kräkel 2008, Dur and Glazer 2008, Kragl and Schmid 2009, Englmaier and Wambach 2010, Neilson and Stowe 2010, and Bartling 2011). In these environments, the focus is typically on agency relationships within firms, where workers compare their income with that of co-workers or their boss. Unlike our results, such social preferences generally create a cost for the principal because workers need to be compensated for the expected disutility from payoff inequity. At the

[2] See the literature cited below. Exceptions are settings with relational contracts (e.g., Kragl and Schmid 2009) or with limited liability on the agents' side (Demougin and Fluet 2003), where the incentive effect of envy may lead to overall reduced agency cost.

societal level and in a general-equilibrium environment, Dufwenberg et al. (2011) study to what extent the well-known welfare theorems hold in economies when agents have other-regarding preferences. However, in that paper information is complete. Finally, we contribute to the macroeconomic literature on income inequality. While that literature typically analyzes income inequality through the lense of skill-biased technological change or human-capital differences, we identify another channel, whereby that inequality is affected by the presence of other-regarding preferences.

3 The Model

We consider a static single-good economy with informational asymmetries and other-regarding preferences. The economy is populated by a measure-one continuum of individuals (agents) with identical preferences and an infinite countable number of firms.[3] While all firms are identical, ex ante there are two types of workers they may employ, "rich" and "poor" denoted respectively by $i = R, P$, who differ only in their initial, commonly known, wealth w_i, where $w_R > w_P$. The rich and the poor constitute, respectively, a fraction λ_R and λ_P of the population (where $\lambda_R + \lambda_P = 1$). Accordingly, the weighted average wealth is given by:[4]

$$W = \sum_{i=R,P} \lambda_i w_i \tag{1}$$

Clearly, by definition, the rich possess above-average and the poor below-average initial wealth.

Workers are randomly matched with firms so that the composition of the workforce employed by every firm is representative. Ownership over the firms is uniformly distributed among all individuals.

3.1 Preferences

All parties are risk neutral. Firms care only about expected profit while workers maximize their personal expected utility as explained in the following.

All individuals participate in the labor market and may be either employed or unemployed. Employed workers exert effort e at an increasing and convex cost $c(e)$ with $c(0) = c'(0) = 0$, where both effort and its cost are non-verifiable. An employed worker receives a wage income y whereas unemployed workers obtain a utility benefit u. Independent of their employment status, all workers obtain the average (per-capita) profit Π. Let $\omega(y, u) = y + u + w + \Pi$ denote a generic worker's total ex-post wealth (with $y = 0$ for the unemployed and $u = 0$ for the employed). In

[3] In the remainder, we use the term "worker" in the context of the labor market. To simplify, we use the male pronoun. Moreover, lower-case letters denote variables related to individual characteristics and decisions; they are accordingly indexed. Whenever we consider generic workers and firms, we omit individual indexation. Upper-case letters stand for societal averages which are therefore taken as given by the workers and the firms.

[4] In the sequel, we will use the term "average" for all expression of the form:

$$X = \sum_{i=R,P} \lambda_i x_i$$

addition, individuals observe the average ex-ante societal wealth W and wage income Y. We denote by $\Omega = Y + W + \Pi$ the societal average ex-post wealth.

Workers' utility depends on their own income and wealth as well as on their relative position in the respective societal distribution. In particular, they care about economic inequality by taking into account deviations of ω from the societal mean Ω.[5] Notice that the foregoing holds *regardless of* whether a worker is employed or unemployed. Altogether, the ex-post utility of a generic worker is given by:

$$U(e, \omega, \Omega) = \begin{cases} \omega(0, u) - \gamma f(\omega(0, u), \Omega) \text{ if unemployed} \\ \\ \omega(y, 0) - c(e) - \gamma f(\omega(y, 0), \Omega) \text{ if employed} \end{cases}, \tag{2}$$

where $\gamma \geq 0$ measures the weight of the worker's valuation of his relative position in the societal ex-post wealth distribution, henceforth the "intensity parameter".

It is worth noting that, also when unemployed, over and beyond the monetary benefit u, the workers are affected by a utility loss due to their social preference. Notice that this differs from most well-known agency models where the outside option is exogenously given. While the latter assumption is natural with purely self-regarding preferences, with other-regarding preferences, it implies that wage comparisons apply within the firm but become irrelevant when the person is unemployed.

The inequality-preference function $f\ (\cdot, \cdot)$ is defined over $\mathbb{R}^2_+$ and is assumed to be twice continuously differentiable.[6] It may represent two different types of other-regarding preferences; (i) inequality aversion and (ii) what we call "competitiveness". In case (i), workers dislike deviations in any direction from the societal average. Accordingly, these workers feel either envy or empathy. In case (ii), workers also suffer from downward deviations from the societal average and feel envy but derive pleasure from outperforming the average.[7] In the sequel, wherever appropriate, we refer to workers who fall behind as *inferiority averse* while workers who outperform are *superiority averse* in case (i) and *superiority seeking* in case (ii).[8] Furthermore, we assume that, for a given deviation from the societal average, the absolute utility impact of falling behind exceeds that of forging ahead. Notice that, for case (i), the foregoing corresponds with the assumption in Fehr and Schmidt (1999) and subsequent work where envy is the stronger emotion as compared to empathy. Finally, we assume that, regardless of the attitudes towards inequality, the workers' utility is strictly increasing in wage income and wealth. That is, in line with other models of other-regarding preferences, we ensure that workers have no interest in

[5] We prefer the term "inequality" rather than "inequity" because the former does not entail a value judgement.

[6] Notice that, while effort enters the utility functions directly through the costs, it does not affect the inequality preference function f. The latter depends only on observables, thereby excluding effort and its cost, which are private information. See also the discussion in Section 7.

[7] That is, case (i) is similar to the preferences proposed by Fehr and Schmidt (1999). In the Fehr and Schmidt (1999)-model, case (ii) would necessitate specifying a positive propensity for envy ($\alpha > 0$) and a negative empathy parameter ($\beta < 0$).

[8] We rule out $\gamma < 0$ for the following reasons. The inequality averse case (i) would then turn around, whereby people are both inferiority *and* superiority seeking. The competitive case (ii) would imply that people are inferiority seeking but superiority averse. We do not believe that, at the societal level, either type of preference is relevant.

destroying resources just because of their inequality aversion.

For illustration, in the figure below we plot both types of inequality preference for the specification introduced in Section 5. Panel (a) represents case (i), hence inequality aversion, and panel (b) case (ii) of competitiveness.[9] Each panel shows the disutility function $\gamma \cdot f(\cdot, \Omega)$ as a function of total income and wealth (henceforth, for simplicity, referred to only as 'income'), ω, and for two intensity parameters γ, where the higher value in red naturally implies a stronger impact of inequality.

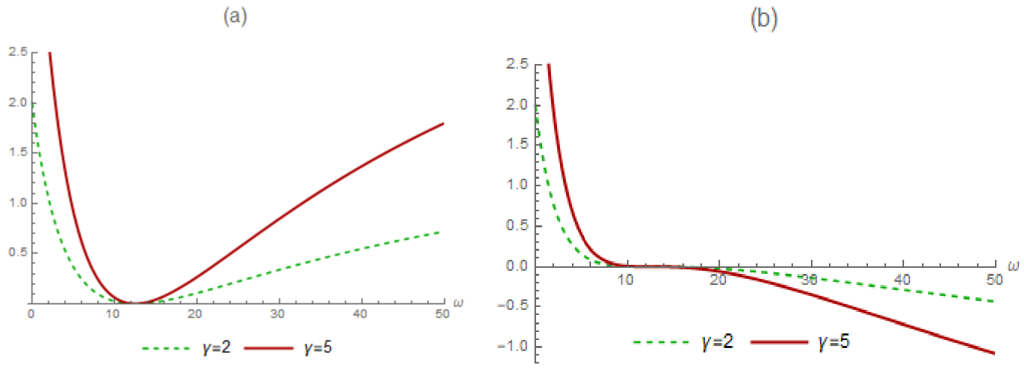

Figure 1: Disutility Function $\gamma \cdot f(\omega, \Omega)$ under (a) Inequality Aversion and (b) Competitiveness

Panel (a) shows that *any* deviation from the societal average wealth Ω (here at 12.5) leads to a utility loss and that an upward deviation of ω is less harmful than an equivalent downward deviation. While this endogenous feature is similar to the exogenous parametrization used by Fehr and Schmidt (1999), we differ by specifying a non-linear formulation. In particular, the figure shows that, for a given deviation, the marginal effect of reducing individual income is larger for the inferiority averse ($\omega < \Omega$) than that of increasing income of the superiority averse ($\omega > \Omega$). Moreover, workers feel envy at an increasing rate as they move further from the societal average and are initially increasingly empathetic. However, as income becomes very high, the marginal impact of empathy starts decreasing. Technically, the disutility function thus possesses an inflection point, henceforth denoted by $\hat{\omega}$, to the right of Ω (see Appendix A2).

For the competitive case in panel (b), people whose income falls short of the societal average incur a utility loss due to envy while those above the average are increasingly happier.[10] At the societal average Ω, the disutility function has a saddle point. Accordingly, competitive individuals become increasingly happy when outperforming the societal average. These attitudes mollify when total income becomes sufficiently large and their marginal utility from becoming even richer starts decreasing. That is, at some point (not shown), the disutility function has another inflection point.

Formally, in general, we formalize case (i) by Assumption 1.

[9] For the functional form and the parameters, see equation (10).

[10] Recall that the inequality-preference function enters the workers' utility function with a negative sign.

Assumption 1 *To represent inequality aversion, the function* $f(\cdot,\cdot)$ *satisfies (i)* $f(\omega,\Omega) > 0$ *for any* $\omega \neq \Omega$*; (ii) for* $\omega \in (0,\Omega)$*,* $f_\omega(\omega,\Omega) < 0$ *and* $f_{\omega\omega}(\omega,\Omega) > 0$*; (iii) for* $\omega \in (\Omega,\infty)$*,* $f_\omega(\omega,\Omega) > 0$*, and (iv)* $f(\Omega - d,\Omega) > f(\Omega + d,\Omega)$ *for any* $d \in (0,\Omega)$*.*

Remark 1 *Under Assumption 1, it must be the case that* $f(\Omega,\Omega) = f_\omega(\Omega,\Omega) = 0$*. Furthermore, there must exist an* $\hat{\omega} \in (\Omega,\infty)$ *such that* $f_{\omega\omega}(\omega,\Omega) > 0$ *for any* $\omega \in (\Omega,\hat{\omega})$*.*

In case (ii), the function $f(\cdot,\cdot)$ is assumed to have the following properties.

Assumption 2 *Competitive attitudes are captured when (i)* $f(\omega,\Omega) > 0$ *for* $\omega < \Omega$ *and* $f(\omega,\Omega) < 0$ *for* $\omega > \Omega$*; (ii) for* $\omega \in (0,\infty)$ $f_\omega(\omega,\Omega) < 0$*; (iii) for* $\omega \in (0,\Omega)$*,* $f_{\omega\omega}(\omega,\Omega) > 0$*.*

Remark 2 *Under Assumption 2, it must be the case that* $f(\Omega,\Omega) = f_\omega(\Omega,\Omega) = 0$*. Furthermore, there must exist an* $\hat{\omega} \in (\Omega,\infty)$ *such that* $f_{\omega\omega}(\omega,\Omega) < 0$ *for any* $\omega \in (\Omega,\hat{\omega})$*.*

According to Assumption 2, formally, we assume that if $\hat{\omega}$ is finite, $f_{\omega\omega}(\omega,\Omega) > 0$ for $\omega > \hat{\omega}$. This feature too is present in our specification below.

3.2 Production and Information Structure

Provided a worker becomes employed and exerts non-observable effort e, he produces an individual non-verifiable output $v(e)$ with $v'(\cdot) > 0$, $v''(\cdot) < 0$. In the process of his work, the worker stochastically generates an effort-related verifiable signal $\delta \in \{0,1\}$ with $\Pr[\delta = 1|e] = p(e)$, where $p(e) \in [0,1]$, $p(0) = 0$, $p'(\cdot) > 0$ and $p''(\cdot) \leq 0$. This signal is used by the employer to align incentives. The firm observes the type of the worker, "rich" or "poor", and adjusts the incentive contract accordingly.[11]

3.3 Contracts and Timing

The timing is as follows. (i) Workers are randomly matched with firms. (ii) Each firm observes every worker's type $i = R, P$ and offers a corresponding take-it-or-leave-it employment contract (s_i, b_i), whereby s_i is a fixed salary and b_i a bonus to be paid if $\delta_i = 1$. (iii) Each worker decides whether to accept the contract or reject it. In the latter case, the worker is unemployed and obtains the utility benefit u while the firm closes shop and gets zero. (iv) If the worker accepts, he chooses effort e_i. (v) The performance signal δ_i is realized, and payments are made. Specifically, the worker obtains wage income $y_i = s_i + \delta_i b_i$ and the firm gains the worker's net contribution to profit $\pi_i = v(e_i) - y_i$. (vi) Finally, total profits are evenly distributed among all individuals (including the unemployed).

[11] We believe that this assumption is plausible given real-world contracts. In particular, workers' outside options depend on their social affiliation, which in our model is represented by wealth. The implications of dropping this assumption are further discussed in Section 7. We thank Anja Schöttner for pointing out this issue.

4 Optimization Problems and Equilibrium

In this section, we present the workers' and the firms' optimization problems, generating the optimal type-dependent contracts, the corresponding effort levels and firm profits. Then we define the equilibrium arising from the interaction between the workers' and the firms' decisions and the economy-wide characteristics they generate.

4.1 The Workers' Problem

Provided that the worker has accepted the contract (s_i, b_i) and for given average levels of income, wealth and profits (Y, W, Π), an employed worker of type i chooses effort e_i to maximize his expected utility:

$$e_i = \arg\max_{\hat{e}_i} \left\{ \begin{array}{l} s_i + p(\hat{e}_i)b_i + \Pi + w_i - c(\hat{e}_i) \\ \quad - \left[\gamma p(\hat{e}_i) f\left(s_i + b_i + w_i + \Pi, Y + W + \Pi\right)\right. \\ \qquad \left. + \gamma\left(1 - p(\hat{e}_i)\right) f\left(s_i + w_i + \Pi, Y + W + \Pi\right)\right] \end{array} \right. \tag{3}$$

The first line of equation (3) represents the contribution to expected utility associated with wage income, profit share, and initial wealth net of effort costs. In the next two lines, the expression in the square brackets stands for the worker's (dis)utility from inequality, referred to in the sequel as *inequality term.* Under inequality aversion, this term is always positive and therefore implies a utility loss while, under competitiveness, it may either be positive or negative, i.e., either a utility a loss or a gain. In evaluating this (dis)utility, the worker considers both possible ex-post relative wealth positions ($\delta = 0, 1$). In particular, the second line represents the case when a bonus is paid whereas, in the third line, no bonus is paid. Assuming that the worker calculates the expected value of the (dis)utilities, he weighs the two cases by the associated probabilities.

The incentive constraint is given by:

$$\begin{aligned} 0 = {} & p'(e_i)b_i - c'(e_i) \\ & - \gamma p'(e_i) f\left(s_i + b_i + w_i + \Pi, Y + W + \Pi\right) \\ & + \gamma p'(e_i) f\left(s_i + w_i + \Pi, Y + W + \Pi\right) \end{aligned} \tag{IC}$$

The first line in equation (IC) coincides with the incentive constraint in moral-hazard settings with purely selfish preferences. The next two lines in (IC) emerge from the worker's inequality term. Specifically, for inferiority averse workers, they sum up to a positive number implying that any given bonus induces higher effort relative to the case of self-regarding workers, commonly known as the *incentive effect of envy.* The same holds for superiority seeking workers, but the opposite is true for superiority averse ones, where the latter feature is known as the *disincentive effect of empathy.* In addition, notice that also the fixed salary s_i appears in the worker's marginal inequality term. This implies that, apart from the bonus, also the fixed pay has an impact on the worker's optimal effort choice. We will elaborate on this in the following subsection (see 1).

Formally, holding effort fixed, condition (IC) also implies that, for $\gamma > 0$, $\dfrac{\partial s_i}{\partial b_i}$ is never nil (see Lemma A1 in the Appendix).[12] Moreover, the combination of $\{b_i, s_i\}$ needed to induce a given level of effort depends on the workers' intensity parameter γ, as indicated by $\frac{\partial s_i}{\partial \gamma}, \frac{\partial b_i}{\partial \gamma} \neq 0$ (see Lemmas A2 - A3 in the Appendix). We will further elaborate on the consequences of these features using our functional specifications in Section 5.3.

The participation constraint guarantees that a worker chooses to become employed:[13]

$$\begin{aligned} s_i + p(e_i)b_i - c(e_i) \\ - \gamma[p(e_i) f\left(s_i + b_i + w_i + \Pi, Y + W + \Pi\right)] \\ - \gamma[(1 - p(e_i)) \, f\left(s_i + w_i + \Pi, Y + W + \Pi\right)] \\ \geq u - \gamma f\left(u + w_i + \Pi, Y + W + \Pi\right) \end{aligned} \tag{PC}$$

The above condition ensures that the worker is at least as well off by accepting the contract compared to rejecting it, thereby obtaining his outside option when becoming unemployed (fourth line). As mentioned above, also when unemployed, the worker experiences a utility loss (or gain) due to his other-regarding preference.

Given the foregoing remark, the variables (s_i, b_i, γ) are interdependent also in the (PC) for a given level of effort. In particular, Lemma A4 in the Appendix shows the impact of the marginal inequality term on $\frac{\partial s_i}{\partial b_i}$. Moreover, similar to condition (IC), both wage components b_i, s_i needed to induce participation depend on the workers' intensity parameter γ (see Lemmas A5 - A6 in the Appendix). These lemmas also show that the impact of γ depends on the interrelationship between γ and the benefit u due to their opposite effects on the workers' outside option. These effects will also be further discussed in Section 5.3.

4.2 The Firms' Problem

Firms also take (Y, W, Π) as given. For each worker of type $i = R, P$, they design a take-it-or-leave-it employment contract (s_i, b_i) so as to maximize expected profit

$$\begin{aligned} \pi_i = \max_{s_i, b_i, e_i} \; & v(e_i) - s_i - p(e_i)b_i \\ s.t. \; & (PC), \end{aligned} \tag{4}$$

where e_i satisfies the workers' incentive constraint (IC). Denote by (s_i^*, b_i^*, e_i^*) the optimal incentive contracts that solves the firms' problem in (4). At that contract, the participation constraint is always satisfied and the contract is accepted by the worker.[14]

The solution of (4) obviously depends on whether condition (PC) is binding. To elaborate on this, notice that, in the participation constraint, the fixed payment s_i has the usual direct positive effect on the worker's expected utility but, as noted above, also impacts the inequality term. For the inferiority averse and the superiority seeking, increasing the fixed payment lowers

[12] Table 3 in the Appendix summarizes the results of Lemmas A1 - A10 in the corresponding order of the lemmas.

[13] Notice that the term $\Pi + w_i$ appears on both sides of the inequality and is hence not shown.

[14] In principle, profits may become negative in which case the firm would close shop and the worker would become unemployed. We ignore this case because, in our numerical experiments below, profits are always positive.

that term, thereby reinforcing the direct effect of s_i. By contrast, for the superiority averse, these two effects go in opposite directions, yet by assumption (see Section 3.1), the direct effect outweighs the inequality consideration.

The foregoing impact of the fixed payment on the participation constraint is true for setups with purely selfish agents as well as for commonly used models with other-regarding preferences (see the respective literature cited in the introduction). In all these models, the participation constraint obviously binds because the fixed salary constitutes only a cost to the firm. Notice however that, in our setup, this is not obvious.

To understand the intuition, note that the mechanism that determines the optimal incentive contracts in our model differs from that found in most principal-agent models. In these models, there typically is a recursive relationship between the optimal incentive pay and the optimal fixed wage. Specifically, given effort, the optimal incentive payment is determined by the incentive constraint while the corresponding fixed pay then follows from the participation constraint. By contrast, as explained in the foregoing subsection, the fixed salary affects both conditions (IC) and (PC). Consequently, whether the participation constraint is binding, depends on the interaction of (IC) and (PC) via the worker's optimal effort choice.

As a first step, the following lemma proven in the Appendix 1.2 analyzes the impact of the fixed salary on that effort along the (IC).

Lemma 1 *Along the incentive constraint* (IC), $\dfrac{\partial e}{\partial s} < 0$ *for all persons with* $\omega(s+b,0) < \Omega$, *superiority averse persons with* $\omega(s+b,0) < \hat{\omega}$, *and superiority seeking persons with* $\omega(s,0) > \hat{\omega}$. *Further,* $\dfrac{\partial e}{\partial s} > 0$ *for superiority averse persons with* $\omega(s,0) > \hat{\omega}$ *and superiority seeking persons with* $\omega(s+b,0) < \hat{\omega}$.

Notice that the results follow a straightforward intuition for all cases where a worker's total income and wealth are below the societal average as well as for those with "moderate" above-average income and wealth (i.e., below the respective inflection point $\hat{\omega}$). Notably, for all workers, the fixed wage has an impact on effort, i.e., it has either an *incentive* or a *disincentive effect.* Intuitively, low-income workers who receive a higher fixed wage suffer less from envy and are hence also less incentivized to earn the bonus. As a result, the fixed wage has a *disincentive effect.* Similarly, moderately rich superiority averse workers try to avoid becoming even richer and therefore reduce effort in response to a higher fixed salary. Analogously, when such workers are superiority seeking, they try to increase their income even further and raise effort; for them, the fixed wage has an *incentive effect.* The intuition behind the remaining cases stems from the workers' very high income and wealth levels where income and wealth have a *declining* marginal effect on their respective inequality terms. For superiority averse workers, the marginal disutility of additional income is decreasing so that earning the bonus *reduces* their marginal loss due to empathy. Consequently, when they receive a higher fixed wage, they increase effort (*incentive effect*). The case of superiority seeking very rich workers is again analogous. Their joy of outperforming is declining at the margin. Accordingly, such workers reduce effort when obtaining a higher fixed wage (*disincentive effect*). We illustrate and further elaborate the foregoing in greater detail for the low- and intermediate-income level workers in Section 5.3.

The implication of Lemma 1 for the participation constraint follows immediately.

Proposition 1 *For all workers with $\omega(s+b,0) < \Omega$, superiority averse workers with $\omega(s+b,0) < \hat{\omega}$ and superiority seeking workers with $\omega(s,0) > \hat{\omega}$, the participation constraint (PC) is binding.*

This result obtains as, in the listed cases, the firm finds it beneficial to decrease the fixed salary *both* for its direct cost-saving effect and its incentive effect. The latter effect is not present for superiority seeking workers with intermediate levels of income as well as superiority averse workers with very high income. However, it is highly plausible that the participation constraint will also bind in these cases, as the marginal impact of the fixed wage on effort is likely to be too small to overturn its direct impact. This is what we find in our numerical exercises below. In the sequel, we hence only consider cases where the participation constraint binds.

The above is likely to have an important impact on the firm's expected wage cost (and hence also the optimal contract). Given effort, to keep the participation constraint binding, the firm adjusts the worker's expected wage according to the difference between the inequality term when employed and the analogous term when unemployed. Specifically, provided that the unemployment benefit u is sufficiently low, the firm benefits from the inferiority averse workers' fear of being unemployed and the associated low societal standing. Similarly, superiority seeking workers experience an extra joy of being employed and hence also want to avoid unemployment, allowing the firm to reduce wage costs. These effects naturally become larger as the importance of the other-regarding preferences increases. The only exception are superiority averse workers who suffer relatively less from compassion when unemployed. The following summarizes this result.

Proposition 2 *For inferiority averse or superiority seeking workers and sufficiently low levels of u, an increased γ reduces both the fixed wage and the bonus required to satisfy the participation constraint for any given level of effort.*

Proof. *See Lemmas A5 and A6 in the Appendix.* ■

Remark 3 *The bound on u listed in the Appendix is sufficient to yield the result. In our numerical experiment, u has to implausibly exceed the expected wage in order to overturn it.*

The foregoing strongly differs from well-known agency models with other-regarding preferences in the within-firm context. To highlight the source of the difference, note that in the latter models, workers become ever more expensive to employ as inequality aversion increases. There, employers are forced to compensate workers for the increased expected disutility arising from inequality. That compensation is referred to in the literature as *inequality premium*. In contrast, in our context, the inequality premium differs from the worker's *inequality term*. To clarify the difference, we rewrite (PC) as:

$$\begin{aligned} s_i + p(e_i)b_i = u &+ c(e_i) \\ &+ \gamma[p(e_i)f\left(s_i + b_i + w_i + \Pi, Y + W + \Pi\right)] \\ &+ \gamma[(1-p(e_i))\,f\left(s_i + w_i + \Pi, Y + W + \Pi\right)] \\ &- \gamma f\left(u + w_i + \Pi, Y + W + \Pi\right) \end{aligned} \tag{IP}$$

The first line in (IP) reflects the firm's expected wage costs that would emerge under purely self-regarding preferences. The next three lines represent the *inequality premium* in our model with other-regarding preferences. Specifically, the second and third lines contain the inequality term associated with the state of employment. This would be equivalent to the inequality premium in the literature. However, in our case, the inequality premium entails also the other-regarding related (dis)utility associated with unemployment and must hence be corrected for it. As discussed below, the latter part in fact tends to reduce the inequality premium incurred by the employer relative to the inequality term alone.

Subject to Proposition 1, in the current setup, the optimal levels of incentive pay and fixed salary are *jointly* determined by the incentive and participation constraints. This implies that, in contrast to the literature cited above, the cost of inducing effort cannot be inferred solely from the participation constraint. Furthermore, the optimal effort is affected not only by the incentive pay but also by the fixed salary. We further discuss the optimal contract and its cost in conjunction with the graphical illustrations presented in Subsection 5.3 below, generated by a tractable model specification introduced in Section 5. In fact, it turns out that, in our specification, employing inferiority averse and superiority seeking workers is cheaper for the firm than hiring purely selfish workers.

4.3 Equilibrium

The various steps described above generate a feedback between the economy-wide characteristics that are taken as given by workers and firms and the underlying variables that both depend on and form these characteristics. In equilibrium, we require these relationships to be consistent. Formally, an equilibrium is thus defined as follows.[15]

Definition 3 *Given $w_R, w_P, \lambda_P, \lambda_R$, and the corresponding W, a rational-expectations type-dependent equilibrium consists of a tuple $(e_i, s_i, b_i, \pi_i, i = R, P)$ and a pair (Y, Π) such that:*

(i) Given (Y, Π) and (s_i, b_i), workers choose e_i by solving (IC).

(ii) Given (Y, Π), profit π_i obtains from (4).

(iii) Average wage income is:

$$Y = \sum_{i=R,P} \lambda_i \left(s_i + p(e_i) b_i\right) \tag{5}$$

(iv) Per-capita profit is:

$$\Pi = \sum_{i=R,P} \lambda_i \pi_i \tag{6}$$

[15] Strictly speaking, the definition should have distinguished between, on the one hand, λ_P and λ_R and, on the other hand, employment rates of poor and rich workers. To avoid cumbersome notation, the definition already incorporates the full employment outcome of the model.

5 Model Specification

In this section, we specify a parametric environment in line with the underlying assumptions introduced above. This specification will be used in the numerical analysis presented in Section 6 below. For simplicity, we omit individual indexation whenever appropriate.

5.1 Production, Effort Costs, and Signal Generation

Given effort e, a worker's individual contribution to output is:

$$v(e) = \theta \cdot e^{\beta},\ \beta \in (0,1), \theta > 0 \tag{7}$$

A worker's cost of effort is assumed to be:

$$c(e) = -\ln(1-e) - e \tag{8}$$

Note that the cost function is non-negative for any $e > 0$ with an associated marginal effort cost of $c'(e) = \dfrac{e}{1-e}$ so that $\lim\limits_{e \to 1} c(e) = \lim\limits_{e \to 1} c'(e) = \infty$. This guarantees that effort belongs to the unit interval ($e \in [0,1)$). Given effort e, the probability that the firm detects a favorable signal is specified to be:

$$p(e) = e \tag{9}$$

5.2 Inequality Preferences

As explained above, workers care about their own income and wealth but also regard their economic standing relative to others. Well-known agency models with other-regarding preferences use absolute income differences to represent workers' interpersonal comparisons. Since we are interested in the impact of other-regarding preferences in the context of an entire economy, we find it more plausible to assume that workers consider the societal income and wealth averages as reference points. Moreover, rather than a difference, they use as a measure of inequality the *ratio* between their own income and wealth and the corresponding societal averages (see Clark et al. 2008).

We implement Assumptions 1 and 2 by the following inequality preference function (for verification, see Appendix A2):

$$f(\omega, \Omega) = \left(\frac{1 - \left(\dfrac{\omega}{\Omega}\right)}{1 + \left(\dfrac{\omega}{\Omega}\right)} \right)^{\alpha},\ \ \alpha \in \mathbb{N} \tag{10}$$

In the above equation, the exponent α captures the type of preferences, whereby an even α reflects inequality aversion while an odd α represents the competitive case. We have used this functional form in Figure 1 in Section 3.1 above, with $\alpha = 2$ or $\alpha = 3$ for the respective preferences. This preference representation is kept for all subsequent figures and the numerical experiments. Furthermore, in the figures, Ω is set at 12.5, thereby reflecting the equilibrium average societal wealth generated by the numerical experiments below.

5.3 Incentive Contracts

As explained above in Subsection 4.2, in our setting, the optimal levels of incentive pay and fixed wage are jointly determined by the incentive and the participation constraints. Given the complexity of the model, we now use a graphical approach to gain an intuition on the contract-setting mechanism. Furthermore, the figures below illustrate the impact of the intensity parameter γ on the two constraints, holding effort fixed. As in Figure 1, all subsequent figures also represent the cases $\gamma = 2$ and $\gamma = 5$ by green and red curves, respectively, distinguishing between the rich and the poor. The results serve to indicate how variations in the workers' other-regarding preference affect the ensuing contracts. These illustrations elaborate on the comparative-statics results shown in Table 3 in Appendix A1.

The Figures 2 and 3 show the cases of inequality aversion ($\alpha = 2$) and competitiveness ($\alpha = 3$), respectively. Both panels in these figures show (s, b) - combinations that satisfy the incentive and participation constraints, i.e., conditions (IC) and (PC), for the two values of the intensity parameter. To isolate the impact of that parameter, all graphs hold effort fixed at its equilibrium value for $\gamma = 5$ derived in Section 6.2. Moreover, the economy's average profit and income also correspond to that equilibrium. It is important to note, however, that by changing γ the outside option changes as well. Thus, the intersection of the constraints for $\gamma = 5$ correctly reflects the equilibrium for that intensity parameter which is not the case for $\gamma = 2$ since the economy-wide equilibrium variables are not allowed to adjust. In both figures, panel (a) shows the case of the poor with initial wealth $w_P = 2.5$ and panel (b) represents the rich with $w_R = 40$.[16] The solid curves show the participation constraint while the dashed ones represent the incentive constraint. In the following, we discuss these figures and thereby refer to the formal comparative-statics results shown in Table 3 in Appendix A1. All figures correspond to parameter values of γ and u which fall in the associated lower ranges in that table. The intuitive discussion below is hence in accordance with the respective formal results presented in Lemmas A1-A8.

5.3.1 Inequality Averse Workers

Incentive Constraints

Turning first to the inferiority averse **poor workers** in Figure 2(a), the incentive constraints are upwards sloping. That is, both instruments can be used to affect the worker's effort choice. Intuitively, raising b increases the inferiority averse worker's expected utility directly as well as indirectly via the inequality term by lowering the envy felt in the state in which he obtains the bonus ($\delta = 1$). Ceteris paribus, this raises the worker's marginal reward and hence his effort. To countervail this positive effect, the fixed payment s needs to be raised due its *disincentive*

[16] The choice of these values is explained below in Section 6. The initial wealth of the rich turns out to exceed the inflection point $\hat{\omega}$.

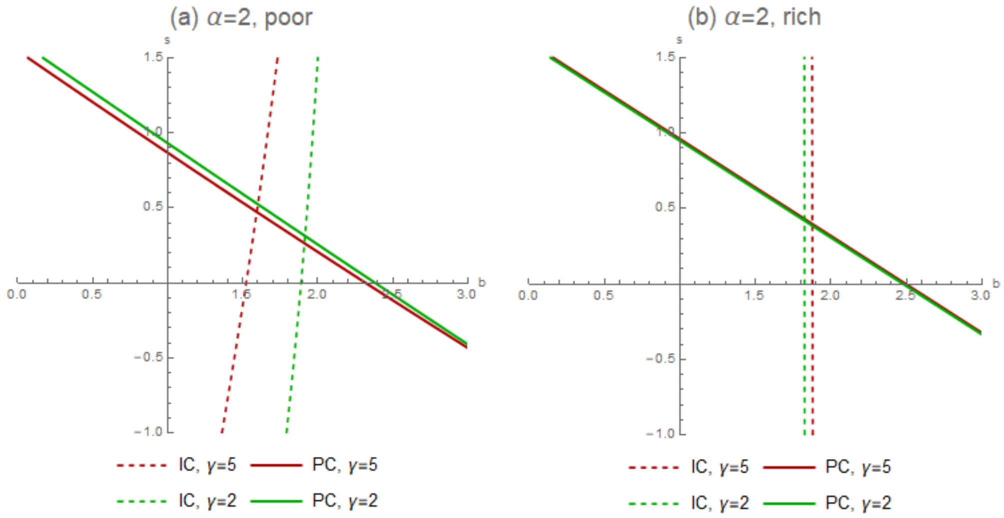

Figure 2: Incentive and Participation Constraints for Inequality Averse Workers

effect (see Lemma 1). Such a move reduces the envy-related disutility for *both* realizations of the signal but more so for the case when no bonus is paid. Therefore, the worker's incentive to avoid the unfavorable outcome ($\delta = 0$) by exerting effort is weakened. Altogether, at a fixed effort, the two wage components are *complements*. This result is different from that usually found in the literature where variations in the fixed wage typically do not affect effort incentives and the incentive constraint would hence be vertical. The latter is not only true for agency models with purely self-regarding workers but also for well-known models using other-regarding preferences.

As to the impact of the intensity parameter γ, note that increasing it shifts the incentive constraint to the left. In this case, as noted above, there is an *incentive effect of envy*. Intuitively, for a given contract (s, b), a poor worker who becomes more inequality averse would want to exert a relatively higher level of effort in order to lower the expected disutility from envy. To hold effort constant, either b needs to be reduced or, due to its disincentive effect, s needs to be raised. This emphasizes the interdependence of (s, b, γ) in our context.

Next consider the superiority averse **rich workers** in Figure 2(b), for whom the incentive constraints are extremely steep.[17] This implies that it is essentially only the bonus that can be used as an instrument to induce the worker to exert effort, as the high initial wealth of the rich in our example very much reduces the indirect incentive effect of income. Note that this observation resembles the case of purely self-regarding workers, whose incentive constraints are vertical.

In contrast to the case of inferiority averse poor workers, the incentive constraint (very slightly) shifts to the right when the intensity parameter γ increases. Due to the *disincentive effect of empathy*, for a given contract (s, b), a rich worker who becomes more superiority averse would want to exert a relatively lower level of effort in order to reduce the expected disutility from compassion. To outweigh this intrinsic effect, the bonus needs to be raised (as the fixed wage has a negligible impact).

[17] Consistent with the very high wealth exceeding the inflection point, the slopes are in fact slightly negative.

Participation Constraints

For the **poor** inferiority averse, the participation constraints in Figure 2(a) are downwards sloping so that the fixed wage s and the bonus b are *substitutes.* Beyond the usual direct monetary substitutability of the two payment modes, both a higher bonus and a higher fixed pay raise a poor worker's utility also indirectly via the inequality term. Consequently, in comparison with purely self-regarding workers, the participation constraints become flatter in the (b, s)-space. Intuitively, in our case, the fixed wage has an additional impact on utility via the inequality term. In particular, in contrast to the bonus, it reduces the envy-related disutility for *both* realizations of the signal. Therefore the substitution rate between b and s becomes lower when $\gamma > 0$. Moreover, the foregoing effect is amplified as γ increases.

An increase in the intensity parameter γ shifts the participation constraint in panel (a) downwards. Intuitively, increasing inferiority aversion, ceteris paribus, raises the worker's disutility due to envy *both* when employed and unemployed but more so in the latter case, due to the low societal standing associated with it. That is, as γ increases, the worker's outside option becomes worse and his fear of getting unemployed increases, which reduces the inequality premium (see equation (IP)). Accordingly, it becomes easier for the firm to make more inferiority averse workers participate. This result contradicts the existing agency models, where increased inequality aversion always leads to increased inequality premia, thereby impeding workers' participation. The difference stems from the endogeneity of the workers' outside option in our societal setting, which stands in contrast to the exogeneity of that option, when social comparisons matter only within firms.

Turning to the superiority averse **rich** in Figure 2(b), the participation constraints are also downwards sloping. This is not obvious because, for the rich, there is a trade-off between the direct and indirect impact of the two wage components on their expected utility under employment. While these workers directly enjoy a higher pay, they also dislike the associated greater inequality due their empathy. Again the high initial wealth of the rich renders the latter effect negligible. Consequently, the direct substitution effect outweighs the indirect complementarity arising from the inequality term.

An increase in the intensity parameter γ shifts the participation constraint in panel (b) slightly upwards. Intuitively, increasing superiority aversion, ceteris paribus, raises the worker's disutility due to empathy when employed but less so when unemployed, thereby increasing the inequality premium. As a result, it becomes slightly more expensive to make these workers participate as γ increases.

Optimal Contract

Due to Proposition 1, the optimal contract inducing a given effort is determined by the intersection point between the two constraints. Therefore, for the **poor** inferiority averse, increasing the intensity parameter seems to have countervailing effects on the optimal contract. For a given bonus, as we have seen above, higher value of γ increases the wage payment required to induce a given effort but reduces the wage required to make the worker participate. The impact on the incentive constraint generally dominates. Accordingly, Figure 2(a) represents this property and the optimal contract implies a higher fixed wage but a lower bonus for $\gamma = 5$ relative to the $\gamma = 2$-case.

For the **rich** superiority averse, an increase in the intensity parameter seems also to have an ambiguous impact on the optimal contract. A higher value of γ increases the bonus required to induce a given effort. Whether this allows a reduction in the fixed wage along the participation constraint depends on the extent to which this constraint moves up. Given its slight movement shown in Figure 2(b), the optimal fixed wage is reduced.

5.3.2 Competitive Workers

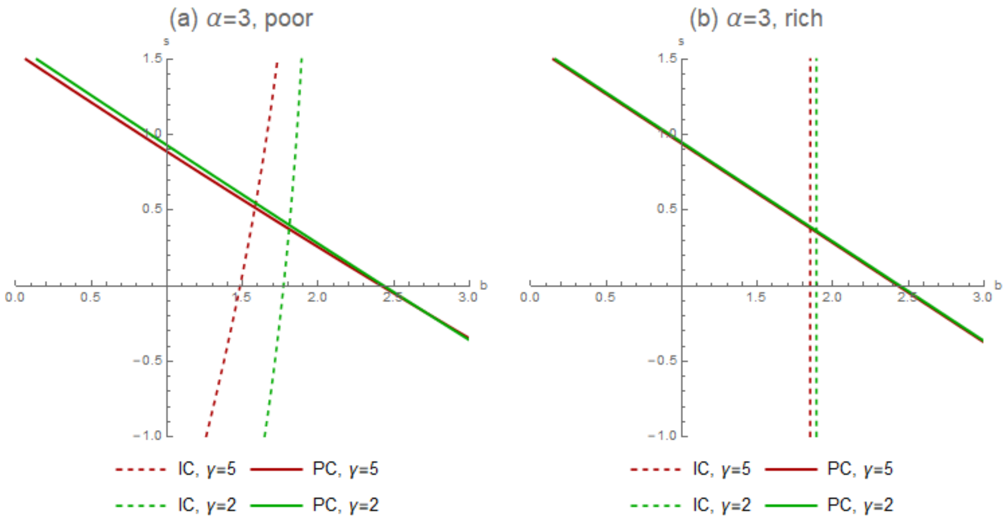

Figure 3: Incentive and Participation Constraints for Competitive Workers

Figure 3 shows the case of $\alpha = 3$ with the same initial wealth values used for $\alpha = 2$. Note that **poor** competitive workers are inferiority averse which is analogous to their inequality averse peers. Consequently, qualitatively, all the features present in panel (a) coincide with the equivalent case in Figure 2(a). By contrast, the **rich** competitive are superiority seeking, i.e., enjoy their advantageous position in the societal wealth distribution. They enjoy both the direct and the indirect impact of the two wage components so that, unlike the case of the superiority averse rich, here the bonus and the fixed wage are *unambiguously* substitutes. Consequently, the **participation constraints** in Figure 3(b) are also downwards sloping. The **incentive constraint** of the superiority seeking rich is very steep. As for the the superiority averse rich, the high initial wealth renders the impact of s very small.

For the **rich**, the impact of γ on the constraints strongly differs across the two preference types. Specifically, when increasing γ, the participation and incentive constraints of the superiority seeking workers move in the opposite direction to that of the superiority averse workers. Intuitively, due to their joy of outperforming others, their inequality premium decreases and it becomes easier to make the former participate. Moreover, it is also easier to incentivize them. Figure 3(b) represents the joint effect of γ on the **optimal contract**. Because of the dominance of the incentive constraint, the bonus decreases and the fixed wage increases. Finally, notice that, the competitive workers are easier to incentivize *regardless* of their initial wealth. We can therefore refer to an *incentive effect of competitiveness* more generally.

5.3.3 Firms' Wage Costs

In this subsection, we discuss the firm's expected total wage costs of inducing different effort levels. Specifically, we demonstrate the impact of γ on these costs, depending on the workers' inequality preference and wealth. Figure 4 depicts the results, where the payments (s^*, b^*) satisfy the incentive and the participation constraints associated with different levels of e.[18] More specifically, the graph shows $s^*(e) + e \cdot b^*(e)$ for two values each of α, γ and w_i.

By the foregoing subsections, γ affects the pair (s^*, b^*) for a given effort level. Lemmas A7 and A8 in Appendix A1 indicate that the two components of the optimal contract move in countervailing directions.[19] Heuristically, the effect of γ on the optimal bonus is likely to dominate since it manifests itself both directly through its monetary impact and indirectly via the inequality term. By contrast, for the optimal fixed wage, only the latter effect is present. The figures below bear this heuristic out.

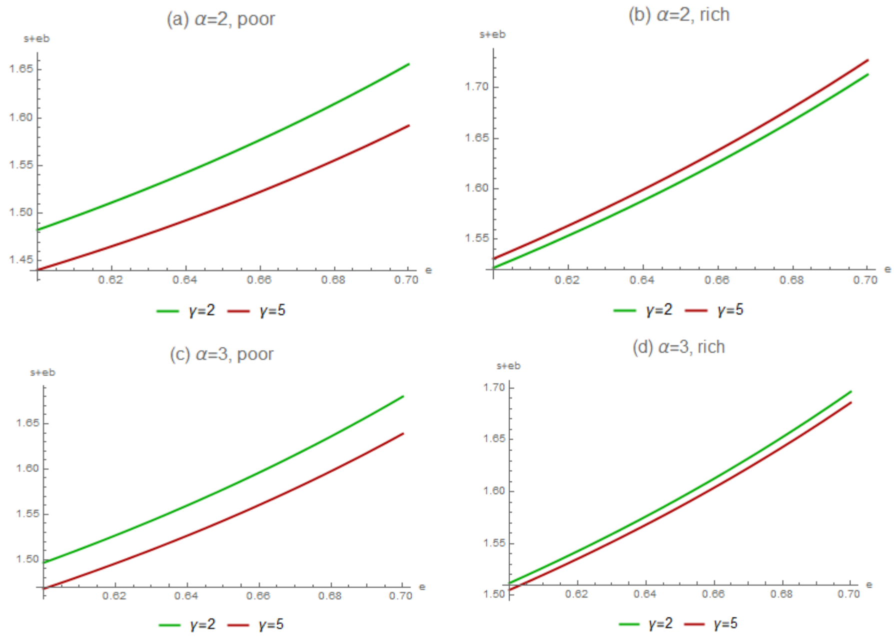

Figure 4: Expected Wage Cost for (a,b) Inequality Averse and (c,d) Competitive Workers

As expected, in all panels above, the wage costs are increasing in e.[20] The sensitivity of these costs to the intensity parameter depends on the worker's preference and wealth type. For

[18] That is, the pairs (s^*, b^*) correspond to the respective intersection points that would emerge in Figures 2 and 3 for various levels of e. In the graphs, we drop the asterisks.

[19] For the direction of the movements of s and b, see Table 3 in Appendix A1. Recall that, for the superiority averse rich, the value of γ used in the figures is "small" in the sense of that table.

[20] Lemmas A9 and A10 again indicate that increasing effort has countervailing effects on the optimal fixed wage and bonus. However, the first-order cost impact of increasing effort dominates.

the poor in panels (a) and (c), increasing inferiority aversion clearly reduces their cost. This reflects the aforementioned incentive effect of envy as well the cost-reducing impact of γ on the inequality premium incurred by the firm. Similarly, the superiority seeking rich in panel (d) also become cheaper as γ increases, in this case due to the stronger incentive effect of competitiveness and their increased joy of income when employed. In contrast, a rich person who becomes more superiority averse, depicted in panel (c), becomes more expensive to employ. First, the disincentive effect of empathy makes incentivization more costly. Second, due to their increased compassion, the disutility associated with inequality is mitigated more strongly under unemployment than in the employment state, which increases their inequality premium.

Notice that Figures 4(b) and 4(d) are in line with the insights of the existing literature; empathy raises a firm's motivational costs while competitiveness lowers them. By contrast, the results implied by Figures 4(a) and (c) contradict other static existent models with inequality averse or envious workers (e.g., Grund and Sliwka (2005) and the literature cited in Kragl and Schmid (2009)). In these models, typically there is a trade-off. As in our case, envy lowers the bonus required to induce some given effort. However, the inequality premium increases in envy so that employing inferiority averse workers always comes at a cost to the firm. By contrast, in our model, the inequality premium decreases in envy because, as γ increases, the firm exploits the workers' increased disutility associated with being unemployed.

Altogether, the structure of the firm's expected wage costs naturally affects its optimization problem, given in (4). In particular, while the marginal benefit of effort is independent of the workers' type, Figure 4 shows that both the level and the marginal wage costs do differ across workers. As a result, the optimal effort the firm will choose to induce and the ensuing output and profit will depend on the worker's type, as verified in the numerical experiments in the following section.

6 Numerical Experiments

In this section, we compare various economic environments and their sensitivity to the type and intensity of other-regarding preferences and the wealth distribution. As there is no analytical closed-form solution to our model, we turn to numerical experimentation. In the following, we explain the solution method, the parameter choice and experiments and describe the numerical results.

6.1 Technique and Parameter Choice

We use Mathematica to numerically generate relevant equilibrium outcomes and test how they depend on the societal wealth distribution, the preference type, and the intensity parameter γ.

In the computational process, we follow the structure of Definition 3 to calculate the equilibrium. Specifically, we choose values of w_R, w_P, the fraction of the poor in the population λ_P, which together determine the corresponding societal average wealth W. Next, we turn to the agency problem between firms and workers as stated in problem (4). In order to find the type-dependent equilibrium contracts (s_i^*, b_i^*) and effort levels e_i^*, we need to take into account the recursive relationship between the optimal contracts and the societal average wage income and profits. In practice, we specify arbitrary initial values for (Y, Π) and solve for the optimal contracts. Given the result, we update these values and derive the new optimal contracts. This process is repeated until the difference between the initial and resulting values converges. To sum, we are numerically solving a fixed-point problem, whereby the model maps (Y, Π)-pairs into themselves.

In general, by our parameter choice, we try to roughly mimic some actual key features of a major industrial economy. For that purpose, we chose Germany for which reliable relevant data are available.

As a starting point, we arbitrarily chose values for $\theta = 3$ and $\beta = 0.5$ and held them fixed throughout. We set $\lambda_P = 0.8$ and the individual wealth of every "poor" worker at 2/8 of the average societal wealth whereas that of the rich at 8/2, implying that every "rich" worker possesses 16 times as much wealth as a "poor" one. This roughly corresponds to the wealth distribution found for Germany, whereby the top 20 % of the population own about 80 % of the total wealth. Moreover, we chose an average wealth of $W = 10$. In our experiments, this exogenous choice generates an income (wages and profits) of about 2.5, thereby mimicking the ratio between average wealth and average income of 4 observed in Germany.[21]

In accordance with the illustrations above, we use $\alpha = 2$ to represent the case of inequality aversion and $\alpha = 3$ for the case of competitive preferences. Moreover, we chose two values of the intensity parameter γ. The first is set at a moderate level of 5, which also serves to characterize our benchmark economy. The second value is set at a high level of 50, chosen in order to emphasize the impact of the population's other-regarding preferences on the variables of interest. Notice however that, even at the higher of these values, the marginal utility of income remains positive. Finally, the value of $u = 1.2$ is chosen to generate an empirically plausible value for the labor share of about 2/3 for the benchmark case, i.e., the average expected wage amounts to 2/3 of the average per-worker output. Moreover, this value turns out to be smaller than $\bar{u}$ as defined in Appendix A1.3, thereby satisfying Proposition 2.

Altogether, we present seven scenarios that illustrate the impact of the preference type and intensity as well as the wealth distribution. As a reference point, we show the purely self-regarding case with $\gamma = 0$. The other-regarding cases are examined for both values of α. For each, we vary γ as explained above and the wealth distribution. Specifically, holding average wealth fixed, we consider an economy in which wealth is perfectly evenly distributed at $W = 10$ as well as an unequal economy where, in line with the aforementioned characterization, $w_P = 2.5$ and $w_R = 40$. The latter comparison enables us to investigate the effect of a hypothetical, frictionless extreme wealth redistribution.

[21] See Sachverständigenrat (2014) for the German data. Note that the ratio between average wealth and average income in the U.S. has reached a level of 6.5 (see https://www.bloomberg.com/news/articles/2017-03-10/u-s-household-wealth-to-income-ratio-jumps-to-a-record-chart).

See also Bauluz (2010), Figure 22. Bauluz claims that Germany's relative low ratio is still due to the equalizing effect of WWII.

6.2 Results

Tables 1 and 2 below focus each on inequality averse and competitive workers, respectively. In every table we report the results for: (i) purely self-regarding workers as a benchmark ($\gamma = 0$), (ii) other-regarding workers with a moderate intensity parameter ($\gamma = 5$), and (iii) other-regarding workers with a high intensity parameter ($\gamma = 50$). In case (i), the wealth distribution is immaterial and hence not taken into account. In all other cases, we present two initial wealth distributions; (a) perfect equality and (b) an uneven distribution with the same total (and therefore also average) initial wealth as in (a). This structure allows us to highlight the impact of the other-regarding preference *per se* (the respective rows (a)) in isolation from that of wealth differences (rows (b_P) and (b_R), showing the results for the poor and the rich, respectively).

At the individual level, for $i = P, R$, we present the workers' equilibrium values of productive effort e_i^*, fixed wage s_i^*, bonus b_i^* and the expected wage, $s_i^* + e_i^* b_i^*$.[22] Further, we report the expected individual utility net of initial wealth. Given that there are no rents, that variable measures the difference between the workers' total expected income (including the average equilibrium profit Π^*) and the effort costs as well as the expected (dis)utility arising from the other-regarding preference. The latter is captured by the inequality term (see (3)), which we also report separately under the column IT. Recall that a positive inequality term indicates a utility loss and a negative one a gain under employment. The column IP reports the inequality premium the firm has to pay in lieu of the other-regarding preferences. Notice that a negative inequality premium indicates in fact a *discount* on the firms' wage costs. We further report the profits, π_i^*, obtained when a firm employs a worker of type i. Finally, we report the economy-wide aggregate output, appropriately weighted from v_i^* as defined in Footnote 4.[23]

6.2.1 Inequality Averse Economy

Table 1 summarizes the numerical results for an economy populated by inequality averse workers ($\alpha = 2$).

No Wealth Differences When there are no initial wealth differences, the effects of the other-regarding preferences are discernible only for a high intensity parameter (comparing rows (i) and (iii)(a) in Table 1). The results are driven by the fact that, ex post, all inequality averse workers experience either envy or compassion since nobody ends up earning exactly the average wage. This leads to an expected utility loss as manifested by the emergence of a positive inequality term. However, falling behind the societal average is more painful than forging ahead. Accordingly, workers try to avoid the former and are willing to exert higher effort, which makes them cheaper to employ as shown by the positive inequality premium and the reduced profits relative to a self-regarding economy. Specifically, the expected wage is smaller and the structure of the optimal

[22] Notice that all our experiments yield positive fixed wages so that imposing limited liability on the workers would be inconsequential.

[23] The table reports the results rounded to two digits after the decimal point.

	Effort	Fixed	Bonus	Wage	Utility$^{(a)}$	IT$^{(b)}$	IP$^{(c)}$	Profit	Output$^{(d)}$
(i) **Self-Regarding**									
	0.65	0.39	1.86	1.60	2.02	0	0	0.82	2.42
(ii) **Inequality Averse**, $\gamma = 5$									
(a) $w_P, w_R = 10$	0.65	0.43	1.81	1.60	2.01	0.01	0.00	0.81	2.41
(b$_P$) $w_P = 2.5$	0.69	0.47	1.59	1.57	1.03	0.97	-0.11	0.92	2.47
(b$_R$) $w_R = 40^{(e)}$	0.64	0.40	1.88	1.60	0.62	1.49	0.02	0.80	
(iii) **Inequality Averse**, $\gamma = 50$									
(a) $w_P, w_R = 10$	0.61	0.64	1.53	1.57	1.97	0.05	0.04	0.78	2.35
(b$_P$) $w_P = 2.5$	0.86	0.39	1.25	1.47	-7.52	9.05	-0.83	1.31	2.67
(b$_R$) $w_R = 40^{(e)}$	0.54	0.48	2.12	1.62	-12.20	14.75	0.18	0.58	
$^{(a)}$net of wealth, $^{(b)}$inequality term, $^{(c)}$inequality premium, $^{(d)}$aggregate,$^{(e)}$exceeds inflection point									

Table 1: Results of Numerical Experiments for Inequality Averse Workers ($\alpha = 2$)

contract changes: the bonus is significantly lower but the fixed payment much higher. In fact, the structure of the optimal contract and the resulting lower probability of obtaining the bonus reduce the variability of the wage payment, thereby mitigating the workers' expected loss due to their inequality aversion. In the final analysis, the emergence of inequality aversion reduces the economy's output.

Inequitable Wealth: The Poor When workers differ in their initial wealth, reflecting the *incentive effect of envy*, the equilibrium optimal contract induces the poor inferiority averse workers to increase their effort beyond that of the equitable-wealth case despite a substantially lower bonus (comparing rows (a) with (b$_P$) in Table 1). With moderate inferiority aversion, the fixed wage is however larger. Intuitively, in this case too, this reduces variability of the payment scheme and hence the workers' expected loss due to envy. When the intensity parameter is large, the worker's effort and the associated probability of obtaining the bonus are so high that the foregoing effect arises despite a reduced fixed wage. In any case, the participation constraint is relaxed, allowing the firms to "exploit" the inferiority aversion of the poor workers to substantially increase their profits. This is manifested by lower expected wages and the *negative inequality premia,* representing the discounts on the firms' wage costs. The foregoing equilibrium results and their sensitivity to the intensity parameter are consistent with the findings shown in Figure 4(a) and the discussion thereof.

Inequitable Wealth: The Rich A comparison of rows (a) and (b$_R$) in Table 1 reveals that the equilibrium results for the superiority averse rich are a mirror image of those for their poor peers. When the intensity parameter increases, their effort decreases while the associated bonus rises. Intuitively, due to the resulting *disincentive effect of empathy*, the firm is forced to pay a very high bonus. With moderate superiority aversion, the firm can afford to reduce the optimal fixed pay, thereby mitigating their expected loss. When the intensity parameter is large, the firm must increase the bonus even further. However, the inequality term becomes so large that the firm must also raise the fixed wage. In any case and in line with Figure 4(b), the rich workers become more expensive to employ, receiving a higher expected wage which compensates them for the corresponding *positive inequality premium.* Altogether, when employing the rich, the firms' profits fall below that generated under an equitable wealth distribution. Moreover, this effect becomes larger as the intensity parameter increases.

Output, Wage Gap, and Utility The above findings have implications for aggregate variables and their impact on individuals, in particular their utility.

Compared to the equitable wealth distribution, rising initial wealth inequality leads to higher aggregate output under inequality aversion (compare row (a) and combined rows (b)). Clearly, this result stems from the higher equilibrium effort of the poor, outweighing the reduced effort of the rich. Nevertheless, the expected wage of the rich is larger than that of the poor. Thus, notwithstanding the aversion towards inequality, in our example an initial inequitable wealth distribution generates even more inequality. In fact, all these effects are accentuated as the economy becomes more sensitive to inequality.

Under inequitable initial wealth, all workers obtain higher expected total income due to the higher average profits (not reported) distributed to them.[24] Nevertheless, all workers poor and rich suffer from wealth inequality. Because of their inequality aversion, the inequality term increases, representing the expected utility loss due to the other-regarding part of the preferences. Consequently, total expected utility (net of wealth) decreases as workers become more inequality averse.

Notice the striking gap between the firms' inequality premia and the workers' inequality terms shown in the table. This gap exposes the difference between our setting, dealing with within-society comparisons, and the literature on inequality aversion within firms, where the inequality premium and the inequality term would coincide (see equation (IP) and the ensuing discussion).

The above utility losses arising for all workers trigger the question whether redistributing initial wealth would increase total welfare and whether a consensus on such a policy would emerge.

Redistribution Finally, we discuss the population's attitude towards a redistribution of initial wealth. To simplify, we consider an extreme case whereby the state costlessly imposes an ex-ante tax of 30 units of wealth on every rich worker and evenly distributes the revenues among the poor, yielding an equitable ex-ante wealth distribution. As explained in the following, such a redistribution would clearly enhance total expected welfare but does not recruit a consensus. Similar results obtain for less extreme redistribution scenarios.

An extreme redistribution would be clearly favored by the poor because they not only gain initial wealth but also avoid the loss due to wealth inequality in the society. Not surprisingly, despite their aversion towards inequality, the rich oppose redistribution. While, under an even

[24] Average profits are given by the weighted sum of the corresponding per-worker profits.

wealth distribution (rows (a)), their utility net of wealth compared to an inequitable distribution (rows (b_R)) would rise by 1.39 for $\gamma = 5$, or even by 14.17 for $\gamma = 50$, the direct loss involved in redistributing their wealth to the poor would entail 30, summing up to a loss of 28.61 in the first case and 15.83 in the second. This is consistent with our assumption that the direct welfare effect of wealth exceeds the loss associated with inequality aversion for the rich. On the other hand, every poor person would gain 8.48 (comprised of 0.98 due to the reduced inequality and 7.5 units of wealth) if $\gamma = 5$, and 16.99 (9.49 + 7.5) if $\gamma = 50$. Thus, for a utilitarian social welfare function, it is obvious that for $\gamma = 50$ such redistribution would be welfare-enhancing. The personal gain of every poor worker exceeds the loss of his rich peer, yielding a total societal net gain of 10.43. For $\gamma = 5$, due to the large share of the poor in the population, the total societal gain would still be positive at 1.06 although, in this case, the gain of every poor worker falls below the loss of the rich.

6.2.2 Competitive Economy

In Table 2, we turn to an economy populated by competitive workers ($\alpha = 3$).

	Effort	Fixed	Bonus	Wage	Utility$^{(a)}$	IT$^{(b)}$	IP$^{(c)}$	Profit	Output$^{(d)}$
(i) **Self-Regarding**									
	0.65	0.39	1.86	1.60	2.02	0	0	0.82	2.42
(iv) **Competitive**, $\gamma = 5$									
(a) $w_P, w_R = 10$	0.65	0.39	1.86	1.60	2.02	0.00	0.00	0.82	2.42
(b_P) $w_P = 2.5$	0.67	0.52	1.58	1.57	1.57	0.44	-0.06	0.88	2.45
(b_R) $w_R = 40^{(e)}$	0.66	0.38	1.85	1.60	2.87	-0.82	-0.01	0.83	
(v) **Competitive**, $\gamma = 50$									
(a) $w_P, w_R = 10$	0.65	0.41	1.84	1.60	2.02	0.00	0.00	0.82	2.42
(b_P) $w_P = 2.5$	0.81	0.54	1.18	1.50	-2.09	3.89	-0.55	1.20	2.66
(b_R) $w_R = 40^{(e)}$	0.71	0.33	1.78	1.58	10.21	-8.00	-0.14	0.98	
$^{(a)}$net of wealth, $^{(b)}$inequality term, $^{(c)}$inequality term, $^{(d)}$aggregate,$^{(e)}$wealth exceeds inflection point									

Table 2: Results of Numerical Experiments for Competitive Workers ($\alpha = 3$)

Remember that, for competitive preferences, the poor are still inferiority averse whereas the rich are superiority seeking. As a result, both the poor and the rich become cheaper to employ (see panels (c) and (d) of Figure 4) under an inequitable wealth distribution. This manifests itself in the equilibrium results of Table 2, where those for the poor resemble the case of inequality aversion while the results for the rich are reversed.

We observe that, when **initial wealth is equitable**, introducing other-regarding preferences and raising the intensity parameter further barely affects the equilibrium (comparing rows (i), (iv)(a), (v)(a) in Table 2). In this case, the ex-ante disutility for those who do not obtain the bonus and fall behind the societal average is basically neutralized by the prospect of forging ahead and enjoying the higher than average income when the bonus is obtained. When **initial wealth is not equal** however, both the poor and the rich increase their effort relative to the equitable economy (compare rows (a), (b$_P$), (b$_R$)), despite the lower bonuses they receive. As for the poor, the reasons have already been elaborated upon above. In contrast to the case of inequality aversion, for the rich there is also an *incentive effect* under competitive preferences; they have an additional incentive to exert effort due to their joy of outperforming the societal average. This allows the firms to reduce the equilibrium bonus also for them. The rich workers' fixed wage too becomes smaller as the intensity parameter increases. This reflects the fact that, similar to the poor inferiority averse, also the superiority seeking rich dislike being unemployed, which relaxes their participation constraint. Consequently, the firms incur a negative inequality premium, implying a discount on the employment costs also for the rich.

All of the above implies that aggregate output as well as the firms' equilibrium profits increase for both types of workers. In a very competitive economy, all foregoing effects are even stronger. Not surprisingly, the expected wage payment of the rich exceeds that of the poor, leading to an even more inequitable wealth distribution ex post, as was the case for inequality aversion.

While, in these environments, the poor suffer a utility loss, the rich enjoy a substantial utility gain, manifested by their negative inequality term. The latter will hence object to any **redistribution** of their initial wealth to the poor. A welfare calculation reveals that, under the same redistribution program discussed above, every rich person loses 30.85 if $\gamma = 5$ and 38.19 if $\gamma = 50$. Each of the poor would gain 7.95 in the first case and 11.61 in the second. The total welfare gain of the poor is greater than the total loss of the rich also in a competitive economy, at 6.36 compared to 6.17 for the low intensity parameter, and 8.93 versus 7.64 for the high intensity parameter. Accordingly, as under inequality aversion, for a utilitarian social welfare function, a redistribution would enhance total welfare despite the lower output that would emerge.

7 Discussion and Conclusion

This paper focuses on the impact of other-regarding preferences on economic performance at the macroeconomic level. For this purpose, it presents a static general-equilibrium framework where labor relations are affected by moral hazard. While workers' other-regarding preferences are self-centered, they do care about societal income and wealth distribution. In particular, they are either inequality averse or competitive, where their reference point is the average economy-wide income and wealth. The utility of inequality averse workers is negatively affected when their societal position either exceeds or falls below that reference point. Competitive workers who are below the societal average also suffer utility losses, but the welfare of those who are above that average increases. Conducting several numerical experiments, we find that in economies with high initial wealth differences those below average (the "poor") increase effort. Notably, this happens although they obtain a lower bonus than they would in an economy with equitable wealth distribution. The same holds also when the distaste for inequality is reduced. In contrast, analogous comparisons reveal that those above average (the "rich") obtain a higher bonus but exert lower effort in more inequitable economies or when the inequality preference is less pronounced. Under both inequality aversion and competitiveness, the expected wage of the rich exceeds that of the poor, indicating a worsening of subsequent wealth and income distributions. Intuitively, firms exploit the poor workers' distaste of below-average earnings by inducing high effort at a relatively low incentive pay. Similarly, though less pronounced, superiority seeking rich workers enjoy their advantage and therefore become less costly to incentivize. In contrast, superiority averse rich workers try to avoid becoming even richer and hence require more incentivization. Consequently, under increased income and wealth inequality, rich workers suffer utility losses in an inequality averse economy whereas their utility increases in a competitive economy. Poor workers suffer utility losses in both types of economies.

Altogether, in our environment social attitudes towards inequality do not, in and by themselves, create any mechanism that reduces inequality. This is particularly surprising where inequality aversion is concerned. As a matter of fact, increasing inequality aversion contributes towards *higher* inequality. Finally, regardless of the aforementioned welfare consequences, the work incentives created by wealth inequality or high intensity of the other-regarding preference result in higher productivity and output but lower total welfare.

Due to our focus, the model abstracts from many important aspects. Specifically, technology, human capital, and skills play no role. Accordingly, by assuming that all workers are inherently identical except for their initial wealth, the model cannot account for the full extent of income differences as observed in reality. Introducing ability and skill differences into our framework would increase income differences as implied by the extensive literature on the effects of skill-biased technological change on inequality (Helpman 2018). Moreover, Cingano (2014) finds a positive relationship between wealth and education. In our model, the foregoing would imply that the wages of the rich would increase even further due to their ability to acquire higher skills than the poor. That, in turn, would further increase the income gap, thereby reinforcing our main findings.

At this stage, we allowed for only two types of workers, "rich" and "poor". An extended environment might include a more realistic wealth distribution. More importantly, the reference points and the outside options may include a broader set. For example, rather than comparing to the societal average, poor workers may compare themselves to the rich and the rich may look at the poor. Finally, a model of this type may be embedded in a dynamic growth framework in order to explicitly study the dynamics of wealth and income distributions and their interaction with economic growth.

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Appendix

A1 Comparative Statics

In this appendix, we explore the properties of the incentive and participation constraints, equations (IC) and (PC) respectively. In addition, we conduct a comparative analysis exercise on the optimal contract (s^*, b^*), for a given level of effort.

A1.1 The Properties of the Function $f(\cdot, \cdot)$

To simplify notation, we let:

$$f_\omega \doteq \frac{\partial}{\partial s} f(\omega, \Omega), \; f_{\omega\omega} \doteq \frac{\partial^2}{\partial s^2} f(\omega, \Omega) \tag{A1}$$

To simplify notation (and with some abuse), in the sequel we define $\omega = s + w + \Pi$, and $\Omega = Y + W + \Pi$. Let $\widehat{\omega} > \Omega$ denote the inflection point of $f(\cdot, \cdot)$. Furthermore, we focus throughout on cases where $b > 0$ and one of the following situations holds (i) $\omega + b < \Omega$, (ii) $\Omega < \omega < \omega + b < \widehat{\omega}$, (iii) $\widehat{\omega} < \omega$. In other words, either a person remains "poor" even if he receives a bonus, or, if he is "rich", receiving a bonus keeps him to the left of the inflection point, or he was to right of that point even without a bonus. All other cases, where obtaining a bonus may "swing" a person beyond either critical point Ω or $\widehat{\omega}$, are ruled out as they may entail ambiguous outcomes. In this context, we have the following implications:

Implications: Given Assumptions 1 and 2; (i) for a person with $\omega + b < \Omega$, $0 < f(s + b, \Omega) < f(s, \Omega)$ (ii) for a superiority person with $\Omega < \omega$, $0 < f(\omega, \Omega) < f(\omega + b, \Omega)$, (iii) for a superiority seeking person with $\Omega < \omega$, $f(\omega + b, \Omega) < f(\omega, \Omega) < 0$, (iii) for $\omega + b < \Omega$, $f_\omega(\omega, \Omega) < f_\omega(\omega + b, \Omega) < 0$, (iv) for a superiority averse person with $\Omega < \omega < \omega + b < \widehat{\omega}$, $0 < f_\omega(\omega, \Omega) < f_\omega(\omega + b, \Omega)$, (v) for a superiority averse person with $\widehat{\omega} < \omega$, $0 < f_\omega(\omega + b, \Omega) < f_\omega(\omega, \Omega)$, (vi) for a superiority seeking person with $\Omega < \omega < \omega + b < \widehat{\omega}$, $f_\omega(\omega + b, \Omega) < f_\omega(\omega, \Omega) < 0$, and (vii) for a superiority seeking person with $\widehat{\omega} < \omega$, $f_\omega(\omega, \Omega) < f_\omega(\omega + b, \Omega) < 0$.

These observations are used below to conduct a number of comparative statics analyses.

A1.2 The Incentive Constraint

Starting with the incentive condition, we rewrite it, omitting arguments, as:

$$p'b - c' - \gamma p' \left[f(\omega + b, \Omega) - f(\omega, \Omega) \right] = 0 \tag{A2}$$

From the implications of Assumption A1 we obtain the following results.

Proof of Lemma 1

Along (A2) we obtain:

$$\frac{\partial e}{\partial s} = -\frac{-\gamma p' \left[f_\omega(\omega + b, \Omega) - f_\omega(\omega, \Omega) \right]}{p''b - c'' - \gamma p'' \left[f(\omega + b, \Omega) - f(\omega, \Omega) \right]} \tag{A3}$$

The denominator of (A3) is negative by SOC. For persons with $\omega+b<\Omega$, superiority averse persons with $\Omega<\omega<\omega+b<\widehat{\omega}$ and superiority seeking persons with $\widehat{\omega}<\omega$ the numerator is positive, leading to $\frac{\partial e}{\partial s}<0$. For superiority averse persons with $\widehat{\omega}<\omega$ and superiority seeking persons with $\Omega<\omega<\omega+b<\widehat{\omega}$ the numerator is negative, leading to $\frac{\partial e}{\partial s}>0$.

Slope

Holding effort and γ fixed, along the incentive constraint the relationship between the fixed payment and the bonus is:

$$\frac{\partial s}{\partial b}=\frac{1-\gamma f_{\omega}(\omega+b,\Omega)}{\gamma\left(f_{\omega}(\omega+b,\Omega)-f_{\omega}(\omega,\Omega)\right)}. \tag{A4}$$

Lemma A1: Holding effort fixed, along the incentive condition we obtain: (i) $\frac{\partial s}{\partial b}>0$ for $\omega+b<\Omega$. (ii) For an superiority averse person with $\Omega<\omega<\omega+b<\widehat{\omega}$ and $\gamma<\frac{1}{f_{\omega}(\omega+b,\Omega)}$, $\frac{\partial s}{\partial b}>0$ and $\frac{\partial s}{\partial b}<0$ if $\gamma>\frac{1}{f_{\omega}(\omega+b,\Omega)}$. If $\omega>\widehat{\omega}$, $\frac{\partial s}{\partial b}<0$ for $\gamma<\frac{1}{f_{\omega}(\omega+b,\Omega)}$ with the reverse holding for $\gamma>\frac{1}{f_{\omega}(\omega+b,\Omega)}$, (iii) For a superiority seeking person with $\Omega<\omega<\omega+b<\widehat{\omega}$, $\frac{\partial s}{\partial b}<0$, and if $\omega>\widehat{\omega}$, $\frac{\partial s}{\partial b}>0$.

Impact of γ

For a given bonus and γ, the impact of a change in γ on s is:

$$\frac{\partial s}{\partial \gamma}=-\frac{f(\omega+b,\Omega)-f(\omega,\Omega)}{\gamma\left(f_{\omega}(\omega+b,\Omega)-f_{\omega}(\omega,\Omega)\right)} \tag{A5}$$

Lemma A2: Along the incentive constraint, holding effort fixed we have: (i) for $\omega+b<\Omega$, $\frac{\partial s}{\partial \gamma}>0$, (ii) for the superiority averse person with $\Omega<\omega<\omega+b<\widehat{\omega}$, $\frac{\partial s}{\partial \gamma}<0$ and $\frac{\partial s}{\partial \gamma}>0$ if $\omega>\widehat{\omega}$, (iii) the reverse holds for the superiority seeking person with $\Omega<\omega$.

Next, we hold s constant and analyze the impact of γ on b:

$$\frac{\partial b}{\partial \gamma}=\frac{f(\omega+b,\Omega)-f(\omega,\Omega)}{1-\gamma f_{\omega}(\omega+b,\Omega)} \tag{A6}$$

Lemma A3: Along the incentive constraint, for a fixed effort level the following holds: (i) for $\omega+b<\Omega$, $\frac{\partial b}{\partial \gamma}<0$, (ii) For the superiority averse person with $\Omega<\omega$, $\frac{\partial b}{\partial \gamma}>0$ if $\gamma<\frac{1}{f_{\omega}(\omega+b,\Omega)}$, $\frac{\partial b}{\partial \gamma}<0$ if $\gamma>\frac{1}{f_{\omega}(\omega+b,\Omega)}$, and (iii) for the superiority seeking persons with $\Omega<\omega$, $\frac{\partial b}{\partial \gamma}<0$.

A1.3 The Participation Constraint

Using the same notation, the participation constraint can be rewritten as:

$$s + pb - c - \gamma \left[pf(\omega + b, \Omega) + (1 - p) f(\omega, \Omega) \right] \geq u - \gamma f(u, \Omega) \tag{A7}$$

Slope

Similar to the exercise above, we start by holding γ fixed to assess the relationship between s and b along the participation constraint:

$$\frac{\partial s}{\partial b} = -\frac{p\left(1 - \gamma f_\omega(\omega + b, \Omega)\right)}{1 - \gamma \left[pf_\omega(\omega + b, \Omega) + (1 - p) f_\omega(\omega, \Omega) \right]}. \tag{A8}$$

Lemma A4: Along the participation constraint, holding effort fixed we have: (i) $\frac{\partial s}{\partial b} < 0$ for $\omega + b < \Omega$, (ii) for the superiority averse person with $\Omega < \omega$ and $\gamma < \frac{1}{\max[f_\omega(\omega + b, \Omega), f_s(\omega, b)]}$ or $\gamma > \frac{1}{\min[f_\omega(\omega + b, \Omega), f_s(\omega, b)]}$, $\frac{\partial s}{\partial b} < 0$. (iii) for the superiority seeking person with $\Omega < \omega$, $\frac{\partial s}{\partial b} < 0$.

Impact of γ

We start by analyzing the impact of γ on the participation constraint when b and e are fixed:

$$\frac{\partial s}{\partial \gamma} = \frac{pf(\omega + b, \Omega) + (1 - p) f(\omega, \Omega) - f(u, \Omega)}{1 - \gamma \left[pf_\omega(\omega + b, \Omega) + (1 - p) f_\omega(\omega, \Omega) \right]}. \tag{A9}$$

Remark A1: To provide incentives, u must satisfy $s < u < s + b$. Define $\overline{u}$ and $\overline{y}$ by $pf(\omega+b, \Omega)+(1-p) f(\omega, \Omega)-f(\overline{u}, \Omega) = 0$ and $\overline{y} = (1-p)\cdot s+p\cdot(s+b)$. Consequently we have: (i) for $\omega+b < \Omega$, the convexity of $f(\cdot, \Omega)$ implies $\overline{u} < \overline{y}$ and $pf(\omega+b, \Omega)+(1-p) f(\omega, \Omega)-f(u, \Omega) < 0$ if $u < \overline{u}$, and positive if $u > \overline{u}$. (ii) For the superiority averse with $\Omega < \omega < \omega + b < \widehat{\omega}$ we have $\overline{u} > \overline{y}$ and $pf(\omega+b, \Omega)+(1-p) f(\omega, \Omega)-f(\overline{u}, \Omega) > 0$ for $u < \overline{u}$, and negative if $u > \overline{u}$. (iii) The same holds for the superiority averse with $\widehat{\omega} < \omega$ except that now $\overline{u} < \overline{y}$. (iv) For the superiority seeking with $\Omega < \omega < \omega + b < \widehat{\omega}$ we have $\overline{u} > \overline{y}$ and $pf(\omega + b, \Omega) + (1 - p) f(\omega, \Omega) - f(u, \Omega) < 0$ for $u < \overline{u}$ and positive if $u > \overline{u}$. (v) The same holds for the superiority seeking with $\widehat{\omega} < \omega$ but now $\overline{u} < \overline{y}$.

Lemma A5: Taking Remark A1 into account, along the participation constraint and holding effort fixed the following obtain: (i) $\frac{\partial s}{\partial \gamma} < 0$ for $\omega + b < \Omega$ and $u < \overline{u}$, positive for $u > \overline{u}$. (ii) For the superiority averse persons with $u < \overline{u}$, if $\Omega < \omega < \omega + b < \widehat{\omega}$ or $\widehat{\omega} < \omega$, $\frac{\partial s}{\partial \gamma} > 0$ for $\gamma < \frac{1}{f_\omega(\omega + b, \Omega)}$, respectively $\gamma < \frac{1}{f_\omega(\omega, \Omega)}$,and $\frac{\partial s}{\partial \gamma} < 0$ if $\gamma > \frac{1}{f_\omega(\omega, \Omega)}$, respectively $\gamma > \frac{1}{f_\omega(\omega + b, \Omega)}$. The reverse relationships hold for the same types of individuals if $u > \overline{u}$ (iii) For a superiority seeking person with $\Omega < \omega < \omega + b < \widehat{\omega}$ or $\widehat{\omega} < \omega$ and $u < \overline{u}$, $\dfrac{\partial s}{\partial \gamma} < 0$. The reverse holds if $u > \overline{u}$

Next, we investigate the impact of changing γ on b when s is held fixed:

$$\frac{\partial b}{\partial \gamma} = \frac{pf(\omega + b, \Omega) + (1-p)\, f(\omega, \Omega) - f(u, \Omega)}{p\,(1 - \gamma f_\omega(\omega + b, \Omega))} \tag{A10}$$

Lemma A6: Considering Remark 1, along the participation constraint, for a given effort we observe: (i) $\dfrac{\partial b}{\partial \gamma} < 0$ for $\omega + b < \Omega$ and and $u < \overline{u}$, positive for $u > \overline{u}$. (ii) For the superiority averse person with $\Omega < \omega < \omega + b < \widehat{\omega}$ or $\widehat{\omega} < \omega$ and $u < \overline{u}$, $\dfrac{\partial b}{\partial \gamma} > 0$ if $\gamma < \dfrac{1}{f_\omega(\omega + b, \Omega)}$, and $\dfrac{\partial b}{\partial \gamma} < 0$ if $\gamma > \dfrac{1}{f_\omega(\omega + b, \Omega)}$. The reverse relationships hold for the same types of individuals if $u > \overline{u}$. (iii) $\dfrac{\partial b}{\partial \gamma} < 0$ for the superiority seeking person with $\Omega < \omega < \omega + b < \widehat{\omega}$ or $\widehat{\omega} < \omega$ and $u < \overline{u}$. The reverse holds if $u > \overline{u}$.

Optimal Contract

We start by investigating the impact of γ on (s^*, b^*) holding e fixed. Conducting the comparative statics analysis simultaneously on equations (A2) and (A7) yields:

$$A \begin{bmatrix} ds^* \\ db^* \end{bmatrix} = B d\gamma \tag{A11}$$

where

$$A = \begin{bmatrix} -\gamma p' \left[f_\omega(\omega + b, \Omega) - f_\omega(\omega, \Omega)\right] & p' \left[1 - \gamma f_\omega(\omega + b, \Omega)\right] \\ 1 - \gamma \left[p f_\omega(\omega + b, \Omega) + (1-p)\, f_\omega(\omega, \Omega)\right] & p \left[1 - \gamma f_\omega(\omega + b, \Omega)\right] \end{bmatrix} \tag{A12}$$

and

$$B = \begin{bmatrix} p' \left[f(\omega + b, \Omega) - f(\omega, \Omega)\right] \\ pf(\omega + b, \Omega) + (1-p)\, f(\omega, \Omega) - f(u, \Omega) \end{bmatrix} \tag{A13}$$

From here:

$$\det A = -p' \left(1 - \gamma f_\omega(\omega + b, \Omega)\right) \left(1 - \gamma f_\omega(\omega, \Omega)\right) \tag{A14}$$

Accordingly:

$$\begin{bmatrix} ds^* \\ db^* \end{bmatrix} = A^{-1} \begin{bmatrix} p' \left[f(\omega + b, \Omega) - f(\omega, \Omega)\right] \\ pf(\omega + b, \Omega) + (1-p)\, f(\omega, \Omega) - f(u, \Omega) \end{bmatrix} d\gamma \tag{A15}$$

or:

$$\begin{bmatrix} ds^* \\ db^* \end{bmatrix} = \frac{1}{\det A} \begin{bmatrix} p'[(f(u, \Omega) - f(\omega, \Omega))(1 - \gamma f_\omega(\omega + b, \Omega))] \\ -p'[f(\omega + b, \Omega) - f(\omega, \Omega) - \gamma\left(f(\omega + b, \Omega) - f(u, \Omega)\right) f_\omega(\omega, \Omega) \\ \qquad - \gamma\left(f(u, \Omega) - f(\omega, \Omega)\right) f_\omega(\omega + b, \Omega)] \end{bmatrix} d\gamma \tag{A16}$$

We can summarize the analysis by the following:

Lemma A7: For a given level of effort, an increase in γ would: (i) increase the optimal wage s^* for a person with $\omega + b < \Omega$, (ii) decrease the wage for the superiority averse person with $\Omega < \omega$ if $\gamma < \dfrac{1}{f_\omega(\omega, \Omega)}$ and increase it otherwise (iii) increase the wage of the superiority seeking person with $\Omega < \omega$.

Proof: For this case

$$\frac{\partial s^*}{\partial \gamma} = -\frac{(f(u, \Omega) - f(\omega, \Omega))}{(1 - \gamma f_\omega(\omega, \Omega))} \tag{A17}$$

Notice that when $\omega + b < \Omega$, we have $(f(u, \Omega) - f(\omega, \Omega)) < 0$, leading to the result. For the superiority averse person with $\Omega < \omega$, $(f(u, \Omega) - f(\omega, \Omega)) > 0$. Therefore the optimal wage decreases if $\gamma < \frac{1}{f_\omega(\omega,\Omega)}$ and increases if the reverse holds. For a superiority seeking individual with $\Omega < \omega$, $(f(u, \Omega) - f(\omega, \Omega)) < 0$ and the denominator of A17 is positive.

Lemma A8: For a given level of effort, the impact of increasing γ would: (i) decrease the optimal bonus b^* for $\omega + b < \Omega$. (ii) increase the optimal bonus for the superiority averse with $\Omega < \omega$ provided γ is sufficiently small and decrease it if γ is sufficiently large (iii) decrease the optimal bonus for a superiority seeking person with $\Omega < \omega$.

Proof: Here we have

$$\frac{\partial b^*}{\partial \gamma} = \frac{f(\omega + b, \Omega) - f(\omega, \Omega) - \gamma\left[(f(\omega + b, \Omega) - f(u, \Omega))\, f_\omega(\omega, \Omega) + (f(u, \Omega) - f(\omega, \Omega))\, f_\omega(\omega + b, \Omega)\right]}{(1 - \gamma f_\omega(\omega + b, \Omega))\,(1 - \gamma f_\omega(\omega, \Omega))} \tag{A18}$$

Notice that $f(\omega + b, \Omega) - f(\omega, \Omega)$, $f(\omega + b, \Omega) - f(u, \Omega)$ and $f(u, \Omega) - f(\omega, \Omega)$ all have the same pattern, comparing higher to lower income levels. Therefore they all have the same sign: negative for persons with $\omega + b < \Omega$, and for individuals with $\Omega < \omega$ they are positive for the superiority averse and again negative for the superiority seeking types. For persons with $\omega + b < \Omega$ and the superiority seeking rich the slope of $f(\cdot, \Omega)$ is negative, yielding the respective result, but for the superiority averse rich the sign of both the numerator and the denominator of $\dfrac{\partial b^*}{\partial \gamma}$ depends on the size of γ. If γ is sufficiently small both the numerator and the denominator are negative, resulting in a positive outcome.

Finally, we look at the changes in s^* and b^* required to induce more effort, holding γ fixed. In this case we obtain:

$$A \begin{bmatrix} ds^* \\ db^* \end{bmatrix} = C de \tag{A19}$$

with

$$C = -\begin{bmatrix} SOC \\ 0 \end{bmatrix} de \tag{A20}$$

where SOC stands for the derivative of (A2), which by the second-order conditions must be negative. The second entry in C is the derivative of (A7), which is just (A2), and equals 0 at the optimum. Accordingly,

$$\begin{bmatrix} ds^* \\ db^* \end{bmatrix} = -\frac{1}{\det A} \begin{bmatrix} p\,[1 - \gamma f_\omega(\omega + b, \Omega)] \cdot SOC \\ -\left[1 - \gamma\,(p f_\omega(\omega + b, \Omega) + (1 - p)\, f_\omega(\omega, \Omega))\right] \cdot SOC \end{bmatrix} de \tag{A21}$$

Form all of the above, we obtain:

Lemma A9: For a given γ, an increase in e: (i) decreases s^* for persons with $\omega + b < \Omega$, (ii) decreases s^* for superiority averse persons with $\Omega < \omega$ and $\gamma < \dfrac{1}{f_\omega(\omega, \Omega)}$, and increases s^* if $\gamma > \dfrac{1}{f_s(\omega, \Omega)}$, (iii) decreases s^* for the superiority seeking persons with $\Omega < \omega$.

Lemma A10: For a given γ, increasing e causes: (i) b^* to increase for the persons with $\omega + b < \Omega$, (ii) b^* to increase for the superiority averse persons with $\Omega < \omega$ and $\gamma < \dfrac{1}{f_\omega(\omega + b, \Omega)}$, and decrease if $\gamma > \dfrac{1}{f_\omega(\omega, \Omega)}$, (iii) b^* to increase for the superiority seeking persons with $\Omega < \omega$.

A1.4 Summary of Comparative Statics

Table 3 below provides a summary of the results of Lemmas A1-A10. In the table, we distinguish between poor workers for whom $s + b + \Pi + w_P < \Omega$, and the rich ones. Clearly, the former are inferiority averse under both inequity aversion and competitiveness whereas the latter are superiority averse in the first case but superiority seeking in the second. We differentiate between (moderately) rich workers with $\Omega < s + \Pi + w_R < s + b + \Pi + w_R < \widehat{\omega}$ and the very rich with $\widehat{\omega} < s + \Pi + w_R$, where, as defined above, $\widehat{\omega}$ denotes the inflection point in $f(\cdot, \Omega)$. We focus on unambiguous results and present them in a simplified manner. Specifically, the terms "small" and "large" are shorthand for "sufficiently small" and "sufficiently large", where the particular thresholds are specified in the respective Lemma.

	Inferiority Averse	**Superiority Averse**		**Superiority Seeking**	
	poor	rich	very rich	rich	very rich
Incentive Constraint					
$(A1)\ \dfrac{\partial s}{\partial b}$	>0	>0 if γ small <0 if γ large	<0 if γ small >0 if γ large	<0	>0
$(A2)\ \dfrac{\partial s}{\partial \gamma}$	>0	<0	>0	>0	<0
$(A3)\ \dfrac{\partial b}{\partial \gamma}$	<0	>0 if γ small <0 if γ large	>0 if γ small <0 if γ large	<0	<0
Participation Constraint					
$(A4)\ \dfrac{\partial s}{\partial b}$	<0	<0 if γ small or large	<0 if γ small or large	<0	<0
$(A5)\ \dfrac{\partial s}{\partial \gamma}$	u small: <0 u large: >0	u small: >0 if γ small, <0 if γ large u large: >0 if γ small, <0 if γ large	u small: >0 if γ small, <0 if γ large u large: >0 if γ small, <0 if γ large	u small: <0 u large: >0	u small: <0 u large: >0
$(A6)\ \dfrac{\partial b}{\partial \gamma}$	u small: <0 u large: >0	u small: >0 if γ small, <0 if γ large u large: <0 if γ small, >0 if γ large	u small: >0 if γ small, <0 if γ large u large: <0 if γ small, >0 if γ large	u small: <0 u large: >0	u small: <0 u large: >0
Optimal Contract (for given e)					
$(A7)\ \dfrac{\partial s^*(e)}{\partial \gamma}$	>0	<0 if γ small >0 if γ large	<0 if γ small >0 if γ large	>0	>0
$(A8)\ \dfrac{\partial b^*(e)}{\partial \gamma}$	<0	>0 if γ small <0 if γ large	>0 if γ small <0 if γ large	<0	<0
$(A9)\ \dfrac{\partial s^*(e)}{\partial e}$	<0	<0 if γ small >0 if γ large	<0 if γ small >0 if γ large	<0	<0
$(A10)\ \dfrac{\partial b^*(e)}{\partial e}$	>0	>0 if γ small <0 if γ large	>0 if γ small <0 if γ large	>0	>0

Table 3: Comparative Statics (see Lemmata A1 - A10)

A2 Model Specification: Properties of the Function $f(\cdot,\cdot)$

In the following, we explore the properties of the utility associated with inequality for the specification introduced in Section 5. We discuss inequality aversion with $\alpha = 2$ and competitiveness with $\alpha = 3$.

A2.1 Inequality Aversion

We investigate a somewhat more general specification of (10):

$$f(\omega, \Omega) = \left(\frac{1 - \frac{\omega}{\Omega}}{1 + \mu \frac{\omega}{\Omega}} \right)^2, \ 0 < \mu \tag{A22}$$

Here a reduction in γ but also an increase in μ lower the splay of the disutility function. Moreover, the function's inflection point (see below) is shifted to the left, thereby reducing mainly the sensitivity people with an above-mean income-and-wealth combination to deviations from the mean.

Property 1: $f_\omega < 0$ for $\omega < \Omega$ and $f_\omega > 0$ for $\omega > \Omega$.

Proof: Obvious.

Property 2: Under (A22), $f(\omega, \Omega)$ is concave for $0 < \omega < \Omega$, convex for $\Omega < \omega < \widehat{\omega}$ and concave for $\widehat{\omega} < \omega$ where

$$\widehat{\omega} = \frac{1 + 3\mu}{2\mu} \Omega \tag{A23}$$

Proof: Immediate from the second derivative of $f(\omega, \Omega)$ with respect to ω.

Property 3: Let $0 < x < \Omega$. Then $f(\Omega - x, \Omega) > f(\Omega + x, \Omega)$.

Proof: Under (A22),

$$\left(\frac{1 - \frac{\Omega - x}{\Omega}}{1 + \mu \frac{\Omega - x}{\Omega}} \right)^2 - \left(\frac{1 - \frac{\Omega + x}{\Omega}}{1 + \mu \frac{\Omega + x}{\Omega}} \right)^2 = \left(\frac{x}{(1 + \mu)\Omega - x} \right)^2 - \left(\frac{-x}{(1 + \mu)\Omega + x} \right)^2 > 0 \tag{A24}$$

A2.2 Competitiveness

Now we explore:

$$f(\omega, \Omega) = \left(\frac{1 - \frac{\omega}{\Omega}}{1 + \mu \frac{\omega}{\Omega}} \right)^3 \tag{A25}$$

Property 4: In the competitive case $f_\omega < 0$ for $\omega < \Omega$ and for $\omega > \Omega$ with $f_\omega(\Omega, \Omega) = 0$.

Proof: Immediate from the derivative of $f(\omega, \Omega)$ under (A25).

Property 5: Under (A25), f is concave for $0 < \omega < \widehat{\omega}_1$, convex for $\widehat{\omega}_1 < \omega < \widehat{\omega}_2$ and concave for $\widehat{\omega}_2 < \omega$ where

$$\widehat{\omega}_1 = \Omega$$

$$\widehat{\omega}_2 = \frac{1+2\mu}{\mu}\Omega \tag{A26}$$

Proof: Obtained by taking the second derivative of $f(\omega, \Omega)$ and finding the inflection points $\widehat{\omega}_1$ and $\widehat{\omega}_2$.

B European Social Survey (2016)

The following two figures present average attitudes towards incentivization and income differences across European countries, as derived from the European Social Survey (2016). The histograms indicate the percentage of those who agree or disagree with the statements presented above the panels. In the figures, "agree" sums those who answered either "agree strongly" or "agree" while "disagree" combines those who replied "disagree" and "disagree strongly". Those who answered "neither agree nor disagree" are omitted. Notice that the questions in the two panels are formulated as mirror-images of one another. "Agreeing" with the statement that large income differences are acceptable is likely to entail "disagreeing" with the idea that differences in income should be small. Accordingly, in both panels the red columns on the right represent attitudes favouring equality, while the blue ones on the left reflect tolerant attitudes towards inequality. The correlation between the columns respectively reflecting the same attitude in the two panels is identical, at 0.66, thereby indicating that they capture similar values.

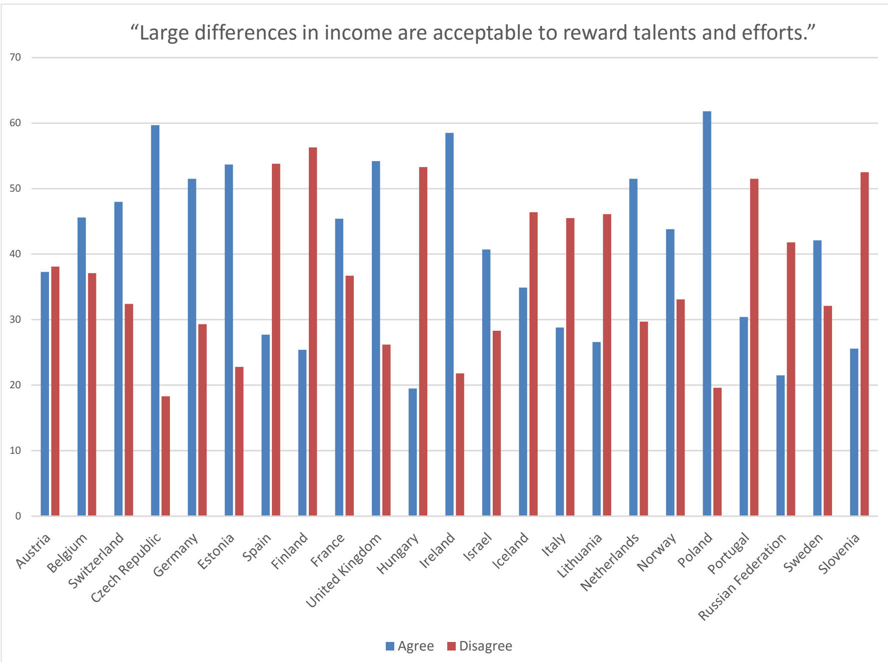

Figure 5: Attitudes towards Incentivization

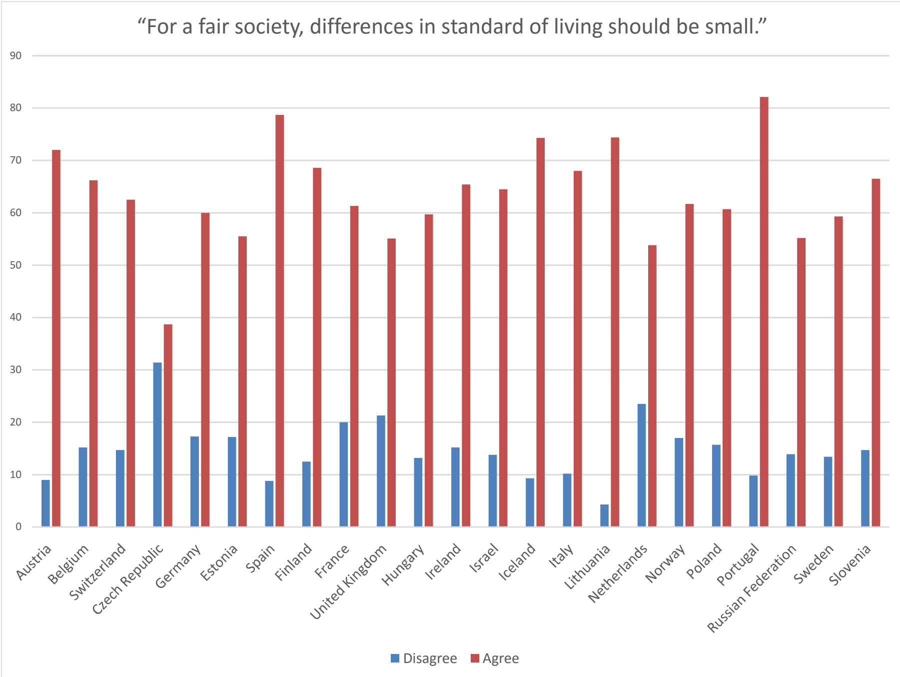

Figure 6: Attitudes towards Income Differences

Table 4 reports the results of simple logistic regressions applied to the entire sample of 35,952 respondents, estimating the likelihood of "agreeing" and "disagreeing" with the aforementioned statements, controlling for the income quintile a respondent belongs to. The omitted quintile is the lowest one, so that the coefficients reflect the respective incremental likelihood of a respondent in a given income quintile to agree or disagree, in comparison to that of a person in the lowest income quintile. The significance levels are reported in parentheses.

(a)

Quintile	Agree	Disagree
2	0.19 (0.000)	0.05 (0.252)
3	0.22 (0.000)	0.11 (0.022)
4	0.23 (0.000)	-0.06 (0.191)
5	0.51 (0.000)	-0.07 (0.198)

(b)

Quintile	Agree	Disagree
2	0.02 (0.719)	0.06 (0.375)
3	-0.08 (0.068)	0.08 (0.213)
4	-0.27 (0.000)	0.17 (0.006)
5	-0.39 (0.000)	0.43 (0.000)

Table 4: Logistic Regressions:
(a) Attitudes towards Incentivization
(b) Attitudes towards Income Differences

The spot estimates in panel (a) consistently show that persons from higher income groups tend to agree more often, and disagree less often, with the statement concerning the reward to effort, although most disagreement coefficients are not statistically significant. Where the fairness question is concerned in panel (b), agreement with the statement decreases with income, while disagreement increases. In this case the agreement coefficients are significant, except for that of the second quintile, whereas the disagreement coefficients are significant for the two highest quintiles.