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### High Standards Enhance Inequality in Idealized Labor Markets

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#### Abstract

We built a simple model of an idealized labor market, in which there is no objective difference in average quality between groups and hiring decisions are not biased in favor of any particular group. Our results show that inequality in employment emerges necessarily also in such idealized situations due to the limited supply of high quality individuals and asymmetric information. Inequalities are exacerbated when employers have high standards and keep only the best workers in house. We found that ambitious workers get higher quality jobs even if ambition does not correlate or even negatively correlates with internal quality. Our findings help to corroborate empirical findings on higher employment discrepancies in high rather than low status jobs.

#### Keywords:

Discrimination, Labor Market Mismatch, Dual Matching, Aspirations, Sampling Bias

#### Introduction

- 1.1 Inequalities persist in many different human social contexts, such as in the labor market, in inter-firm relations and in partner selection for marriage. In two-sided matching problems, it is generally difficult to establish and maintain efficient selection mechanisms (Roth & Sotomayor 1990; Shiba 2013). Labor market models showed that inefficient outcomes and a frequent mismatch between employer demands and worker skills are likely to emerge (Lucas & Prescott 1974; Burdett & Mortensen 1980; Diamond 1981; 1982; Mortensen 1986; Flabbi 2010), but did not focus on consequential processes leading to inequality.
- 1.2 One of the most important consequences of asymmetric information is that employers cannot check individual employee quality or skills in advance and tend to rely on signals (Frank 2007; Spence 1973, Spence 1974; Gambetta 2009) and external characteristics for hiring (Akerlof 1976). Easily recognizable traits, such as gender, ethnicity, or age are the most salient social categories immediately encoded in any interaction (Fiske 1998). In the absence of individual information, employers read these traits as cues. When information is hard to collect, recognizable social category membership is often used to form group reputation and prejudices, which are used as proxies to estimate individual abilities of category members (Heilman 1995; Petersen 2009).
- 1.3 Persistent inequalities could be due to purposeful discrimination. *Statistical discrimination* is based on objective statistical differences between the categories. For instance, there is a well-documented difference between men and women in average emotional support for children (Wellman & Wortley 1990; de Waal 2005). In this case, trusting a woman more than a man when looking for a baby-sitter could be viewed as "rational" statistical discrimination similar to pricing practices of insurance companies based on hazard categories. Purposeful discrimination that is *not based on objective statistical differences* is usually attributed to cognitive or "uneconomic aspects" (Allport 1954; Kalter

2000) or tastes (Becker 1971).

- 1.4 Discrimination might be channeled by harmless social practices. For instance, hair color does not make a difference in car driving or in task performance in secretary work, still, blond women are widely labeled as clumsy, less effective, and they are subject to many derogating jokes (e.g., Benokraitis 1997). In general, recognizable traits (e.g., gender, ethnicity, hair color) are factually irrelevant for job quality as there is no statistical basis to discriminate members of different categories. Still, employers use these traits "as inexpensive screening devices when hiring for jobs, particularly skilled jobs, in the belief (correct or not) that race and sex status are, on average, related to productivity. Individual workers are stereotyped as qualified or not, with more attention given to their membership in a race or sex group." (Kaufman 2002, 550).
- 1.5 This paper shows that in an idealized labor market without any historical path-dependence and with fair employers who lack innate tendencies or preferences for discrimination, inequality still emerges. This hypothesis builds on earlier results that showed that 'unfair' conditions can emerge in cases of asymmetric information due to sampling bias (Simon 1955, Simon 1956; Denrell 2005; Denrell & Le Mens 2007; Fiedler & Juslin 2006; Le Mens & Denrell 2011).
- 1.6 In addition, we wanted to understand why high status jobs are particularly susceptible to discrimination. For instance, research shows that women are under-represented in top jobs in particular, which is often described as the 'glass ceiling' phenomenon (Powell & Butterfield 1994). Some studies have explained this by looking at the supply side of the labor market, namely on gender differences in expectations (Evetts 1993), time constraints and opportunities (Bielby & Bielby 1992; Albrecht et al. 1999; McBrier 2003), or aspirations (women do not get top jobs because they do not want to get there as much as men do, see Polachek 1981). Our hypothesis is that discrimination in jobs offered by employers with high standards will be higher than in jobs offered by employers with medium or low standards.
- 1.7 We examined a situation in which individuals were *unaware* of the statistical distributions of quality and learnt only from their own experience. We looked at why and how discrimination could emerge as an unintended consequence of intentional and fair action. We built a simple model that diverged from analytical models of wage differences in economics (Lucas & Prescott 1974; Burdett & Mortensen 1980; Diamond 1981, 1982; Mortensen 1986; Flabbi 2010), from labor market experiments that looked at the persistence of discrimination (Riach & Rich 2002, Riach & Rich 2004), from earlier computational and agent-based models that investigated matching functions that lead to efficient equilibria (Richiardi 2004; Neugart 2004, 2008; Fagiolo et al. 2004), and from earlier work describing workplace segregation (Abdou & Gilbert 2009; Tassier 2005; Tassier & Menczer 2008), or structures and traps of referral hiring (Tassier & Menczer 2001; Stovel & Fountain 2009; Gemkow & Neugart 2011; Fountain & Stovel 2014). Here, similarly to Tassier and Menczer (2008), who showed that inequality might arise in the labor market under different social structures via referral hiring, we focused on the emergence of large-scale labor market inequality under fair market conditions and asymmetric information.
- 1.8 In our model, we considered hiring as a two-sided matching process without referrals, where employers select applicants and workers can accept or reject offers. Therefore, disproportional hiring is not necessarily due to employer selection, but it could be due to the applicants' ambition. This is a well-known phenomenon for educational attainment (Boudon 1981), as well as for progress in the labor market (Polachek 1981). Conventional wisdom confirms the mismatch that the best jobs are not filled with the best workers, but with the most ambitious ones, which results in inefficiency overall. If ambition correlates with quality, then rational employers could consider ambition as a credible signal. Ambition, however, does not necessarily correlate positively with skills or quality. If this is the case, then ambition is a *cheap* signal: the presence of the signal does not contain any reliable information for the employers and should not be taken seriously. For the sake of simplicity, however, the potential of signaling with ambition is not considered in our model.
- 1.9 In this study, we investigated how an ambition trap could emerge, i.e., how ambitious workers could end up in the best jobs, even if they had quality lower than average. We show that zero or even a negative level of correlation between quality and ambition could lead to a disproportional concentration of ambitious workers in the best jobs due to their higher willingness of extended exploration.

## Model

- 2.1 We modeled a small job market, in which a fixed number of employers ( $E$ ) select employees for a restricted number of jobs ( $J$  each).<sup>[1]</sup> We assumed that there are more workers than available jobs ( $N > E * J$ ), hence there is unemployment (cf. Abdou & Gilbert 2009). Employers hire workers for a fixed contract period of one year, during which the contract cannot be broken. Both employees and employers have an internal *quality* taken from a distribution with possible integer values between 0 and

19. We assumed that quality scores *summarize* different aspects of worker skills and different aspects of firm quality (wage, working conditions) in a single dimension. Note that jobs within the firm were assumed to be identical (firms had internal qualities and not jobs). The scale of  $\{0, 1, \dots, 19\}$  is arbitrarily chosen and has *no impact* on our results. Here, we have discussed only results from simulations in which a uniform distribution of qualities were assumed. We have analyzed scenarios with alternative (e.g., normal) distributions and found similar results.
- 2.2 For the sake of simplicity, we assumed that individual quality is exogenously given, fixed over time, and hence does not improve with experience. We considered one recognizable trait for workers (e.g., gender) and two social categories of this trait (e.g., men and women) and fixed category membership. Here, we have discussed only results for equal numbers of workers in both categories ( $N_1 = N_2 = N/2$ ).
- 2.3 While workers vary in quality, the variations are *independent* of category membership. Therefore, there is no statistical basis for discrimination. We assumed that all employers are perfectly *neutral*, i.e., they do not belong to any of the workers' social categories and do not have any initial bias towards them. We considered asymmetric information in the sense that employers are *unable to observe the true individual quality* of workers until they hire them. They can observe, however, the social category of applicants, which is the characteristic of empirical hiring situations (Akerlof 1976).
- 2.4 Selection and acceptance decisions were based on the *aspiration levels*  $\{0, 1, \dots, 19\}$  of employers and *ambition levels*  $\{0, 1, \dots, 19\}$  of workers; both were taken from a uniform random distribution except otherwise noted. Individual aspiration and ambition levels act as reservation thresholds and are fixed over time. The highest levels imply that individuals search for the best available option (cf. Boero et al. 2010) and are not satisfied unless they find it. Each employer forms *reputations* about the two groups based on private experience with the workers. Group reputations for each employer are calculated as the mean quality of the workers hired from that category in the previous  $m$  periods. Reputations are updated after every round (year) of employment and *vary* between employers, and in practice replace employer aspiration thresholds over time.
- 2.5 We considered a two-sided matching protocol in which hiring into job positions takes place sequentially. Employers try to fill *all* their jobs, while workers can accept or reject job offers. This protocol is different from labor market models that consider an aggregate matching function instead of actual individual *choice* (Pissarides 1979; Montgomery 1991; Merz 1995; Petrongolo & Pissarides 2001). Our matching protocol also diverges from microeconomic search models that focus on a single, representative agent (Simon 1955; Stigler 1961; Mortensen 1970), from those that consider wage determination as the key aspect of equilibrium search (Becker 1971; Arrow 1972, 1973; Rogerson et al. 2004), or assume homogeneity of workers and firms with regard to needs and quality (Diamond 1981, 1982; Mortensen 1982; Pissarides 1984, 1985).
- 2.6 It is worth noting that varying micro mechanisms have been successfully used to understand hiring practices, but none is accepted generally (Petrongolo & Pissarides 2001). We thought to departure from equation-based models to consider action-based models, at the same time keeping agent decisions as simple as possible (cf. Lewkovicz & Kant 2008). We started from certain rules of thumb that reflect bounded rationality rather than perfectly optimizing behavior ("satisficing" rather than "maximizing"), while looking at the two-sided character of search in the labor market.
- 2.7 In our model, each available job was filled in the following way. The employer checked previous employees he was satisfied with and picked the one available with the highest quality. The contract has been extended if the employee's quality was higher than the group reputation scores. This assumption is in line with the empirical fact that employers solve the problem of asymmetric information internally, if they can (e.g., Williamson 1985; Greenwald & Stiglitz 1990). Among the available and high quality workers, selection is based on quality ranking (Blanchard & Diamond 1994). Employers do not keep anyone below their thresholds in house, as they rationally expect that a random worker (at least from one category) has a higher quality than their current employee. We assumed that new workers accepted contracts automatically, as they had no available information on job quality in advance. If they worked at the firm before, we assumed they rejected the proposal if the job quality was below their ambition level.
- 2.8 If there was no previous employee who satisfied the previous condition, an unemployed worker was picked randomly from a group with higher reputation. This follows the idea that employers have no information about the quality of workers who were not contracted previously and they can observe category membership only. Therefore, worker performance has human capital externalities to the (ethnic) group, as suggested by studies in economics (Borjas 1995). Note that it does *not* mean that employers are innate discriminators but rather the opposite: a higher group reputation is easily ruined and balanced by a new and less satisfactory employee.

- 2.9 If group reputation was equal (e.g., at the outset), then an unemployed worker was randomly selected. This procedure was repeated until all jobs were filled and no vacancies remained. If workers were hired by an employer, they were unavailable for any other job. This meant that in our model there are *externalities* of selection choices, which creates interdependence between hiring decisions. As a consequence, a shortage of high quality workers can quickly take place in the labor market.
- 2.10 The quality of employees was remembered by the employer from the last employment until  $m$  periods, irrespective of the employee's quality. For the sake of simplicity, we assumed that the *memory* parameter  $m$  was the same for all employers. It is worth outlining that memory limitation is an assumption that prevents the system from running into a market with full information and follows empirical findings showing that people have limited capacity of information processing (Miller 1956; Cowan 2001). Finally, note that our matching procedure neglects important economic factors, such as wage and company profit. We compressed all relevant returns from the job into a single *quality* score and we did not deal with endogenous dynamics, such as the creation of new jobs at more successful firms.

#### Measures

- 2.11 As a dependent measure, we used *macro level discrimination*  $\delta$  as the objective extent to which members from different groups were hired disproportionately. We defined  $\delta$  as

$$\delta = \frac{|H_1 - H_2|}{\max\{H_1, H_2\}}, \quad (1)$$

where  $H_1 \leq N_1$  was the number of hired workers from category 1. The index is 0 in case of no inequality in employment, and 1 when each job is filled with workers belonging to the same category. Macro level discrimination is distinguished from *micro level discrimination*  $\delta_i$ , which is the average extent to which individual employers stock up employees from the same group. The micro level discrimination index  $\delta_i$  is calculated as Eq.1 for each individual employer and then averaged over all employers.

- 2.12 The concentration of ambitious workers in better jobs was measured by the Pearson correlation of obtained firm quality and ambition. Similarly, we used this measure to describe the concentration of good workers in good jobs. After the quality  $q_i$  of worker  $i$  was determined from a random uniform distribution, the ambition  $a_i$  of  $i$  was either taken randomly (in case of perfect independence,  $r = 0$ ) or was assigned according to the following procedure: first, all workers were assigned a random ambition level  $a_i^*$ . Secondly, both quality and ambition were standardized a mean of zero and standard deviation of one. Thirdly, we used a linear transformation of

$$a_i = \frac{r}{\sqrt{1-r^2}} q_i + a_i^*. \quad (2)$$

Subsequently, means and variances were back-adjusted by simple linear transformations to the  $\{0; 19\}$  range and floored to the integer below. This allowed us to obtain a correlation between  $q_i$  and  $a_i$  that was close to the required correlation  $r$ . The correlation between employer aspirations and quality of jobs was imposed using the same procedure.

## Results

- 3.1 Our results are presented in the following structure. First, we examined whether discrimination emerged in our idealized labor market or not. We reported the discrimination indexes and the correlation indexes about the concentration of high quality workers in good firms and the concentration of ambitious workers in good firms as dependent measures. In order to understand the effect of the aspiration levels on our dependent variables, we assigned the same aspiration level to each firm and varied this value stepwise, while keeping any other parameters fixed. Second, we fixed the aspiration level of the employer to the minimum value and analyzed the impact of the correlation between worker ambitions and quality on the same set of dependent variables. Furthermore, we repeated the same experiment for the case in which we fixed the aspiration level of the employer to its maximum and intermediate values. Finally, we reported results also from simulations in which employer aspiration were heterogeneous to provide a robustness test of previous findings.
- 3.2 Our first aim was to understand whether discrimination could emerge without any differences in quality

between the workers' social categories. Fig. 1 shows results from our first experiment in which we assigned the same aspiration level to each firm and varied this value stepwise, while keeping any other parameters fixed. We found that the micro level discrimination  $\delta_i$  was around 0.8 (st.dev.=0.06) even for the zero aspiration level of employers. This doubled the expected value of 0.416, which we would have obtained had employers selected six workers always at random.

- 3.3 The large difference between the micro and the macro level discrimination values indicates that discrimination is primarily a bias inherent in individual decision making. The macro level discrimination index  $\delta$  was above 0.21 for all employer aspiration levels and therefore higher than the value of 0.125 that we would have obtained if 8 of 15 employers had discriminated one group fully and others the other group perfectly.
- 3.4 On the one hand, this meant that individual bias, which made employers discriminate against members of one category, did not linearly result at the aggregate level. The macro level discrimination in favor of one of the categories emerged early in the first contract years and then stabilized (see Fig. 2 for some typical runs). On the other hand, this was likely due to a random binomial process in which employers totally discriminated one of the groups. Indeed, the observed macro level discrimination index for low aspiration values was close to a value that would have occurred if, in half of the cases, 8 out of 15, and in the other half of the cases, 9 out of 15 employers had perfectly discriminated one of the groups.

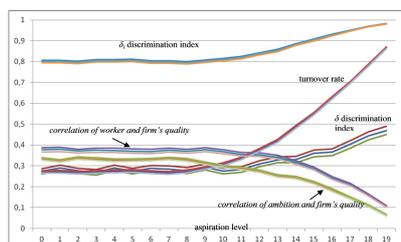


Figure 1. Discrimination and the trap of ambition as a function of employers' aspiration level. Mean values and 95% confidence intervals of the micro level  $\delta_i$  discrimination index, of the  $\delta$  discrimination index, of the observed correlation between worker quality and firm's quality, and of the observed correlation between ambition and firm quality. Each single value is the average of the index in the given simulation run. Each simulation run lasted for 100 contract years (which means that 100 values of each index were averaged for each single observation). Results are from a total of 10,000 runs in which ambition and worker quality were perfectly independent. The aspiration level of each of 15 employers was fixed to the same integer value, which was varied across runs.  $J = 6, N = 200, m = 10$ .

See the Measures section for definitions.

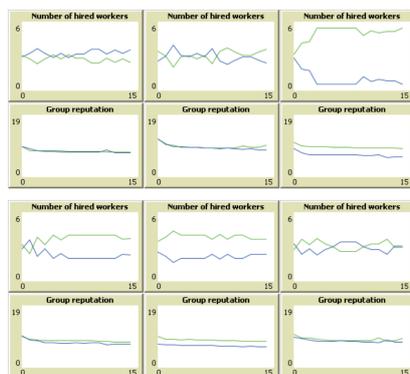


Figure 2. Six randomly selected runs to illustrate the early development of discrimination. Note that the two panels belong to the same simulation run. The panel above shows the average number of hired workers in the two categories, while that below shows the average values of group reputations among the employers (green and blue colored lines). Only the first 15 contract years were included as no major changes have been observed later. Simulations had identical parameter values as in Fig. 1.

- 3.5 We found that higher employer aspiration levels led to higher discrimination rates. This is a general result that occurred for aspiration levels higher than the scale mean (Fig. 1). Specifically, there was a linear increase in discrimination for aspiration levels higher than the scale mean. Fig. 1 shows that almost all employers ( $E = 15$ ) were perfect discriminators when they had the highest aspiration levels. As employers were never completely satisfied, high aspiration levels resulted in higher turnover rates. The finding that the highest aspiration levels lead to the highest levels of inequality, and consequently to inefficiency, resonates to some elementary results of search theory stating that search beyond the reservation price is not profitable. This line of research, however, concentrates on efficiency, rather than inequality.

- 3.6 The macro level discrimination index  $\delta$  also increased in its value with higher employer aspirations. Particularly for the highest aspiration levels, there was more discrepancy between the categories at the macro level than expected from random distribution of individual discriminating tendencies. The increased level of discrepancy at the macro level was clearly the consequence of the limited supply of high quality workers. The limited supply of high quality workers in case of high employer aspirations resulted in a high turnover rate, which in turn attenuated initial differences due to initial choice and to random statistical differences between the categories. With an extremely extended labor supply and sufficient number of workers with the highest qualities, the aspiration trap would have faded away.
- 3.7 We also found a *concentration* of the most ambitious workers in the best jobs, even if worker quality and ambition were perfectly independent and employers did not consider ambition for selection. This result was obtained from a wide range of parameter values. In the example shown in Fig. 1, the correlation between a firm's quality and worker ambition was around one third for low employer aspiration levels. Although the ambition trap appeared under various conditions, it generally decreased when employers had higher aspirations. It is interesting that higher employer aspirations also *decreased* the concentration of better workers in better jobs. This means that not only did desperate attempts to get the best workers increase discrimination and unequal handling of equal groups; they also created a less meritocratic system, in which better workers did not end up in better available jobs.

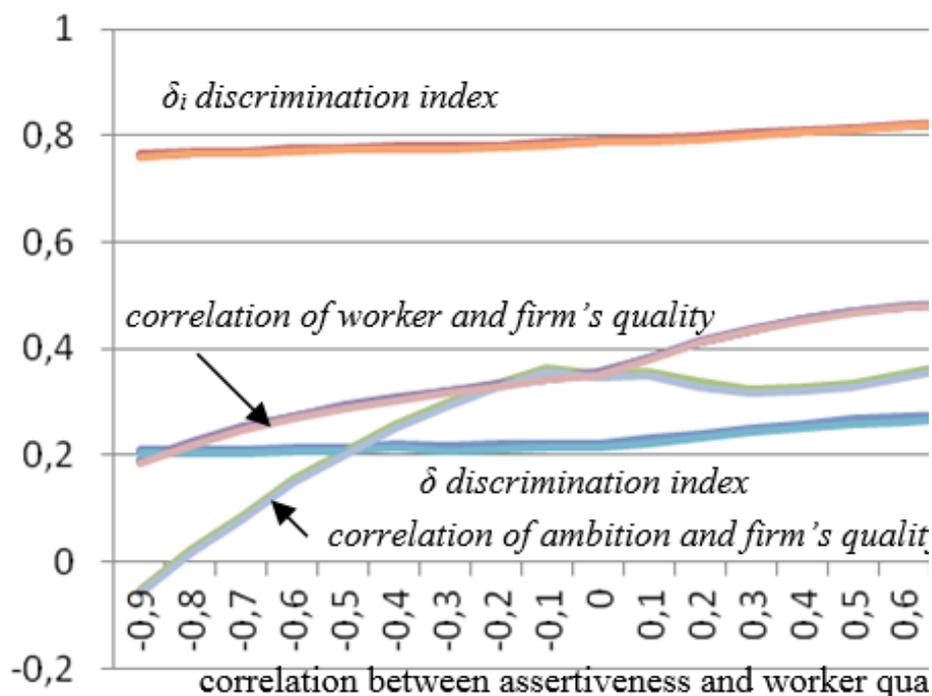


Figure 3. Labor market mismatch occurs for any correlation between workers' ambition and quality. Mean confidence intervals of the *micro level*  $\delta_i$  discrimination index, of the  $\delta$  discrimination index, of the *observed correlation between worker quality and firm's quality*, and of the *observed correlation between ambition and firm's quality* from 57000 runs. Each single value is the *average* of the index in the given simulation run. Each simulation contract years (which means that 100 values of each index were averaged for each single observation) between ambition of workers and their quality was imposed according to the procedure described in the text and varied from -0.9 to 0.9 in steps of 0.1 across runs.  $E = 15, J = 6, N = 200, m = \{3, 5, 10, 20, 30, 50\}$ ; aspiration level was fixed to 0 in all runs.

- 3.8 We manipulated the correlation between worker quality and ambition in our second experiment, while we fixed the aspiration level of the employer to its minimum value. First, note that micro level discrimination was high for any correlation value. Macro level discrimination was present for high correlation values. Indeed, high correlations between worker quality and ambition increased employer expectations that lead to a shortage of best workers in the group that was favored on average. Secondly, we expected that increasing the correlation between worker quality and ambition would have strengthened the concentration of ambitious workers in the best jobs. This hypothesis was confirmed as we found a positive relationship (Fig. 3). Except for extreme correlation values, an ambition trap occurred even if ambition and quality were negatively related. This meant that the most ambitious workers received the best jobs even if their quality was on average *lower* than that of less ambitious workers. Note that ambitious workers received better jobs even though employers did not take ambition into account for selection.

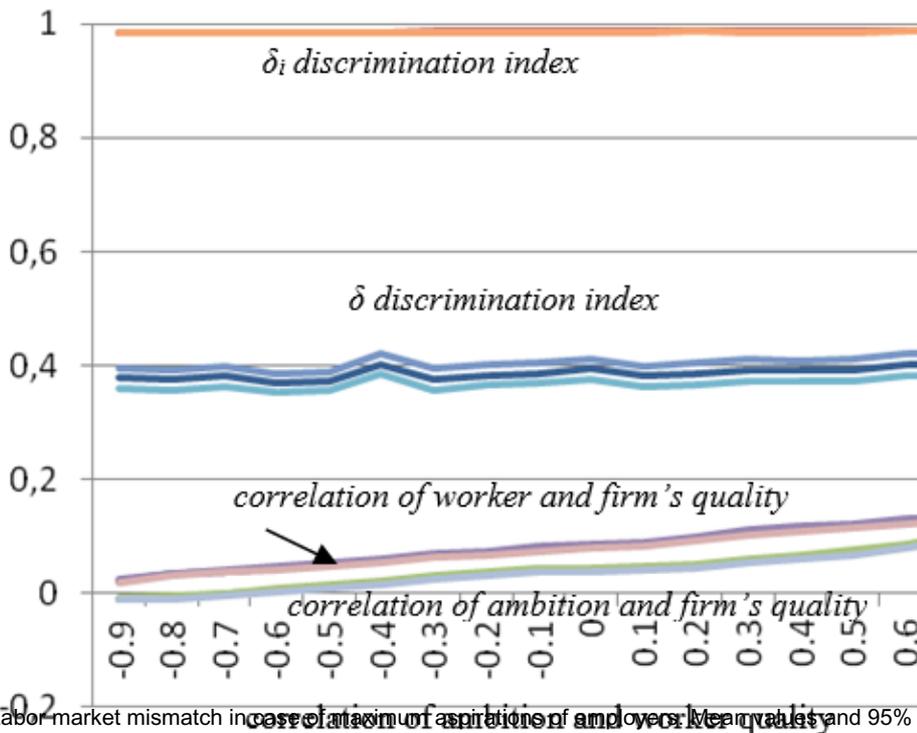


Figure 4. Labor market mismatch in equilibrium in a total of 950 simulation runs. The mean values and 95% confidence intervals of the micro level  $\delta_i$  discrimination index, of the  $\delta$  discrimination index, of the observed correlation between worker quality and firm's quality, and of the observed correlation between worker quality and firm's quality in a total of 950 simulation runs. Each simulation run lasted for 100 cont means that 100 values of each index were averaged for each single observation). The correlation between workers and their quality was imposed according to the procedure described in the Measures section a to 0.9 in steps of 0.1 across runs.  $E = 15, J = 6, N = 200, m = 10$ , employer aspiration level  $v$

3.9 In our third experiment, we manipulated the correlation between worker quality and ambition again, while we fixed the aspiration level of the employer to its maximum and intermediate values. Our results showed that the labor market could never achieve a perfect matching of worker quality and firm quality. The concentration of better workers in better jobs improved when the correlation between ambition and quality increased, but a close match of worker and firm quality was never found. For instance, in the case of the highest aspiration levels, the correlation between worker and firm quality never even reached 0.14 (Fig. 4). Fig. 5 shows the three-way association between aspiration level, the correlation of ambition and worker quality, and the correlation of ambition and the firm's obtained quality (as dependent variable).

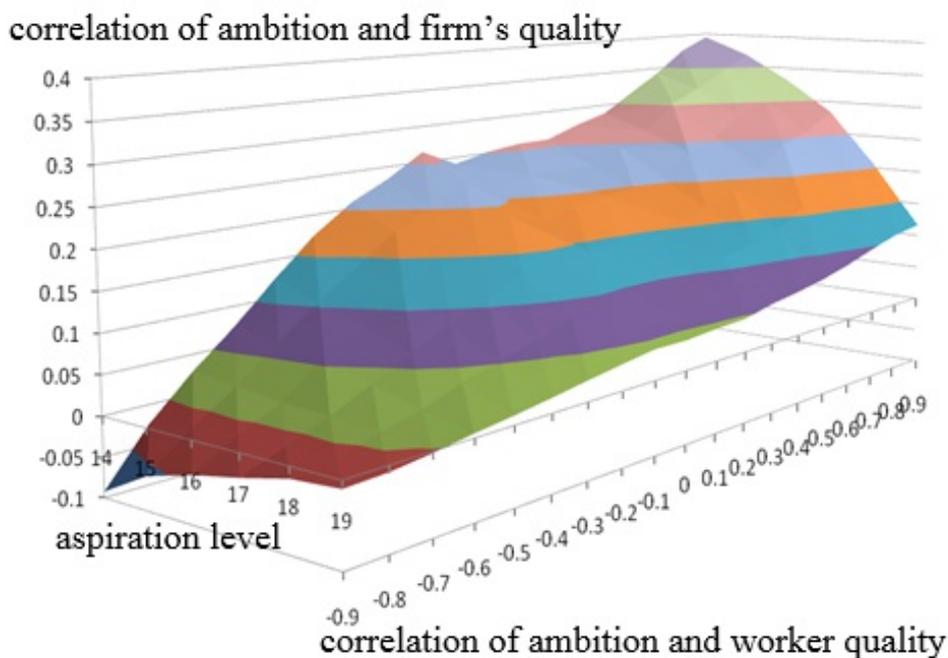


Figure 5. Average values of the observed correlation of ambition and firm's quality. Results are from a total of 57000 runs. Each single correlation value is the *average* from the given simulation run. Each simulation run lasted for 100 contract years (which means that 100 correlation values were averaged for each single observation). The correlation between ambition of workers and their quality was imposed according to the procedure described in the Measures section and varied from  $-0.9$  to  $0.9$  in steps of  $0.1$  across runs. The aspiration level of each of 15 employers was fixed to the same integer value, which was varied across runs.  $J = 6$ ,  $N = 200$  workers,  $m = 10$ .

- 3.10 In our last experiment, we relaxed the assumption that employers had the same aspiration levels. This was to check whether the aspiration trap and the ambition trap were simply due to the uniformity of employer aspiration levels. Fig. 6 shows that there was no qualitative difference when we relaxed the assumption of homogeneity.
- 3.11 We also tested whether our results were robust against a wider range of parameter values. We did not find any qualitatively significant deviation from the results reported above. Among the control variables, memory of employers had a remarkable effect both on discrimination and on the correlation of ambition and firm's quality. Longer memory enlarged the available pool of information and decreased discrimination, but it increased the extent of the ambition trap under any aspiration level as well as the initial correlation of ambition and worker quality.

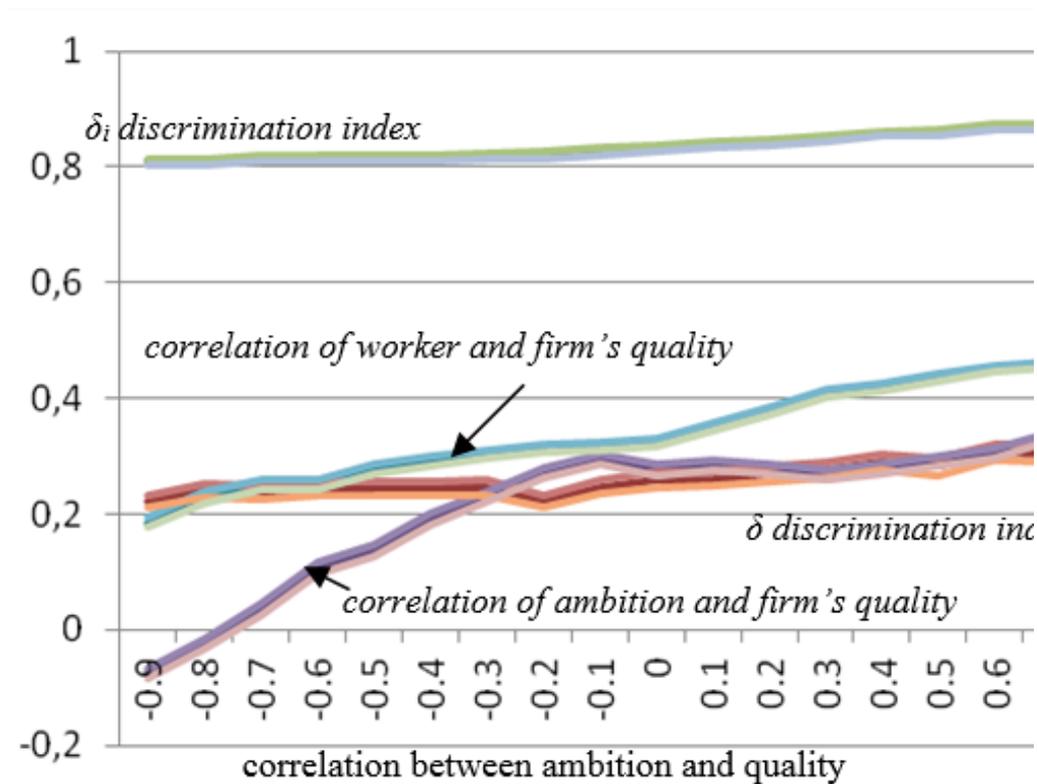


Figure 6. Heterogeneous aspirations do not prevent labor market mismatch. Mean values and 95% cor the micro level  $\delta_i$  *discrimination index*, of the  $\delta$  *discrimination index*, of the *observed correlation between firm's quality*, and of the *observed correlation between ambition and firm's quality* in a total of 9500 runs is the *average* of the index in the given simulation run. Each simulation run lasted for 100 contract year: 100 values of each index were averaged for each single observation).  $E = 15$ ,  $J = 6$ ,  $N = 200$ ,  $m = 10$ ,  $e_i$  levels were taken from a random uniform distribution.

## Discussion

- 4.1 Partner selection does not work efficiently in various social contexts. As search theory has demonstrated, in case of asymmetric information, maximizing principles (looking for the best options) do not lead to higher profit, while higher utility is achieved when the search stops at the first option that is within the reservation price. We constructed a simple model of two-sided matching and demonstrated that in addition to mismatch, *discrimination* emerges as an unintended and un-institutionalized process, simply as a result of selection decisions that are based on experience. This implies that in case of asymmetric information, optimal matching and equality in employment is hard to achieve, even if opportunities are not biased in any sense. In our study, we modeled hiring in labor markets and showed that perfectly neutral employers widely discriminated between groups. No true statistical difference between individual types was necessary to generate discrimination. We showed that, even with fair employers, individual discrimination was extreme and caused inequality at the aggregate level.
- 4.2 Our simulations show that inequality can be the unintended consequence of a neutral hiring process, similar to other judgment bias during repeated sampling (cf. Simon 1955, 1956; Denrell 2005; Fiedler & Juslin 2006; Denrell & Le Mens 2007; Le Mens & Denrell 2011). Hence, statistical differences and built-in preferences and prejudices cannot be considered as the only mechanisms responsible for inequality in the employment rates of different groups. This contrasts with the economists' view that discrimination should not persist if beliefs were incorrect as employers not sharing false beliefs would gain a competitive advantage (Arrow 1973; Aigner & Cain 1977). Indeed, there is poor empirical evidence that employer practices reflect any efficient and rational response to differences in skills and turnover costs (Bielby & Baron 1986).
- 4.3 It is worth noting that this was possible as in our model we intentionally excluded other empirically relevant factors and mechanisms, such as referral hiring (Fernandez et al. 2000; Fernandez & Fernandez-Mateo 2006; Stovel & Fountain 2009; Fountain & Stovel 2014), on-the-job search (Richiardi 2004, Richiardi 2006); market evolution (Ballot 2002; Neugart 2004; Fagiolo et al. 2004), and endogenous policy (Neugart 2004, Neugart 2008). Our results show that discrimination is prevalent even *without* these auxiliary assumptions, which would likely to lead to even *higher inequality*.
- 4.4 Secondly, we showed that discrimination was intensified when employers had high aspirations. Employers' high aspirations are typical for high-status, high-wage jobs. Our results indicate that when available expertise is limited, high aspirations do not pay off and lead to more judgment partiality. This result confirms the "paradox of meritocracy"; according to which organizations with meritocratic evaluation may ironically show greater bias, for instance, in favor of men over equally performing women (Castilla & Benard 2010). Third, our model confirmed conventional wisdom: in the simulation scenarios where worker quality and ambition were independently set, the most ambitious workers

achieved the highest quality jobs. Even if worker quality and ambition were negatively correlated, ambitious workers ended up in better jobs.

- 4.5 Finally, note that worker ambitions were not updated during our simulations. Endogenous ambition updates are important both theoretically and empirically in reinforcement learning and various social interactions (see e.g., Diekmann & Preisendörfer 1998; Macy & Flache 2002; Bendor, Diermeier & Ting 2003; Izquierdo, Gotts & Polhill 2004; Matsen and Nowak 2004). In future model extensions, we could explore the macro implications of different variants of endogenous ambitions, reinforcement learning and strategic matching on labor market dynamics.

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## Notes

<sup>1</sup>Our agent-based model was built in NetLogo (Wilensky 1999). We re-implemented the model in Repast in order to check its internal validity. Both versions are available at the CoMSES Net (Network for Computational Modeling in the Social and Ecological Sciences): <https://www.openabm.org/model/4379/version/2/view>.

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